



EUROPEAN  
COMMISSION

Brussels, 10.7.2013  
SWD(2013) 247 final

2/6

**COMMISSION STAFF WORKING DOCUMENT**

**Annexes 1 and 2 of the Impact Assessment**

*Accompanying the document*

**Proposal for a  
COUNCIL REGULATION**

**on the Bio-Based Industries Joint Undertaking**

{COM(2013) 496 final}  
{SWD(2013) 248 final}

## ANNEX 1 – GLOSSARY

**Bioeconomy** encompasses the sectors producing renewable biological resources (e.g. agriculture, forestry, aquaculture and fisheries) and the industries (e.g. pulp and paper, food, chemical and energy industry) converting these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. The bioeconomy has a strong innovation potential due to the use of a wide range of sciences, enabling and industrial technologies.

**Bio-based industries** are industries, which use renewable biological resources for the production of innovative bio-based products and biofuels. Production usually takes place in biorefineries and often relies on bio-based processes.

**Renewable biological resources** or **biomass** means "*the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste*"<sup>1</sup>.

**Bio-based products** are products that are wholly or partly derived from materials of biological origin, excluding materials embedded in geological formations and/or fossilised<sup>2</sup>. In the context of this Impact Assessment on a PPP on bio-based industries, the focus lies on innovative bio-based products, which refer to "*non-food products derived from biomass [...]. Bio-based products may range from high-value added fine chemicals such as pharmaceuticals, cosmetics, food additives, etc., to high volume materials such as general bio-polymers or chemical feedstocks [i.e. building blocks]. The concept excludes traditional bio-based products, such as pulp and paper, and wood products, and biomass as an energy source*"<sup>3</sup>.

**Building blocks** are basic chemical components that are used for the production of more complex molecules in chemical production processes. They are usually produced at high volumes.

**Biofuels** are considered to be "*liquid or gaseous fuels for transport produced from biomass*"<sup>4</sup>.

**Biorefineries** rely on a concept that is analogous to that of petro-chemical refinery processes. However, instead of producing a wide range of products and fuels from fossil resources, biorefineries aim to produce multiple bio-based products and fuels using renewable biological resources as a feedstock. The processes used in biorefineries are often bio-based. (See Box 2 for further explanations.)

**Bio-based processes** are processes based on the use of industrial biotechnology. They are usually more energy and water efficient, emit less greenhouse gases (GHG), and generate less

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<sup>1</sup> Directive 2003/30/EC

<sup>2</sup> CEN - Report on Mandate M/429

<sup>3</sup> DG ENTR (2009) Taking Bio-based from Promise to the Market – A report from the Ad-hoc Advisory Group for Bio-based Products in the framework of the European Commission's Lead Market Initiative

<sup>4</sup> Directive 2003/30/EC

toxic waste than conventional processes. They can both reduce production costs and improve environmental performance<sup>5</sup>.

**Feedstock** refers to the raw material that is transformed into products by industrial processes. In the case of biorefineries, the feedstock is biomass.

**Joint Technology Initiative (JTIs)** are instruments for addressing technological challenges that are of key importance for the future competitiveness of the EU industry involved and that industry and markets would fail to address without a sizeable public intervention extended over a multi-annual timescale. Both the importance of the JTIs to the future competitiveness of the industry involved and the special nature of the public commitment requested (large-scale, multi-annual cash contribution) warrant an explicitly defined commitment from industrial members which goes beyond standard cost-sharing under H2020. Only such commitments are creating a true public-private partnership.

**Joint Undertaking (JU)** is often used to designate established JTIs. The term "Joint Undertaking" refers to the administrative structure of the JTI.

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<sup>5</sup> COM(2012) 582

**ANNEX 2 – BIO-BASED INDUSTRIES – MARKET PLAYERS AND THE "BIC"**

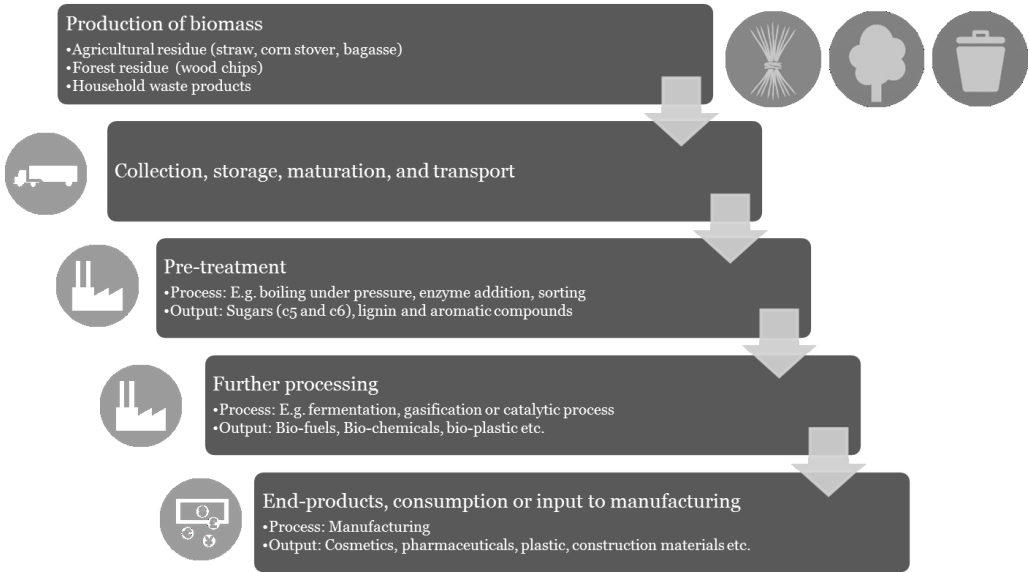
**1. BIO-BASED INDUSTRIES AND THEIR VALUE CHAINS**

Bio-based industries produce innovative bio-based products and biofuels from renewable biological resources. They are considered to be a cornerstone of the European Bioeconomy Strategy, as they offer new opportunities for economic growth and job creation, while contributing to moving towards a sustainable low-carbon economy.

A number of traditional European sectors, such as the chemical, textile, wood-based, pulp and paper and energy industries, have been using biomass for the production of traditional bio-based products, such as clothes, furniture, paper and energy. In the light of increasing competition from third countries with cheaper biomass resources, these industries have made use of their strong science and technology base to explore new sources of revenue, such as innovative, high added value bio-based products (e.g. biopolymers, biochemicals, etc) and biofuels. This and concerns about our dependence on fossil resources and their impact on climate change have given rise to the sector of “bio-based industries”.

Bio-based industries can be considered as a nascent industry sector, as its players include both traditional industries that are moving partially or entirely towards innovative bio-based products and biofuels and entirely new companies entirely dedicated to bio-based applications. Indeed, bio-based processes and products can replace processes and products from the petro-chemical industries; they are however also giving rise to entirely new products and thus new markets.

While European companies have been key players in developing bio-based applications world-wide, the further growth of bio-based industries in Europe is being hampered by lack of support for the development of their value chains, see Figure 1. Many of the key market players are traditionally not used to collaborating, yet the challenges they are facing cannot be addressed by a single company or sub-sector.



Note: Copenhagen Economics, based on Biorefining Alliance (2012b)

**Figure 1: The value chain of bio-based industries<sup>6</sup>**

Some of the key market players for the establishment of bio-based value chains are listed in Table 1. Due to the relatively novel nature of bio-based industries it is however difficult to dissociate clearly the percentage in annual turnover and employment associated to them today.

**Table 1: Key market players for the establishment of value chains for bio-based industries<sup>7</sup>**

Sector	Annual turnover (billion Euro)	Employment (thousand)	Data sources
<b>Agriculture (crop output)</b>	205	26,700	COPA-COGECA and Eurostat (2012)
<b>Industrial material use: 6%<sup>8</sup></b>	12.3	1,602	Eurostat (2012)
<b>Forestry a wood industry</b>	668	470	Eurostat and Star-Colibri (2012)
<b>Manufacture of sugar</b>	15	41	Eurostat (2012)
<b>Manufacture of starch and starch products</b>	10	18	Eurostat (2012)
<b>Manufacture of vegetable and animal oils and fats</b>	42	66	Eurostat (2012)
<b>Pulp, paper and paper products</b>	170	690	Eurostat (2012)
<b>Woodworking industry</b>	283	2,772	Eurostat (2012)
<b>Chemicals and plastics (total)</b>	642	1190	CEFIC and Eurostat (2012)
<b>Bio-based: 10%<sup>9</sup></b>	64	119	
<b>Enzymes</b>	0.8	5	Based on input from Amfep, Novozymes, DuPont/Genencor, DSM (2010)
<b>Biofuels</b>	42.6	221	Global Renewable Fuels Association (2012)
<b>Manufacture of textiles and textile</b>	97	1,199	Eurostat (2012)

<sup>6</sup> Copenhagen Economics (2013) Biobased industries - The case for investment

<sup>7</sup> Table compiled by CleverConsult and Nova Institute

<sup>8</sup> Nova Institute (2013)

<sup>9</sup> Estimation based on:

- USDA (2008) – US Biobased Products Market Potential and Projections through 2025. See: <http://www.usda.gov/oce/reports/energy/BiobasedReport2008.pdf>
- Peter J. Nieuwenhuizen, David Lyon, Julia Laukkonen and Murray Hartley (2009) - A rose in the bud? Anticipating opportunities in industrial biotechnology. Prism/2/2009
- G. Festel (2010) - Industry Structure and Business Models for Industrial Biotechnology. Discussion paper at the OECD workshop: Outlook for Industrial Biotechnology (Vienna 13-15 January 2010)
- McKinsey (2009) – Presentation of J. Riese at DSM. See [http://www.dsm.com/en\\_US/downloads/sustainability/white\\_biotech\\_mckinsey\\_feb\\_2009.pdf](http://www.dsm.com/en_US/downloads/sustainability/white_biotech_mckinsey_feb_2009.pdf)

The following sections provide an overview over the main industries and sectors associated to bio-based industries. The value chain for bio-based industries has been roughly split into three steps: 1) Biomass production, collection and transport; 2) Processing industries; and 3) End users/consumer markets. It should be noted that the separation between these steps is often not so clear and that market players are often involved in more than one of them.

For a more comprehensive discussion of challenges, opportunities and bottlenecks for the different industries and sectors also see the "Joint European Biorefinery Vision for 2030" that was prepared by the FP7 project Star-COLIBRI<sup>10</sup>.

### **1.1. Biomass production, collection and transport**

Europe has highly developed agriculture and forestry sectors. In 2008 the total land cover of EU 27 was around 420 million hectares with approximately 43% dedicated to agricultural production and 40% to forestry. These sectors dispose of significant unused or underexploited biomass that could be transformed by bio-based industries, such as residues from agricultural and forestry activities, or industrial crops.

However, the role of primary production sectors does not have to be limited to that of biomass supplier. Unlike the well-established supply chains for the food sector, the supply chains for bio-based industries are still at an early development stage. By investing in the development of these supply chains and the deployment of biorefineries, agricultural cooperatives have the opportunity to become involved at a higher level in the value chains, allowing them to benefit directly from the added value and jobs these will generate. Developing value chains for bio-based industries can thus provide a win-win situation for primary production and processing industries.

#### *1.1.1. Agriculture*

The EU agriculture is one of the biggest suppliers to global agricultural markets. It has a share of 18% in world food exports, worth € 76 billion. In production values, it agriculture provides more than 40% of total OECD food production. There are about 14 million farmers in the EU and a further 4 million people working in the food sector<sup>11</sup>. Together, the farming and food sectors provide about 7% of all jobs and generate 6% of European gross domestic product.

Farmers and agri-cooperatives are typically organised in national trade associations, which again are grouped at European level in the Committee of Professional Agricultural Organisations COPA and the General Confederation of Agricultural Cooperatives COGECA, which work closely together under the umbrella of COPA-COGECA.

#### *1.1.2. Forestry and wood industry*

Over the past 20 years, Europe has seen a net increase in forest areas, gaining 16.9 million hectares in forest land since 1990 and the highest levels of timber since recoding began<sup>12</sup>.

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<sup>10</sup> Star Colibri (2011) Joint European Biorefinery Vision for 2030

<sup>11</sup> DG AGRI (2012) The Common Agricultural Policy – A partnership between Europe and farmers

<sup>12</sup> FAO (2011) State of European forests

From the 620 million cubic meters of net annual increment in 2010, only about 60% were harvested.

It should be noted that the amount of currently unused wood growth that can be economically harvested is limited by diminishing wood dimensions and quality, as well as logistical accessibility. Large portions of any significant increased wood harvesting, including forest and wood industry residues, are likely to be attracted to the highly-subsidised bioenergy market for heating and electricity generation in the foreseeable future.

Forest owners and forestry and wood industries are organised at European level in the Confederation of European Forest Owners (CEPF) and the European State Forest Association (EUSTAFOR).

### *1.1.3. Challenges for biomass production*

Primary production sectors are facing several challenges, ranging from<sup>13</sup>:

- Providing a reliable supply of biomass in sufficient quantity and quality, this includes considerations around "sustainable intensification", efficient land use, and increasing the availability of forestry biomass;
- Increasing the efficiency of supply chains, e.g. reducing losses and waste, putting in place closed-looped systems;
- Anticipating and adapting to climate change;
- Developing sustainability criteria for the sourcing of biomass;
- Communicating with the general public to improve the image of bio-based industries.

## **1.2. Processing industries**

Europe has a strong technology base for the transformation of biomass into high value added bio-based products and biofuels. A comparison with the US and Asia shows that the EU is leading in research and innovation in several areas of high relevance for bio-based industries, including industrial biotechnology, enzyme technology, fuel from waste, waste management and renewable energy<sup>14</sup>. Europe has a leading share in the total number of patent applications in the area of industrial biotechnology filed since 2000<sup>15</sup> and is home to the world's leading enzyme producers<sup>16</sup>.

While the market share of bio-based products and biofuels in the EU is still relatively low and confined to specific niche markets, Europe is in a good position to develop the potential of bio-based industries due to its strong (petro-)chemical and pulp and paper industries. In view of an increasingly strong global competition, further investments in research, innovation and deployment of bio-based processes and products will be needed to maintain and expand this

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<sup>13</sup> Star Colibri (2011) Joint European Biorefinery Vision for 2030

<sup>14</sup> SEC(2011) 1427

<sup>15</sup> EPO (2012) Analysis of EPO data on industrial biotechnology patents provided by Novozymes

<sup>16</sup> Star-Colibri (2011) Joint European Biorefinery Vision for 2030

position<sup>17</sup>. This includes the development of policy instruments, such as standards and labels, supporting the uptake of bio-based products in consumer markets and public procurement.

### *1.2.1. Forest-based industries*

The wood working industry is made up of about 365 000 SMEs, including sawmilling (15%), wood construction products (37%) and furniture manufacture (48%)<sup>18</sup>. European forest-based industries (including pulp and paper, wood industries) are an important part of the European economy. Many of the top 100 players in the global forest, paper and packaging industry world-wide are European, such as Stora Enso, UPM-Kymmene, SCA, Smurfit Kappa, Mondi Group, Metsä Group, Sappi, Norske Skog, Holmen, Södra, BillerudKorsnäs, ENCE<sup>19</sup>.

Forest-based industries are organised in several trade associations at European level, namely the European Confederation of Woodworking Industries (CEI-Bois) and the Confederation of European Paper Industries (CEPI).

### *1.2.2. Sugar and starch industries*

The EU is the world's leading producer of beet sugar. It accounts for about 50% of the total beet sugar production, which about 20% of the world's sugar production. In view of increasing competition from sugar producers from other parts of the world, the European sugar industry has been diversifying their activities, by providing feedstock for the production of bioethanol and other fermentation processes for many years. Companies active in this area include Nordzucker, Südzucker, Tereos, Cristal Union and Suiker Unie.

The European starch industry produced more than 600 products for the use in a vast range of food, non-food and feed applications, going from native and modified starches to liquid and solid sweeteners. About 70 starch production facilities across Europe produce close to 10 million tonnes of starch every year from EU-grown wheat, maize and potatoes. The EU consumption of starch and starch derivatives reached almost 9 million tonnes in 2011. Changes in subsidies allocated to starch sector, such as the potato starch industry, are motivating many players to explore new sources of income, such as bio-based products. Companies active in this area include Cargill, Roquette, Vivecia and Tereos-Syral. At European sector is represented mainly by the European Starch Industry Association AAF.

### *1.2.3. Vegetable and animal oil and fat processing industries/Oleochemical industry*

More than 11 million hectares are dedicated to cultivating oilseeds (e.g. rapeseed, sunflower seed, soybeans and linseed) in the EU, which are used for food, feed, fuel and industrial purposes. Significant amounts of animal fats are generated by the food industry, mainly by the meat industry. Vegetable oils and animal fats are used in the food industry and for the production biodiesel and in the oleochemical industry, ranging from detergents, lubricants to cosmetics. The worldwide consumption of basic oleochemicals is estimated at 3.5 million tonnes<sup>20</sup>, of which more than a third is produced in Western Europe.

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<sup>17</sup> COM(2007) 860

<sup>18</sup> Forest-Based Platform (2012) Horizons – Vision 2030 for the European Forest-based Sector

<sup>19</sup> PriceWaterHouseCooper (2012) Global Forest, Paper & Packaging Industry Survey 2012 edition – survey of 2011 results

<sup>20</sup> APAG (2013) - <http://www.apag.org/oleo/index.htm>



European key players in this sector include many (petro-)chemical companies, such as Akzo Nobel, BASF, Evonik, Clariant, Procter and Gamble Chemicals, Dow Europe, Shell and Danisco. They are represented at European level by trade associations, such as European Oleochemicals and Allied Products Group (APAG) and the European Chemical Industry Council (CEFIC).

#### *1.2.4. Biochemicals and materials producers*

Biochemicals and materials, such as lactic acid, acetic acid and biopolymers, are a growing sector in Europe driven by an increasing demand for sustainable solutions. Bioplastics are growing at an annual rate of about 20%, as they are being used in an increasing number of markets, ranging from agriculture, automotive, packaging to toys and textiles<sup>21</sup>.

Most of the key players are existing chemical companies that are diversifying their activities towards bio-based applications. The chemical industry in 2010 generated a turnover of € 491 billion, a significant positive trade balance and represented direct employment of 1.2 million people (3.4 million jobs including indirect employment)<sup>22</sup>. They include companies such as BASF, Novamont, Arkema, DuPont, Metabolix, Limagrain, BioAmber and Braskem. These are grouped in trade associations at European level, such as European Bioplastics or European Renewable Resources and Materials Association (ERRMA).

#### *1.2.5. Enzymes industry*

About 64% of all companies involved in biochemical research and production of enzymes are located in the EU, making Europe a world-leader in this area<sup>23</sup>. The use of industrial biotechnology, i.e. of enzymes and microorganisms, has lowered the costs of biochemical production, establishing as an interesting production method of its own in addition to being a co-production. Key players in the enzyme business include Novozymes, Dupont Genencor and DSM. They are represented at European level by the European Biotechnology Association for Bio-industries EuropaBio.

#### *1.2.6. Biofuels industry*

The "first generation" or "conventional" biofuels sector in Europe has been growing well as a result of the EU's renewable energy targets in transport ("biofuel targets") of 10% by 2020. In 2012, industry was already producing sufficient biofuels to meet half of the target. In 2010, the production volume of the biodiesel industry was double that of the bioethanol industry, due to the prevalence of oilseed rape as an industrial crop in Europe. It is expected that the two sub-sectors will produce comparable amounts by 2020. Market players include companies, such as Roquette, Cargill, Tereos, Südzucker, British Sugar, Abengoa, Inbicon, Neste Oil, Ineos, etc, many of which are issued from the sugar, starch, vegetable oil or animal fats industries. They are grouped in the European trade associations European Renewable Ethanol (ePURE) and European Biodiesel Board (EBB).

The on-going revision of the EU biofuel targets in the light of the controversy around food security and indirect land use change (ILUC) intends to cap conventional biofuels at their

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<sup>21</sup> European Bioplastics (2013) - <http://en.european-bioplastics.org/market/>

<sup>22</sup> CEFIC (2011) Facts and figures 2011

<sup>23</sup> Star Colibri (2011) Joint European Biorefinery Vision for 2030

current level and to promote "second generation" or "advanced" biofuels, which are produced from non-edible renewable biological resources, such as agricultural or forestry residues and bio-waste. The "advanced" biofuel sector is not very developed yet, as production of biofuels from these feedstocks is currently taking place at a small scale in pilot and demonstration plants<sup>24</sup>. It is likely that the players from the "conventional" biofuels sector will gradually move to "advanced" biofuels.

### *1.2.7. Challenges for processing industries*

Processing industries are facing several challenges, ranging from<sup>25</sup>:

- Maintaining the production output from existing facilities, while making the transition to bio-based applications;
- Securing sufficient sustainable feedstock in Europe (e.g. agricultural and forestry residues) and remaining competitive in volatile raw material markets;
- Exploring the use of wastes, by-products and recycled materials as a feedstock source;
- Improving sustainability (e.g. reducing greenhouse gas emissions (GHG));
- Optimising resource efficiency of processes (e.g. for energy, water, raw material use);
- Developing cascading approaches that create new synergies between industries to use resources in a "smart" way;
- Reducing costs of production processes, in particular balancing economic return with minimal environmental impact;
- Developing sustainability criteria for the sourcing and processing of biomass;
- Communicating with the general public to improve the image of bio-based industries.

### **1.3. End users/consumer markets**

Bio-based products can range from high-value added fine chemicals, such as pharmaceuticals, cosmetics, food additives, etc., to high volume materials such as general bio-polymers or chemical feedstocks (i.e. building blocks).

While some processing industries may develop consumer products themselves, others may sell their bio-based products to companies that are specialised in developing "final products" that can be commercialised to consumers. Thus, biomaterials can be used for textiles and packaging, bio-based ingredients in cosmetics or foods, etc. These companies are often also established consumer brands, such as Procter and Gamble and Unilever. Since they constitute the link to consumer markets, they are also considered to be "end users".

In the case of biofuels, end users can range from transport companies to normal consumers. The development of high added value biofuels, such as jet fuels, could also attract airlines.

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<sup>24</sup> Copenhagen Economics (2013) Biobased industries - The case for investment

<sup>25</sup> Star Colibri (2011) Joint European Biorefinery Vision for 2030

In view of broader economic and social sustainability issues and of implications for consumers, the Commission is currently studying biofuels from a consumer perspective as a part of a broader study on the functioning of the fuel markets. The study is expected to generate recommendations on improving and harmonising fuel labelling at the pump across Member States<sup>26</sup>.

### *1.3.1. Challenges for end users*

- Developing new and sustainable bio-based products and biofuels that either replace existing fossil-based products or open entirely new markets;
- Developing sustainability criteria, certificates, standards and labels for bio-based products in order to ensure their sustainability and communicate their environmental benefits.
- Communicating with the general public to improve the image of bio-based industries.

## **2. THE BIOBASED INDUSTRIES CONSORTIUM (BIC)**

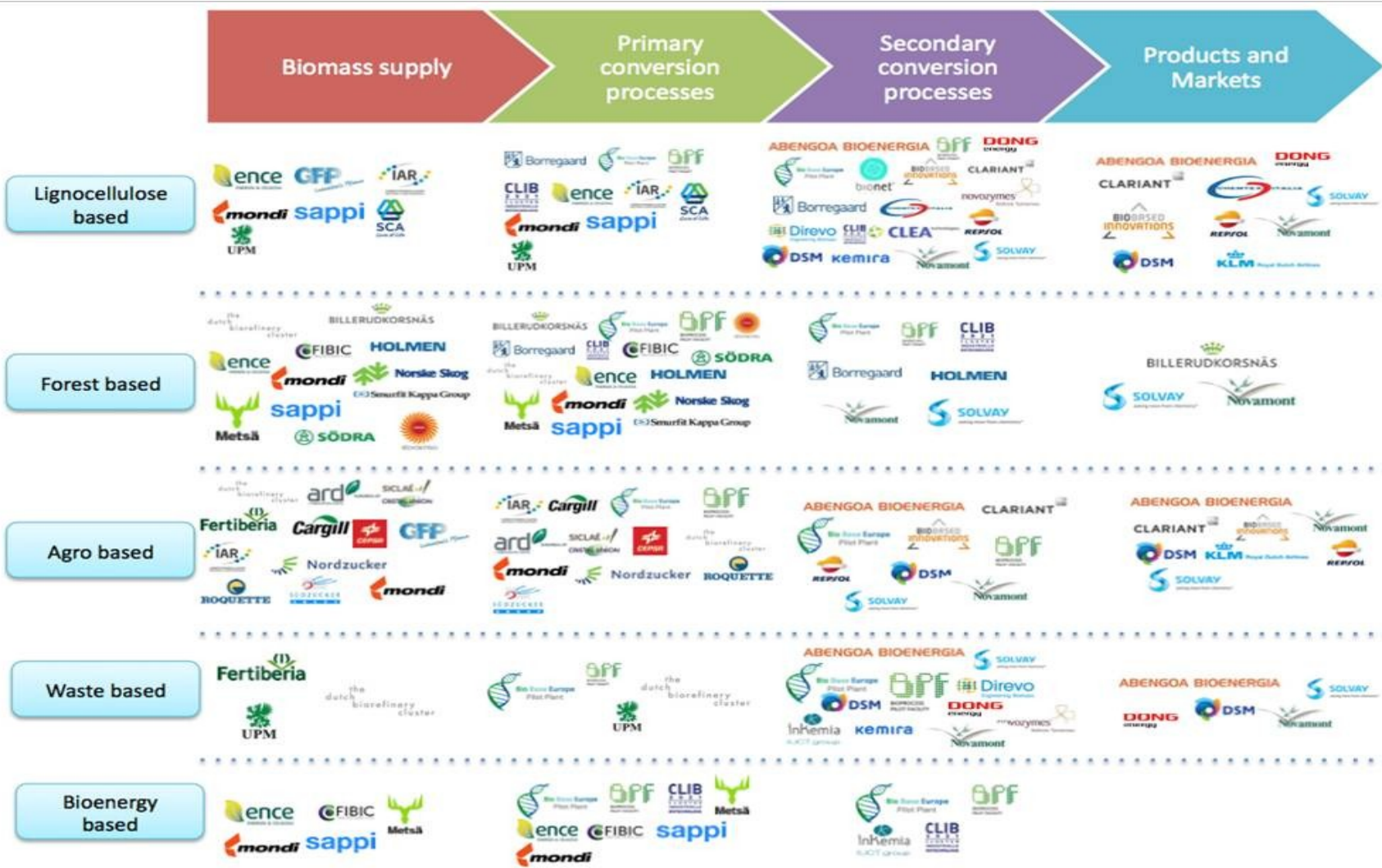
The industry group backing the proposal for a Bio-based PPP represents a wide range of stakeholders along the entire bio-based industry value chain: the agro and agri-food sector, the sugar and starch industries, the forestry and pulp and paper sector, materials and chemical industries, bioenergy and biofuel sector, the biotechnology industry and other technology providers. Figure 2 shows the role of different players along the five value chains to be established as a basis for building competitive bio-based industries in Europe.

The group has organised itself in a new legal entity called the “Biobased Industries Consortium” (BIC) end of 2012, which would be the private partner in a possible Bio-based PPP. All sectors are represented in the BIC Board, including SMEs or SME clusters. BIC is also supported by major industry trade associations (e.g. EuropaBio, CEPI, COPA-COGECA, European Bioplastics, CEFIC) and the European Technology Platforms (e.g. Forestry ETP, SusChem ETP), who can become associate members. The BIC membership is open to any relevant industry parties, several companies from the different market players are negotiating their participation in the BIC.

The Impact Assessment discusses the establishment of five value chains based on the main feedstock available in Europe. Figure 2 indicates how the different members of BIC are positioned along these value chains.

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<sup>26</sup> Note: The study (to be published by end of 2013) explores whether consumers are able to make informed choices by looking into consumer understanding and the transparency of information. The study also tackles the issues of availability of different fuels and retailers, and retail prices.



Note: Primary Conversion: refining of biomass into its valuable components; Secondary conversion: Valorisation of intermediates and products.

Figure 2: BIC members and their position along the value chain