INNOVATIVE BIO-BASED PRODUCTS FOR A SUSTAINABLE FUTURE:

A Cepi study on Pulp and Paper Industry biorefineries in Europe

EXECUTIVE SUMMARY

OUR AMBITION

Cepi was the first industry association to launch its 2050 Roadmap in 2011. The roadmap anticipated that by 2050 Europe's forest fibre industries would be decarbonised by 80%, while creating 50% more added value. In November 2019, European pulp and paper industry CEOs declared their intention to be at the forefront of the 2050 decarbonisation efforts by reducing the impact of their operations on climate change, while increasing production in Europe.

The contribution of forests as a net sink and the substitution of fossil-based materials and fossil energy with more environmentally friendly alternatives will be essential to meet this challenge.In the future, a growing share of the added value generated by the industry will come from bio-based product, other than pulp and paper. European pulp and paper companies are developing more and more business related to new bio-based products. To achieve our 2050 goals, the time to invest is now. Many major investments in new and existing biorefineries were announced and carried out recently.

OBJECTIVES

Cepi supports fact-based policymaking by bringing reliable data to EU policymakers about the industry. The study carefully registers wood-based biorefineries in Europe, providing estimates about investments, turnover, added value and jobs. The study demonstrates the role of the bioeconomy in making the European Green Deal climate ambition happen, but also identifies the value of new bio-based products coming on the market. These insights also emphasize the opportunities to expand the valorisation of wood even further, thus contributing to the Cepi 2050 ambition of 50% more added value.

METHODOLOGY

A biorefinery has been defined as the concept of a processing plant where forest-based feedstock* is converted and extracted into a spectrum of added value products.

Biorefineries have been classified according to the following sub-categories:

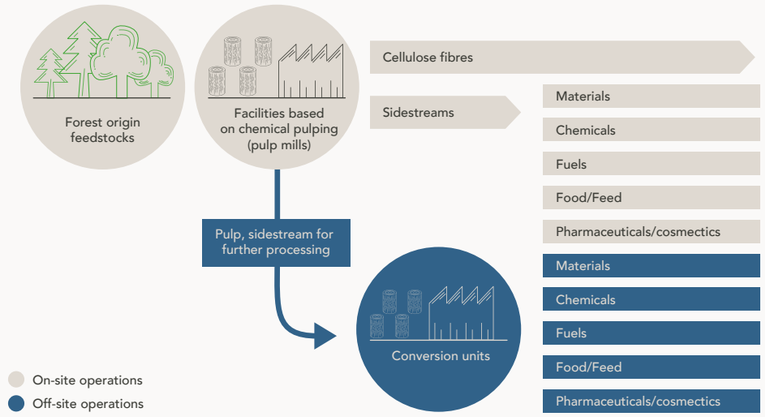
- Category 1: Biorefineries based on chemical pulping operations to produce various existing or emerging bio-based products
- Category 2: Biorefineries using virgin pulp and/or recycled fibres to produce emerging bio-based products
- Category 3: Other biorefineries using lignocellulose as raw material to produce various existing or emerging bio-based products

In all cases the feedstocks are of primary **forest origin** (wood). Bioproducts are classified as materials, chemicals, fuels, food/feed, pharmaceuticals and cosmetics and can be both for commercial and internal use.

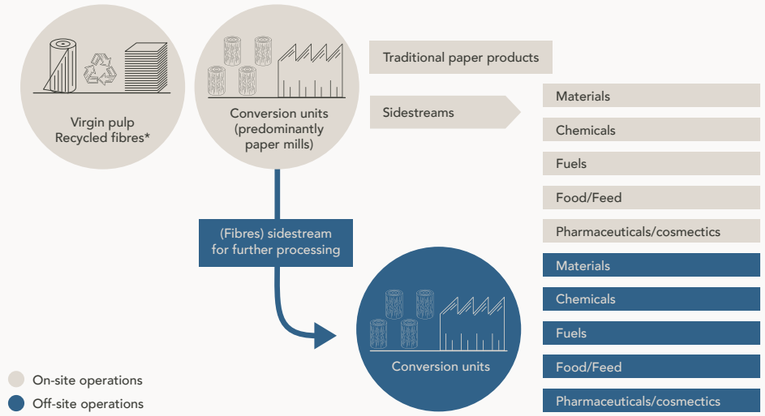
The value of the biorefinery sector is derived from the volumes of identified bio-based products combined with the current market prices for each product. There is no single source for emerging new bio-based products, so in the study price estimates are collected from various sources and derived from the NC Partnering database.

**virgin and/or recycled fibres*

Category 1: Biorefineries based on chemical pulping operations to produce various existing or emerging bio-based products



Category 2: Biorefineries using virgin pulp or/and recycled fibres to produce bio-based products



Category 3: Other biorefineries using lignocellulose as raw material to produce existing or emerging bio-based products

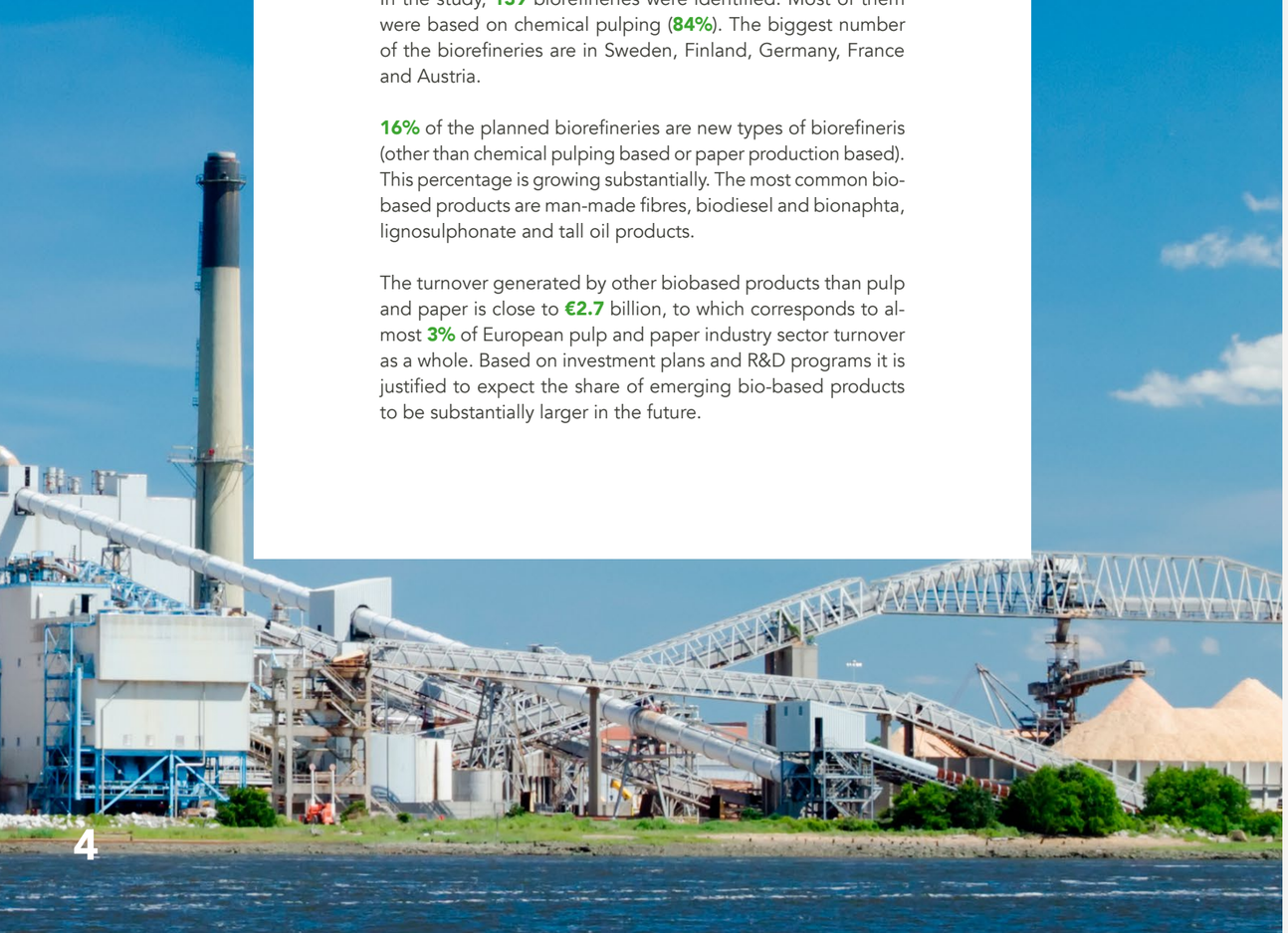
KEY RESULTS

Chemical pulp manufacturing and recycling are within the scope of the Cepi membership. As an association, Cepi represents pulp, paper, and board producing companies.

In the study, **139** biorefineries were identified. Most of them were based on chemical pulping (**84%**). The biggest number of the biorefineries are in Sweden, Finland, Germany, France and Austria.

16% of the planned biorefineries are new types of biorefineris (other than chemical pulping based or paper production based). This percentage is growing substantially. The most common bio-based products are man-made fibres, biodiesel and bionaphta, lignosulphonate and tall oil products.

The turnover generated by other biobased products than pulp and paper is close to **€2.7** billion, to which corresponds to almost **3%** of European pulp and paper industry sector turnover as a whole. Based on investment plans and R&D programs it is justified to expect the share of emerging bio-based products to be substantially larger in the future.



COUNTRY OVERVIEW

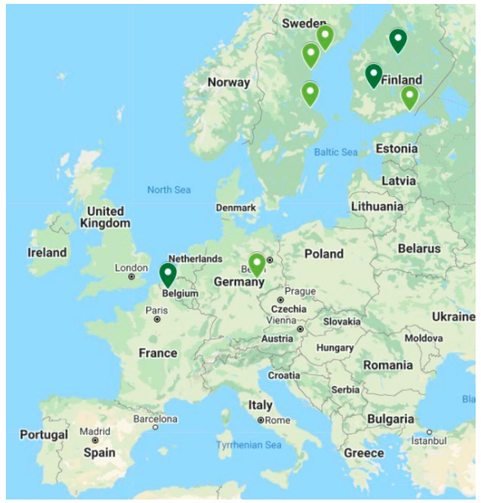
Map of biorefineries in Europe – CAT 1 (chemical pulping based biorefineries)

Dark blue markers indicate an existing plant and light blue a planned facility.

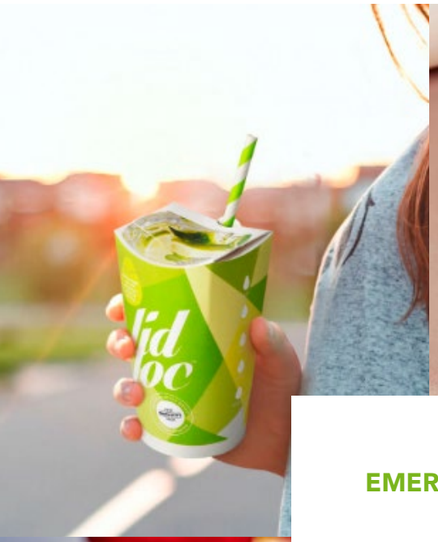
Map of biorefineries in Europe – CAT 2 (paper mill based biorefineries)

Dark orange markers indicate an existing plant and light orange a planned facility.

Map of biorefineries in Europe – CAT 3 (Biorefineries based on new processes)

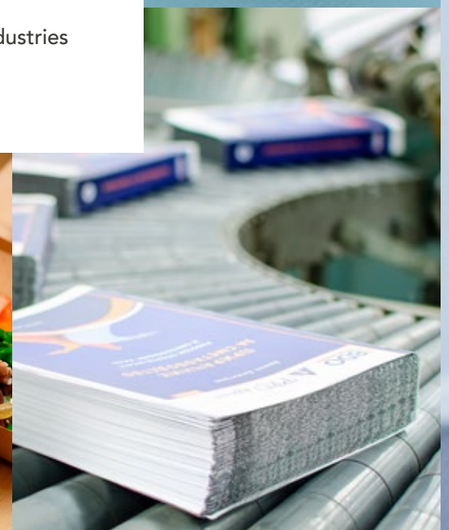


Dark green markers indicate an existing plant and light green a planned facility.



EMERGING BIO-PRODUCTS

- Aviation
- Civil construction
- Printing & publishing
- Packaging
- Food
- Automotive and batteries
- Cosmetics & personal hygiene
- Electronics
- Pharmaceutical & medical
- Furniture
- Chemicals
- Textile
- Energy
- Various industries



CONCLUSIONS - FUTURE OF OUR INDUSTRY

The current value of new bio-based products represents already almost **3%** of the total industry value, as represented by Cepi. This percentage is growing rapidly, becoming a major contributor to the sectors' 2050 target of **50%** more added value.

Currently, the largest share of bio-based products is related to materials. Out of materials, man-made fibres are among the largest in the sector. The global **textile** market is over **100 million** tons with just **6%** being based on man-made cellulosic fibres. It is expected that man-made cellulosic fibres' share will increase during the vision 2050 time period. In order to realize this, more and more traditional kraft mills will be converted to produce dissolving pulp.

In the near future there will be several **biofuel** production investments. Parts are based on crude tall oil as a feedstock, though tall oil availability will become limited, as it will also be exploited for use in other biobased products.

Another route to produce biofuels is the use of residuals and other side-streams as a feedstock. For example via the utilization of lignin from the black liquor from kraft mills to produce lignin oil. Biofuels may also be produced via fermentation of hydrolysed (hemi)celluloses, which normally leads to lower yields reducing profitability.

Biochemicals are an interesting market segment. At the moment a few companies are advancing in this field by announcing substantial investments. We will see more and similar types of announcements. The share of activities related to food and feed as well as pharmaceuticals and cosmetics is minor. Based on on-going R&D programs, we expect investments, in the material sector in particular, to grow. This sector concentrates most innovation programs, both in terms of the number and value of these programs.

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