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PRESS RELEASE

Global Bio-Based Polymer Market to Grow 13% Annually Through 2029, Led by Asia and North America

New report reveals: Capacity expansions in Asia and North America drive growth – Europe continues to lag behind

Hürth, 18 March 2025: The new market and trend report "Bio-based Building Blocks and Polymers – Global Capacities, Production and Trends 2024–2029", written by the international biopolymer expert group of the nova-Institute, shows capacities and production data for 17 commercially available, bio-based polymers in the year 2024 and a forecast for 2029. The full report for € 3.000 and a free short version are now available here: https://renewable-carbon.eu/commercial-reports

Comprehensive Market Report on Bio-Based Polymers and Building Blocks

The just released, annually updated market report by nova-Institute includes the following features on 434 pages: Coverage of 17 bio-based building blocks and all 17 commercially available bio-based polymers, comprehensive information on the capacity development from 2018 to 2029, as well as production data for the years 2023 and 2024, per bio-based polymer and analyses of market developments and producers per building block and polymer, allowing readers to quickly gain an overview of developments that go far beyond capacity and production figures. In addition, the market study includes a statistical report on "Mass Balance and Attribution (MBA)" products available worldwide, based on an extensive analysis of the ISCC database, a detailed review of current European policy landscape for bio-based polymers, as well as a comprehensive summary of biodegradability and biodegradable polymers. This information is supported by 60 figures, 50 tables and 218 company profiles.

The data published annually by European Bioplastics and the data published by Plastics Europe for 2023 are taken from the market report published by the nova-Institute, but with a smaller or different selection of bio-based polymers, based on different scopes.

Strong Growth for Bio-Based Polymers until 2029

2024 was a respectable year for bio-based polymers, with an overall expected CAGR of 13 % to 2029. Overall, bio-based biodegradable polymers have large installed capacities with an expected CAGR of 17 % to 2029, but the current average capacity utilisation is moderate at 65 %. In contrast, bio-based non-biodegradable polymers have a much higher utilisation rate of 90 %, but will only grow by 10 % to 2029.

Epoxy resin and PUR production is growing moderately at 9 and 8 %, respectively, while PP and cyclic APC capacities are increasing by 30 %. Despite a decline in production of biodegradables, especially for PLA in Asia, capacities have increased by 40 %. The same applies to PHA capacities. Commercial newcomers such as casein polymers and PEF recorded a rise in production capacity and are expected to continue to grow significantly until 2029.

Additionally, the total production volume of bio-based polymers has been 4.2 million tonnes in 2024, which is 1 % of the total production volume of fossil-based polymers, and the CAGR of bio-based polymers is, with 13 %, significantly higher than the overall growth of polymers (2–3 %). This development is expected to continue until 2029 (Figure 1). With these growth rates, the share of bio-based polymers will increase up to 2 %.

Of the total 4.2 million tonnes of bio-based polymers produced in 2024, cellulose acetate (CA), with a bio-based content of 50 %, and epoxy resins, with a bio-based content of 45 %, account for more than half of the bio-based production, 26 % and 32 %, respectively. This is followed by 30 % bio-based polyurethanes (PUR) with 9 %, 100 % bio-based polylactic acid (PLA) with 8 %, polyamides (PA) (60 % bio-based content) with 7 % and polytrimethylene terephthalate (PTT) (31 % bio-based content) with 6 %. (Figure 2). The share of aliphatic polycarbonates (APC; circular and linear), poly(butylene adipate-co-terephthalate) (PBAT), polyethylene (PE), polyethylene terephthalate (PET), polyhydroxyalkanoates (PHA) and starch-containing polymer compounds (SCPC) was less than 5 %. Casein polymers (CP), ethylene propylene diene monomer rubber (EPDM), polybutylene succinate (PBS), polyethylene furanoate (PEF) and polypropylene (PP) accounted for less than 1 % of the total bio-based polymer production volume and are not shown.

The increase in production capacity from 2023 to 2024 is mainly due to the expansion of PLA capacity and epoxy resin production in Asia, as well as a global increase in PUR production. Also, Asian expansions for PHA and PTT were already included in the report from 2024. PP, PHA and PEF are particularly expected to grow continuously by 65 % on average until 2029. While PHA capacities will increase mainly in Asia and PEF in Asia and in Europe, PP capacities will increase mainly in North America.

Demand for Bio-based Feedstock and Land Use

Considering the steadily increasing demand for bio-based polymers, the need for biomass feedstocks should be considered as an important factor. This is particularly true for the recurring debate on the use of food crops for the production of bio-based polymer. The total demand for biomass was 13.6 billion tonnes for feed, bioenergy, food, material use, biofuels as well as bio-based polymers. While the majority of biomass (56%) is used for feed production, only 0.023% is required for the production of bio-based polymers (Figure 3). This results in a biomass feedstock demand of 3.2 million tonnes for the production of 4.2 million tonnes of bio-based polymers and reflects a land use share of only 0.013%. This is due to the fact that the main feedstocks used in the production of bio-based polymers are sugars (25%) and starch (20%), which are obtained from high-yield crops such as sugar cane and maize, resulting in a high area efficiency.

In addition, the protein content of these crops is used not only for polymer production but also for animal feed, so only the corresponding part is allocated to polymer production. Glycerol (31 %), a biogenic by-product of biodiesel production, is a biomass with only an indirect, passive land use. This glycerol is mainly used in the production of epoxy resins via epichlorohydrin as an intermediate. The biomass used also included 12 % from non-edible plant oils, such as castor oil, 9 % from cellulose (mainly used for CA) and 3 % from edible plant oil. Of the 4.2 million tonnes of bio-based polymers produced (fully and partially bio-based) 2.2 million tonnes were actual bio-based components of the polymers (52 %), meaning that almost 1.6 times more feedstock was required than was actually incorporated into the final product. The 1.4 million tonnes (36 %) of feedstock that did not end up in the product is due to the high number of conversion steps and the associated losses of feedstock and intermediates, as well as the formation of by-products.

Global Shift to Renewable Carbon Needed to Handle Regional Challenges for Bio-Based Polymers

The key market drivers in 2024 are several global brands that have adapted their strategic agendas to transition the polymers, plastics and chemicals industry to become sustainable, climate-friendly and part of the circular economy, thus offering their customers green solutions and alternatives to petrochemical products. The only way to achieve this successful transition is to fully replace fossil carbon with renewable carbon from alternative sources: biomass, CO_2 and recycling (www.renewable-carbon.eu). By expanding their feedstock portfolio to include renewable carbon in addition to fossil-based carbon, these brands are leading the way from a market perspective. In particular, the use of biomass has increased and will continue to increase the supply of bio-based polymers.

Nevertheless, the market remains challenging, especially in Europe. While Asia and North America will continue to strengthen their global role in the supply of bio-based polymers, Europe's market share is expected to decline by 2029. With new investments in several large-scale bio-based polymer production capacities, Asia and North America will increase their market share by 4 % and 5 %, respectively, and together they will account for more than 80 % of the global supply of bio-based polymers. Although some new large-scale plants are also planned in Europe, this will not be enough to prevent Europe's market share from falling from 13 % today to 10 % in 2029. Although, the European policy landscape for bio-based polymers is constantly evolving, it does so not yet provide a consistent policy framework that sufficiently incentivises the benefits, properties and applications of bio-based polymers – unlike other regions of the world.

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Bio-based Polymers – The Highlights

The global polymer market includes functional and structural polymers, rubber products as well as man-made fibres (Figure 4). This report focuses on the bio-based share of the structural polymers. Bio-based structural polymers are composed of the polymers that will later form the structural mass of the finished plastic part, which is covered in detail in this report and the bio-based linoleum part. Together, they total 4.3 million tonnes. On the other hand, the total amount of bio-based functional polymers consists of bio-based functional polymers and paper starch, giving 13.7 million tonnes. In addition to these two groups, which account for 18 million tonnes of bio-based functional and structural polymers, rubber products and man-made fibres can also be bio-based. In total, 15 million tonnes of rubber products and 7.8 million tonnes of man-made fibres are made from bio-based resources, 51 % and 9 %, respectively.

All (semi-) commercial pathways from biomass via different intermediates and building blocks to bio-based polymers are shown in Figure 5. Bio-based building blocks and polymers are analysed in detail within the report and highlighted in bold.

The different pathways of bio-based “drop-in”, “smart drop-in” and “dedicated” inputs within the chemical production chain are shown in Figure 6. For each group, certain bio-based polymers are presented as examples. In addition, biodegradable bio-based polymers are highlighted with a green dot. The different groups of bio-based polymers are subject to different market dynamics. While drop-ins have direct fossil-based counterparts and can replace them, the dedicated ones have new properties and functionalities that are not available from petrochemicals. Both have their own advantages and disadvantages from a production and market perspective. While bio-based drop-in chemicals are bio-based versions of existing petrochemicals that have established markets and are chemically identical to existing fossil-based chemicals, smart drop-in chemicals are a special sub-group of drop-in chemicals. Although they are chemically identical to existing chemicals based on fossil hydrocarbons, their bio-based pathways offer significant process advantages over conventional pathways. In addition, these bio-based pathways can be based on completely new approaches, such as epichlorohydrin, where the fossil feedstock propylene is not replaced by bio-based propylene but by glycerol from biodiesel production. Dedicated bio-based chemicals are chemicals that are commercially produced via a dedicated pathway and do not have an identical fossil-based counterpart.

The results of the report and the development of capacities from 2018 to 2029 based on forecasts from current and some new producers are shown in Figure 7. Total installed capacity in 2024 was 5.2 million tonnes with an actual production of 4.2 million tonnes. Capacity is expected to increase to 9.5 million tonnes in 2029, indicating an average compound annual growth rate (CAGR) of around 13 %. The following polymers show an even higher increase, well above the average growth rate: PP, PHAs and PEF are expected to grow continuously by an average of 65 % until 2029.

Global Production Capacities of Bio-based Polymers by Region

Asia as the leading region in 2024, has the largest installed bio-based production capacities worldwide with 59 %, with the largest capacities for PLA and PA. North America had 16 %, with large installed capacities for PLA and PTT and Europe had 13 %, mainly based on installed capacities for SCPC and PA. South America had a share of 11 % with major installations for PE and Australia / Oceania less than 1 % of was based on SCPC (Figure 8). With an expected CAGR of 25 % between 2024 and 2029, North America has the highest growth in bio-based polymer capacities compared to other regions of the world. This increase is mainly due to expanded and new production capacities for PHA and PP.

Market Segments for Bio-based Polymers

Today, bio-based polymers can be used in almost all market segments and applications, but the different applications per polymer can be very different. Figure 9 shows a summary of the applications for all bio-based polymers covered in the report. In 2024 fibres including woven, non-woven (mainly CA and PTT) had the highest share with 27 %. Packaging, flexible and rigid, had a total share of 23 %, followed by functional applications with 16 % (mainly epoxy resins and PUR), consumer goods with 10 % (mainly epoxy resins, PLA and PA) and automotive and transport with 9 % (mainly PUR, PA and epoxy resins). Building and construction accounted for 5 % (mainly epoxy resins and PUR) and electrics and electronics for 4 % (mainly epoxy resins and PA). The market segments agri- and horticulture and others had a market share of 3 % and 2 %, respectively.

Bio-based and Non-biodegradable Polymers and Biodegradable Polymers

Bio-based non-biodegradable polymers show a CAGR of 10 % to 2029 (Figure 10). The highest growth is expected for PP and PEF, followed by PE. Despite a current moderate average utilisation rate of 65 %, bio-based biodegradable polymers show a high growth of 16 % to 2029 (Figure 11). This is mainly due to high growth rates for PHA, PLA and casein polymers. The biodegradability of polymers is completely independent of the resource from which the polymer is made, so being bio-based does not necessarily mean that certain polymers are biodegradable. PBS and copolymers such as poly(butylene succinate-co-butylene adipate) (PBSA) are both industrial compostable, but only PBSA biodegrades also under home composting conditions and in soil, according to the conditions defined in the established standards and certification schemes. The same applies to PBAT, which is industrial compostable and, for certain grades, also home compostable and biodegradable in soil. This biodegradability applies to both bio-based and fossil-based PBS and PBAT. As this report focuses on bio-based polymers, the development of fossil-based PBS and PBAT, although biodegradable, is not shown in detail here. However, fossil-based PBS and PBAT production capacities, mainly in Asia, were at 3 million tonnes in 2024, with an assumed actual production of around 600,000 tonnes. Until 2029 fossil-based PBS and PBAT production capacities are not expected to increase significantly, with a CAGR of 1 %.

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nova-Institut GmbH has been working in the field of sustainability since the mid-1990s and focuses today primarily on the topic of renewable carbon cycles (recycling, bioeconomy and CO_2 utilisation/ CCU).

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