



# INNOVATIVE BIO-BASED PRODUCTS FOR A CLEAN TRANSITION

A Cefi 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 products, other than pulp and paper. European pulp and paper companies are developing more and more businesses 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. This study carried by the nova Institute is an update on similar research carried in 2020 and published in 2021, and provides revised estimates about the number of wood-based biorefineries in Europe, investments, turnover, added value and jobs. It 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 and their comparative impact on carbon emissions. These insights emphasise the opportunity that exist in substituting fossil-based products with bio-based ones.

## 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.

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

- **Category 1:** Biorefineries based on chemical pulping operations to produce biobased products
- **Category 2:** Biorefineries using virgin pulp and/or paper for recycling to produce evolving bio-based products
- **Category 3:** Other biorefineries not related to pulp & paper manufacturing using lignocellulose as raw material to produce various existing or evolving biobased products

- **Category 4:** Category 1-3 refineries that implement Carbon Capture and Utilisation (CCU) technologies to capture and utilise biogenic carbon to produce bio-based products.

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

The study also provides a list of the main EU R&D projects and a Life Cycle Assessment (LCA) analysis comparing quantitatively the carbon emission potential and fossil resource use of several key bio-based products and by-products of the pulp and paper industry to their fossil counterparts.



### EMERGING BIO-PRODUCTS

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



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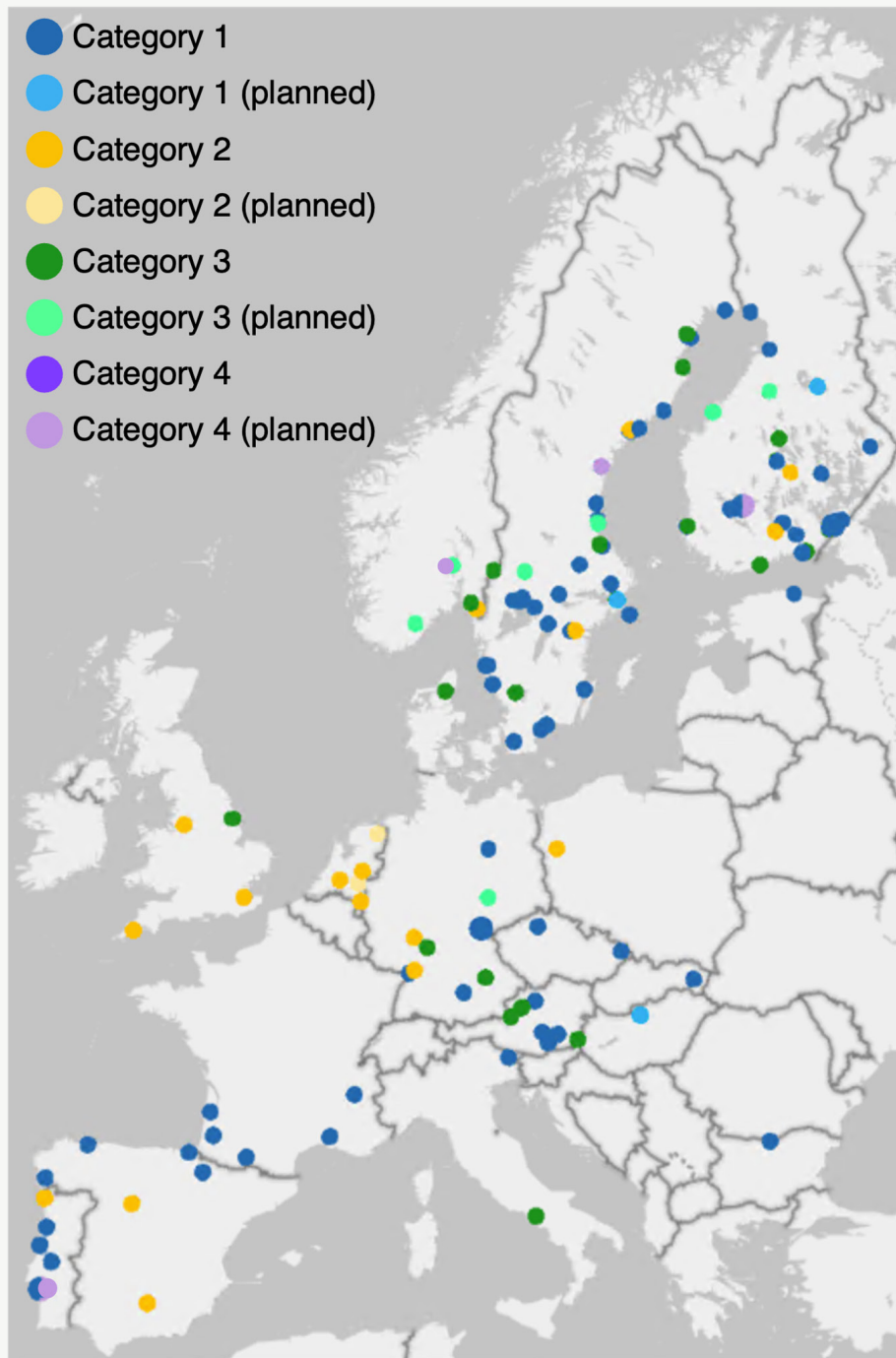
## KEY RESULTS

In the study, 143 biorefineries were identified, 126 operational and 17 planned, in line with the results of the first study in 2021. Most of them are based on chemical pulping (67%). The biggest number of the biorefineries are in Sweden, Finland, Germany, Portugal and Austria. But there are already biorefineries - either operational or planned - in 18 different European countries.

41% of the planned biorefineries are new types of biorefineries (other than chemical pulping based or paper production based). This percentage is growing substantially. The most common bio-based products are man-made fibres, electricity and district heat, fuels - including for sustainable aviation, lignin, and tall oil products.

The turnover generated by these new products has more than doubled since 2021, raising to €6 billion, which corresponds to 6% of European pulp and paper industry sector turnover as a whole. Based on investment plans and R&D programmes it is justified to expect the share of emerging bio-based products to be substantially larger in the future.

## COUNTRY OVERVIEW



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

Blue are Category 1- Chemical pulping based biorefineries. Yellow are Category 2 - Paper mill based biorefineries. Green are Category 3 - Biorefineries based on new processes. Purple are Category 4 - Biorefineries implementing CCU.

## THE SUBSTITUTION EFFECT:

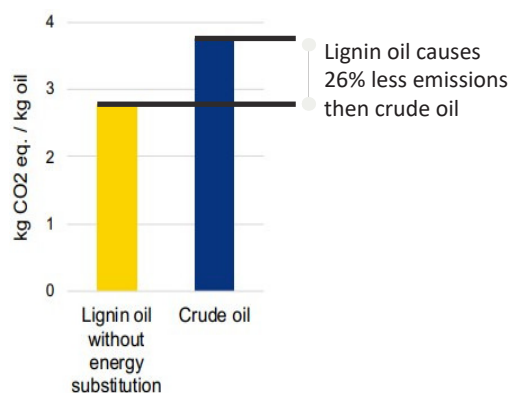
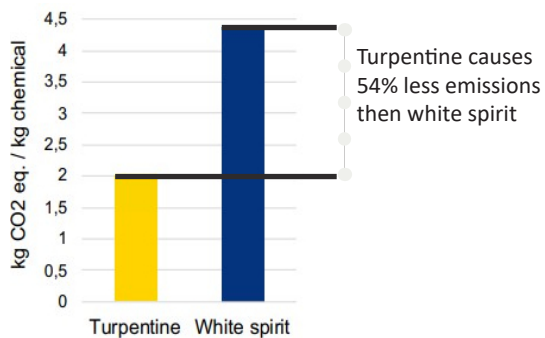
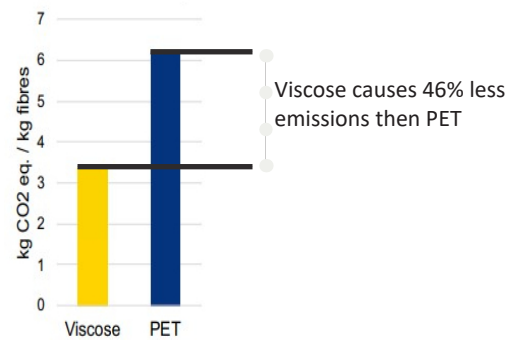
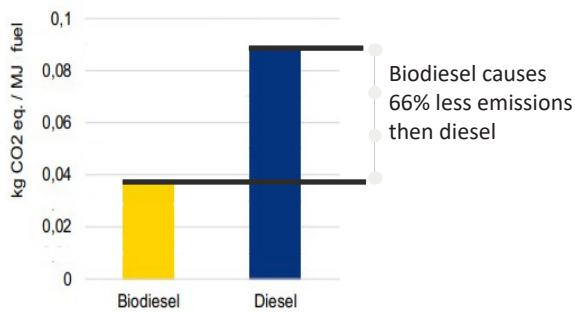
### Cradle-to-grave results of the impact category Climate change

Four value chains were selected for observation on potential substitution effects:

1. Biodiesel vs. diesel
2. Viscose vs. fossil polyester fibres
3. Turpentine vs. white spirit
4. Lignin oil vs. crude oil

The total operational production of biodiesel, MMCF, turpentine, and lignin oil (1.4 Mt/a) corresponds to a substitution potential of 3.1 Mt CO<sub>2</sub> eq. The substitution potential is expected to be significantly higher if all other identified bio-based products would be considered, that are currently produced with a total capacity of 3.0 Mt/a.

Considering all planned biorefineries an additional production capacity of 0.5 Mt/a is expected for biodiesel, MMCF, turpentine, and lignin oil which corresponds to a substitution potential of 0.8 Mt CO<sub>2</sub> eq.. Again, the substitution potential is expected to be significantly higher if all remaining identified biobased products would be considered, that are also intended to be produced with a capacity of 1.8 Mt/a.



## CONCLUSIONS

### WHAT THE BIOECONOMY CAN OFFER

The current value of new bio-based products represents already almost **6%** of the total industry value, as represented by Cepi. This percentage is growing rapidly.

The study found that an **annual growth of up to 5%** for the biorefinery sector could be anticipated until 2050. A reasonable assumption when considering the number of investment plans reviewed in the study. By mid-century, the development of biorefineries could also add nearly **20.000 new jobs**.

These new ventures do not come as a replacement for traditional pulp and paper-making activities, but rather as a complement as they mobilise resources that would previously not be used commercially. They represent a way for companies in the sector willing to invest to develop new revenue streams while increasing efficient use of the resource.

This will have an impact on the EU's capacity to reach its climate targets. The study quantifies an already effective '**substitution effect**' of over **3.1 megaton of CO<sub>2</sub>**, by which bio-based products are already manufactured to replace those by fossil-based industries, resulting in a significantly lower impact on the climate.

The products of biorefineries are broadly green alternatives to what is currently mostly delivered by Europe's large petrochemical sector: materials, chemicals, fuels and energy, food and feed, pharmaceuticals and cosmetics. The demand for these products is ramping up, as many sectors, from aviation to fashion, are willing to pivot away from fossil-based feedstocks.

For Europe, biorefineries present a promising growth potential, as only new technologies can readily help European economy to grow. The bioeconomy, and in particular the pulp and paper industry biorefineries, are leading the way.

Biorefineries deserve a place of choice in an updated EU bioeconomy strategy.

