An overview on the biopolymers market potential in Europe

European Bio-polymers Summit 2016, London, UK
Who is speaking

EUBIA
The European Biomass Industry Association
Supporting Biomass Sector at all Levels

EUBREN
The European Biomass Research Network
Researching for Bioeconomy
A MULTI-FACETED SUPPORT

A business facilitator

- Identification of competitive projects
- Markets potentials evaluation
- Creator of Business opportunities
- Technical consultancy

Information provider & diffuser

- Organizer of workshops, training events
- International conferences supporter
- Policy Measures Position papers
- Dissemination opportunities
- Legal framework barriers identification

International Projects developer

- More than 50 EC projects experience
- Coordinator/Partner in technical tasks, policy and market assessment,
- Supporting Dissemination
European Biomass Industry Association

EUBREN - The European Biomass Research Network
Researching for bioeconomy

EUBREN Home
Introduction
Polymers (Greek: poly-many, meros-particle)

compounds with high molecular mass, constructed of interlinking, perennial basic building blocks, called monomers.

Polymers are the main components of plastics, with additives as fillers (inorganic or organic), pigments, lubricants, inhibitors of oxidation, etc.

About 75% of all produced plastics are:

- PET (polyethylene terephthalate),
- Polypropylene (PP)
- Polystyrene (PS)
- Polyethylene (PE)
Biopolymers from Nature
Most of the living world is based on polymers.

Natural polymers are produced in the growth cycles of cells of living organisms.

Their synthesis includes enzyme-catalysed polymerisation reactions of activated monomers, which occur within cells as products of complex metabolic processes.

Polymers can be found in animals (hydrocarbons, proteins, fats, nucleic acids, etc.), plants (e.g. cellulose, oils, starches, even polyesters) as well as in lower organisms.

Making artificial Biopolymers

With biosynthesis, polymers can be produced in a manner identical to the natural.

There are primarily two types of Biopolymer, one that is obtained from living organisms and another that is produced from renewable resources but require polymerization.

Those created by living beings include proteins and carbohydrates.
Difference between Polymer and Biopolymer

Biopolymers and Bioplastics are often confused for one another. However, these are different materials.

**Biopolymers** are polymers that can be found in or manufactured from, living organisms. These also involve polymers that are obtained from renewable resources that can be used to manufacture Biobased plastics by polymerization.

**Bioplastics** are the plastics that are created by using biodegradable polymers. The great automobile manufacturer Henry Ford devised a way of manufacturing bioplastic car sections from soybeans back in the middle of the 20th century.
Biobased polymers production routes

Polymers directly extracted/removed from biomass:

- polysaccharides, for example starch and cellulose;
- proteins, for example casein and gluten.

Polymers made by classical chemical synthesis using renewable monomers:

- polylactide,
- bio-polyester formed by polymerisation of monomers, i.e. lactic acid (PLA).

Polymers obtained with the help of microorganisms or genetically modified bacteria:

- polyhydroxyalkanoates (PHA)
- bacterially synthesised cellulose

<table>
<thead>
<tr>
<th>Bio-Based Chemical</th>
<th>Reference petrolchemicals</th>
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<tbody>
<tr>
<td>Ethyl lactate</td>
<td>Ethyl acetate</td>
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<tr>
<td>Ethylene</td>
<td>Ethylene</td>
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<tr>
<td>Adipic Acid</td>
<td>Adipic Acid</td>
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<tr>
<td>Acetic Acid</td>
<td>Acetic Acid</td>
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<tr>
<td>n-Butanol</td>
<td>n-Butanol</td>
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<tr>
<td>PTT</td>
<td>PTT &amp; Nylon 6</td>
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<tr>
<td>PHA</td>
<td>HDPE</td>
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<td>PLA</td>
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<td>FDCA</td>
<td>Terephtalic acid</td>
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<td>Succinc Acid</td>
<td>Maleic Anhydride</td>
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Biochemicals in Europe and worldwide
EU GHG emission reduction targets

- a 40% cut in greenhouse gas emissions compared to 1990 levels
- at least a 27% share of renewable energy consumption
- at least 27% energy savings compared with the business-as-usual scenario
- A reformed EU emissions trading scheme (ETS)
- New indicators for the competitiveness and security of the energy system, such as price differences with major trading partners and interconnection capacity between EU countries
Material production specific energy consumption

Semiconductors - 3,000 MJ per kg

Silicon - 230 to 235 MJ per kg

**Plastics from crude oil requires 62 to 108 MJ per kg (35% eff.)**

Steel (from iron) - 20-50 MJ,

paper (from timber) - 25-50 MJ per kilogram.

iron from iron ore requires 20-25 MJ of energy,

glass (from sand, etc.) - 18-35 MJ
Bio-based polymers market trend from 2011 to 2020

Polymers market in 2011:
- Total production: 265 million tons
- Bio-based polymers: 3.5 million tons
- Bio-based polymers share: 1.5%

Polymers market expected in 2020:
- Total production: 400 million tons
- Bio-based polymers: 12 million tons
- Bio-based polymers share: 3%

Source: NOVA Institute
Shares of biobased polymers production expected capacity in different world regions

Source: NOVA Institute
Plastic demand in EU by sector in 2014

- **Packaging**: 39.6%
- **Building & Construction**: 20.3%
- **Automotive**: 8.5%
- **Electrical & Electronics**: 5.6%
- **Agriculture**: 4.3%
- **Others (include sectors such as consumer and household appliances, furniture, sport, health and safety)**: 21.7%

Source: Plastics Europe
European type of polymer demand by sector

Packaging: PE (LD), PE (HD), PP, PET

Building & Construction: PP, PET

Automotive: PP, PET

Electrical & Electronic: PET

Others: PE (LD), PE (HD), PP, PS, PSE, PVC, PET, ABS, ASA, SAN, PMMA, PA, PC, Other, PUR

Source: Plastics Europe
Market sector development foreseen for Biobased polyethylene (PE)

*Biobased polyethylene production is stable at around 250,000 t/year, without a strong increase expected for 2020*

Bio-Polyethylene (PE) is a 100% bio-based drop-in polymer. The bio-based building block needed is bio-based ethylene. Polyethylene is produced as HD polyethylene (PE HD) and light Polyethylene (PE)

**Bioethylene production systems:**
- Dehydratation of bioethanol using alumina catalyst (most used in Brazil and USA)
- Cracking of bionaptha from Fischer Tropsch process

Emergence of substitutes such as bio-based PET, PLA and PEF in packaging is expected to hamper bio-based PE market growth over the forecast period
Market sector development foreseen for Biobased polypropylene (PP)

Biobased polypropylene (PP) market is at a nascent stage. Most of the companies are pursuing activities on manufacturing naturally derived isopropanol and n-butanol.

Corn, biomass, and vegetable oil are typically used for the manufacturing of aforementioned biobased products.

Europe was the largest biobased PP market in 2013, with more than 35% of the global volume share.

The European Biobased polypropylene production in 2020 should be around 8,000 t/year.

Global PP market trend from 2012 to 2020 (ktons)
Polylactic acid (PLA) is a 100% bio-based and biodegradable (only under certain conditions) polymer, produced from lactic acid. Lactic acid (LA) is easily produced from starch bacterial fermentations and extracted.

In 2014, packaging application garners the highest share of 65.2% in the global PLA market.

PLA Market is expected to reach €5 billion, at a growth rate of 19.5% from 2013 to 2020.

According to NOVA institute study, 25 companies produce more than 180,000 tons/year of PLA.

The capacity is planned to reach around 800,000 t/a by 2020.

Source: Future Market Insights
Market sector development foreseen for Bio-based PET

Bio-based PET: 7 million production capacity by 2020

Bio-PET market in Europe, with food & beverage industry growth in Germany, France & UK, expects to reach over 2.8 billion € by 2023.

Bio Based Polyethylene Terephthalate (PET) Market size was 500.0 kilo tons in 2015.

Currently the material is 20% bio-based and produced out of glucose hydrolysis, fermented in two different tanks to gain ethanol and isobutanol, further processed into bio-based monoethylene glycol (MEG) and terephthalic acid (TPA) as a drop-in bio-based polymer.

Polyethylene furanoate (PEF) is 100% bio-based and is produced out of bio-based 2,5-furandicarboxylic acid (2,5-FDCA) and MEG.

PEF is similar to PET. Both PEF and PET are used in bottle production, however PEF is said to have better properties, such as better barrier properties, than PET.
Europe driving the development: the pathway towards Biopolymers market growth
European supports the application of biobased building blocks

2008

2012
- Communication on Industrial Policy also identifies bio-based products as an area where further investment should be encouraged
- Innovation for sustainable growth: A bio-economy for Europe

2013
- The Commission issued the standardization mandate M/430 on bio-polymers and bio-lubricants
- A Commission Expert Group for Bio-based Products was set up from 2013 to 2017. Expert Group's objective is to advise the Commission on the development of the bio-based products sector
**EuroBioRef**

European Multilevel Integrated Biorefinery Design for Sustainable Biomass Processing

29 partners project from 15 countries

Demonstrating the technical and economic viability of the synergy of the biomass agro-industry with chemical, biochemical and thermochemical conversion processes.

Combination of technologies to optimise production routes of high added value bio aviation fuels, chemicals and polymers.
WP 5: Biowaste valorisation into high value products

Task 5.2. Bioadditives for polymers or biopolymers

Extraction, purification and modification of valuable fractions from potato waste

Potato extracted proteins aqueous solution, partially denatured and processed

valorised as gas barrier biopolymers for packaging of oxidation sensitive food

Rice Bran processing and RB Oil extraction

Novel self nano-emulsifying drug delivery systems

polymer processing on compostable polymers (PLA, PHAs, and CDA)

bio-polymeric blends produced in lab scale
Thank you for your attention!

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