BioTrade2020plus

Supporting a Sustainable European Bioenergy Trade Strategy

Intelligent Energy Europe
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Deliverable 5.2

Strategies for bioenergy in potential supply regions and regulatory SWOT analysis as trade partner to the EU – Draft document for discussion

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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 analysing 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 (Canada, US, Russia, 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:

- Assessment of **sustainable potentials of lignocellulosic biomass** in the main sourcing regions outside the EU
- 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
- **Policy advice on long-term strategies** to include sustainable biomass imports in European bioenergy markets
- **Involvement of stakeholders** through consultations and dedicated workshops

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

About this document

This report corresponds to Deliverable D5.2 of BioTrade2020+ – Report discussing strategies for bioenergy in potential supply regions to the EU, and analysing potential risks and potential impacts of policy changes. It has been prepared by VITO and CENER.

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Table of Contents

Acronyms

B..	diesel fuel with …% (volume basis) biodiesel
BAU	Business-as-Usual scenario
BRA	Brazil
CND	Canada
CO2-eq	CO2-equivalent emissions
COL	Colombia
COP21	21st yearly session of the Conference of the Parties
E..	gasoline fuel with …% (volume basis) ethanol
EGU	electric generating unit (United States)
EPA	Environmental Protected Agency (United States)
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FRA	Forest Resources Assessment
FSC	Forest Stewardship Council
GDP	Gross domestic product
GHG	Greenhouse Gas
GW	Giga (10^9) Watt
ha	hectare
HWSD	Harmonized World Soil Database
IDN	Indonesia
IEA	International Energy Agency
IMF	International Monetary Fund
INDC	Intended nationally determined contributions
JRC	Joint Research Centre of the European Commission
KEN	Kenya
kha	thousand hectares
LCFS	Low Carbon Fuel Standard (California)
LULUCF	Land use, Land Use Change and Forestry
MAL	Malaysia
MDG	Millennium Development Goal
MOZ	Mozambique
Mtoe	million tonnes of oil equivalent
Mton/MT	Million tonnes
MW	Mega (10^6) Watt
NAMA	Nationally Appropriate Mitigation Actions to reduce greenhouse gas emissions
NREAP	National Renewable Energy Action Plan
OECD	Organisation for Economic Co-operation and Development
PEFC	Programme for the Endorsement of Forest Certification
PV	Photovoltaic
RE	Renewable Energy
REDD+	Reducing emissions from deforestation and forest degradation
RFS	Renewable Fuels Standard (United States)
RUS	Russian Federation
SDG	Sustainable Development Goal

SWOT	Strengths, Weaknesses, Opportunities and Threats
TPES	Total Primary Energy Supply
TRWR	Total Renewable Water Resources
UKR	Ukraine
UNFCCC	United Nations Framework Convention on Climate Change
UNSDSN	United Nations Sustainable Development Solutions Network
US / USA	United States of America
USDA	United States Department of Agriculture
WGI	Worldwide Governance Indicators

1. Introduction

Availability of global biomass for export to the EU will also depend on international policies and strategies on biomass and bioenergy. Countries may – for a certain time – put focus on exporting biomass to initiate local supply chains, and may shift to domestic valorisation over time. Long term climate, renewable energy or specific bioenergy strategies can indicate a shift to a higher local use of biomass; it is also important to consider the regulatory stability and how firm sustainability provisions are in terms of biomass production in sourcing regions.

The sourcing regions considered here are linked to the case studies selected in WP2 and WP3. Canada is also added as it is an important sourcing region for biomass currently. Data from some other countries - mentioned between brackets - are also indicated for comparison. This is the overview of countries which were reviewed:

- North America: United States, Canada
- South America: Brazil, Colombia
- East Europe: Ukraine, (Russia)
- Southeast Asia: Indonesia, (Malaysia)
- East Africa: Kenya, (Mozambique)

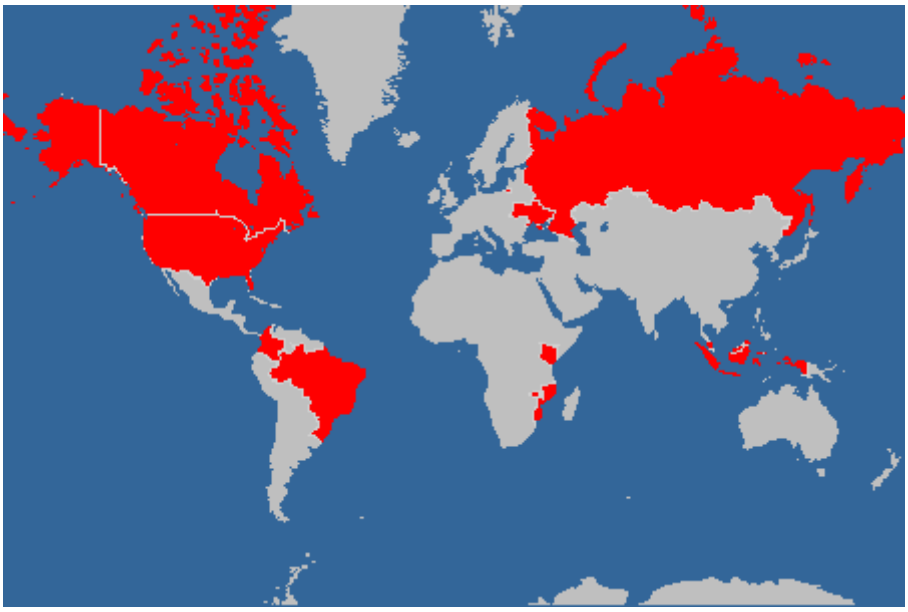

Figure 1: the considered potential sourcing regions indicated in red on the world map

The report will conclude with an overview of the main bioenergy related strategy documents and a SWOT analysis on regulatory level of the biomass trade position of the different sourcing regions. This SWOT analysis will be integrated in the on-line toolset of the BioTrade2020+ website, so actors can have an overview of the pros and cons of trading with a certain region.

The report will start with a description of the criteria that will be used for comparing different regions and an overview of general data that will be used for the SWOT analysis. After that, we will split up the analysis with separate discussion documents per country.

2. Methodology

Several criteria have been considered which in some way indicate strengths and weaknesses of a certain countries in terms of potential biomass trade to the EU. The below overview includes the strength of their economy and an assessment of their governance (in general) in terms of investment climate. The second part is about local production of biomass in forestry and agriculture, and the current extraction rates. Finally we consider the current status in greenhouse gas emissions, the role of renewable energy and the strategies/actions plans presented to indicate their future directions for uptake of renewable energy. In the regulatory SWOT analysis we will focus on the following criteria of the different countries:

- Economy & governance
    - Economic strength and growth prospects
    - Governance (general)
    - Investment climate
- Current biomass extraction (for all uses)
    - Food & feed production
    - Forest biomass extraction
- Sustainable forest management
    - Share of certified forest
    - Change in forest carbon stock
- Sustainable agriculture and food provision
    - Soil conditions
    - Water use in agriculture
    - Food security
- Climate policy
    - Current greenhouse gas emissions related to fossil fuel use
    - Role of LULUCF
    - Climate action plans and their consistency with 'fair effort sharing'
- Renewable energy and the role of biomass
    - Share of renewables and bioenergy in the energy system
    - Role of traditional biomass
    - Renewable energy strategies

Below the background of these indicators is shortly described, as well as some overview tables comparing the different countries.

2.1. Economy & governance

The **strength of an economy** can be expressed in its GDP (per capita). This is often linked with the level of total primary energy demand (TPES), see further.
Prospects of **economic growth** are also very relevant as this may induce an increase in energy demand, and potentially also other uses of biomass (food, materials).

Economic indicators are available from the International Monetary Fund (IMF)[1]. The table below shows GDP per capita (2014) and economic growth prospects (for 2020) for the different potential sourcing regions. There is a clear distinction between developed countries like the US and Canada (which have high GDP and limited growth perspectives) and developing countries like Mozambique, Kenya or Indonesia (with low GDP and higher growth perspectives).

Table 1: GDP and economic growth figures in the different potential sourcing regions (source of the data: IMF-World Economic Outlook Database)

	GDP	Growth perspective in 2020
	US$/capita (2014)	%
USA	**54370**	2.0
CND	**50304**	2.0
BRA	11573	2.5
COL	7928	4.1
IDN	3524	**6.0**
MAL	11049	**5.0**
MOZ	630	**17.6**
KEN	1420	**6.9**
UKR	3051*	4.0
RUS	12718	1.5

** impacted by the recent crisis in Ukraine. Ukraine GDP was 4435 US$/capita in 2013.*

The World Bank has published **Worldwide Governance Indicators** (WGI). Governance consists of the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implement sound policies; and the respect of citizens and the state for the institutions that govern economic and social interactions among them. [2]

The WGI report six aggregate governance indicators for over 200 countries and territories over the period 1996-2014, covering i) Voice and Accountability, ii) Political Stability and Absence of Violence/Terrorism, iii) Government Effectiveness, iv) Regulatory Quality, v) Rule of Law, and vi) Control of Corruption.

- **Voice and accountability** captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.
- **Political Stability and Absence of Violence/Terrorism** measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism.

[1] https://www.imf.org/external/pubs/ft/weo/2015/01/weodata/index.aspx
[2] https://www.govindicators.org

- **Government effectiveness** captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
- **Regulatory quality** captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
- **Rule of law** captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
- **Control of corruption** captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

The resulting 'governance score' is a value on a scale from -2.5 to 2.5. Higher values correspond to better governance. The following table shows an overview for the selected countries. The figures in red indicate that the situation is rather poor. This is particularly the case in African countries and in Ukraine and Russia. USA and Canada score highest in terms of governance.

Table 2: Worldwide Governance Indicators (source of the data: World Bank - Worldwide Governance Indicators)

2014	USA	CND	BRA	COL	IDN	MAL	MOZ	KEN	UKR	RUS
Voice & accountability	1.05	1.43	0.41	-0.10	0.13	-0.33	-0.23	-0.16	-0.08	-1.04
Political stability & absence of violence/terrorism	0.62	1.18	-0.01	-1.12	-0.37	0.34	-0.25	-1.27	-1.93 *	-0.84
Government effectiveness	1.46	1.76	-0.15	-0.11	-0.01	1.14	-0.73	-0.30	-0.38	-0.08
Regulatory quality	1.27	1.83	-0.07	0.50	-0.10	0.84	-0.39	-0.34	-0.63	-0.40
Rule of law	1.62	1.89	-0.08	-0.34	-0.35	0.64	-0.84	-0.45	-0.79	-0.71
Control of corruption	1.32	1.82	-0.38	-0.39	-0.58	0.48	-0.70	-0.94	-1.00	-0.87

(-2.5 weak; 2.5 strong)

** impacted by the recent crisis in Ukraine. In 2012 this value was -0.10.*

Countries with better governance structures would logically be more stable and reliable trade partners.

The **Investment climate** is closely linked to the governance structures. The World Bank Group measures business regulations in different countries towards the 'Ease of doing business'[3], according to 10 underlying topics. The following table shows an overview of a combined indicator, showing how far a country is from the 'best performer'. It is clear that the conclusions of this table are similar as in Table 2.

Table 3: Investment Climate according to the World Bank Group

[3] http://www.doingbusiness.org/

2016	USA	CND	BRA	COL	IDN	MAL	MOZ	KEN	UKR	RUS
Doing business indicator[4]	82.1	79.9	57.7	69.9	56.7	79.1	53.7	53.6	62.3	69.3

2.2.Current biomass extraction (for all uses)

On www.materialflows.net[5], data are provided on national based extraction of different materials, including fossil fuels, industrial and construction materials, ore, and also biomass. For biomass, distinction is made between feed, food, forestry biomass, animal biomass and other biomass,
Feed and food biomass are closely linked to agricultural land use, while forestry biomass is related to the use of forests. Mind that extraction also includes quantities destined for export.

Extraction from agricultural land

Table 4: Extraction from agricultural land (materialflows.net)

2013	Biomass feed & food extraction			
	Mton* (absolute value)	ton/capita	ton/ha**	% unused***
EU27	1824	3.6	11.4	35%
USA	1878	5,9	4.6	32%
CND	238	6,7	3.6	24%
BRA	2477	12,1	8.9	14%
COL	207	4,4	4.9	13%
IDN	565	2,2	9.9	28%
MAL	158	5,4	20.2	13%
MOZ	39	1,5	0.8	33%
KEN	120	2,7	4.3	12%
UKR	225	5,0	5.5	40%
RUS	299	2,1	1.4	28%

* mass data are transformed to a standard of 15% water content
** in relation to the total agricultural area in the country[6]
*** Unused extraction refers to materials that never enter the economic system and comprises agricultural harvesting losses.

Highest extraction rates can be found in Southeast Asia (mostly related to palm oil plantations) and Brazil. Mind that climatic circumstances in these regions also influence yield rates. Brazil has a high extraction per capita, which is in part also related to products destined for exports.
Russia and Mozambique have very low extraction rates.

[4] The distance to frontier score shows how far on average an economy is at a point in time from the best performance achieved by any economy on each Doing Business indicator since 2005 or the third year in which data for the indicator were collected. The measure is normalized to range between 0 and 100, with 100 representing the frontier
[5] http://www.materialflows.net/data/datadownload/
[6] http://data.worldbank.org/indicator/AG.LND.FRST.K2/countries

Residues can be as high as 40% of extraction rates, showing some potential for agricultural residues.

Extraction from forestry

Table 5: Extraction from forestry (materialflows.net)

2013	Forestry biomass extraction		
	Mton* (absolute value)	ton/capita	ton/ha**
EU27	318	0.64	2.0
USA	287	0.91	0.93
CND	105	2.99	0.30
BRA	217	1.06	0.44
COL	10	0.21	0.17
IDN	99	0.39	1.09
MAL	18	0.62	0.82
MOZ	16	0.59	0.41
KEN	23	0.53	5.2
UKR	13	0.28	1.33
RUS	287	0.91	0.93

* mass data are transformed to a standard of 15% water content
** in relation to the total forestry area in the country[7]

In terms of forestry biomass, high extraction rates are reached in Kenya, which is likely linked to traditional biomass use. Extraction rates (per ha) in Colombia and even Canada are on the low side, so there could be ways to increase there. Mind that growth rates of forest biomass also depend on climatic circumstances and forest management practices.

2.3.Sustainable forest management

As an indication of how forests are managed, we will consider the area of forest with sustainable management certification (FSC, PEFC). We do realize that also non-certified forest may be managed in a sustainable way.
A certified forest area indicates responsibly managed forests, including natural or semi-natural forests that are used to produce timber and non-timber forest products, and forest plantations. It generally does not contain protection areas as these are not used for timber production. An increase in the area of PEFC and FSC certified forest represents an increase in the area for which evidence of sustainable forest management is available in terms of forest managed responsibly with respect to biodiversity conservation, including the protection of critical ecosystems, in addition to promoting the social and economic, cultural and ethical dimensions of sustainable forest management (Biodiversity Indicators Partnership).

[7] http://data.worldbank.org/indicator/AG.LND.FRST.K2/countries

The area of FSC and PEFC certified forest has increased from 53 million hectares in 2000 to 460 million hectares in 2015. The following figure shows the distribution between boreal, temperate and tropical regions.

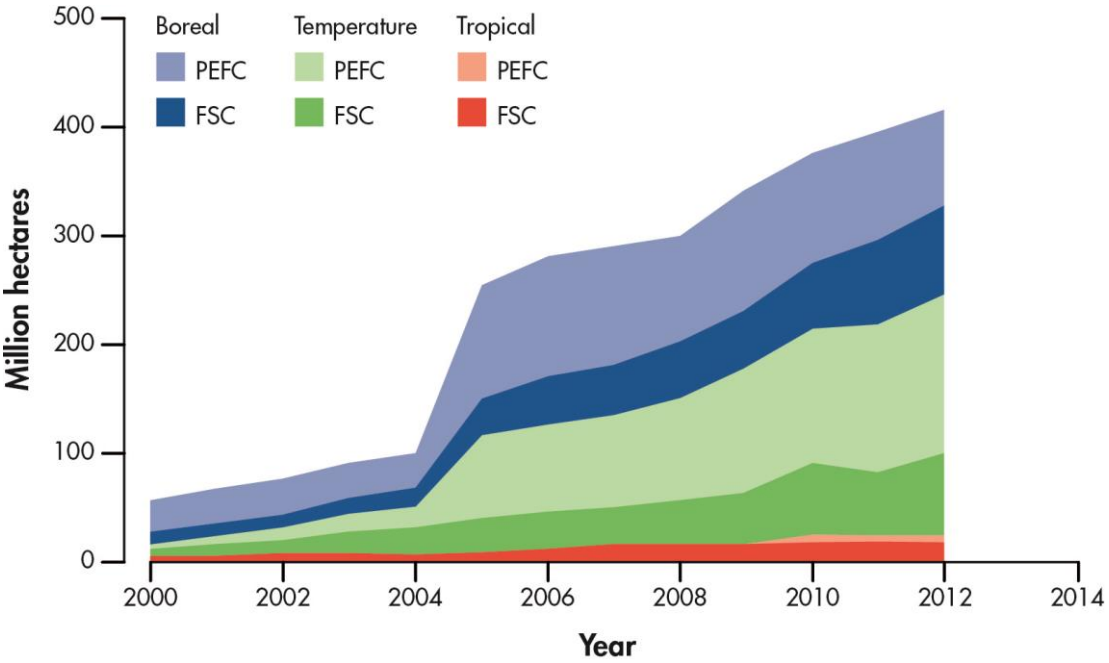

Figure 2: total area of forestry under FSC and PEFC certification in boreal, temperate and tropical regions (source: Biodiversity Indicators Partnership[8])

The following tables show an overview of total forest area in the considered regions, the distribution between public and private ownership, the share of forest in protected areas and forest with a management plan, and the amount of forest certified under FSC and PEFC. Data in the first table are from the FAO Global Forest Resources Assessment 2015 (FRA 2015)[9]; FSC and PEFC data in the second table are actual data (situation early 2016), derived from the FSC and PEFC websites.

Table 6: Total forest area, public vs private ownership and amount in protected areas or with management plan (source of the data: FRA2015)

2015	Total forest Area (kha)	% public ownership	*Of which business mgt**	% private ownership	% forest in protected areas	% forest with management plan
USA	310095	43%	-	57%	11%	**66%**
CND	347069	92%	-	8%	7%	59%
BRA	493538	81%	-	19%	42%	12%
COL	58502	22%	-	67%	18%	14%
IDN	91010	91%	*57%*	9%	35%	95%
MAL	22195	98%	*10%*	2%	23%	**61%**
MOZ	37940	100%	*2%*	-	25%	75%
KEN	4413	39%	-	61%	13%	20%
UKR	9657	100%	-	-	12%	**89%**
RUS	814931	100%	*17%*	-	2%	**100%**
Global	*4033060*					

[8] http://www.bipindicators.net/forestcertification
[9] http://www.fao.org/3/a-i4808e.pdf

** share of public forest managed by business entities and institutions*

Table 7: Amount of forest area certified under FSC and PEFC (source of the data: FSC, PEFC)

	Total forest area (kha)	FSC[10] (kha)	FSC (%)	PEFC[11] (kha)	PEFC (%)
USA	310095	13873	4.6%	33413	10.8%
CND	347069	52339	**16.9%**	130317	**37.5%**
BRA	493538	6186	1.2%	2906	0.6%
COL	58502	137	0.2%	-	-
IDN	91010	2186	2.2%	1053	1.2%
MAL	22195	673	3.3%	3893	**17.5%**
MOZ	37940	57	0.2%	-	-
KEN	4413	-	-	-	-
UKR	9657	2625	**27.0%**	-	-
RUS	814931	40710	5.0%	-	-
Global		*187172*	*4.6%*	*275282*	*6.7%*

Mind that in some places the same stand is certified by the two schemes so the total of certified forest in a country is not the sum of the area certified by the two schemes

Considering forest management, the situation is very different in the countries considered. Canada, Malaysia and Ukraine have a relatively high share of certified forest (>20%), in the US the share is around 15%, while in the other regions the share is 5% or lower.
On the other hand, the forest may be managed through local management plans, which are not necessarily endorsed by the certification schemes. This is mainly the case in Russia, Ukraine, Malaysia, the US and Kenya (for the public forests). It is not fully clear to what extent these local management plans compare to each other.

The distribution between public and private ownership is also relevant. In particular in Colombia, Kenya and the US, the majority of forests are in private ownership, mostly smallholders. In Indonesia, 92% of forest is in public ownership; however most are managed by businesses.

The following table shows an overview of **changes in forest area and carbon stock** in living forest biomass (source: FRA2015), in the period 2010-2015.

Table 8: Changes in forest area and carbon stock in living forest biomass (source: FRA2015)

	Annual change rate forest area 2010-2015		Forest affected by forest fires (avg 2003-2007)	Forest affected by insects / diseases (avg 2003-2007)	Carbon stock in living forest biomass 2015	Annual change 2010-2015	
	kha/yr	%/year	kha/yr	kha/yr	MT	MT/yr	%/year
USA	+275	+0.1	2169	5640	17330	+53	**+0.3**
CND	-47	-0.0	1230	17273	13992	-42	-0.3
BRA	-984	-0.2	-	-	59222	-80	-0.1
COL	-26	-0.0	-	-	8867	-4	-0.0
IDN	-684	-0.7	5	-	12488	-272	-2.0

[10] https://ic.fsc.org/en/facts-figures (Feb 2016)
[11] http://www.pefc.org/images/documents/PEFC_Global_Certificates_-_March_2016.pdf

MAL	+14	+0.1	2	-	2787	+50	+1.9
MOZ	-206	-0.5	-	-	1641	-10	-0.6
KEN	+37	+0.9	-	-	634	+8.6	+1.4
UKR	+22	+0.2	5	272	783	+5	**+0.7**
RUS	-41	0.0	991	4152	32800	+60	+0.2
Global	*-5581*	*-0.14*					

In absolute figures, Brazil lost most forest area in this period, with almost one million hectares per year on average – in relative terms the loss in Indonesia and Mozambique was bigger. Mind that deforestation rates in Brazil have seriously decreased in the past ten years.
The US, Kenya, Malaysia, Ukraine and Russia had an increase of forest area and forest carbon stock in the same period.
Mind that the amount of forests affected by fires or insects/diseases is substantial in Canada (6%), Ukraine (2.9%), the US (2.6%) and Russia (0.6%). This could be mitigated through better forest management, which may open up opportunities for bioenergy.

Forestry governance:
FRA2015 contained a survey to countries to indicate if they have policies supporting sustainable forest management. All mentioned countries confirmed they have such policies, either at national or regional/provincial level.

2.4.Sustainable agriculture: soil quality, water stress and food security

Agriculture – supplying nutrition as a basic human need – is the world's largest user of land, occupying more than one third of the Earth's terrestrial surface and also using vast amounts of water. Agriculture is expected to supply sufficient nutrients, economically and culturally valued foods, fibres and other products. Agriculture must also provide employment and optimized land use and productivity in relation to limiting resources.
Meeting world food demand conflicts with current trends of increasing competition for land, water and other natural resources by non-agricultural sectors, and needs to be accomplished under a more extreme and also more uncertain future climate in many parts of the world.[12]
Management of population growth, food losses and waste will be important for reducing the pressure on agricultural land, water and natural ecosystems, in addition to increases in agricultural productivity and efficiency and measures to protect natural resources from unsustainable exploitation, degradation or pollution.

Some indicators have been defined to measure different issues of sustainability in agriculture. We will focus here on soil quality and water stress on the one hand, and food security on the other hand.

Soil quality can be defined as "the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation" (Karlen et al., 1997).

[12] http://unsdsn.org/wp-content/uploads/2014/02/130919-TG07-Agriculture-Report-WEB.pdf

Soil quality is defined according to the soil functions (e.g. bearing function, production function, habitat function, resources function, reactor function) and cannot be measured by a single parameter. However, **soil organic carbon** has been defined by EUROSTAT as the more appropriate indicator for soil quality. High organic carbon content corresponds to good conditions from an agro-environmental point of view. Soils with organic carbon content less than 1% in weight are generally affected by soil degradation processes and erosion. On the other hand, soils with 1-10% organic carbon content have high agricultural value[13].
The data used for the production of this indicator are geo-spatial raster data contained in the **Harmonized World Soil Database** (HWSD) released by FAO, IIASA, ISRIC, ISSCAS, and JRC in 2008 with a spatial resolution of 30 by 30 arc seconds (approximately 1 km).

Table 9: Average carbon content in topsoil (FAOSTAT)

2008	Average carbon content in the topsoil
	% of weight
USA	1.52
CND	4.28
BRA	1.21
COL	3.82
IDN	5.21
MAL	3.48
MOZ	0.84
KEN	0.90
UKR	2.33
RUS	3.89

This indicator indicates the condition of the soils and adequacy of soil management in the different sourcing regions. Mind that it includes both forest and agricultural soils. The quality of soils in African countries is problematic; Brazilian and US soils are also relatively low in carbon content.

Total **freshwater withdrawn** in a given year, expressed in percentage of the total renewable water resources (TRWR), gives an indication of the pressure on the renewable water resources. It is the Millennium Development Goal (MDG) Indicator 7.5 and the Sustainable Development Goal (SDG) indicator 6.4.2. Countries could be defined as water-stressed if they withdraw more than 25 percent of their renewable freshwater resources.
Mind that national level data may hide large disparities within a country, which especially can be the case for large countries.
Worldwide around 9 percent of the renewable freshwater resources are withdrawn and at continental level it is less than 5 percent for each of them except Asia, where it is 20 percent. However, these continental figures hide large differences between regions as well as within large countries, such as China and India. China is facing severe water shortage in the dry north, while the humid south still has abundant water resources.

Agriculture is by far the largest **water use** at global level, with about 70 percent of water withdrawal and 90 percent of water consumption. In several developing countries, irrigation represents up to 95 percent of all water uses, and plays a major role in food production and

[13] http://faostat3.fao.org/download/G2/GI/E

food security. Future agricultural development strategies of most of these countries depend on the possibility to maintain, improve and expand irrigated agriculture. On the other hand, the increasing pressure on water resources by agriculture faces competition from other water use sectors and represents a threat to the environment in an increasing number of regions.[14]

The importance of agricultural water withdrawal is highly dependent on both climate and the place of agriculture in the economy. Water withdrawal ratios vary by continent, where the agricultural part (including irrigation, livestock and aquaculture) varies from more than 80 percent in Africa and Asia to just over 20 percent in Europe. The following table shows the share of agriculture in total water withdrawal, as well as what this means in terms of total renewable water resources.

Table 10: Average water withdrawal in agriculture and pressure on renewable water resources (FAO-AQUASTAT[15])

	Water withdrawal for agricultural		Arable land equipped for irrigation	Total freshwater withdrawal
	% of total water withdrawal	% of total renewable water resources	% of total arable land (2011-2013)	% of total renewable water resources
USA	40.2 (2005)	6.27 (2005)	17.1	15.5 (2005)
CND	12.2 (2010)	0.16 (2010)	2.5	1.34 (2009)
BRA	60.0 (2010)	0.52 (2010)	7.3	0.96 (2010)
COL	54.3 (2008)	0.27 (2008)	67.4	0.50 (2008)
IDN	81.9 (2000)	4.59 (2000)	28.6	5.61 (2000)
MAL	22.4 (2005)	0.43 (2005)	39.9	1.93 (2005)
MOZ	78.0 (2001)	0.32 (2001)	2.1	0.41 (2001)
KEN	59.3 (2010)	6.21 (2010)	2.6	10.48 (2010)
UKR	30.0 (2010)	2.54 (2010)	6.7	8.47 (2010)
RUS	19.9 (2001)	0.29 (2001)	3.6	0.29 (2001)

The share of total renewable water resources used for agriculture is one of the parameters to check if local agriculture is not putting too much stress on water supply. The highest figures are measured in the US, Kenya, Indonesia and Ukraine.

- Food security

The prevalence of undernourishment expresses the probability that a randomly selected individual from the population consumes an amount of calories that is insufficient to cover her/his energy requirement for an active and healthy life. This is the traditional FAO hunger indicator, adopted as official Millennium Development Goal indicator for Goal 1, Target 1.9.
The prevalence of food inadequacy indicator measures the percentage of the population that is at risk of not covering the food requirements associated with normal physical activity, and therefore including also those who, even though cannot be considered chronically undernourished, are likely being conditioned in their economic activity by insufficient food.
The cereal imports dependency ratio tells how much of the available domestic food supply of cereals has been imported and how much comes from the country's own production. This indicator provides a measure of the dependence of a country or region from cereal imports. The greater the indicator, the higher the dependence.

[14] http://www.fao.org/nr/water/aquastat/irrigationmap/index50.stm
[15] http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en

Table 11: Food security indicators (FAOSTAT)

	Prevalence of undernourishment	Prevalence of food inadequacy	Cereal import dependency ratio
	% (2014-2016)	% (2014-2016)	% (2009-2011)
USA	<5.0	<5.0	-24.0
CND	<5.0	<5.0	-81.0
BRA	<5.0	<5.0	-3.0
COL	8.8	15.5	63.3
IDN	7.6	13.9	12.7
MAL	<5.0	5.5	76.0
MOZ	25.3	32.3	27.3
KEN	21.2	32.1	36.4
UKR	<5.0	<5.0	-60.3
RUS	<5.0	<5.0	-27.5

In the case a region faces substantial undernourishment or food inadequacy, the main aim of its agriculture should be to increase food provision. This is certainly the case for the African countries, to a lower extent also for Colombia and Indonesia.
Several countries rely on imports of cereals for domestic food provision, which would question their ability to produce crops for exports (for bioenergy) on their arable land. This is certainly the case for Malaysia, Colombia, Indonesia, Kenya, Mozambique and Indonesia. The other countries are net cereal exporters.

2.5. Climate policy

In terms of climate policy, two aspects will be considered:

1. What is the actual level of GHG emissions per capita, including efforts made in the frame of the Kyoto agreement?
2. What is the commitment of the country towards the future (connected to the Paris Climate Agreement achieved after COP21[16])?

The following table shows total primary energy consumption (TPES) and CO_2 emissions related to **combustion of fossil fuels** in 2013 (source: IEA[17]) for the different potential sourcing regions. The EU28 is also mentioned for comparison. The last column expresses the figures per capita, which will serve as comparison between the countries. The US, Canada and Russia have very high levels of CO_2 emissions from combustion of fossil fuels, while African and South American countries have much lower CO_2 emissions, mostly in relation to their lower energy use.

Table 12: Total primary energy consumption (TPES) and CO2 emissions related to combustion of fossil fuels (source of the data: IEA)

2013	Population	TPES		CO2 emissions*	
	million	Mtoe	toe/capita	Mt CO2	t CO2/capita
EU28	508	1625,6	3,2	3340,1	6,57

[16] http://www.cop21.gouv.fr/en/
[17] http://www.iea.org/statistics/ieaenergyatlas/

USA	316	2188,4	6,91	5119,7	16,18
CND	35	253,2	7,2	536,3	15,26
BRA	200	293,7	1,47	452,4	2,26
COL	48	31,7	0,66	68,3	1,41
IDN	250	213,6	0,85	424,6	1,70
MAL	30	89,0	2,99	207,2	6,97
MOZ	26	10,8	0,42	2,9	0,11
KEN	44	21,5	0,48	11,7	0,26
UKR	45	116,1	2,55	265,0	5,83
RUS	143	730,9	5,11	1543,1	10,79

** CO_2 emissions linked to fossil fuel combustion; non-CO2 GHG emissions or LULUCF are excluded*

Considering their high CO_2 emissions, the US, Canada and Russia in principle will need to make extra efforts to reduce their GHG emissions in energy production, through energy savings and renewable energy, which may induce a higher use of domestic biomass, with may reduce their availability of biomass for international markets over time.
On the other hand, some of the developing countries may experience much higher energy consumption levels when their economies grow further, which may also result in a higher domestic claim on their resources (see also category economy).

LULUCF (land use, land use change and forestry) emissions are part of the reporting for climate agreements (Kyoto agreement in the past, Paris agreement in future). The following overview shows UNFCCC figures of greenhouse gas emissions, with a distinction between LULUCF and other GHG emissions[18] and the evolution between 1990 and 2012. Annex I parties reported to UNFCCC, emissions of non-Annex I parties are estimated with different time frames (indicated in the table).
In comparison to table 3, the GHG figures also include GHG emissions not related to fossil fuel combustion (like methane and nitrous oxides emissions).

Table 13: Evolution of greenhouse gas emissions, split up in LULUCF and other GHG emissions; 2012 data also expressed per capita (source of the data: UNFCCC)

	GHG emissions, excl. LULUCF			**LULUCF emissions**		
	Mt CO2-eq		**t CO2-eq /capita**	**Mt CO2-eq**		**t CO2-eq /capita**
	1990	**2012**	**2012**	**1990**	**2012**	**2012**
EU28	5626	4544	8,9	-258	-304	-0,6
USA	6220	6488	20,5	-817	-942	-3,0
CND	591	699	19,9	-71	41	1,2
BRA*	576	863 *(2005)*	4,3 *(2005)*	813	1329 (2005)	6,6 (2005)
COL*	119	154 *(2004)*	3,2 *(2004)*	11	26 (2004)	0,5 (2004)
IDN*	267	554	2,2 (2000)	198	821	3,3

[18] http://unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3814.php Other GHG emissions include CO_2, CH_4 and N_2O emissions.

		(2000)			(2000)	(2000)
MAL*	137 (1994)	193 (2000)	6,5 (2000)	-61 (1994)	-220 (2000)	-7,4 (2000)
MOZ*	6,8	8,2 (1994)	0,3 (1994)	2	8 (1994)	0,3 (1994)
KEN*	21,5 (1994)	21,5 (1994)	0,5 (1994)	-28 (1994)	-28 (1994)	-0,6 (1994)
UKR	944	403	8,9	-70	-27	-0,6
RUS	3368	2297	16,1	165	-542	-3,8

** Non-Annex I parties*

Very high GHG emissions are reported in the US, Canada and Russia (as was already clear in the previous table on CO_2 emissions). In terms of LULUCF emissions the highest figures are reached in Brazil and Indonesia, although these figures need to be updated with more recent figures.

Future climate action plans:

In preparation of the Paris Agreement, most countries have submitted "INDC"s (Intended nationally determined contributions) to indicate their plans to reduce greenhouse gas emissions. Climate ActionTracker[19] has evaluated most of these plans and checked if these were consistent with the target of maximum 2°C global warming.

- The plans of Brazil, EU, and the US were rated as 'medium', meaning '*not consistent with limiting warming below 2°C as it would require many other countries to make a comparably greater effort and much deeper reductions*'.
- The plans of Canada, Indonesia, Russian Federation, and Ukraine were rated as 'inadequate', meaning '*if all governments put forward inadequate positions warming likely to exceed 3–4°C*'.
- The INDCs of Colombia, Malaysia, Mozambique and Kenya are not assessed (yet) by Climate Action Tracker.

2.6. Renewable Energy

The following table gives an overview of the share of renewable energy – and specifically energy from biomass and waste – in total primary energy supply (TPES). Data are derived from the IEA database.

Table 14: overview of the role of renewables and biomass in the energy system (source of the data: IEA)

2013	**Renewables in TPES**		**Biomass & waste in TPES**		**Biomass in residential**
	Mtoe	**%**	**Mtoe**	**%**	**toe/capita**
EU28	208,8	12,8%	140,1	8,6%	0,08
USA	146,8	6,7%	97,4	4,4%	0,03

[19] http://climateactiontracker.org/countries.html

CND	47,9	18,9%	13,2	5,2%	0,10
BRA	116	39,5%	81,2	27,7%	0,03
COL	7,8	24,6%	4,0	12,5%	0,04
IDN	72,5	34,0%	54,9	25,7%	0,18
MAL	4,6	5,2%	3,7	4,1%	0,05
MOZ	9,9	91,4%	8,6	**79,8%**	0,24
KEN	17,6	81,8%	15,5	**72,2%**	0,17
UKR	3,2	2,7%	1,9	1,6%	0,02
RUS	23,3	3,2%	7,2	1,0%	0,01

The role of biomass in the energy system in Ukraine, Russia, Malaysia, the US and Canada is very low, despite substantial domestic biomass potential. In Mozambique, Kenya and Indonesia, the role of biomass is already very important, however, most of it is traditional biomass in residential applications. Brazil also has a high share of biomass in its energy system, but more focused at non-residential applications (industry and transport fuel).

Renewable energy strategies and targets

Most countries expressed certain targets on renewable energy implementation, also in the frame of the climate negotiations (INDC) – some also mention the role of bioenergy.[20] Most focus is on renewable electricity (where non-biomass renewable energy forms like wind and solar may have a more prominent role in the strategies), and transport, where biofuel blending mandates are common practice.

[20] http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015_Onlinebook_low1.pdf

Table 15: Renewable energy targets (REN21, 2015)

2013	Renewable Energy Target (%)			
	overall	**Electricity**	**Heating & Cooling**	**Transport**
EU28	20% by 2020 27% by 2030	- -	- -	10% by 2020 -
USA	-	State level renewable portfolio standards	-	National: The Renewable Fuels Standard 2 (RFS2) requires 136 billion litres (36 billion gallons) of renewable fuel to be blended annually with transport fuel by 2022. States: specific blend mandates
CND	-	Provincial level targets	-	Biofuel blend mandates National: E5 and B2 Specific provincial blend mandates
BRA	-	Target of 45% of renewables in the energy mix by 2030	-	Blend mandates: E27.5 and B7 Target of 18% sustainable biofuels by 2030
COL	-	Electricity (grid-connected) 3.5% of generation by 2015; 6.5% by 2020 Electricity (off-grid) 20% of generation by 2015; 30% by 2020	-	Blend mandate: E8
IDN	25% by 2025	26% by 2025	-	Blend mandates: E3 and B5 Biofuels 10.2% share of primary energy by 2025
MAL	-	5% by 2015 9% by 2020 11% by 2030 15% by 2050	-	Blend mandate: B5
MOZ	-	Bio-digesters for biogas 1,000 systems installed (no date) Hydropower, solar PV, wind 2 GW each (no date) Solar PV 82,000 solar home systems installed (no date) Wind turbines for water pumping 3,000 stations	Targets for Solar water and space heating: (no date)	Blend mandates: E10 in 2012–2015; E15 in 2016–2020; E20 from 2021

		installed (no date) Renewable energy-based productive systems 5,000 installed (no date)		
KEN	-	Geothermal power 1.9 GW by 2016; 5 GW by 2030 Hydropower 794 MW by 2016 Solar PV 423 MW by 2016 Wind power 635 MW by 2016	Targets for Solar water and space heating: (no date)	-
UKR	11% by 2020 18% by 2030	12.4% by 2020 20% by 2030	11% by 2020	Blend mandates: E5; E7 by 2017 10% target by 2020
RUS	-	2.5% by 2015 4.5% by 2020	-	-

3. SWOT analysis of sourcing regions

3.1. United States

Bioenergy strategies in the United States

The United States has put relatively high attention to transport biofuels in the past, 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 following is an overview of the most important documents determining the strategies of the US in terms of bioenergy and/or renewable energy in general up to 2030.

Energy Independence and Security Act of 2007[21]
This legislation seeks to expand the production of renewable transport fuels, reduce US dependence on oil, increase energy security and address climate change. Key provisions include:

1) Increasing the supply of alternative fuel sources by setting a mandatory **Renewable Fuel Standard** (RFS) requiring fuel producers to use at least 36 billion gallons of biofuel in 2022, and by providing for further incentives for the development of renewable energy technologies;
2) Reducing US demand for oil by setting a national fuel economy standard of 35 miles per gallon by 2020. The act also allows the Transportation Department to issue "attribute-based standards".
3) provisions to improve energy efficiency in lighting
4) provisions to improve energy efficiency in appliances
5) provisions to improve energy efficiency in buildings

The **Renewable Fuel Standard** (RFS) program was authorized under the Energy Policy Act of 2005 and expanded under the Energy Independence and Security Act of 2007 (to RFS2).[22]

The RFS program is a national policy that requires a certain volume of renewable fuel to replace or reduce the quantity of petroleum-based transportation fuel, heating oil or jet fuel. The four renewable fuel categories under the RFS are: Biomass-based diesel; Cellulosic biofuel; Advanced biofuel; Total renewable fuel. RFS2 required the use of 9 billion gallons in 2008 and scheduled a requirement for 36 billion gallons in 2022. The quota for 2022 was to allow no more than a maximum of 15 billion gallons from corn-starch ethanol and a minimum of 16 billion gallons from cellulosic biofuels. In recent years EPA reduced advanced biofuels targets. Considering the low uptake of cellulosic biofuel, the EPA has consistently lowered targets for cellulosic biofuel in the past years.

The Californian **Low Carbon Fuel Standard (LCFS) Program** is the most prominent example of a parallel State level initiative. This standard promotes the use of greenhouse-gas-reducing transportation fuels (such as liquid biofuels, renewable natural gas, electricity, and hydrogen) through a fuel-neutral declining carbon intensity standard. Carbon intensity is a measure of the GHG emissions associated with the production, distribution, and consumption steps in the "life cycle" of a transportation fuel. The target is to reduce the carbon intensity of California's transportation fuels by at least 10% by 2020.

In parallel to the RFS, various support programmes exist on Federal and State level to support advanced biofuels production and biorefineries.

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[21] https://www.epa.gov/laws-regulations/summary-energy-independence-and-security-act
[22] https://www.epa.gov/renewable-fuel-standard-program/program-overview-renewable-fuel-standard-program

The 2008 **Farm Bill** established new energy programs, including the **Biorefinery Assistance Program**, the Biobased Marketing Program and the Biomass Crop Assistance Program. The Biorefinery Assistance Program was expanded in the 2014 Farm Bill to include biobased product and renewable chemical manufacturing. The 2014 Farm Bill also expanded the **Biopreferred program** to include forestry products.[23]

The **Biorefinery Assistance Program** (which was recently renamed to 'Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Assistance Program'[24]) assists in the development, construction, and retrofitting of new and emerging technologies for the development of Advanced Biofuels, Renewable Chemicals, and Biobased Product Manufacturing by providing loan guarantees for up to $250 million.

The goal of the **BioPreferred Program**[25] is to increase the purchase and use of biobased products. The BioPreferred program was created by the 2002 Farm Bill and reauthorized and expanded as part of the 2014 Farm Bill to include forest products. The program's purpose is to spur economic development, create new jobs and provide new markets for farm commodities. The two major parts of the program are:

- mandatory purchasing requirements for federal agencies and their contractors,
- a voluntary labelling initiative for biobased products.

Strategies towards climate change

The United States is not a Party to the Kyoto Protocol. While a target of a 7% reduction below 1990 until 2008-–2012 was originally negotiated and agreed, the US never ratified the Protocol and the target therefore never came into force.

In June 2013, President Obama put forward a broad-based **Climate Action Plan** to cut the carbon pollution in the US[26]. The plan, which consists of a wide variety of executive actions, has three key pillars:

1. Cut Carbon Pollution in America
2. Prepare the United States for the Impacts of Climate Change
3. Lead International Efforts to Combat Global Climate Change and Prepare for its Impacts

Some focus points:

- Cutting carbon pollution from power plants
- Developing and deploying advanced transportation technologies (incl. Renewable Fuels Standard)
- Preserving the role of forests in mitigating climate change (Conservation and sustainable management)

On 31 March 2015, the US submitted its **Intended Nationally Determined Contribution** (INDC) to reduce net GHG emissions by 26–28% below 2005 in 2025 incl. land use, land use change and forestry (LULUCF) (equivalent to 24-31% below 2005 or 12–19% below 1990 levels of GHG emissions excluding LULUCF).

On August 3, 2015, President Obama and the EPA announced the **Clean Power Plan**[27] to reduce carbon pollution from power plants. The Clean Power Plan sets standards to reduce

[23] http://www.usda.gov/documents/usda-2014-farm-bill-highlights.pdf
[24] http://www.rd.usda.gov/programs-services/biorefinery-renewable-chemical-and-biobased-product-manufacturing-assistance
[25] http://www.biopreferred.gov/BioPreferred/faces/pages/AboutBioPreferred.xhtml
[26] https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf
[27] https://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants

CO_2 emissions by 32% from 2005 levels by 2030. EPA is establishing interim and final CO_2 emission performance rates for two subcategories of fossil fuel-fired electric generating units (EGUs):

- Fossil fuel-fired electric steam generating units (generally, coal- and oil-fired power plants)
- Natural gas-fired combined cycle generating units

Interim CO_2 performance rates are prescribed for the period between 2022 and 2029, and the final emission performance rates by 2030.

In the final Clean Power Plan, EPA determined that BSER (best system of emissions reduction) consists of three building blocks:

- Reducing the carbon intensity of electricity generation by improving the heat rate of existing coal-fired power plants.
- Substituting increased electricity generation from lower-emitting existing natural gas plants for reduced generation from higher-emitting coal-fired power plants.
- Substituting increased electricity generation from new zero-emitting renewable energy sources (like wind and solar) for reduced generation from existing coal-fired power plants.

The final Clean Power Plan provides guidelines for the development, submittal and implementation of **state plans** that establish standards of performance or other measures for affected EGUs in order to implement the interim and final CO2 emission performance rates. States must develop and implement plans that ensure the power plants in their state – either individually, together, or in combination with other measures – achieve the equivalent, in terms of either or rate or mass, of the interim CO2 performance rates between 2022 and 2029, and the final CO2 emission performance rates for their state by 2030.

States may choose between two plan types to meet their goals:

- Emission standards plan– includes source-specific requirements ensuring all affected power plants within the state meet their required emissions performance rates or state-specific rate-based or mass-based goal.
- State measures plan– includes a mixture of measures implemented by the state, such as renewable energy standards and programs to improve residential energy efficiency that are not included as federally enforceable components of the plan.

States have been active in adopting or increasing **renewable portfolio standards**, and 29 States now have them (see figure). These standards require utilities to sell a specified percentage or amount of renewable electricity. The requirement can apply only to investor-owned utilities but many states also include municipalities and electric cooperatives, though their requirements are equivalent or lower. [28]

In June 2015, the US and Brazil committed their countries to sourcing 20% of their electricity from non-hydro renewables by 2030[29].

[28] http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

[29] https://www.whitehouse.gov/the-press-office/2015/06/30/fact-sheet-united-states-and-brazil-mature-and-multi-faceted-partnership

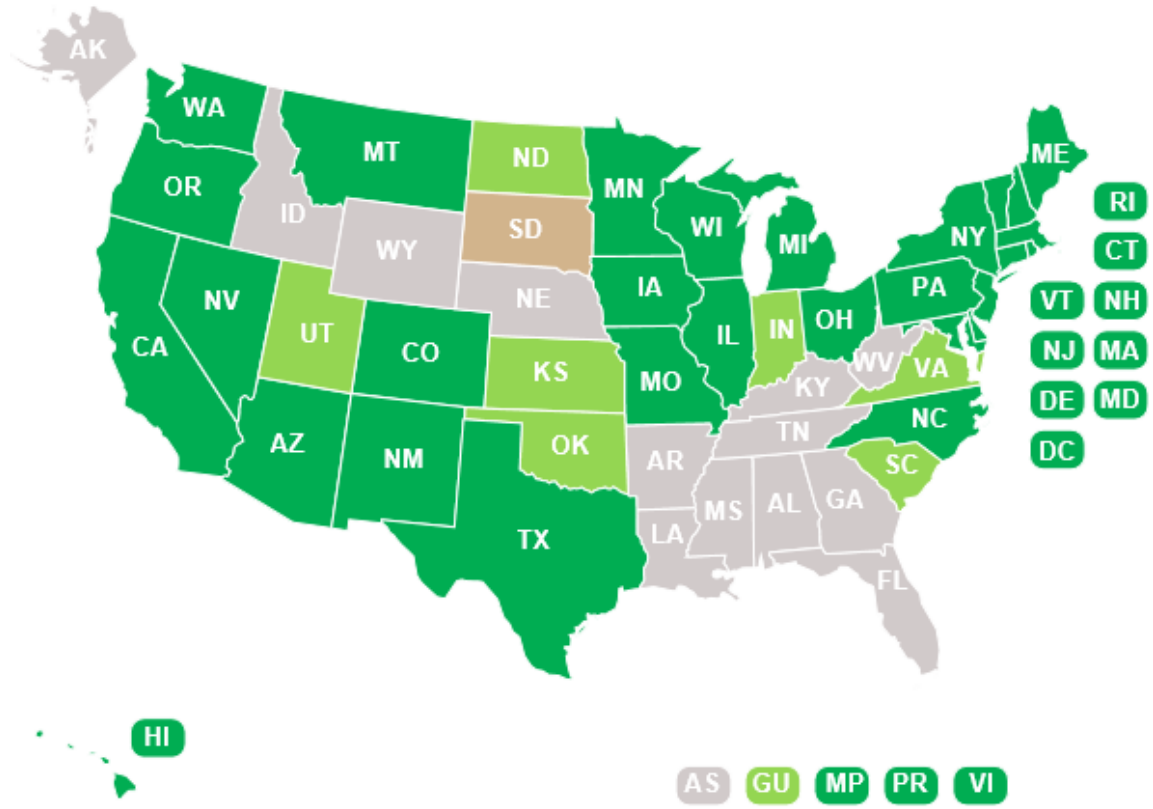

Figure 3: Renewable Portfolio Standards or Voluntary Targets in US States (status March 2016)

SWOT table for the United States

Table 16: SWOT of the United States as a sourcing region for biomass to the EU, in relation to regulations and governance

United States	Strengths / Opportunities	Neutral	Weaknesses / Threats
Economy & governance in general	- High **GDP** - Overall high **governance** scores, which makes the US a stable trade partner.		
Sustainable forest management	- Net uptake of GHG through **LULUCF** - Relatively high share of forest has a management plan	- Modest increase in **forest area**, with increasing carbon stock	- Relatively low uptake of **sustainable forest management Certification** (FSC or PEFC) - high share of private, family ownership of forests (fragmented)
Sustainable agriculture	- No issues with **food security** - Net exporter of cereals - Already some sustainability aspects considered in liquid biofuels promotion programs such as RFS and LCFS	- Average **carbon content** in the topsoil is relatively low	- Relatively high **freshwater withdrawal** for agriculture - Relatively high share of arable land needs irrigation
Climate policy & renewable energy	- Low share of **traditional (unsustainable) biomass use** - Ongoing program (RFS) on the promotion of liquid biofuels (also LCFS at states level) - Different tools at federal and state level for green power production.	- US **climate action plan** (INDC) is classified as 'medium', meaning 'not consistent with limiting warming below 2°C as it would require many other countries to make a comparably greater effort and much deeper reductions'.	- Efforts in the past to reduce GHG emissions have been limited. - Doubts about the efficiency of existing programs of lignocellulosic liquid biofuels promotion - Very **high energy consumption** per capita / high CO_2 emissions related to fossil fuel consumption - The role of **renewables and biomass** in energy provision is limited. ⇨ substantial efforts needed in energy saving and renewable energy, which may induce a much higher use of domestic biomass and reduce availability for export.

3.2. Canada

Bioenergy strategies in Canada

While Canadian government policies and incentives were initially focused on biofuels, there has been increased focus on policy development supporting bio-heat and power. Bioheat and biopower are supported by provincial goals.

The **Canadian renewable fuel standards** (RFS) fulfil commitments made by the government in 2006, through amendments made to the Canadian Environmental Protection Act 1999, more commonly known as the Clean Air Act. As of December 2010, the amendments required an annual average renewable content of 5% in gasoline, and a 2% requirement for renewable content in diesel and heating oil as of July 2011.

There are provincial renewable fuel mandates in effect in the provinces of British Columbia, Alberta, Saskatchewan, Manitoba and Ontario. British Columbia also has a Low Carbon Fuel Standard in place.

The **Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations (SOR/2012-167)**[30] set a performance standard for new coal-fired electricity generation units and those that have reached the end of their useful life (at 50 years of age). This came into force on July 1, 2015. The level of performance standard is set at 420 t CO_2/GWh. The stated aim of this approach is that it will implement a permanent shift to lower- or non-emitting types of generation, such as high-efficiency natural gas, renewable energy, or fossil fuel-fired power with CCS.

Canadian Energy Strategy (July 2015)[31] is built on the collaboration of provinces and territories through the Council of the Federation. In conjunction with provincial and territorial Energy Ministers, Premiers identified three themes to inform the future of energy in Canada: sustainability and conservation (a.o. transition to a lower carbon economy), technology and innovation (a.o. facilitate the development of renewable, green and/or cleaner energy sources to meet future demand and contribute to environmental goals and priorities) and delivering energy to people.

The **Canadian Biomass Innovation Network (CBIN)** is a network of federal researchers, program managers, policy makers, and expert advisors partnered with industry, academia, non-governmental organizations, other government levels and the international community. The Network's goal is to continually ensure the availability of knowledge, technology and enabling policy required to support the development of a sustainable Canadian bioeconomy.

The **Investments in Forest Industry Transformation** (IFIT)[32] program was created in 2010 to support Canada's forest sector in becoming more economically competitive and environmentally sustainable. The initial four-year $100-million initiative supported forest industry transformation by accelerating the deployment of highly innovative, first-in-kind technologies at Canadian forest industry facilities. These projects included bioenergy, biomaterials, biochemicals and next-generation building products. IFIT was renewed in February 2014, with an additional $90.4 million provided for the program over four years.

[30] http://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=209
[31] http://www.canadaspremiers.ca/phocadownload/publications/canadian_energy_strategy_eng_fnl.pdf
[32] http://www.nrcan.gc.ca/forests/federal-programs/13139

State-level initiatives: some examples

Alberta Bioenergy Strategy Framework: In 2006, an industry and Government of Alberta collaboration resulted in the 9-Point Bioenergy Plan framework. From 2007 to 2014, industry expanded bioenergy production capacity. The Bioenergy Producer Credit Program (BPCP) was the key catalyst to industry growth from 2011 to 2014. This program expired March 2016.[33]
Alberta government recently announced plans to phase out coal power by 2030 and move up to 30% of renewable energy in the electricity grid by 2030.[34]

The **2007 British Columbia Energy** Plan calls for provincial energy self-sufficiency by 2016, and for a clean and renewable energy standard of greater than 90%.The subsequent **2008 British Columbia Bioenergy Strategy** identified the following action items for the province[35]:

- $25 million in funding to establish the Bioenergy Network.
- $10 million over the course of three years for biodiesel production
- Meeting 50% or more of B.C.'s renewable fuel requirements by 2020 with biofuels produced in B.C.
- Establishing at least 10 community energy projects that convert local biomass into energy by 2020.
- Establishment of one of Canada's most comprehensive provincial biomass inventories that creates waste-to-energy opportunities.

Ontario's Green Energy Act (GEA) was created to expand renewable energy generation, encourage energy conservation and promote the creation of clean energy jobs.[36] Ontario's updated Long-Term Energy Plan of December 2013 mentions that by 2025 about half of Ontario's installed generating capacity will come from renewable sources.

In February 2016 the Government of Yukon has announced the adoption of the **Yukon Biomass Energy Strategy** which is part of the Renewable Energy priority action to "develop a wood based bio-energy industry in Yukon by building a local market for wood energy technologies and wood fuel products[37].

Climate change mitigation actions

In 1997 Canada signed the Kyoto Protocol, committing itself to reducing its greenhouse gas emissions to 6% below 1990 levels by 2012. However, in December 2011, Canada withdrew from the Kyoto Protocol. In 2012, Canada subsequently reported an emissions increase of 18% above 1990 levels. In particular, Canada's extraction of oil from tar sands is expected to contribute to a significant emissions increase.

On 15 May 2015 the Government of Canada has submitted its **intended nationally determined contribution (INDC**) to the UNFCCC Secretariat. Canada intends to reduce greenhouse gas emissions economy-wide by 30% below 2005 levels by 2030. Climate

[33] http://westerncanadabiodiesel.org/wp-content/uploads/2015/11/Alberta-Bioenergy-Strategy-Framework-FINAL-11-09-15.pdf
[34] http://www.alberta.ca/release.cfm?xID=389297B6E1245-F2DD-D96D-329E36A4573C598B
[35] http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/bc_bioenergy_strategy.pdf
[36] http://www.energy.gov.on.ca/en/green-energy-act/
[37] http://www.energy.gov.yk.ca/pdf/Yukon-Biomass-Energy-Strategy-Feb2016.pdf

Action Tracker rated Canada's INDC as inadequate, meaning that it is not consistent with interpretations of an equitable approach to reach a 2°C pathway,

SWOT table for Canada

Table 17: SWOT of Canada as a sourcing region for biomass to the EU, in relation to regulations and governance

Canada	Strengths / Opportunities	Neutral	Weaknesses / Threats
Economy & governance in general	- High GDP - Overall high governance scores, which makes Canada a stable trade partner.		
Sustainable forest management	- Relatively high uptake of sustainable forest management Certification (FSC or PEFC) – 92% of forests are in public hands. - Substantial amount of forests affected by insects/diseases. This opens up volumes for energy use.	- Slight reduction in forest carbon stock.	
Sustainable agriculture	- High average carbon content in the topsoil - Low freshwater withdrawal for agriculture - No issues with food security - Net exporter of cereals		
Climate policy & renewable energy	- Low share of **traditional (unsustainable) biomass use**		- The **Canadian climate action plan** (INDC) is classified as 'inadequate', meaning 'if all governments put forward inadequate positions warming is likely to exceed 3–4°C' - Efforts in the past to reduce GHG emissions have been limited. - Very **high energy consumption** per capita / high CO_2 emissions related to fossil fuel consumption - The role of biomass in energy provision is limited. ⇨ substantial efforts needed in energy saving and renewable energy, which may induce a much higher use of domestic biomass and reduce availability for export.

3.3. Brazil

Bioenergy strategies in Brazil

Brazil consumes 40% of the energy used in South America. Favourable climatic conditions and the availability of much potentially usable land make the cultivation of energy crops, especially sugar cane, 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. The oil price rise of 1973 and the full in sugar prices led the government to subsidize ethanol production through the **ProAlcool** programme. In 1979, with the second oil chock, Brazilian Government decided to enlarge the Program, supporting large-scale production of hydrated ethanol to be used as neat fuel in modified engines.[38]
End 2004 the Brazilian government launched a wide-ranging programme, the **National Program of Biodiesel Production and Use** (PNPB), intended to promote the development of a competitive biodiesel sector, in particular targeted at the poorest regions of the country. The **Brazilian Agroenergy Plan** (2006-2011)[39] aimed to organize and develop a technology research, development, innovation, and transfer proposal with a view to guaranteeing the sustainability and competitiveness of the agroenergy chains. The plan was to make greater use not only of biofuels, but also of electricity generation from biomass. CHP from sugar cane bagasse has great potential in this area.

In December 2008 Brazil's president signed the **National Climate Change Plan** (PNMC)[40]. The Plan largely focuses on reducing greenhouse gas emissions from deforestation, and contains targets for cutting deforestation, and establishing funding mechanisms and financial incentives to achieve the aim of reducing Amazon deforestation by over half by 2017. The Plan does also contain provisions regarding energy efficiency and renewable energy. It seeks to increase energy efficiency across various sectors of the economy in line with best practice and to maintain the high renewable energy mix in Brazils transport and electricity sectors. In terms of renewable energy, the Plan seeks to increase the share of electricity generated from wind and sugarcane bagasse plants, add a number of hydroelectric projects to the electricity network, expand the solar PV industry and exploit it for rural electrification. Electricity produced from cogeneration, mainly from sugarcane bagasse, is to make up 11.4% of the country's electricity supply by 2030. The National Climate Change Plan also foresees an increase in the use of biofuels. It encourages industrial users to increase their average annual consumption of ethanol by 11% in the next ten years, and envisages implementing a 5% biodiesel blending requirement from 2010 rather than 2013 as previously planned.

Brazil is not an Annex I country in the Kyoto Protocol and, thus, does not have commitments regarding emission reductions up to 2020. However, Brazil is one of the top emitters, even not considering the emissions due to land use change and deforestation that, in the past, was the main reason for high emission levels. Deforestation rate in the Brazilian Amazonia has been reduced by 82% between 2004 and 2014.

[38] R. Schubert (ed), 2009: Future Bioenergy and Sustainable Land Use
[39] http://www.agricultura.gov.br/arq_editor/file/Ministerio/planos%20e%20programas/plano%20nacional%20de%20agroenergia%202006%202011%20ingles.pdf
[40] http://www.mma.gov.br/estruturas/smcq_climaticas/_publicacao/141_publicacao07122009030757.pdf

In its INDC[41] submitted for the Paris Climate Agreement, Brazil expressed it intend to reduce GHG emissions by 37% below 2005 levels in 2025. The following measures are announced:

i) increasing the share of sustainable biofuels in the Brazilian energy mix to approximately 18% by 2030, by expanding biofuel consumption, increasing ethanol supply, including by increasing the share of advanced biofuels (second generation), and increasing the share of biodiesel in the diesel mix;

ii) in land use change and forests:
- strengthening and enforcing the implementation of the **Forest Code**, at federal, state and municipal levels;
- strengthening policies and measures with a view to achieve, in the Brazilian Amazonia, **zero illegal deforestation** by 2030 and compensating for greenhouse gas emissions from legal suppression of vegetation by 2030;
- **restoring and reforesting** 12 million hectares of forests by 2030, for multiple purposes;
- enhancing sustainable native forest management systems, through georeferencing and tracking systems applicable to native forest management, with a view to curbing illegal and unsustainable practices;

iii) in the **energy sector**, achieving 45% of renewables in the energy mix by 2030, including:
- expanding the use of renewable energy sources other than hydropower in the total energy mix to between 28% and 33% by 2030;
- expanding the use of non-fossil fuel energy sources domestically, increasing the share of renewables (other than hydropower) in the power supply to at least 23% by 2030, including by raising the share of wind, biomass and solar;
- achieving 10% efficiency gains in the electricity sector by 2030.

In addition, Brazil also intends to:

iv) in the agriculture sector, strengthen the **Low Carbon Emission Agriculture Program** (ABC) as the main strategy for sustainable agriculture development, including by restoring an additional 15 million hectares of degraded pasturelands by 2030 and enhancing 5 million hectares of integrated cropland-livestock-forestry systems (ICLFS) by 2030;

Brazil's INDC was rated by Climate Action Tracker as 'medium', indicating that Brazil's climate plans are at the least ambitious end of what would be a fair contribution.

41 http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf

SWOT table for Brazil

Table 18: SWOT of Brazil as a sourcing region for biomass to the EU, in relation to regulations and governance

Brazil	Strengths / Opportunities	Neutral	Weaknesses / Threats
Economy & governance in general	-	- Average GDP, modest growth projections - Average levels of governance scores	- Potential issue related to control of corruption
Sustainable forest management	- National Climate Change Plan (PNMC) largely focuses on reducing greenhouse gas emissions from deforestation, and contains targets for cutting deforestation, and establishing funding mechanisms and financial incentives to achieve the aim of reducing Amazon deforestation by over half by 2017.	- Majority of forests in public ownership; 17% in protected areas	- Share of forest with management plan is limited - Very low uptake of **sustainable forest management** Certification (FSC or PEFC) - Still a substantial loss in forest area and carbon stocks in forests (through deforestation), although this decreased in past years
Sustainable agriculture	- Low freshwater withdrawal for agriculture	- Average carbon content in the topsoil is relatively low - No issues with food security - Small excess of cereals for export	
Climate policy & renewable energy	- Relatively low **energy consumption** and low GHG emissions related to fossil fuel consumption - High share of **renewable energy**, with an important role of biomass. Consistent policy focus in renewable energy. - Low share **of traditional (unsustainable) biomass use** (use of biomass is focused on industry and transport fuels)	- Brazil **climate action plan** (INDC) is classified as 'medium', meaning 'not consistent with limiting warming below 2°C as it would require many other countries to make a comparably greater effort and much deeper reductions'.	- Still elevated levels of **LULUCF** emissions related to deforestation (although LULUCF emissions have been reduced dramatically in recent years) - Decrease of hydro power production due to several years of droughts → might increase biomass power production → may induce a much higher use of domestic biomass and reduce availability for export

3.4. Colombia

Bioenergy strategies in Colombia

Colombia is the third largest economy in South America. The main export products are fossil fuels and agricultural products like coffee and bananas. Primary and secondary energy demand doubled between 1975 and 2009, which required a rapid growth of the energy conversion capacity. New coal- and gas-fired power plants were built to reduce the overdependence on hydropower, which has proven vulnerable to droughts. Deforestation ate up 6.2 million hectares of tropical forest between 1990 and 2010, which has been mostly replaced by extensive cattle farms.
Biomass plays an important role in the energy mix of the country, as it is today the second largest renewable energy source after hydroelectricity. Colombia is also characterized by a vast bioenergy potential that remains untapped.[42]

The Colombia **National Energy Plan 2006-2025**[43] intends to

- ensure supply by means of diverse types of energies at competitive prices,
- increase energy coverage,
- decrease energy poverty,
- contribute to the growth of developing economies and populations and regions;
- facilitate the introduction of new energy sources and technologies, control, information and telecommunications;
- and minimize negative environmental impact by means of a sustainable energy system.

In particular it is seeking inclusion of wind power plants, photovoltaic solar, geothermal and generation from biomass in the electricity mix in the country. In terms of biofuels for transport, tax exemptions and blending obligations (for ethanol) were established.

In its **INDC**[44] Colombia commits to reduce its greenhouse gas emissions by 20% with respect to the projected Business-as-Usual Scenario (BAU) by 2030. Subject to the provision of international support, Colombia could increase its ambition to 30%.
To fulfil its mitigation goal, Colombia has prioritized mitigation measures through eight **Sectorial Mitigation Action Plans** (SMAPs) that aim to maximize the carbon efficiency of economic activities. Mitigation measures have also been identified in the land use change sector, with processes under the REDD+ strategy and the Amazon Vision program, among others.

The Colombian INDC was not (yet) assessed by Climate Action Tracker.

[42] http://eprints.unife.it/774/1/Bioenergy_technology_roadmap_for_Colombia.pdf
[43] http://www.upme.gov.co/English/Docs/PLAN_ENERGETICO_NAL_EN.pdf
[44] http://www4.unfccc.int/submissions/INDC/Published%20Documents/Colombia/1/Colombia%20iNDC%20Unofficial%20translation%20Eng.pdf

SWOT table for Colombia

Table 19: SWOT of Colombia as a sourcing region for biomass to the EU, in relation to regulations and governance

Colombia	Strengths / Opportunities	Neutral	Weaknesses / Threats
Economy & governance in general	-	- Average GDP, modest growth projections - Governance: average in terms of voice & accountability, government effectiveness and regulatory quality	- Governance: issues in terms of political stability & absence of violence/terrorism, rule of law and control of corruption
Sustainable forest management	-	- Slight reduction in forest carbon stock.	- High share of private ownership of forests No reporting of forests with management plan - No reporting of uptake **sustainable forest management** Certification (FSC or PEFC)
Sustainable agriculture	- High average carbon content in the topsoil - Low freshwater withdrawal for agriculture	-	- Substantial levels of undernourishment or food inadequacy, high dependency on cereal imports. The main aim of its agriculture should be to increase food provision.
Climate policy & renewable energy	- Substantial share of **renewable energy**, with an important role of biomass. - **National Energy Plan 2006-2025** is seeking inclusion from biomass in the electricity mix in the country and encourage development and use of biomass	- Relatively low **energy consumption** and low GHG emissions related to fossil fuel consumption (which may increase with economic growth) - Limited share of traditional (unsustainable) biomass use - Modest LULUCF emissions	- *Climate action plan not assessed yet*

3.5. Indonesia

Bioenergy strategies in Indonesia

The strategy for bioenergy development in Indonesia contains the following items:[45]

- Increase the use of biofuel as a fossil fuel substitution
- Developing bioenergy based power plants (as base load)
- Increase the sustainable supply of bioenergy feedstock through development of energy farms/forests
- Utilization of organic waste as a source of energy
- Increase contribution of national economy through development of bioenergy industries

The main strategies for further implementation of bioenergy in Indonesia include[46]:

- Increase the mandatory implementation of biofuel in all sectors (transportation, industry and power generation) (reg. 25 yr 2013, reg 20 yr 2014, reg 12 yr 2015)
- Feed-in tariff for bioenergy based power plants (biomass, biogas, MSW) (reg. 4 yr 2012, reg 19 yr 2013, reg 27 yr 2014)
- Regulate waste/biomass for export purposes.
- Utilisation of biomass wastes in agroindustry, for example regulation on palm oil mill effluent in palm oil industry,
- Allocate special fund for implementation by local government as energy access program.

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. This target was anchored in the **National Energy Policy** in 2014 and is supported by a feed-in tariff. However, Indonesia is also working on the construction of new coal-fired power plants to meet rapidly increasing electricity demand, a development which is likely to bind the country to this carbon-intensive technology for many decades.

The Government of Indonesia enacted a **National Plan for GHG emission reduction** (RAN-GRK) in September 2011. Indonesia committed to achieve the target of 26% reduction in carbon emissions from a Business As Usual (BAU) scenario by 2020, and up to 41% with international support. Indonesia has also actively engaged in REDD+ negotiations and development since 2007. A number of REDD+ initiatives have been launched, accompanied by proclaimed changes in national policies and legislation in favour of REDD+. Indonesia also signed an agreement with the Government of Norway to address emissions from deforestation and forest degradation. As a follow up, Indonesia formulated a REDD+ national strategy and action plan.[47]
The **Community Forest Partnership for Wood Biomass Based Energy** (CFFBE NAMA) started in August 2015 and is one of the initiatives supported by the Indonesia Climate Change Trust Fund (ICCTF).
In September 2015 Indonesia released its **INDC**, including an unconditional 2030 GHG emissions reduction target (including land-use, land-use change and forestry (LULUCF)-emissions) of 29% below business-as-usual (BAU) and a conditional 41% reduction below BAU by 2030 (with sufficient international support). Climate Action Tracker assessed this INDC as inadequate due to the lack of detailing in the area of LULUCF emissions. Indonesia's INDC targets include deforestation emissions due to deforestation and peatland destruction, which at present account for the largest source of the country's emissions, an average of 60% of total emissions over the last ten years (based on national data).

[45] https://www.iea.org/media/technologyplatform/workshops/southeastasiabioenergy2014/Indonesia.pdf
[46] http://www.globalbioenergy.org/fileadmin/user_upload/gbep/docs/2015_events/3rd_Bioenergy_Week_25-29_May_Indonesia/25_5_3_WIBOWO.pdf
[47] http://www.nama-database.org/index.php/Indonesia

Indonesia's deforestation already contributes to a large share of global deforestation emissions: around 30--40% for the period 2000-2010. Despite the fact that Indonesia has, temporarily (2010–2016), prohibited the clearing of primary forest and the conversion of peat lands, different sources indicate a strong increase of deforestation in this period[48].

[48] http://climateactiontracker.org/countries/indonesia.html

SWOT table for Indonesia

Table 20: SWOT of Indonesia as a sourcing region for biomass to the EU, in relation to regulations and governance

Indonesia	Strengths / Opportunities	Neutral	Weaknesses / Threats
Economy & governance in general		- Governance: average in terms of voice & accountability, government effectiveness and regulatory quality	- Relatively low GDP and high growth perspectives, which may induce an increase in energy demand, and potentially also other uses of biomass (food, materials). - Governance: potential issues in terms of political stability & absence of violence/terrorism, rule of law and control of corruption
Sustainable forest management	- 40% of forests are in protected areas		- 91% of forests are in public ownership, although most (57%) are managed by businesses - No reporting of forests with management plan - Limited uptake **sustainable forest management** Certification (FSC or PEFC) - Relatively high loss of forest area and carbon stock in forests
Sustainable agriculture	- High average levels of carbon content in the topsoil		- Relatively high freshwater withdrawal for agriculture - Relatively high share of arable land needs irrigation. - Substantial levels of undernourishment or food inadequacy; 13% dependency on cereal imports. The main aim of its agriculture should be to increase food provision.
Climate policy & renewable energy	- Green Energy Policy identifies Indonesia's strategy to maximise the utilisation of its renewable energy potential.	- Relatively low **energy consumption** and low GHG emissions related to fossil fuel consumption (which will increase with economic growth)	- High share of traditional (unsustainable) biomass use - High LULUCF emissions - The Indonesian **climate action plan** (INDC) is classified as 'inadequate', meaning 'if all governments put forward inadequate positions warming is likely to exceed 3–4°C'. The country may need to focus more on using domestic resources for renewable energy.

			- Government policy for the power sector specifies that the use of domestic energy sources will be prioritised in the national interest.

3.6. Kenya

Bioenergy strategies in 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. The Vision comprises of three key pillars: Economic; Social; and Political. The Economic Pillar aims to achieve an average economic growth rate of 10 per cent per annum and sustaining the same until 2030. Agriculture is one of the six priority sectors.[49]
The National Energy policy is in its 5th draft as at August 2011. This Policy sets out the national policies and strategies for the energy sector that are aligned to the new Constitution and are in tandem with the Vision 2030.

The latest **draft National Energy Policy** was presented in February 2014. The vision is affordable quality energy for all Kenyans, with a mission to facilitate provision of clean, sustainable, affordable, competitive, reliable and secure energy services at least cost while protecting the environment.[50] 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 Agro forestry and social forestry programmes 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.

Kenya has developed a National Climate Change Response Strategy in 2010 and a National Climate Change Action Plan (NCCAP) in 2013. The country published an **Intended Nationally Determined Contribution** (INDC) in July 2015, indicating that Kenya seeks to abate its GHG emissions by 30% by 2030 relative to the BAU scenario of 143 MtCO2eq; and in line with its sustainable development agenda[51] Kenya's total greenhouse gas (GHG) emissions are relatively low, standing at 73 MtCO2eq in 2010, out of which 75% are from the land use, land-use change and forestry (LULUCF) and agriculture sectors. This may be explained by the reliance on wood fuel by a large proportion of the population coupled with the increasing demand for agricultural land and urban development. Kenya strives to be a newly industrialised middle income country by 2030. This development is expected to increase emissions from the energy sector.

[49] http://www.vision2030.go.ke/
[50] http://www.ketraco.co.ke/opencms/export/sites/ketraco/news/Downloads/National_Energy_Policy_-_Final_Draft_-_27_Feb_2014.pdf
[51] http://www4.unfccc.int/submissions/INDC/Published%20Documents/Kenya/1/Kenya_INDC_20150723.pdf

SWOT table for Kenya

Table 21: SWOT of Kenya as a sourcing region for biomass to the EU, in relation to regulations and governance

Kenya	Strengths / Opportunities	Neutral	Weaknesses / Threats
Economy & governance in general		- Governance: average in terms of voice & accountability	- Low GDP and relatively high growth perspectives, which may induce an increase in energy demand, and potentially also other uses of biomass (food, materials). - Governance: potential issues in terms of political stability & absence of violence/terrorism, government effectiveness, regulatory quality, rule of law and control of corruption
Sustainable forest management		- 24% of forests with management plan - Limited loss in forest area and forest carbon stocks	- High share of private ownership of forests - No reporting of uptake **sustainable forest management** Certification (FSC or PEFC)
Sustainable agriculture			- Very low average carbon content in the topsoil - Relatively high freshwater withdrawal in agriculture - High levels of undernourishment or food inadequacy; 36% dependency on cereal imports. The main aim of its agriculture should be to increase food provision.
Climate policy & renewable energy	- Clear attention for biomass in National Energy Policy document.	- Very low **energy consumption** and low GHG emissions related to fossil fuel consumption, which will increase with economic growth - Stable LULUCF emissions	- Very high share of biomass in energy provision, most through traditional (unsustainable) biomass use (wood fuel) - *INDC not assessed by Climate Action tracker*

3.7. Ukraine

Bioenergy strategies in Ukraine

Renewable sources of energy can play an important role in meeting Ukraine's energy needs and generating green growth. First, the country currently has a high level of energy intensity, almost three times the average of industrialised countries.
Second, the natural gas price is expected to increase, therefore creating an incentive to switch to cheaper sources of energy.
Ukraine has significant natural endowments in the field of renewable energy. In particular, the country's abundant agricultural and forestry waste is a key asset for developing heat and power generation based on biomass. Ukraine's substantial potential for producing energy from renewable sources remains largely untapped. [52]

In cooperation with the European Union, Ukraine joined the Energy Community in 2011, in that way committing to binding renewable energy targets by 2020. The **Ukraine National Renewable Energy Action Plan** (NREAP)[53] is the document setting the targets of use of renewable energy sources until 2020, as well as the manner of their achievement. Amongst other things, its aim is to enhance investments into the field of renewable energy sources.

Ukraine's renewable energy 2020 targets:

- Overall target: 11% of share of energy generated from renewable sources in gross final energy consumption;
- Heating and Cooling: 12.4% of demand met by renewable energy sources;
- Electricity: 11% of electricity demand met by electricity generated from renewable energy sources;
- Transport: 10% of energy demand met by renewable energy sources.

The development of Ukraine's renewable energy production is supported by the following measures:

- Green feed-in tariff;
- Land tax reduction for renewable energy enterprises;
- Number of tax exemptions: (1) operating profits of the energy companies producing electricity from renewable sources; (2) biofuel producers' profits earned from biofuel sales; (3) company profits earned from combined electricity and heat production; (4) profits of producers of machines, equipment and devices for the manufacture and reconstruction of technical and transport means consuming biological fuel types; (5) value-added tax exemption for the transactions related to importation to Ukraine's customs territory of equipment working on renewable energy sources.

The support for the renewable energy producers has undergone significant changes at the beginning of 2015. The framework is currently not attractive anymore for the development of new renewable projects. Almost all new investment decisions for new projects have been postponed. The legislative inconsistencies (namely unexpected reduction of feed-in tariffs, cancellation of tax exemptions, etc.) are detrimental to the investment climate. This is jeopardizing the fulfilment of the 11% renewable energy target in 2020. [54]

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[52] https://www.oecd.org/countries/ukraine/UkraineRenewableEnergy.pdf
[53] https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3430146/067A653E3AF24F62E053C92FA8C06D31.PDF
[54] https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Ukraine/Renewable_Energy

In 2013 an updated '**Energy Strategy of Ukraine till 2030'** was adopted. The strategy sets new targets for different energy carriers such as electricity generation from renewable energy sources and nuclear power. The possibilities of bioenergy are basically ignored in this document.[55]

On 30 September 2015, Ukraine submitted an **INDC** for the Paris Climate Agreement, including the target to reduce GHG emissions including land use, land use change and forestry (LULUCF) by at least 40% below 1990 levels by 2030[56]. However, the most recent historical data shows that emissions excl. LULUCF have already declined by 57% below 1990 levels, while LULUCF sinks remain rather stable. This means that under Ukraine's INDC, emissions will grow by up to 39% of 2012 levels excl. LULUCF. Climate Action Tracker assessed this INDC as inadequate indicating that Ukraine's commitment is not in line with interpretations of a "fair" approach to reach a 2°C pathway.

[55] http://iet.jrc.ec.europa.eu/remea/sites/remea/files/files/documents/events/geletukha.pdf
[56] http://www4.unfccc.int/submissions/INDC/Published%20Documents/Ukraine/1/150930_Ukraine_INDC.pdf

SWOT table for Ukraine

Table 22: SWOT of Ukraine as a sourcing region for biomass to the EU, in relation to regulations and governance

Ukraine	Strengths / Opportunities	Neutral	Weaknesses / Threats
Economy & governance in general	-	- Governance: average in terms of **voice & accountability**	- Relatively low **GDP** and relatively high **growth perspectives**, which may induce an increase in energy demand, and potentially also other uses of biomass (food, materials). - **Governance**: issues in terms of political stability (current crisis) & absence of violence/terrorism, government effectiveness, regulatory quality, rule of law and control of corruption
Sustainable forest management	- Most forests are in public ownership. 92% of forests have a **forest management** plan. 27% are FSC certified. - Substantial amount of forests affected by insects/diseases. This opens up volumes for energy use. - The State Target Program 'Forests of Ukraine for the period of 2010 – 2015 foresees the annual construction of more than 1.500 km of forest roads to provide access to wood resources and to increase the logging/felling/collection of wood wastes	- Moderate increase in forest area and forest carbon stocks	-
Sustainable agriculture	- No issues with **food security** - Net exporter of cereals	- Average carbon content in the **topsoil** - Medium **freshwater**	-

		withdrawal in agriculture	
Climate policy & renewable energy	- Net uptake of GHG through **LULUCF**	- Average **energy consumption** and CO_2 emissions related to fossil fuel consumption - Limited role of traditional biomass	- The Ukraine **climate action plan** (INDC) is classified as 'inadequate', meaning 'if all governments put forward inadequate positions warming is likely to exceed 3–4°C' - The Energy Strategy of Ukraine till 2030 does not specifically include biomass promotion measures. - Difficult implementation of the State Target Economic Program for energy efficiency and the development of energy production from renewable energy sources and alternative fuels. - The **role of renewables and biomass** in energy provision is very limited. => substantial efforts could be anticipated in renewable energy, which may induce a much higher use of domestic biomass and reduce availability for export.

4. SWOT statements per sourcing region – survey results

Early June 2016 a survey was distributed to a long list of international stakeholders to validate a number of statements in relation to the strengths and weaknesses of certain regions as a trade partner to the EU.

4.1. United States

	Statement	Agree	Partially agree	Disagree
General conditions				
1	(+) The US has a **strong economy** and **regulatory stability**, with a **positive investment climate** and a **high trade orientation**. This makes the US a **stable trade market** for the EU.			
2	(-) The US has very **high energy consumption** per capita, with **high greenhouse gas emissions** related to fossil fuel consumption. Considering the global climate targets, substantial efforts will be needed in energy savings and renewable energy and a **major growth in domestic use of lignocellulosic biomass** can be anticipated (for transport fuels, renewable energy, biobased products). This reduces the room for biomass export in the medium term.			
Export conditions for biomass from forestry				
3	(+) The highly forested area in the US Southeast is **easily accessible** for trade with the EU through its Atlantic harbours.			
4	(-) The uptake of sustainable forest management (SFM) **certification** in the US is relatively low, so the sustainability of forest biomass from the US is difficult to demonstrate.			
5	(+) While SFM is not very common, a relatively high share of US forests is managed with a **forest management plan** and **national regulations** address aspects in terms of biodiversity, water and soil.			
6	(+) Forest area and carbon stock in forests in the US has continued to grow in the past decades, resulting in a net **greenhouse gas sink from LULUCF**, so US forest biomass (residues) is not associated with a loss of forest carbon.			

Export conditions for biomass from agriculture				
7	(-) **Agriculture** is relatively **intensive** in the US, with reduced carbon content in the topsoil and high irrigation needs. Further intensification of harvesting in agriculture may induce sustainability risks.			
8	(+) The US has sufficient area to supply domestic food and feed demand through its own agriculture and there is **room for diversification to include non-food crops**.			
9	(-) Considering the stimulation of **domestic biofuels from agricultural residues or energy crops** (corn stover, switchgrass) through the RFS2, there will be little room for exporting agricultural biomass to the EU.			

Analysis of the survey results to be included

4.2. Canada

	Statement	Agree	Partially agree	Disagree
General conditions				
1	(+) Canada has a **strong economy** and **regulatory stability**, with a **positive investment climate** and **high export orientation**. This makes Canada a **stable trade market** for the EU.			
2	(-) Canada has very **high energy consumption** per capita, with **high greenhouse gas emissions** related to fossil fuel consumption. Considering the global climate targets, Canada will need to do much more (current plans are inadequate); substantial efforts will be needed in energy savings and renewable energy and a **major growth in domestic use of lignocellulosic biomass** can be anticipated (for transport fuels, renewable energy, biobased products). This reduces the room for biomass export in the medium term.			
Export conditions for biomass from forestry				
3	(+) The highly forested area in Canada is **easily accessible** for trade with the EU - particularly in the East - through its harbours. Infrastructure is available.			
4	(+) The uptake of sustainable forest management (SFM) **certification** in Canada is high, also in relation to the high share of public forest (92%). This facilitates the demonstration of the sustainability of forest biomass from Canada.			
5	(+) Forest area and forest carbon stocks in Canada have slightly decreased in past years. This is mostly due to **forest fires and forests infected by insects**. Managing forests against these risks can provide a lot of resource which can be used for energy.			
Export conditions for biomass from agriculture				
6	(+) Canada has high average carbon content in the topsoil and low freshwater withdrawal, which are **good conditions for agriculture**.			
7	(+) Canada has sufficient area to supply domestic food and feed demand through its own agriculture – it is actually a major exporter of cereals. There is room to use **agricultural residues**, or for **diversification to include non-food crops**.			

Analysis of the survey results to be included

4.3. Brazil

	Statement	Agree	Partially agree	Disagree
General conditions				
1	(+/-) Although there are potential issues related to **corruption control**, Brazilian **modest economic growth** projections and average levels of **country governance**, make Brazil a **relatively stable trade market** for the EU.			
2	(+) Brazilian **energy consumption** per capita is relatively low, with **low greenhouse gas emissions** related to fossil fuel consumption. There is a high share of renewable energy, with an important role of biomass, through a **consistent policy focus in renewable energy**. So no abrupt changes in biomass use (just a consistent growth) are projected to fulfil climate targets.			
3	(-) The decrease of **hydro-power production** due to several years of droughts might increase biomass power production, inducing a higher use of domestic biomass and **reducing the availability for export**.			
Export conditions for biomass from agriculture				
4	(+) The agricultural area in Brazil Southeast and South is **easily accessible** for trade with the EU through its Atlantic harbours.			
5	(-) Brazil has low average **carbon content** in its topsoil. Further intensification of harvesting in agriculture may induce sustainability risks.			
6	(+) Brazil has sufficient area to supply domestic food and feed demand through its own agriculture and there is **room for diversification to include non-food crops**.			
7	(+) There are prospects of **increasing productivity** of extensively managed grasslands (higher yields, but also increasing soil carbon content).			
8	(-) Brazil is investing in **advanced ethanol** from lignocellulose, and will prefer trade of ethanol instead of biomass.			
Export conditions for biomass from forestry				
9	(-) Both the uptake of sustainable forest management (SFM) **certification** and share of **forest management plans** are very low, so the sustainability of forest biomass from Brazil is difficult to demonstrate.			

10	(-) Although at lower rates in the past decades, forest area and carbon stock in forests in Brazil have continued to decline, resulting in elevated levels of **greenhouse gas emissions from LULUCF.** So Brazilian forest biomass (residues) are still associated with a loss of forest carbon.			

Analysis of the survey results to be included

4.4. Colombia

	Statement	Agree	Partially agree	Disagree
General conditions				
1	(+/-) In terms of **governance** Colombia has issues related to political stability & absence of violence/terrorism, rule of law and control of corruption. On the other hand, regulatory quality is positive, and overall the **investment climate** is rated positive.			
2	(+/-) Colombia shows relatively low energy consumption that may increase with economic growth. Besides, biomass is starting to play an important role in the energy mix of the country. Furthermore, a higher share of biomass in the electricity mix is envisaged in long term plans. This may **reduce the room for biomass export** in the medium term.			
3	(-) The **accessibility** of some sourcing areas in Colombia makes it difficult to transport biomass to the ocean harbours.			
Export conditions for biomass from forestry				
4	(-) Colombia has a high share of private ownership of forests. No uptake of **sustainable forest management** certification (FSC or PEFC) is reported, nor is there reporting of forests with a management plan. So the sustainability of forest biomass from Colombia is difficult to demonstrate.			
5	(-) There has been **some reduction of forest area** (net deforestation) and forest carbon in the past years in Colombia, resulting in net LULUCF emissions.			
Export conditions for biomass from agriculture				
6	(+) Agriculture in Colombia shows quite **high yields**, with **high average carbon content** in the topsoil and **low freshwater withdrawal**, which are very good circumstances for agriculture.			
7	(+) In Colombia, **sugarcane mills** play an important role in agriculture residues management. Currently the bagasse is the main residue used to generate power in sugarcane mills, but starting to use **thrash** (leaves) could increase biomass availability for export.			
8	(-) The level of undernourishment and food inadequacy in Colombia is relatively high, as well as the cereals import dependency, meaning that Colombia should **prioritize domestic production of food and feed in its agriculture**, with little room for diversification to include non-food crops. Potential trade should focus on **agricultural residues**.			

Analysis of the survey results to be included

4.5. Indonesia

	Statement	Agree	Partially agree	Disagree
General conditions				
1	(-) Indonesia has issues in terms of political stability, rule of law and control of corruption and its investment climate is considered poor. This makes Indonesia an **unstable trade market** for the EU.			
2	(-) Indonesia's GDP is relatively low, presenting low **energy consumption** per capita. However, relatively high growth perspectives will increase energy demand (including biomass for energy) and other biomass uses. Considering the global climate targets, Indonesia will need to do much more (current plans are inadequate). Therefore, **major growth in domestic use of biomass** can be anticipated. This reduces the room for biomass export in the medium term.			
Export conditions for biomass from forestry				
4	(-) The uptake of sustainable forest management (SFM) **certification** in Indonesia is low, so the sustainability of forest biomass from Indonesia is difficult to demonstrate.			
5	(+) While SFM certification is not very common in Indonesia, most forests have a **management plan**, also in relation to the high share of public forest (91%).			
6	(-) Indonesia has serious issues with deforestation. Indonesia represented around 30 to 40% of global deforestation emissions for the period 2000-2010. Forest area and carbon stock in forests in Indonesia have continued to decline, resulting in elevated levels of **greenhouse gas emissions from LULUCF.** So Indonesian forest biomass (residues) can be associated with a loss of forest carbon.			
Export conditions for biomass from agriculture/plantations				
7	(+/-) Indonesia shows high average **carbon content in the topsoil**, but also relatively high **water withdrawal** for agriculture. Yields are high due to climatic conditions.			
8	(-) Indonesia's palm oil production – which is primarily for food purposes - is associated with deforestation rates and peatland draining.			
9	(+) Palm oil production in Indonesia produces **high amounts of residues** which can be available for energy production.			

Analysis of the survey results to be included

4.6. Kenya

	Statement	Agree	Partially agree	Disagree
General conditions				
1	(-) Kenya has issues in terms of political stability, violence, terrorism, government effectiveness, regulatory quality and corruption control, which make Kenya an **unstable trade market** for the EU.			
2	(-) Kenya's GDP is low, presenting **low energy consumption** per capita. However, relatively high growth perspectives will increase energy demand (including biomass for energy) and other biomass uses. Therefore, **major growth in domestic use of lignocellulosic biomass** can be anticipated. This reduces the room for biomass export in the medium term.			
Export conditions for biomass from forestry				
3	(-) No uptake of **sustainable forest management certification** (SFM) is reported in Kenya, and the share of **forest management plans** is still quite low, so the sustainability of forest biomass from Kenya will be difficult to demonstrate.			
4	(+) Forest area and carbon stock in forests in Kenya are quite limited, but there is no loss of forest or forest carbon in recent years, resulting in stable **greenhouse gas emissions from LULUCF**. So Kenya forest biomass (residues) is not associated with a loss of forest carbon.			
5	(-) Considering that wood fuel is and will continue to be the primary source of energy for the majority of rural and urban poor population, there will be **little room for exporting forest residues to the EU**.			
Export conditions for biomass from agriculture				
6	(-) Kenya shows very low **carbon content in the topsoil**, and **high irrigation needs**. Further intensification of harvesting in agriculture may induce sustainability risks.			
7	(-) Kenya presents high levels of **undernourishment** and food inadequacy and shows high dependency on cereals imports. Therefore, the main aim of its agriculture should be to **increase food provision.**			

Analysis of the survey results to be included

4.7. Ukraine

	Statement	Agree	Partially agree	Disagree
General conditions				
1	(-) Ukraine has large issues at the moment in terms of political stability, rule of law and control of corruption, which make Ukraine an **unstable trade market** for the EU.			
2	(-) Ukraine's GDP is relatively low, with average energy consumption per capita. There is **high reliance on fossil fuels**; uptake of renewable energy (including biomass) is very low. Considering the global climate targets, Ukraine will need to do much more (current plans are inadequate); substantial efforts will be needed in renewable energy and a **major growth in domestic use of lignocellulosic biomass** can be anticipated. This reduces the room for biomass export in the medium term.			
Export conditions for biomass from forestry				
3	(+) The uptake of **sustainable forest management certification** (SFM) in Ukraine is relatively high, also related to the fact that all forests are in public hands. This facilitates the demonstration of the sustainability of forest biomass from Ukraine.			
4	(+) Forest area and carbon stock in forests in Ukraine has continued to grow in the past decades, resulting in a net **greenhouse gas sink from LULUCF**, so Ukraine forest biomass (residues) is not associated with a loss of forest carbon.			
Export conditions for biomass from agriculture				
5	(+) Ukraine has relatively high average carbon content in the topsoil and modest freshwater withdrawal, which are **good conditions for agriculture**.			
6	(+) Ukraine has sufficient area to supply domestic food and feed demand through its own agriculture – it is actually a major exporter of cereals. There is room to use **agricultural residues**, or for **diversification to include non-food crops**.			

Analysis of the survey results to be included

5. Conclusions

To be elaborated

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