



Delivery of sustainable supply of non-food biomass to support a
“resource-efficient” Bioeconomy in Europe

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D5.3

Summary report on how sustainability aspects of introduction bioeconomy value chains are currently considered

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About S2Biom project

The S2Biom project - Delivery of sustainable supply of non-food biomass to support a “resource-efficient” Bioeconomy in Europe - supports the sustainable delivery of non-food biomass feedstock at local, regional and pan European level through developing strategies, and roadmaps that will be informed by a “computerized and easy to use” toolset (and respective databases) with updated harmonized datasets at local, regional, national and pan European level for EU28, western Balkans, Turkey and Ukraine. Further information about the project and the partners involved are available under www.s2biom.eu.

Project coordinator



Scientific coordinator



Project partners



About this document

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Introduction

The aim of the selected country analysis is to map how sustainability aspects of introducing bioeconomy value chains are considered in a selected number of countries and assess how to implement a sustainable and resource efficient bioeconomy through national strategies, policies and instruments, guidelines etc.

Given the diverse nature of current bioeconomy settings in Member States and the broader Europe, selected country analyses on how sustainability aspects of introducing bioeconomy value chains are nationally considered have been carried out for:

- Belgium and the Netherlands,
- Germany,
- Finland,
- Spain,
- Bulgaria, Croatia, Greece, Serbia, and Turkey

In detail, the work in this task was carried out through the following interlinked steps:

- Capacity mapping in terms of
 - institutions
 - legislation, regulations and policies/instruments at national level, including existing certification schemes.
- Gap analysis (regarding sustainability policy & market issues)

The aim of this analysis will be to determine those gaps that are critical to the future development of the sustainable supply and delivery of the biobased economy with non-food lignocellulosic biomass.

- Recommendations

Based on the work in the two previous steps a set of tailored suggestions per country with the appropriate timeframe for implementation will be prepared and presented for further discussion with stakeholders via the case studies in WP9. The work for the recommendations has been postponed to early 2016 to match the work in WP9 both for the Advanced and Strategic case studies.

The aim of the first version of this deliverable¹ is to:

- present an overview on how sustainability aspects of introducing bioeconomy value chains are currently considered in selected countries and regions,

¹ A final update, including the recommendations is expected M36.

- provide a structured gap analysis where the foreseen work for the recommendations will be built on.

Brief overview of the under study countries, with relation to bioeconomy

This section presents an overview of the under study countries in relation to bioeconomy profiles for land, population, industrial activity, energy and biomass.

Table 1 Country bioeconomy profiles

	BE	BUL	HR	DE	GR	FIN	NL	RS	ES	TUR
Climate	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Land area	Red	Green	Red	Green	Red	Green	Red	Green	Green	Green
Population density	Red	Red	Red	Green	Red	Red	Green	Red	Yellow	Yellow
Industrial activity	Green	Red	Red	Green	Red	Green	Green	Red	Yellow	Yellow
Primary energy use	Green	Red	Red	Green	Red	Green	Green	Red	Yellow	Yellow
Energy dependence	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green
Biomass resources	Red	Green	Yellow	Green	Yellow	Green	Red	Green	Green	Yellow
Focus on biomass trade	Green	Red	Red	Yellow	Red	Yellow	Green	Red	Yellow	Red

The table uses traffic light colour coding to reflect the relative strength and importance of each issue in the development of bioeconomy. The traffic light colour coding provides an initial qualitative interpretation provided by the authors and will be further validated through the case study consultations in collaboration with Work Package 9. The code is as follows:



Belgium is divided into three regions, Wallonia, Flanders, and Brussels, with different languages and Governments.

The country is small but has very intensive agriculture with high yields, high livestock density (excess manure in north) and experience in processing. The role of industry is also very important with the following sectors being the most important for bioeconomy: a) chemical industry, b) food / feed industry, c) paper & products and d) wood products.

Bulgaria is the 11th largest EU member state by territory (2.6% of EU territory) and accounts for only 1.4% of EU population (7.284 million by the end of 2012).

The territory of Bulgaria is mainly occupied by agricultural lands – 64,235 km² (57.9 % of the whole territory), followed by forest areas – 38,284 km² (34.5% of the

territory). These facts predispose the potential development of bioeconomy-related sectors.

The average population density of Bulgaria is 65 people per km² – significantly lower than the EU average of 118 people per km². The population is concentrated in big cities and/or in the Southern part of the country, leaving waste areas in the North (especially in the Northwest) scarcely populated. The urbanization level is rather high – 73%. The capital of Sofia has almost 1.3 million people, while the four biggest cities alone account for approximately 1/3 of the whole population. On the one hand, this means that large land areas are available for developing bioeconomy-related sectors, but on the other hand – there is a great deal of economic challenges (logistics, labour force, etc.) to develop this potential, due to the disproportionate distribution of population.

The contribution of the primary sector that includes agriculture, forestry and fishing to the country's gross national product in 2012 was 5.4 %, down from 7.2 % from 2008. Conversely, the sector ensures significant share (almost 20%) of the overall employment, i.e. it is very important from the socio-economic point of view.

Bulgaria is 12th largest exporter of wheat in the world. The largest markets of Bulgarian wheat are Spain – 30%, Italy – 23%, Romania – 16% and Greece – 12%. The highest prices are, however, achieved in the markets of UAE, Lebanon and Egypt – on average about USD 320 per tonne. All major markets recently registered significant growth, reaching more than 100% in Italy and Portugal. The main competitors of Bulgaria in wheat export are Ukraine, Russia and USA. The price competition from Ukraine and Russia is particularly strong and Bulgaria finds herself often in a weaker position.

Despite the 25% decline in sunflower seeds export (in terms of value) last year, Bulgaria still remains the second largest exporter in the world for 2012. The most important markets are Portugal, the Netherlands, Turkey, Spain and Germany, where the highest prices are obtained. With the exception of Germany, the export prices for the remaining markets range around 600 USD per tonne, which is not that far away from the average prices in the main markets. According to the Bulgarian Industrial Association (BIA), Bulgaria is gaining market share in Portugal and Germany, at the expense of reduction in Turkey.

In 2013 Bulgaria became the largest exporter of sunflower seeds in the world, with a share of 17.8%. The value of the exported sunflower seeds amounted to almost 744 million USD. According to the analysis of the BIA, based on preliminary data from the WTO, within the period 2009-2013 Bulgaria achieved an impressive average annual growth of 21% in monetary terms and 7% in quantitative terms.

After several years of declining growth in the biofuel consumption in the EU, for the first time the biofuel use registered an absolute reduction. However, the use of sustainable biofuels (i.e. those which are certified and hence, count for purposes of RED) slightly increased. The use of biofuels in Bulgaria remained virtually unchanged over the past two years, standing around 86,000 tons per year. Nonetheless, the country is among the few ones in the EU that are still missing an effective system of certification.

There is no specific national strategy for bioeconomy in **Croatia**, but some government action plans provide guidance for the development of this sector in agriculture, forestry, timber and paper industry.

Germany is located in the centre of Europe, sharing approx. 3,600 km of borders with 8 EU Member States² plus Switzerland. At the end of 2013, Germany had a population of 80.8 million living in 40 million households, and generated a GDP of approx. 2.9 billion €²⁰¹⁴³. Germany covers a land area of 35.7 million hectares (Mha). A share of approximately 32% (11.4 Mha) of the land is covered by forests. Agricultural land covers 16.8 Mha (47%), of which approx. 12 Mha are arable land, and about 5 Mha pasture and grassland⁴.

Since 2011, Germany has started several political initiatives addressing biomass in a broader context: DBZF/UFZ, IINAS IEA BioT40: Germany 2014 38 The Federal Ministries for Research (BMBF) and Agriculture (BMEL) developed jointly the “Biorefinery Roadmap”⁵ which describes opportunities for multi-output biomass conversion, and especially addresses sustainability requirements, and opportunities for biomass residues and wastes. Both ministries also engage in the Federal Bioeconomy Strategy which runs from 2011 to 2016, covering a budget of more than 2 billion € for R&D in this area⁶, and founded the “Bioeconomy Council”⁷ which advises the Federal Government on the issue. So far, there are no specific policy instruments or regulations in Germany addressing biorefineries or the bioeconomy in general, all incentives are for R&D activities. Yet, there is a growing debate about incentives for bio-based materials, and “advanced” biomass conversion systems such as biorefineries⁸.

The Netherlands is dominated by the delta of three great rivers – the Rhine, Maas and the Schelde. The country is low-lying and flat; around half its area is below sea level and/or prone to flooding. The reclamation of land from the sea started in the 12th century and has continued through recent times; dykes and mechanical drainage are

² AT, BE, CZ, DK, FR, LU, NL, PL

³ DESTATIS 2015

⁴ FNR (Fachagentur Nachwachsende Rohstoffe e. V.) 2014a: Bioenergy in Germany: Facts and Figures; Gülzow http://mediathek.fnr.de/media/downloadable/files/samples/b/a/basisdaten_9x16_2013_e_ngl_web.pdf

⁵ BMBF (Federal Ministry for Research) et al. 2012: Biorefineries Roadmap as part of the German Federal Government action plans for the material and energetic utilisation of renewable raw materials; BMELV, BMBF, BMU, BMWi (eds.); Berlin http://www.bmbf.de/pub/roadmap_biorefineries.pdf

⁶ BMBF (Federal Ministry of Education and Research) 2014: Destination Bioeconomy - Research for a Biobased and Sustainable Economic Growth; Berlin http://www.bmbf.de/pub/Destination_Bioeconomy_bf.pdf

⁷ <http://www.bioekonomierat.de/english.html>

⁸ https://www.dbfz.de/fileadmin/user_upload/Referenzen/studien/IEA_T40_Country_Report2014.pdf

a necessity in many agricultural areas. The Netherlands is a small country, with high population density and relatively high GDP.

The utilised agricultural area (UAA) is at 1.8 million hectares, which represented 45 % of Dutch territory in 2010 – one of the highest shares recorded within the EU-27. It has a moderate forest land area per capita.

Agriculture is among the most intensive of the EU with high yields, and high livestock density (manure excess) because of favourable climatic circumstances, overall good quality soils and highly qualified and well organised farmers.

Waste management is well developed; The Netherlands is even a frontrunner in recycling in Europe, having managed over the last years to divert more than half of the MSW generated in 2010 to material and organic recycling. Out of the 9.8 million tonnes of MSW generated in 2010, 5 million tonnes were recycled, 3.2 million tonnes were incinerated (with or without energy recovery) and only 0.03 million tonnes ended up in the landfills. There is no certain information about the remaining 1.8 million tonnes.

The Netherlands is a strongly industrialized country and has a relatively high primary energy demand. The energy dependence of the Netherlands is not so high as for many other EU countries as it (still) has large natural gas resources. The latter are not expected to last for more than 2 decades, so the urgency to develop additional renewable energy production is increasing. Furthermore, there are increasing problems with natural gas exploitation in the North of the Netherlands which are likely to lower the total natural gas winning levels per year further.

The Netherlands is strongly industrialized country and has a strong representation of the chemical and food processing industry as becomes clear from the tables underneath.

The total BBE added value was estimated at between 2.6 and 3.0 billion Euro which is subdivided in:

- Materials (wood&paper); 2.4 billion €
- Chemical sector: 542 million €
- Biofuel sector: 100 million €
- Energy sector: 70 million €

It was also estimated in the country report (Ree & Annevelink, 2014) that the BBE created between 29,300 – 33,400 full time employment places.

Important trends seen that confirm an increase towards a larger BBE are:

- **In the agricultural sector:** 2nd largest exporter of agricultural & food products in the EU in which processing and upgrading (protein extraction) of agro-residues is increasingly improving
- **Horticulture sector:** there is a biobased focus on residues upgrading, production high-quality/complex extractives, production of aquatic based biomaterials.
- **Chemical industry:** set itself a target of consuming 50% less fossil resources within the next 25 years. Currently the Netherlands produces 200 kt of

biopolymers (2013). With the target set this will need to be at 650 kt of biopolymers by 2020

The current application of biomass in the BBE (Ree & Annevelink) is as follows:

- Wood processing & paper industry: 4 Mt
- Chemical industry: 3 Mt
- Energy sector: 6 Mt (power/heat)

This is a total of 13 Mt biomass.

- The Netherlands has a very low 2020 renewable energy target compared to the EU average (14% compared to 20%). The share in 2012 amounted to 4.5% (97 PJ) which means that an increase of almost 200% still needs to be made until 2020, in all three sectors (electricity, heating and cooling, and transport).
- Biomass forms the major share in renewable energy in the Netherlands (75% or 71 PJ).

The largest contribution of biomass is through domestic and industrial wood stoves. Domestic waste incineration contributes with almost 15% of the renewable energy end use share. Another 15% is contributed through biofuels. Biogas contributes by 9%. Given the large amount of manure availability one would expect this contribution to grow substantially for example in terms of biomethane upgrading.

Finland is situated in northern Europe with an area of 338,432 km² of which 72% forest, 10% water and 8% cultivated land. Population is 5.5 million with average density of 18 persons per square kilometre. Finland is sparsely populated and amount of older people will increase more than in other EU countries. Use of indigenous energy sources are 35% of final energy consumption. Indigenous energy sources are hydropower, wood and peat. In Finland forest industry has 11% of value added gross in production in 2013 and energy supply is 12%. Total energy consumption per capita is 245 GJ/capita (5.9 toe/capita) and electricity consumption 15.261 kWh/capita. At more than 16%, the share of bioeconomy in the Finnish national economy is high. The output of the Finnish bioeconomy currently exceeds EUR 60 billion, and more than 300,000 people are employed in the sector. These figures are high, even if they exclude the share of the technology industry that can be classified as belonging to the bioeconomy. The objective of the Bioeconomy Strategy is to push Finnish bioeconomy output up to 100 billion € by 2025 and to create 100,000 new jobs. According studies of Luke, sustainable harvesting potential for roundwood is 73 million solid m³ and for energy wood 21 million solid m³. Most of the biomass used in Finland is Finnish origin. Finland is importing round wood and pulp chips 11.0 million m³, of which import of wood chips is 2.5 million solid m³. Finland is importing 46 000 tons and exporting 56 000 tons wood pellets.

The Republic of **Serbia** is a landlocked country in the central part of the Balkans. Based on international standards NUTS, basic territorial division of Serbia is into two parts - north (Vojvodina and Belgrade) and south (the rest of the country). At the

same time, the country is divided and the five (5) statistical regions: Vojvodina, Belgrade, Šumadija and Western Serbia, Southern and Eastern Serbia, and Kosovo and Metohija. The country consists of 30 districts (from which 5 districts is in the region Kosovo and Metohija) and 202 municipalities (24 cities, 28 city municipalities and 150 municipalities)⁹.

Serbia covers a total area of 88.499 km². The terrain is varied: rich fertile plains in the north, rich fertile plains and basins to the east and mountains and hills to the south.

In the period 2000 – 2013, two censuses were conducted: 2002 and 2011. Based on 2011 national census, the population stands at 7.164.132 in 2013 year. The average density is 92.3 capita per km² (without region Kosovo and Metohija).

Serbia has a transitional economy mostly dominated by services, manufacturing and agriculture. The economy is heavily reliant on imports and foreign investment.

Serbia still suffers from a high unemployment rate (18.9% in 2014¹⁰) and an unfavourable trade deficit. Serbia is classed as an upper-middle income economy. GDP (PPP) for 2012 is estimated at 33.075 million EUR or \$12.659,7 per capita (PPP)¹¹. GDP per capita stood at 35% of the EU average in 2014.¹²

Serbia has free-trade agreements with the EFTA and CEFTA, a preferential trade regime with the European Union, a Generalized System of Preferences with the United States, and individual free-trade agreements with Russia, Belarus, Kazakhstan, and Turkey.

In August 2012 Standard & Poor's Ratings Services downgraded Serbia's foreign-currency credit rating to double-B-minus and the outlook is negative¹³.

In 2014 the unemployment rate is high and according to the survey was 18,9%¹⁴. The total number of employed people was 2.310.718 with 491.952 (21,3%) working in the agricultural, forestry and aquatic sectors¹⁵.

The Serbian economy is highly energy intensive. Energy is the second largest sector, which contributes 10% to GDP. Problems in the energy sector are the consequence of the cumulative effects from earlier periods. They could be summarized as high dependence on the energy import (31,7 % in 2014), high dependence on fossil fuels (especially lignite), high energy consumption, low energy efficiency, technically

⁹ Statistical Yearbook 2014, Statistical office of the republic of Serbia Belgrade, 2004.

¹⁰ Key macroeconomic indicators, national bank of Serbia, <http://www.nbs.rs>, Belgrade, 2015.

¹¹ <http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD>

¹² <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tec00114>

¹³ Indicators of Serbia's external position, National bank of Serbia, <http://www.nbs.rs/internet/cirilica/80/index.html#i1>

¹⁴ Key macroeconomic indicators, National bank of Serbia, <http://www.nbs.rs/internet/cirilica/80/index.html#i1>

¹⁵ Statistical Yearbook 2014, Statistical office of the republic of Serbia Belgrade, 2004.

outdated facilities with insufficient equipment for environmental protection. Electricity production is based on the combustion of low-quality domestic coal in existing power plants and the use of hydropower. The share of renewable energy in total consumption is 21.2%. General domestic, public and commercial electricity consumption has increased significantly at the expense of industrial electricity consumption.

Renewable energy sources with an estimated technically usable potential of about 5.6 MtOE per annum can have a considerable contribution to a lesser utilization of fossil fuels and achievement of defined targets regarding the share of renewable sources in the GFEC, as well as regarding the improvement of environment. The biomass potential amounts to approximately 3.4 MtOE per year (2.3 MtOE per year is unused, and 1.1 MtOE is used), 1.7 MtOE lies in hydro potential (0.8 MtOE per year is unused, and 0.9 MtOE per year is the used hydro potential), 0.2 MtOE per year in geothermal energy, 0.2 MtOE per year in geothermal energy, 0.1 MtOE per year in wind energy, 0.2 MtOE per year in solar energy and 0.04 MtOE per year in biodegradable part of waste. Out of the total available technical potential of RES, the Republic of Serbia already uses 35% (0.9 MtOE of used hydro potential and 1.06 MtOE of used biomass and geothermal potential). Until the beginning of this decade, biomass was used mostly for household heating in old and inefficient stoves and boilers with low or negligible environmental standards.

As biomass represents the most significant renewable energy source (RES) in Serbia, bioeconomy could be important driver for future development. According to drafted and adopted NREAP¹⁶, Serbia is relying on bioenergy for the achievement of 2020 RES targets, with 35% projected growth in consumption, compared to 2009. Dominant use of bioenergy for heating should be further increased in 2020 for additional 4%, compared to 2009. For fulfilment of RES target in 2020, Serbia will be faced with great challenge of biomass utilization for electricity production set at 84.5 ktOE in 2020, and biofuel consumption on the level of 245 ktOE.

Today, 65 % of the territory is considered to be agricultural land, forestland occupies 29.7 % of the territory, while other land types comprise the remaining 5.3%. Current condition of the state-owned forestland is characterized by insufficient production capacities, unfavourable stand structure with respect to stand age, unsatisfactory stand density, unfavourable forest composition, including a large number of locations occupied by damaged forest stands and large percentages of weed infested areas, as well as unsatisfactory tree health. The ongoing process of transition to a market oriented economy has imposed higher demands on forestland use change, caused

¹⁶ NATIONAL RENEWABLE ENERGY ACTION PLAN OF THE REPUBLIC OF SERBIA, REPUBLIC OF SERBIA, Ministry of Energy, Development and Environmental Protection, Belgrade, Official Gazette of RS No. 53/2013, 2013.

by additional land needed for construction of industrial, infrastructure and recreational facilities¹⁷.

Spain is located in the south-west part of Europe (Iberian Peninsula). Population archives 46.464.000 inhabitants (INE, 2014). One of major problem of the country is the aging of the population. Spain has a moderate population density, with 92 inhabitants per km².

Therefore, there is a similar surface dedicated to forest and crops. Mostly is a Mediterranean agriculture with a high number of sun hours, rainfall limitations and poor soils. Then, the herbaceous crops yields are low, but there is a great potential for the cultivation of fruit trees, vineyard and olive trees.

Regarding economic matters, the Spanish GDP in 2013 was 1,023 billion €. The main economic sector is service, followed distantly by construction and industry. The unemployment is a crucial problem since the level is above 22 % (July 2015), one of the higher of Europa.

Finally, although there was a very active promotion of RES during the last years, (14.2 % of the primary energy came from RES, including a 5.3% from bioenergy) Spain has a high level of energy dependency, achieved around 70%.

Turkey has the world's 17th largest nominal GDP and 15th largest GDP by PPP with 19.293 USD per capita. The country is a founding member of the OECD (1961) and the G20 major economies (1999). Since December 31, 1995, Turkey is also a part of the EU Customs Union.

Among the bioeconomy sectors, “agriculture and livestock” has an important role with more than 60 billion USD of production value. In addition, manufacturing and industry sectors based on agriculture are also important especially from the point of international trade. For example, Turkish wheat flour export value is 946 million USD for 2013, 20% of global baker’s yeast is manufactured in Turkey, of which about half is exported at a market value of 220 million USD. Some food industries like pickles and vinegar, mushrooms, dairy products (yogurt and cheese), alcoholic beverages and other traditional fermented food and drinks (boza, kefir, tarhana) are largely developed by private companies supporting thereby Turkey’s competitiveness. Tissue cultures and seed technologies, microbial plant support preparates and microbial control products are other bioeconomy sectors that are developed in Turkey, too.

Turkey has approximately 23.8 million hectares agricultural land and 21.7 million hectares of forest. The forest sector provides about 14.4 million m³ per year of wood

¹⁷ SERBIA'S FIRST NATIONAL COMMUNICATION UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, Republic of Serbia, Ministry of environmental protection and spatial planning, Belgrade, 2010.

logs for various industrial applications such as paper and cardboard, furniture and wooden works. The paper and cardboard products are being exported to more than 180 countries. Turkey is the 6th largest producer of corrugated cardboard with 91 company and 114 factories, and the sector is continuously growing. Approximately 70% of the raw material for corrugated cardboard is obtained from recycled paper, while the remaining 30% comes from imported paper.

The market for herbal products has reached 71.6 million USD recently and it is continuously growing.

Turkey has a high potential of bioenergy which includes bio-solids, bio-liquids and bio-gases. Turkey's annual biomass potential is estimated as 32 MtOE, which potential includes agricultural waste, forest products and waste, manure, household waste and wood industry waste. In addition, Turkey's agricultural crops potential (mostly waste and residues) is estimated as 54.4 million tons per year. This type of agricultural waste inventory offers substantial potential for production of bio-fuels (biodiesel, bioethanol and biogas).

There are 34 biodiesel production facilities, which have received Processing License. The total biodiesel production capacity of these plants is 561 thousand tons as reported by Energy Market Regulatory Authority of Turkey (EMRA). However, the actual production is noticeably lower than the capacity because of the ongoing tax policy. A recent modelling study by Institute of Agricultural Economy and Policy Development (IAEPD) indicates that under current cropping systems, the bio-fuel production in Turkey is most competitive from sunflower and sugarbeet feedstock.

Along the EU association and enlargement process, between 50 and 100 billion Euros are to be invested in environmental compliance projects during the next 10 years. A large share of this investment will cover the application of biotechnology. Removing organic pollution, biological treatments, composting and bioremediation technologies will be considered as alternatives to the traditional incineration and sludge storage. Dedicated wetlands with reed beds are being tested to replace the conventional treatment systems for municipal waste water.

Capacity mapping

The aim of this section is to provide an update overview of capacities for the development of bioeconomy in the under study countries in terms of institutions, legislation relevant to sustainability and certification schemes (where information was available).

Institutions

In all countries, the responsibility of biomass for energy and biobased products lies mainly within ministries of agriculture, economy, energy and environment. Other institutional capacities include energy agencies, state regulators, federal agencies (in the case of Germany) as well as various research and technology organisations which act as knowledge providers and steer innovation across sectors.

Table 2 Institutions involved in bioeconomy within the under study countries

Country	Institutions
Belgium	
Bulgaria	Ministry of Economy Ministry of Environment Ministry of Agriculture
Croatia	Ministry of Economy Ministry of Environmental and Nature Protection Ministry of Agriculture
Germany	Ministry for Food and Agriculture (BMEL) Ministry of Economy and Energy (BMWi) Ministry for Environment, Building, Nature Conservation and Nuclear Safety (BMUB) Ministry for Education and Research (BMBF) Federal Agency for Renewable Resources (FNR) Federal Agency for Agriculture and Food (BLE) German Biomass Research Center (DBFZ) Federal Environment Agency (UBA) Federal Agency for Nature Conservation (BfN) Several federal research institutions (ATB, JKI, TI) German Bioeconomy Council (Bioökonomierat) Many State-level institutions for agriculture, forestry, and regional development
Greece	Ministry of Environmental, Energy and Climate Change (YPEKA) / General Secretariat for Energy and Climate Change / Independent RES Service. Under its “umbrella” : <ul style="list-style-type: none"> • The National Organization for the Alternative Management of Packaging and Other Products deals with the supervision of the material recovery from waste recycling. • The Green Fund is a major tool for financing, The Inter-Ministerial Committee for Green Public Procurement <p>Ministry of Regional Development & Competitiveness is in charge for “<i>green investments</i>” including recycling activities and reuse of waste. <i>Fuel specifications</i>: Ministry of Finance / General Chemical State Laboratory (G.C.S.L.) / Directorate of Petrochemicals <i>Market monitoring</i>: Minister for Development and Competitiveness / General Secretariat of Industry</p>
Finland	Ministry of Employment and the Economy Ministry of Agriculture and Forestry Ministry of the Environment Finnish Innovation Fund Sitra VTT Technical Research Centre of Finland Ltd Luke Natural Resources Institute Finland
Netherlands	Ministry of Economic affairs for Res-electricity and heat and also most recent Energy agreement Ministry for Transport and Environment for implementation of Biofuel targets and Fuel quality

	<p>Directive, monitoring on the sustainability criteria Task Force Biobased Economy (set-up by the Ministry of Economic affairs) for strategy development in relation to non-energy and non-food uses of biomass.</p>
Serbia	<p>Competence is belonging to various institutions, at various levels: 1) institutions at the level of the Republic; 2) institutions at the level of the Autonomous Province of Vojvodina, and 3) institutions at the level of the local self-government unit.</p> <p>The most important institutions are:</p> <ol style="list-style-type: none"> 1) Ministry of Mining and Energy 2) Ministry of Agriculture and Environmental Protection 3) Ministry of Construction, Transport and Infrastructure. <p>Additionally, besides the competence of the ministries, the renewable energy sources are also in the jurisdiction of a certain number of special organisations and other institutions i.e.:</p> <ol style="list-style-type: none"> 1) Energy Agency 2) Republic Agency for Spatial Planning 3) Republic Geodetic Authority 4) Republic Hydrometeorological Service 5) Statistical Office of the Republic of Serbia 6) Institute for Standardization of Serbia. <p>Institutions in charge at the level of Autonomous Province are:</p> <ol style="list-style-type: none"> 1) Provincial Secretariat for Energy and Mineral Raw Materials 2) Provincial Secretariat for Urban Planning, Construction and Environmental Protection
Spain	<ul style="list-style-type: none"> • <u>Ministry</u> <ol style="list-style-type: none"> 1. Ministerio de Agricultura, Alimentación y Medio Ambiente. Ministry of Agriculture, Food and Environment. www.magrama.gob.es 2. Ministerio de Economía y Competitividad. Ministry of Economy and Competitiveness. www.mineco.gob.es/ • <u>Governmental bodies</u> <ul style="list-style-type: none"> • CNMC. Comisión Nacional de los Mercados y de la Competencia. National Market and Competence Commission. www.cnmc.es/ • CDTI. Centro de Desarrollo Técnico Industrial. Centre for the technical and industrial development. www.cdti.es/ • IDAE. Instituto para la Diversificación y Ahorro de la Energía/Energy diversification and saving Institute. www.idae.es/ • <u>Statistic</u> <ol style="list-style-type: none"> 1. INE. Instituto Nacional de Estadísticas. National Statistical Institute. www.ine.es • <u>Industries association</u> <ol style="list-style-type: none"> 1. APPA – Asociación de Productores de Energías Renovables/ Renewable Energies producers association www.appa.es 2. ASEBIO- Asociación Española de Bioempresas. Spanish Biobased companies Association. www.asebio.com/es <p>BIOPLAT-Plataforma Tecnológica de la Biomasa/Biomass Technology Platform. www.bioplat.org</p>
Turkey	<p>Ministry of Economy Ministry of Energy Ministry of Agriculture</p>

Legislation relevant to sustainability

Table 3 Legislation for sustainability and bioeconomy in the under study countries

Country	Legislation
Belgium	Law of 17 July 2013 on the mandatory nominal blending of sustainable biofuels
Bulgaria	Bulgarian Energy Efficiency and Renewable Energy Credit Line (BEERECL) Renewable Transport Fuel tax exemption Bulgarian Rural Development Programme
Croatia	Agricultural Land Act Ordinance on recording the usage of agricultural land Ordinance on implementation of IPARD measure 302 Diversification and development of rural

	<p>economic activities</p> <p>Act on support to agriculture and rural development</p> <p>Act on agricultural advisory service</p> <p>Ordinance on cross compliance</p> <p>I Action Programme for protection of water from pollution caused by nitrates of agricultural origin</p> <p>Ordinance on by-products of animal origin not intended for human consumption</p> <p>Forest Act</p> <p>Ordinance on forest management</p> <p>Regulation on the procedure and criteria for servitude of forest and forest land owned by the Republic of Croatia aimed for perennial plantation</p> <p>Act on implementation of EU directives related to illegal trade of cut wood and products made of that wood</p> <p>Ordinance on determination of fees for transferred and limited rights in forest and forest land</p> <p>Nature Protection Act</p> <p>Regulation on environmental impact assessment</p> <p>Regulation on environmental permit</p> <p>Air Protection Act</p> <p>Regulation on the quality of biofuels</p>
Germany	<p>Renewable Energy Sources Act 2012 - Act on Granting Priority to Renewable Energy Sources</p> <p>Ordinance on the Generation of Electricity from Biomass</p> <p>Biomass Sustainability Regulation</p> <p>Biofuel Sustainability Regulation</p> <p>Renewable Energies Heat Act - Act to Promote Renewable Energy for Heating Purposes</p> <p>Biofuel Quota Act</p> <p>Emission Control Act</p> <p>Federal Emission Control Act</p> <p>Environmental impact assessment Act</p> <p>Technical Instructions on Air Quality Control</p> <p>Technical Instructions on protection against noise</p> <p>Waste Management and Product Recycling Act</p> <p>Regulation on requirements for the recovery and disposal of wastewood</p> <p>Regulation on disposal of commercial municipal waste and certain types of construction and demolition waste</p>
Greece	<p>Law 3054/2002 - Organisation of the Oil market and Miscellaneous Provisions</p> <p>Law No. 4062/2012, Project HELIOS: Promotion of the Use of Energy from Renewable Sources (Transposition of Directive 2009/28/EC) and Biofuels Sustainability Criteria (Transposition of Directive 2009/30/EC)</p>
Finland	<p>(O) Energy and Climate Roadmap 2050; Roadmap how to achieve 80% reduction of GHG emissions</p> <p>(E) National Energy and Climate Strategy; Long-term strategy for Finnish energy economy, Update started in September 2015, first published in 1991</p> <p>(O) The Finnish Bioeconomy strategy</p> <p>(O) Finland National Forest Strategy 2025</p> <p>(R) Forest Act (1093/1996) and Degree (1311/1996). to promote economically, ecologically and socially sustainable management and utilisation of forests in order that the forests produce a good output in a sustainable way while their biological diversity is being maintained</p> <p>(F) Act on the Financing of Sustainable Forestry (1094/1996, 1311/1996, 544/2007, 100/2011) and degree</p> <p>(R) Timber Measurement Act (414/2013). Regulations on timber and energy wood measurements.</p> <p>(R) Act on Trade in Forest Reproductive Material (241/2002, 684/1979, 623/1999, 1210/1994, 1055/2002) Main principles: (1) The provisions of this act apply to the production, marketing and import of forest reproductive material.</p> <p>(R) Act on placing timber and wood product to market (897/2013).</p> <p>Forest Damages Prevention Act (1087/2013, 1039/2013, 263/1991, 6/2014, 567/2014).</p> <p>(O) The National Waste Plan and (R) Waste Act (646/2011), Waste Decree (179/2012) and Government Decree on waste incineration (151/2013), Government Decree concerning the recovery of certain wastes in earth construction (591/2006).</p> <p>(R) Finland's Nature Conservation Act (1096/1996, as amended by 492/1997, 144/1999, 371/1999, 553/2004, 1069/2004, 506/2005 and 591/2005)</p> <p>(R) Environmental protection act (527/2014), and Environmental protection decree (713/2014).</p> <p>(R) Water act (587/2011), the Act on Water Resources Management (1299/2004), the Degree on Water Resources Management (1040/2006) and the related Decree on (Water Resources Management Regions (1303/2004), Government Decree on Urban Waste Water Treatment (888/2006)</p> <p>(R) The Government Decree on air quality (38/2011).</p> <p>(R) Act on Environmental Impact Assessment Procedure (468/1994),</p> <p>(R) Government Decree on Environmental Impact Assessment Procedure (713/2006).</p>

	<p>(R) The Governmental decree on emission regulation for plants more than 50 MW (96/2013) and the Governmental decree on emission regulation for plants less than 50 MW (750/2013). Decree (96/2013) gives limit values for sulphur oxides, nitrogen oxides, dust emissions and carbon monoxide for combustion plants Land use and building Act (132/1999 and amendment 132/2003) and Land Use and Building Decree (895/1999) and Building Codes. Act on Energy Certificates for Buildings /50/2013), Governmental decree on expertise requirements and simplified energy certificates (170/2012). (F)The Act on Production Subsidy for Electricity Produced from Renewable Energy Sources (1396/2010), Decree on Production Subsidy for Electricity Produced from Renewable Energy Sources (1397/2010). (F) Government Decree on General Terms of Granting Energy Support (1063/2012). (O) Guarantee of origin of electricity (1129/2003, 417/2013, 1116/002/2013). (R) The act on electricity and natural gas market control (590/2013) and Governmental Decree on electricity markets (65/2009). (F) Act on emission trading (311/2011) and Decree on Emission trading (28/2013) (R) Act on the sustainability of biofuels and bioliquids (393/2013). Act on the promotion of the use of biofuels for transport (446/2007). (F) Act on Excise Duty on Liquid Fuels (1472/1994) and decree (1547/1994) (F) Act on Excise Duty on Electricity and Certain Fuels (1260/1996) and decree (309/2003) (F) Act on public procurement for water and energy sector, transport and for post services (349/2007) and decree (614/2007)</p>
Netherlands	<ol style="list-style-type: none"> 1) Renewable energy directive target of 14% renewables in energy consumption by 2020. Policy support is organized through the SDE Subsidies: budget 2013 was 3 billion € 2) Since 2011 there is a legal support framework of the SDE+ for renewable heat and power production. 3) The national energy agreement (2012) was signed between government and industry. It sets targets of: <ol style="list-style-type: none"> a. 1,5% extra energy savings (100 PJ) by 2020 from final energy consumption b. 16% renewable energy consumption by 2023 (and 14% by 2020), with a cap of 25PJ on cofiring c. Promotes sustainable energy at local level and a strong emission trading schemes with a -80% CO2 reduction target for 2050. d. Transition to clean coal and carbon capture and storage technologies through closing of old coal fired power plants by 2016 e. Energy savings and emission reductions in transport (also through introduction of more electricity based transport) f. Creation of 15,000 jobs by 2020 <p>For reaching these targets sectors have committed themselves to implement these measures and the government has committed resources from the public budget for reaching these targets.</p> <p>In March 2015 an agreement was reached on the sustainability criteria applicable to solid biomass used for co-firing to be subsidized through the SDE+ support system. It was agreed to that for solid biomass sustainability criteria are set. in relation to sustainable forest management, GHG emissions, carbon debt and ILUC avoidance:</p>
Serbia	<p>Energy law (Official Gazette of the RS", No. 145/2014) Law on Efficient Use of Energy (Official Gazette of the RS", No. 25/2013) National Renewable Energy Action Plan of the Republic of Serbia, In accordance with the template foreseen in the Directive 2008/29/EC- Decision 2009/548/EC (Official Gazette of RS No. 53/2013) Decree on conditions and procedure for acquiring the status of privileged power producer ("Official Gazette of the RoS", No. 08/2013, 70/2014) Decree on incentive measures for privileged power producers ("Official Gazette of the RoS", No. 08/2013) Decree on the method of calculation and allocation of funds collected for purpose of incentive remunerations for privileged power producers ("Official Gazette of the RoS", No. 08/2013) Decree on the amount of special Feed-in Tariff in 2015.year ("Official Gazette of the RoS", No. 63/2015) Rulebook on Technical and Other Requirements for Bio-Derived Liquid Fuels (Official Gazette of RS and Montenegro No. 23/2006)</p>
Spain	<p><i>Power generation:</i></p> <ol style="list-style-type: none"> 1. <i>Royal Decree-Law 9/2013, adopting urgent measures to guarantee the financial stability of the electricity system</i> 2. <i>Law 24/2013, on Electricity Sector</i> 3. <i>Royal Decree 413/2014, dated on 6 June, regulating electricity production from renewable energy sources, cogeneration and waste</i>

	<p>4. <i>Ministerial Order IET 1045/2014, dated 16 June, approving the remuneration parameters for standard facilities, applicable to certain electricity production facilities based on renewable energy sources, cogeneration and waste.</i></p> <p><i>Biofuels:</i></p> <ol style="list-style-type: none"> 1. <i>Order ITC/2877/2008 establishing a support scheme for biofuels and other renewable fuels for transport</i> 2. <i>Resolution dated 8 July 2013, by the Secretary for Energy, updating for 2013 values used in calculation formulas of compensatory payments related to the biofuels obligation fulfilment, included in Order ITC/2877/2008</i> 3. <i>Law 1172013, to support entrepreneurs and boost economic growth and job creation (establish mandatory goals for biofuels for 2013 and coming years)</i> 4. <i>Resolution dated 27 December 2013, by the Secretary of State for Energy, updating the annex ITC 28/77/2008</i> 5. <i>Order IET/822/2012 governing the allocation of biodiesel production volumes for computing compliance with mandatory biofuels targets</i> 6. <i>Order IET/2736/2012, amending Order IET/822/2012 governing the allocation of biodiesel production volumes for computing compliance with mandatory biofuels targets.</i> 7. <i>Resolution dated 24 January 2014,, by the Secretary of State of Energy, publishing the definitive list of plants or production units with an allocated productions quantity of biofuels</i>
Turkey	Turkey Bioeconomy Strategy Document

Revision to the Fuel Quality Directive and Renewable Energy Directive

On 28 April 2015, the European Parliament voted to approve new legislation, the "iLUC Directive", which limits the way Member States can meet the target of 10% for renewables in transport fuels by 2020, bringing to an end many months of debate. There will be a cap of 7% on the contribution of biofuels produced from 'food' crops, and a greater emphasis on the production of advanced biofuels from waste feedstocks. Member States must then include the law in national legislation by 2017, and show how they are going to meet sub-targets for advanced biofuels.

The following table presents an overview of current (2015) updates in the under study countries in relation to sustainability following the Parliamentary decisions of April 2015. It aims to illustrate how (and if) these are taken (or provisions for update) into account, which are the relevant feedstocks in each country and what is the range of their potentials

Table 4 Updates of sustainability according to EU Parliament decision

Country	Feedstocks of high relevance	Cap on food crops by 2020	Sub target for 2020	Double counting	Renewable electricity in rail ¹⁸	Renewable electricity in electric vehicles ¹⁹	GHG for 2030
Belgium	Wastes, Forest	No	No	No	No	No	No
Bulgaria	Forest, Agricultural residues/ Wastes	No	No	No	No	No	No
Croatia	Forest, Agricultural residues/ Wastes	No	No	No	No	No	No
Germany	Agricultural residues/ Wastes						Yes
Greece	Agricultural residues/ Wastes	No	No	No	No	No	No
Finland	Forest	Only imported palm oil for biodiesel (Neste)	20% liquid biofuels in 2020, new target 40% in 2030	Yes,	Forest	78 million solid m3	Only imported palm oil for biodiesel (Neste)
Netherlands	Agricultural residues/ Wastes	No	No	No	No	No	No
Serbia	Forest, Agricultural residues/ Wastes	No	No	No	No	No	No
Spain	Agricultural residues	No	No	No	No	No	No
Turkey	Forest, Agricultural residues/ Wastes	No	No	No	No	No	No

¹⁸ counted 2.5 times

¹⁹ counted 5 times

Gap analysis

The aim of this analysis will be to determine those gaps that are critical to the future development of the sustainable supply and delivery of the biobased economy with non-food lignocellulosic biomass. This has been done via web-search, based on officially published national policy documents and structured interviews (where feasible in collaboration with national partners), questionnaires, attendance at events and searching the literature.

Table 5 Gap analysis for the development of bioeconomy in the under study countries

Country	Gaps
Belgium	<p>Coherency in the different policy domains:</p> <ul style="list-style-type: none"> • within the energy field (liquid vs solid biomass; transport vs stationary) • with neighbour countries (too tough requirements drive feedstock over the border) <p>implementation of cascading (learn from experience) level playing field between different biomass applications (e.g. -CO₂ reduction) balance between domestic – imported biomass renewable heat;</p> <ul style="list-style-type: none"> • too much focus on renewable electricity (residual heat often neglected) • efficiency (including heat use), bio-CHP • lack of district heating <p>how to stimulate biorefinery approach (different products)</p> <ul style="list-style-type: none"> • build experience in terms of biorefinery, also advanced biofuels <p>biomethane: legislative framework missing</p>
Bulgaria	<p>Encourage the development of processing industries for agricultural products, mainly cereals and industrial crops;</p> <p>Improve the statistics and reporting on forest reproduction, timber harvesting, timber consumptions and exports. The use of wood by private holdings and illegal / unregulated logging deserve particular attention.</p> <p>Improve the energy accountancy and balance with regard to the use of wood for heating and cooking, which appears to be a main, if not the main energy source for low-income households and/or in rural areas.</p> <p>Encourage the use of waste wood and agricultural residues (straw, hay, cornstalks, sunflower cakes, etc.);</p> <p>Stimulate manufacturing of industrial products from bio-resources – agricultural crops and their residues, bioethanol, biodiesel, etc.</p> <p>Increase the value added of exported agricultural and forest products, to improve country's foreign trade balance;</p> <p>in country's exports by more comprehensive to reduce the trade balance of the country.</p> <p>Support and promote the associated employment opportunities;</p>
Croatia	<p>Lack of integrated policy approach</p> <p>No prioritization of different biomass chains/most efficient value chains are not selected</p> <p>Multiple competition for the same biomass feedstock</p> <p>practically no experience with waste origin feedstock – no advanced biofuels</p>
Germany	<p>Bioeconomy Roadmap exists, but no implementation into legislation/instruments beyond R&D.</p> <p>Bioeconomy Councils prepares recommendations, but no uptake into federal policy (yet).</p>
Greece	Lack of national strategy on bioeconomy

	Often, reliable data are lacking Legislative framework for active bioeconomy sectors has been drafted long after the actual market development, e.g. biomass heating
Finland	Changing subsidy policy for feed-in-tariffs for forest chips No support for small-scale biomass use (only CO ₂ tax for fossil fuels in heat production) Competition of forest resources between forest industry and bioenergy sector Economy of CHP production Recycling and reuse of waste
Netherlands	Netherlands did not set targets for Renewable heat.
Serbia	Lack of integrated policy approach Coherent statistical data are missing Low interaction among the relevant institutions & Ministries for the various sectors of bioeconomy Lack of biomass market and long term contracts Multiple competition for the same biomass feedstock No strategy for biofuels, although the interest of different stakeholders exist Lack of sustainability scheme
Spain	<ul style="list-style-type: none"> • Regulatory uncertainty at national and European level. • Financial constraints: public financing is hampered by the economic situation, which has led to cutbacks in the public sector, and private banks still deem these projects as risky and unbankable. • Lack of an integrated and long-term oriented R&D strategy that could take advantage of possible synergies at national and regional level. • Need for integrating agricultural and forestry sector in the development of bioeconomy. <p>So far, the Spanish Strategy on Bioeconomy in development lacks a holistic and integrated vision, so it should be reconsidered. Furthermore, a better collaboration between government and economic sectors involved in the bioeconomy sector would be necessary</p>
Turkey	Lack of integrated policy approach

Summary expert evaluation of the situation, including potential SWOT summary table / analysis.

A SWOT analysis is presented in Table 6 providing an overview of the respective strengths, weaknesses, opportunities and threats for the under study countries in relation to bioeconomy. This table will be used as a basis for the work with the advanced and strategic case studies and will be further validated by the local stakeholders.

Table 6 SWOT analysis for bioeconomy in the under study countries

Country	Strengths	Weaknesses	Opportunities	Threats
Belgium	<p>Knowledge base (biotech) Modern agriculture Strong industry (food, chemistry, energy) Existing logistics (land, water, harbours) Waste collection and recycling</p>	<p>Small surface, high population density High environmental pressure Fragmented research landscape Extensive regulation and complex policy structures Limited financing programmes</p>	<p>Existing policy and initiatives (new Industrial Policy) Action materials management Biomass inventory Working groups Cooperation with NL</p>	<p>Limited own technology Low involvement in European clusters Incoherent policies</p>
Bulgaria	<p>Significant availability of land area and unexploited potential for agricultural and forestry production; Experience in cultivation and production of cereals, industrial crops and vineyards; Proximity to the markets in the EU and in the Mediterranean region;</p>	<p>High concentration of arable land in the hands of large owners and users of land; Lack of a coherent national programmes for the development of the primary sector (agriculture and forestry), as well as for the production of energy <i>and</i> food; Declining and ageing rural population; Widespread under-investment e.g. in mechanization, irrigation, seeds, plant protection, etc.; Deficit of agricultural and forest specialists; Tough price competition in the Black sea region from lower cost, non-EU producers, e.g. Russia and Ukraine.</p>	<p>Development of knowledge-driven agriculture and forestry; Elaborate and implement prospective bio-product strategies; Elaborate and implement programmes for deeper processing of primary production, as opposite to the export of non-processed raw materials; Development and implementation of technologies for processing waste and residues from agriculture and forestry; Restoration of irrigation systems and water storage facilities; Utilization of organic waste from farms and households;</p>	<p>Lack of focused national strategies and programmes to stimulate the development of bioeconomy; Lack of incentives to attract qualified professionals in agriculture and forestry sectors; Lack of training programmes and dissemination activities about the benefits of bioeconomy; Lack of coordination and exchange of best practices with EU member states that are more advanced in the development of bioeconomy in various aspects – research and innovation, training, technology transfer, investment schemes, etc.</p>
Croatia	<p>High potential – agriculture, forestry, wood industry Well-developed forest industry Recent policy framework supporting RES/ biomass Rapid development of pellet production</p>	<p>No reliable statistics at municipal level for wood supply No biomass CHP in wood industry General reluctance within households to invest in pellet boilers Poor development of domestic market (households, public or commercial buildings)</p>	<p>Existing boilers in wood industry use fossil fuels or need refurbishment. In specific cases, the potential savings on fuel are enormous and a biomass boiler system could be paid back in less than 3 years. Under developed biofuels sector Rapid market developing Intensive international cooperation</p>	<p>Complicated and long procedure for licences Low overall efficiency of agricultural production Low level of farmers education and awareness</p>

Country	Strengths	Weaknesses	Opportunities	Threats
Germany	Excellent R&D capacities and technological base, many industrial activities, existing roadmap and collaboration between federal ministries	Legislative implementation missing, no cross-sectoral incentives	Significant resource base, Bioeconomy Council recommendations, strong public procurement base, interested NGOs	Critical public opinion and media coverage; no policy for international biomass trade, low prices for competing fossil feedstocks, missing incentives for biobased products, unclear role of sustainability schemes and certification
Greece	Good availability of agricultural and agro-industrial residues in some areas Favourable geographic location Production of many high-added value products in the bio-economy sector	Sloped landscape makes collections of forest biomass / residues difficult or expensive Warm climate makes it difficult to have economically viable biomass DH systems in many areas of the country Fragmented agricultural holdings make it difficult to mobilize sufficiently large quantities of biomass for large-scale investments Lack of monitoring mechanisms for handling of by-products, wastes, etc.	High feed-in tariffs for bioelectricity Widespread interest for alternative heating solutions due to increased cost of heating oil Business opportunities in the primary sector attractive due to the economic crisis	Economic crisis and political volatility limits access to finance and investment Instability in legal framework and support systems affect investor confidence (In some cases) public opposition / negative perceptions, especially for waste streams
Finland	<ul style="list-style-type: none"> •Cost efficient supply of round wood and energy wood •Efficiency of biomass energy use in forestry, CHP plants and heating boilers •Expertise related to the energy use of biomass (boiler technology, biofuel technology, procurement chains, distributed production) •Domestic biomass use will reduce the import of fossil fuel •Strong forest industry, which is willing to invest on new bioeconomy products •R&D inputs to bioeconomy •Modern agriculture - high ecological farming •Existing logistics (e.g., forest roads) •High biomass resources and waste collection well-organised 	<ul style="list-style-type: none"> •Deviation from “mainstream” EU; Finland’s forestry industry, wood-processing industry and integrated bioenergy production are not typical in the EU •The possibility of the state to finance the implementation or use of biomasses to a broader extent and the unpredictability of the EU’s state subsidy policies •Economic non-profitability of first thinning and the management work of a young forests •Long distances •Changing subsidy policies effect especially to bioenergy sector •Decreasing financing for R&D 	<ul style="list-style-type: none"> •Existing policy and initiatives •Nordic cooperation in bioeconomy and low carbon economy •High knowledge of technology development for new areas •Forest industry looking new bioeconomy innovations •Export of cleantech technology •Building of new types of resource-efficient value chains and the profitability and environmental benefits obtained from them •Developing distributed production as part of the energy policy 	<ul style="list-style-type: none"> •Global development related to the sustainability and carbon-neutrality of biomass, particularly the change of international and EU-level greenhouse gas emission calculation rules •Impact of policy changes on the demand for advanced traffic biofuels and on the profitability of investments •The position of biomass and its use in the international climate policy is yet to be organised •The capacity of forest industry will not grow, which will limit the of wood harvesting •Poor profitability of new biomass CHP plants •Difference between the regional supply and demand of forest biomass •Effect of the broad-scale use of forest biomass on nature diversity. •Low involvements in European clusters •Aging of population

Country	Strengths	Weaknesses	Opportunities	Threats
Netherlands	<p>Strong already in food-feed processing Chemical sector large Good research infrastructure Good transport infrastructure (harbours, good connections to rest of EU and world) Good energy infrastructure Well-developed sustainability criteria for bioenergy (bioenergy NTA8080, Commissie Corbey) which is now extended to BBE and food/feed. Relative large availability of residues/waste biomass Good coordination of BBE relevant research</p>	<p>Behind in reaching bioenergy targets (now 4.5%, needs to be 14% in 2020 and 16% in 2023) Still strong focus on fossil based economy (large natural gas resource) <input type="checkbox"/> lack of urg Large government involvement in implement the regulation framework, but limited financial resources from government available. Strong dependence on green deals.</p>	<p>Stable economic and political climate Attractive investment climate Good research infrastructure to attract high level research and collaboration with private companies. Still very large biomass residue availability with no alternative use (e.g. manure) Cooperation opportunities with neighbours particularly Belgium, Germany</p>	<p>Influence of NGOs is large which could threat the pragmatic implementation of the sustainability criteria on biomass use in BBE Difficult to capture R&D of large companies on BBE within NL&EU Strict planning regulation making implementation of BBE activities slow R&D budget is not very large particularly a decline in last years, lack of R&D contribution from private sector Not clear vision on how to implement the principle of sustainable biomass valorisation in practice</p>
Spain	<ul style="list-style-type: none"> •Biomass availability. <ul style="list-style-type: none"> ○ Arable and forestry land available. ○ Relative large availability of residues (agriculture & food industry). •Good research infrastructure. •Strong companies interested in the development of the bioeconomy. •Successful demo-projects already commissioned. <p>Good assessment of the opportunities of bioeconomy, carried out by the industrial (Bioplat, Suschem-España) and R&D sectors involved.</p>	<ul style="list-style-type: none"> •Agronomic constraints lead to low agricultural yields. Low water availability for irrigation is a major issue. •Lack of good management in forestry areas. •Conservative approach in the agricultural and forestry sectors when it comes to new crops and products. •Weak financing possibilities (public and private). <p>Regulatory uncertainty at national and European level.</p>	<ul style="list-style-type: none"> •Important food processing sector. High amount of waste (olive oil, juice, preserved food) •New emerging biotechnology companies on the rise. •Leadership in the renewable energy sector. Strong presence of companies working in the biomass and biofuels sector. •Diversified chemical sector, which has showed strong interest in the development of new bioproducts. <p>National strategy on bioeconomy in development.</p>	<ul style="list-style-type: none"> •Solid Biomass export to other EU countries (better prices there). •Biofuels Import from other world regions. •Overall economic situation, which leads to investments being redirected abroad.

Country	Strengths	Weaknesses	Opportunities	Threats
Serbia	<p>High biomass potential (wood and agriculture) National Biomass Action Plan is currently being developed Ambitious national RES targets are set Feed-in tariffs for bio-electricity Possibilities for marginal land use Available chain: resources, production, people Advantages of location – near the river Research and development – knowledge at universities Knowledge from previous period & pilot projects</p>	<p>Large number of small private owned forests- difficult to manage. Large number of small agriculture land owner Relatively small investment capacity Limited venture capital Limited success stories Strategy – define the targets & methodology Upgrade the knowledge & make the awareness Statistic data collection Necessary infrastructure – standards, rules, certificates Low price of electricity Prices in energy sector defined by government Biofuel market is not developed, no measures for biofuel promotion Low energy efficiency Lack of model/methodology for defining the targets</p>	<p>Direct substitution of natural gas and coal Export of biomass pellets Space heating in households and buildings using biomass pellets or briquettes Co-firing or biomass in district heating plants firing heavy oil or coal Production of electricity utilizing agricultural and wood wastes Production of biofuels for transport. Environmental protection (GHG reduction, waste management, sustainable management, pollution reduction) Economics (investment, employment in rural area, EU market, development the infrastructure in rural area) Technology (human capacities, manufactures of different equipment – boilers, stoves) Finance opportunities (funds, strategic – reducing the dependence of fossil fuels)</p>	<p>Illegal forest cuttings Low reforestation rates Low price of electricity results to low use of biomass heating purposes (households use electricity for heating)</p>
Turkey	<p>rich biodiversity, sizeable bioeconomy, abundant fertile agricultural lands, traditional fermentation products, a number of academic institutions, human resources and professionals, new R&D incentives and funds, innovation supports to the industrial sector, innovative private companies, rich agri-food industry and export capacity</p>	<p>Relatively small investment capacity, unclear national KBBE strategy, limited collaboration between academia and industry, limited commercialization of innovations, limited venture capital, limited success stories,</p>	<p>Increasing value of agricultural products and food, wide domestic and regional demand from Balkans, Black sea region, Caucasia, Middle East and North Africa, and Europe, bio-nanotechnology applications, entrepreneurship programs in universities and techno-parks, marine biotechnology works, European Research and Development Funds,</p>	<p>Climate change and extreme agro-meteorological conditions with water shortage, risk of losses of biodiversity because of reservoir construction for energy, global competitiveness and trade agreements.</p>

**Annex I: Background note and minutes from Task 5.3 workshop in Ispra
(20th November 2014)**

Imperial College
London

Sustainability Issues for the Deployment of Bioeconomy

S2Biom Workshop – Background Note and Agenda

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March 2014, updated **July & November 2014**

Setting the Scene

The sustainability of bioenergy has been a key issue in the formulation of the legally binding criteria of the Renewable Energy Directive (RED)²⁰ and Fuel Quality Directive²¹ (FQD) since 2009, but the current EU legislation only addresses biofuels and liquid bioenergy carriers. Since 2009, several communications from the Commission, EU-funded projects (4FCrops, BioBench, BiomassFutures, BioTop, Crops2Industry), studies of European Environment Agency (EEA) and Joint Research Centre (JRC) of the European Commission, as well as national (e.g. by Austria, Germany, Sweden, The Netherlands, UK) and international bodies (International Energy Agency /IEA/, IEA Bioenergy, FAO, UNEP, among others) broadened the view to cover the sustainability of all forms of bioenergy.

Further work in the EU and beyond began addressing the sustainability of the *overall biomass* use for non-food purposes, i.e. including biomaterials and biorefineries.

For example, significant improvement of knowledge on the sustainability issues of forest bioenergy has been achieved in various fora both within the EU, and internationally. However, questions such as the carbon neutrality of forest bioenergy and biodiversity impacts of intensified extraction of agricultural and forestry residues

²⁰ Directive 2009/28/EC of 23 April 2009

²¹ Directive 2009/30/EC of 23 April 2009



are still under discussion and scientific review, and social issues such as food and land tenure as well as fuelwood security need to be addressed.

Thus, there is still *no widely shared consensus* yet on how to “frame” the sustainability of the bioeconomy, neither in its environmental nor its economic dimension, and adequate considerations of social aspects such as access to land and water, and food security are often lacking, especially regarding feedstock provision impacts in developing countries.

S2Biom (www.s2biom.eu) builds on the existing knowledge available at the Member State and EU levels, integrate and learn from the JRC capabilities in the sustainability domain as well as the international domain (through IEA Bioenergy, and Global Bioenergy Partnership -GBEP). Work within the project will collect and compile respective approaches especially regarding the broader biobased economy, and will propose integrated sustainability criteria for bioeconomy value chains based on lignocellulosic biomass. Furthermore, guidelines for harmonized methodologies to measure and assess respective impacts will be suggested and included in the project toolset. In that, emphasis will be given to the environmental and social dimensions, while economic issues will be addressed more broadly (beyond costs).

The development of sustainability criteria for the bioeconomy based on lignocellulosic biomass will also give due respect to views of different stakeholders, in particular bringing together countries with stronger background in the consideration of sustainability issues alongside with countries that may be less experienced in the field of biomass sustainability and hence, potentially requiring guidance and assistance towards forming the appropriate capacities to deal with these issues in their policy and monitoring procedures.

Methods & Approaches

S2Biom will employ a combination of top down and bottom up approaches in order to provide an improved understanding among decision-makers in policy and industry regarding sustainability requirements in the lignocellulosic biomass value chains across the biobased sectors (...beyond energy and fuels).

Top Down

LCA approach towards bioeconomy (Task 5.1)

Life cycle assessment is central to environmental policy development and management in the EU. Life-cycle based environmental footprint methods can be

used to construct realistic models of biomass supply chains, taking into account context-specific variables including energy mixes, technological efficiencies, input sourcing patterns, and distribution modes. Such methods allow for multi-criteria environmental assessment (including, for example, greenhouse gas, nitrogen, and phosphorus emissions), facilitating identification of both mitigation leverage points and trade-offs. The European Commission has developed methodologies and supporting guidance documents for Product and Organisation Environmental Footprinting, which can be adapted to non-food biomass value chain-specific applications.

Benchmark and gap analysis of criteria and indicators (C&I) for legislation, regulations and voluntary schemes (Task 5.2)

The current legislation at European and Member State level considers various sustainability C&I specific to some biomass feedstock but lacks specific developed criteria for other resources (such forest residues). On the other hand, many voluntary certification schemes (recognized or not by the EC) have proliferated, many of them with more restraining and ambitious indicators and thresholds than those posed by the different pieces of regulation. The work in the task will examine:

- Sustainability requirements in current legislations and regulations, as collected under other activities of the project (RED, CAP, national regulations for biofuels and bioliquids and for solid and gaseous biomass, e.g. BE, DE, DK, FR, NL, SE, UK),
- Voluntary approaches and management practices in selected Member States (e.g. Dutch Sustainable Bioeconomy Platform, French recommendations for “rational slash harvesting in the forest”, German Biorefinery Roadmap, Swedish recommendations for extraction of harvesting residues and ash recycling, etc...),
- Voluntary certification schemes (Global Bioenergy Partnership, Roundtable on Sustainable Biofuels, specific roundtables i.e. soy, sugar cane, palm oil, forest certification schemes, i.e. FSC and PEFC, etc...). This will allow identifying the current state of the art on sustainability issues for the whole bioeconomy value chain. Following that, a benchmark and gap analysis of C&I proposed in various initiatives will be developed to determine various C&I relevant for each feedstock resource and value chain.

The task will build on previous scientific efforts, e.g. results from the EU projects BioBench, Biomass Futures, Crops2Industry, the Joint Workshop series on Extending the RED, and work of JRC.

Bottom Up

Selected country analysis (Task 5.3)

The aim of the selected country analysis is to map how sustainability aspects of introducing bioeconomy value chains are considered nationally and assess the needs to implement a sustainable and resource efficient bioeconomy.

Given the diverse nature of current bioeconomy settings in Member States and the broader Europe, selected country analyses on how sustainability aspects of introducing bioeconomy value chains are nationally considered will be carried out for:

- Belgium and the Netherlands (DLO + VITO),
- Germany (IINAS + FNR),
- Scandinavia and Baltic States (VTT),
- Spain (CENER),
- Bulgaria, Greece, Croatia, Serbia & Turkey (JRC + Imperial).

In detail, the work in this task will be performed in the following interlinked steps: i) capacity mapping, ii) gap analysis, and iii) trends and future requirements for the sustainable and resource efficient bioeconomy.

i. Capacity mapping in terms of

- legislation and regulations at the selected Member States,
- Voluntary approaches and management practices at the selected Member States,
- Voluntary certification schemes.

ii. Gap analysis (regarding to sustainability policy issues)

This will be done via web-search, based on officially published national policy documents and structured interviews (where feasible in collaboration with national partners), questionnaires, attendance at events, searching the literature and the web. The aim of this analysis will be to determine those gaps that are critical to the future development of the sustainable supply and delivery of the biobased economy with non-food lignocellulosic biomass.

iii. Suggestions

Based on the work in the two previous steps a set of tailored suggestions per country with the appropriate timeframe for implementation will be prepared and presented for further discussion with stakeholders.

Key outputs

The main outputs from the above research work within S2Biom will be:

- Final version of Environmental Footprint methods for non-food biomass supply chains,
- Proposal for a set of science-based criteria and indicators for sustainable bioeconomy value chains for all lignocellulosic resources and routes. Special focus will be given, to the feasible extent, to issues currently under discussion, e.g. indirect land use change (ILUC), carbon neutrality of forest biomass, metric for resource efficiency, approaches to integrate cascading use and multiple use concepts such as biorefineries,
- Summary report on how sustainability aspects of introducing bioeconomy value chains are currently considered in selected countries and regions,
- Proposals (qualitative and quantitative) for evaluating bioeconomy value chain sustainability performance in a “user friendly” tool. The proposals will be publically available and will be used as a means for capacity building.

Aim of the workshop

The aim of the workshop will be dual:

- To present the adaptation of the EU Environmental Footprint methodology to the specifics of non-food biomass value chains, assessed in the framework of S2Biom project (Task 5.1), and
- To present the country analysis profiles (Task 5.3), discuss their outputs and integration to the related research of the S2Biom project (in terms of policy and strategy formation).

A briefing on the current status of S2Biom Task 5.2 (Benchmark and gap analysis of criteria and indicators for legislation, regulations and voluntary schemes at international and EU level, and in selected EU Member States) and an outlook to Task 5.4 (Consistent Cross-Sectoral Sustainability Criteria & Indicators) and Task 5.5 (Guidelines for evaluating bioeconomy value chain sustainability performance in the toolset development) will be given as well.

Duration: one half day session

Place and date of the workshop: JRC premises in Ispra (Italy), Meeting Room Raffaello (building 26A), 20 November 2014, 14:00 – 18:00

Final Agenda

Thursday, 20 November 2014

- 14:00-14:15 Welcome and scope of the workshop – B. Kavalov (Workshop Co-Coordinator, JRC-IES Sustainability Assessment Unit /SAU/), on behalf of C. Ciupagea, Head of SAU - JRC-IES
- 14:15-14:35 S2Biom WP5 Overview – L. Iriarte, on behalf of U. Fritsche (IINAS)
- 14:35-14:50 S2Biom Task 5.1: Adaptation of the EU Environmental Footprint methodology to the specifics of non-food biomass value chains – S. Manfredi (JRC-IES-SAU)
- 14:50-15:05 S2Biom Task 5.2: Benchmark and gap analysis of criteria and indicators - State of Play – L. Iriarte (IINAS)
- 15:05-15:15 S2Biom Task 5.3: Selected Country Analyses of Sustainable Bioeconomy in Europe – C. Panoutsou (Workshop Co-Coordinator, Imperial College London, Centre for Energy Policy and Technology)
- 15:15-15:30 Belgium and the Netherlands – L. Pelkmans (VITO) & B. Elbersen (DLO)
- 15:30-15:45 Germany – L. Wenzelides (FNR) & U. Fritsche (IINAS)
- 15:45-16:00 Questions & Answers
- 16:00-16:20 Coffee break & discussion*
- 16:20-16:40 Scandinavia and Baltic States – E. Alakangas (VTT)
- 16:40-16:55 Spain – D. Sanchez (CENER)
- 17:55-17:10 Bulgaria & Turkey – B. Kavalov (JRC-IES-SAU) & I. Breshkov (UNWE, on behalf of JRC-IES-SAU) & Y. Kayam (JRC-IES-SAU)
- 17:10-17:25 Greece, Croatia, Serbia – C. Panoutsou (Imperial College London)
- 17:25-17:40 Questions & Answers
- 17:40-17:50 Integration of country analyses & conclusions – C. Panoutsou (Imperial College London) & B. Kavalov (JRC-IES-SAU)
- 17:50-18:00 End of the workshop

Imperial College
London

Sustainability Issues for the Deployment of Bioeconomy

Workshop Minutes²²

Thursday, 20 November 2014

- 14:00-14:15** *Welcome and Scope of the workshop – B. Kavalov (Workshop Co-Coordinator, JRC-IES Sustainability Assessment Unit /SAU/) on behalf of C. Ciupagea (Head of SAU - JRC-IES)*
- 14:15-14:35** *S2Biom WP5 Overview – L. Iriarte, on behalf of U. Fritsche (IINAS)*
Presentation about the methodology proposed by IINAS for evaluating the sustainability of bioeconomy value chains under the S2BIOM project that includes 12 indicators (6 environmental, 5 social and 1 economic). The proposed methodology includes minimum required indicators that should be evaluated in all studies (e.g. greenhouse gases) and descriptive / qualitative indexes. The methodology allows for comparisons with other non-biomass value chains (i.e. fossil fuel-based ones) and between different bioeconomy value chains.
- 14:35-14:50** *S2Biom Task 5.1: Adaptation of the EU Environmental Footprint methodology to the specifics of non-food biomass value chains – S. Manfredi (JRC-IES-SAU)*
Presentation about the methodology proposed by JRC for measuring the environmental sustainability under the S2BIOM project that includes 14 impact categories in line with the Product Environmental Footprint (PEF). The use of the methodology to analyse a CHP-plant was shown as example.
Questions raised: (1) the results of the example explained in the presentation were typical or atypical, i.e. more environmental benefits than emissions?; (2) For biorefineries, would all products be considered?; (3) How accurate were the assumptions about the LCA; (4) What was the benchmark used to compare the CHP-plant system?; (5) How could this methodology be used in support to policy making? (7) Suggestion to include a sensitivity analysis; (8) How to deal with the carbon debt? Was biomass considered neutral concerning CO₂ emissions?
Comments and answers: (1) U. Fritsche commented that the objective of WP5 was to provide a tool for evaluating sustainability, but not to judge

²² The workshop briefing was prepared by Cristina Torres de Matos, Jorge Cristobal Garcia & Simone Manfredi (JRC-IES-SAU)



which methodology/indicator was better; (2) There is a challenge with the introduction of non-trivial services and how to deal with the “basket of products” approach; (3) To account for different products, system expansion should be used. However this expansion should be limited to avoid excessive increase of the system complexity that will make the analysis unfeasible; (4) The PEF methodology provides a picture of the analysed system. Other environmental assessment methods can be used to complement the evaluation of the target system;

14:50-15:05
S2Biom Task 5.2: Benchmark and gap analysis of criteria and indicators - State of Play – L. Iriarte (IINAS)

L. Iriarte presented further data of the methodology presented previously by IINAS concerning the benchmark used and the gap analysis.

Questions raised: (1) What was the rationale of the gap analysis? How the gap was evaluated in the scheme presented?

Comments and answers: (1) The gap analysis was performed in the following sequence: 1st identify and collect information on already existing sustainability assessment schemes for biomass value chains (e.g. voluntary schemes for biofuels); 2nd compare that information with the methodology being developed in S2Biom to identify important gaps in the existing information. (2) The marine (blue) sector/products should be considered.

15:05-15:15
S2Biom Task 5.3: Selected Country Analyses of Sustainable Bioeconomy in Europe – C. Panoutsou (Workshop Co-Coordinator, Imperial College London, Centre for Energy Policy and Technology)

Different presentations on the selected regions/countries were given. These presentations included an overview of the bioeconomy issues, facts and figures about bioeconomy sectors (such as agriculture and forestry), the legislative framework and a SWOT analysis.

15:15-15:30
Belgium and the Netherlands – L. Pelkmans (VITO) & B. Elbersen (DLO)
15:30-15:45
Germany – L. Wenzelides (FNR) & U. Fritsche (IINAS)
15:45-16:00
Questions & Answers
16.00-16:20
Coffee break & discussion
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Scandinavia and Baltic States – E. Alakangas (VTT)
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Spain – D. Sanchez (CENER)
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Bulgaria & Turkey – B. Kavalov (JRC-IES-SAU) & I. Breshkov (UNWE, on behalf of JRC-IES-SAU) & Y. Kayam (JRC-IES-SAU)
17:10-17:25
Greece, Croatia, Serbia – C. Panoutsou (Imperial College London)

Comments and questions raised: (1) a regional analysis should be performed; (2) connect the work with the smart specialization – S3 platform (<http://s3platform.jrc.ec.europa.eu/home>); (3) identify similarities in

bioeconomy strategies and types of investments; (4) research gaps should be identified; (5) clarification on the objective of S2Biom task 5.3, which is to provide guidelines on how to analyse sustainable bioeconomy in Europe, in order to obtain uniform, coherent and traceable data for bioeconomy; (6) the suggestions of the stakeholders will be incorporated in the final analyses (e.g. effort to include regions of the countries that are being analysed).

17:25-17:40

Questions & Answers

17:40-17:50

Integration of country analyses & conclusions – C. Panoutsou (Imperial College London) & B. Kavalov (JRC-IES-SAU)

The conclusions of the workshop include: (1) promising regions should be selected for the regional analysis (there are already two: one in Spain and one in France; more regions may come up in the future). (2) The importance of having uniform, traceable and coherent data and how one can use that information to inform accordingly policy-makers were highlighted. (3) Links with other projects and stakeholders related to S2BIOM were proposed.

17:50-18:00

End of the workshop

All presentations can be found in <http://www.s2biom.eu/en/news-events/events.html>