

SPOTLIGHT

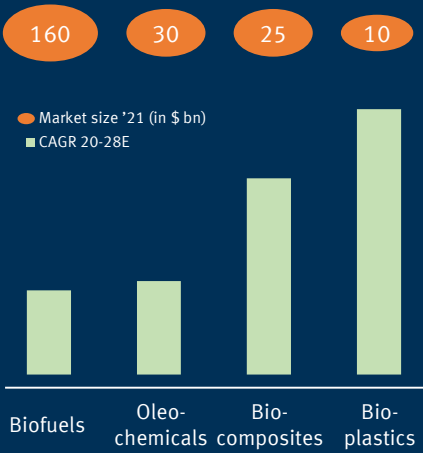
Plant Based Plastics – what's next?

- Sector overview
- Key Trends
- Deal Activity

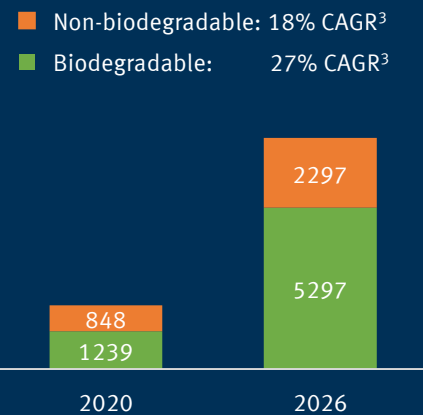




Key bio-based materials¹



Global capacity (kt) of bioplastics²



Stifel chemicals team members have deep knowledge of the bio-based materials market.



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Introduction

The use of bio-based plastics is not new; the panels of the Henry Ford's first cars were made of them, but the idea was discarded in favor of lost cost fossil based products.

However, over the years there has been steady progress across various use cases, with bio-fuels becoming more mainstream (with a market size of c.\$150bn in FY21¹)

With significant recent increase in consumer awareness about sustainability and climate change as well as tightening of regulations, bio-materials are poised to rapidly grow on the back of demand as well as investor appetite.

Bioplastics, (a c.\$10bn¹ market comprising diverse materials and a spectrum of uses) is one such key segment.

It is expected to grow at a CAGR of c.17%¹ with the bio-degradable⁴ plastics growing much faster.

Landscape

Bio-plastics are broadly categorized as biodegradable (PEF, PLA etc.) and non-biodegrade-able (PE, PP PET etc.).

The initial progress was in established polymers e.g. PE. Braskem set up first renewable based PE plant in 2010 for \$290m. Now it has c. 5% of its total PE production of 4 mtpa via sugarcane.

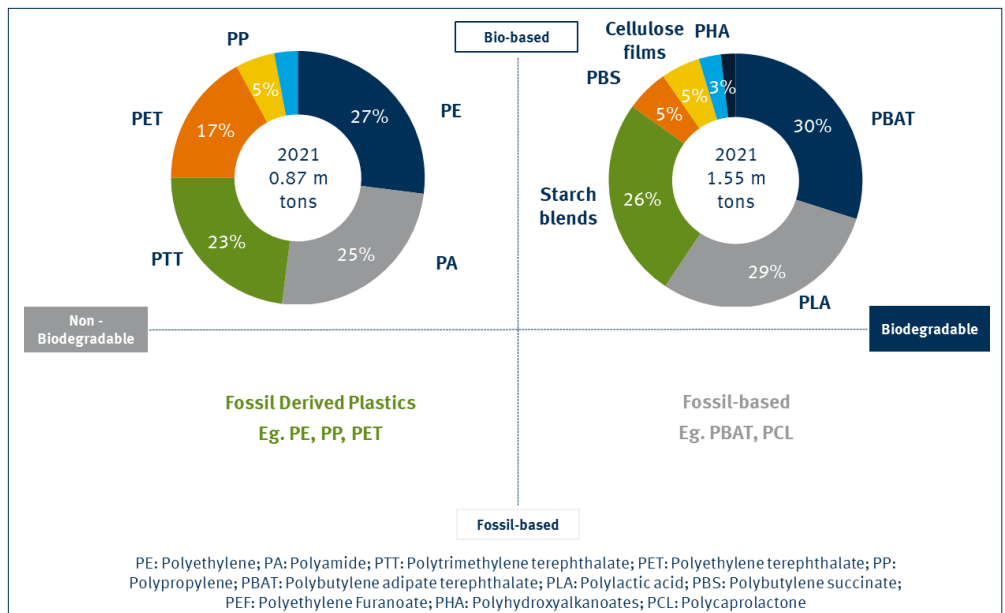
Subsequently, a number of players started focusing on different polymers, particularly those which are bio-degradable.



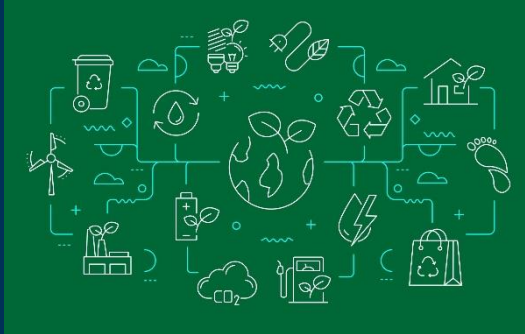
In 2016, Novamont set up butane-diol plant in Italy based on direct fermentation of sugar for c.€100m.

Over the years it has set up (and expanded) its bio-plastics and bio-polyester plants (based on bio-based butane-diol), including converting a former PET plant

Global bioplastic market by type²

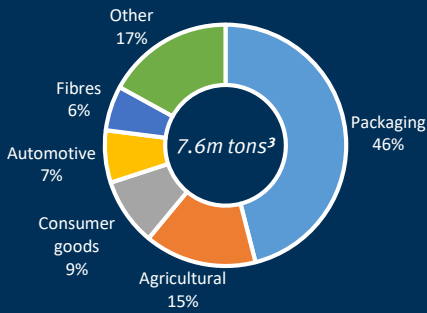


Source: Publicly available company data
 1) Stifel view based on various research reports; 2) Source: European Bioplastics website 3) 20-26E 4) Naturally decomposed, though timeframe and conditions required may be very different for different materials



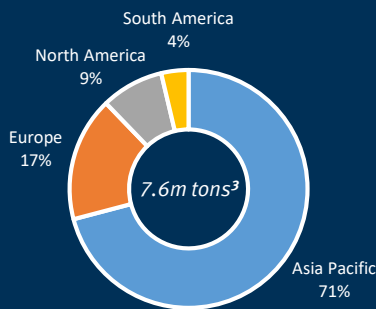
The industry continues to explore bio-plastics as well as raw material sources beyond the established materials driven by the evolving end use requirements, legislation, costs and performance

2026E Production Capacity by end-market³



Asia currently has the majority share of bio-plastics capacity (led by China), and would continue to do so, however significant capacities are planned in Europe and the US

2026E Production Capacity by region³



The majority of bio-plastics are based on sugars or alcohols. Some are established plastics e.g. PBAT, PLA and starch blends while others, such as PEF are in the pilot stage and are expected to have superior properties.

The companies are exploring a range of raw material sources including starch and sugar containing plants, such as corn or sugar cane as well as other innovative approaches based on seaweed or cellulose diacetate.



avantium

Avantium begun construction on a PEF project based on MEG and FDCA from sugar beets in 2022

- ✓ Superior barrier properties for gases compared with PET
- ✓ 100% bio-based
- ✓ Single step process for MEG



Notpla

Notpla has developed bioplastics based on seaweed

- ✓ Seaweed, abundant and fast growing does not compete with food crops for land and doesn't need fertilizers/ fresh water
- ✓ Fast decomposition- < 6 weeks

Some of the key players (outside of China), including their products and capacities, are outlined in the table below:

Company	Key raw materials	Bioplastic	Capacity (ktpa)
Avantium	Sugar beet	PEF	Pilot
BASF	Corn	PBAT, PLA	74
Braskem	Sugar cane	PE	200
Total Corbion	Sugar cane	PLA	100
Novamont	Sugar	PE	100
NatureWorks	Corn, sugar cane & beets	PLA	150
Nurel	Corn	PLA	26

Significant capacities are planned by established players like Corbion (second PLA plant for €200 million), Novamont etc. as well as early stage companies e.g. Orion, Avantium etc.

Further, the incumbent oil and petrochemical companies have been partnering with bio-materials focussed companies and start-ups to develop new projects

- In 2011, PTT paid \$150 million for a 50% stake in NatureWorks
- TotalEnergies and Corbion entered into a joint venture to produce PLA in 2017

Company	Project location	Product	Project completion year	Capacity (ktpa)	Capex (\$ m)
Origin	TBD	Multiple products ¹	2027+	5,596	811
Corbion/Total	France	PLA	2024	100	228
NatureWorks	Thailand	PLA	2024	75	600
Zhejiang Hisun Biomaterials Co.	China	PLA	2024	150	-
Danimer Scientific (Bainbridge Site)	USA	PLA, other-biopolymers	2023	113	700
Braskem	Brazil	PE	2022	60	61
Novomer (Acquired by Danimer Scientific)	USA	PHA	2022	80	-
IMDT Co. ²	China	BDO / PBAT	2022	500 / 120	565

Source: Publicly available company data;
 1) Proposed Origin product portfolio includes PET, PET/F, PEF, CMF, FDCA
 2) Inner Mongolia Dongyuan Technology Co
 3) European Bioplastics website



The incumbent oil and petrochemical companies have been partnering with bio-materials focussed companies and start-ups to develop new projects

Key drivers of the industry are evolving government regulations as well as companies setting robust targets to meet the demands of an increasingly aware customer base

Given the relatively early stage of the sector, the key value drivers of a company are its technology, product focus and project delivery abilities

- BASF established a JV with Avantium in 2016 for setting up a 50ktpa FDCA plant
- Lyondellbasell's and Borealis use bio-propane sourced from Neste to produce PP

Key drivers

One of the key drivers for this growth is the evolving government regulations around the world; particularly those relating to packaging, disposal of waste and recycling

- Ban of non-biodegradable disposable plastic cutlery and plastic bags in several countries
- Potential laws to shift the recycling and disposal costs for non-biodegradable packaging to the manufacturers
- Ban of import and export of plastic waste
- Potential health protection requirements which may limit use of recycling of current plastics in certain applications e.g. toys

Further companies setting robust targets to meet the demands of increasingly aware customers about sustainability e.g.

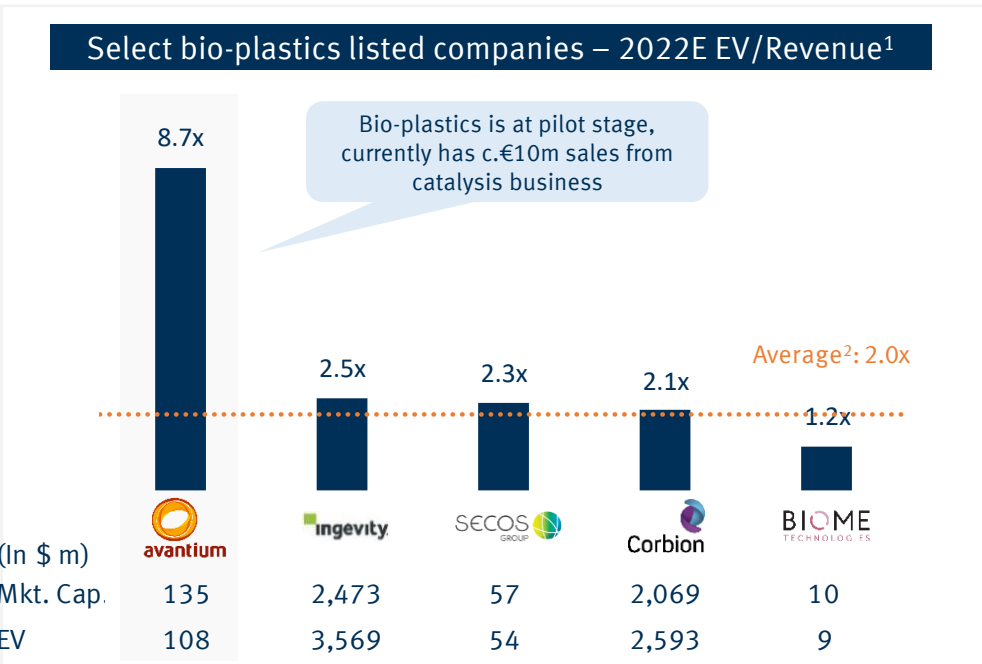
- Brand owners (Unilever, Henkel) are trying to use 100% recyclable or renewable packaging
- Lego to replace fossil fuel PE with bio-PE by 2030 and announced a \$400m budget in 2020
- Croda announced that by 2030, over 75% of their raw materials by weight will be bio-based

Valuation

Given the relatively early stage of the sector, the key value drivers of a company are its technology, product focus and project delivery capabilities.

Among the number of listed companies in the bio-plastics space only a few generate / are forecast to generate revenues in the immediate future.

Such companies trade at an EV/ Revenue multiple of c.2x



Source: Publicly available company data;
 1) As of 10th May 2022 from Cap IQ
 2) Excluding Avantium from the average calculation



There is significant appetite both for strategic transactions by the industry players as well for equity investments by institutional and retail players

Key Transactions in the Sector in 2021



There is significant appetite both for strategic transactions by the industry players.

Key drivers are access to/ enhancing

- Distribution
- Technology
- Lower cost production
- ESG credentials

There is also significant appetite for equity investments by institutional and retail players (as demonstrated by success of SPACs)

- In 2021, Avantium secured €130m in equity and debt for its new PEF plant, and €45m in 2022 to develop and scale
- Danimer Scientific and Origin raised c. \$1.3bn via SPACs (details below) in 2020 / 2021

Illustrative SPAC transactions

	danimer scientific	ORIGIN
Overview	<ul style="list-style-type: none"> Founded in 2004 EV: \$0.44bn¹; MC: \$0.36bn¹ Develops, produces, and provides bioplastics Danimer has two U.S. locations; Georgia and Kentucky 	<ul style="list-style-type: none"> Founded in 2008 EV: \$0.37bn¹; MC: \$0.76bn¹ Converts bio-based carbon into useful materials Origin has two U.S. locations; Sacramento and Sarnia
IPO Date	30 th December 2020	25 th June 2021
SPAC Partner	Live Oak Acquisition Corp.	Artius Acquisition Inc.
Pro Forma Valuation	\$890m (equity value); \$525m (EV)	\$1,843m (equity value); \$999m (EV)
Funds Raised	\$410m (\$210m PIPE, \$200m public)	\$925m (\$200m PIPE, \$725m Artius cash in trust)
Transaction price benchmarking (by the company)	2022E EV/Revenue 2.5x ²	2021E EV/Revenue 7.8x ³
	2022E EV/EBITDA 15.0x ²	2021E EV/EBITDA 18.2x ³

Source: Publicly available company data;
 1) Capital IQ as of 11th May 22
 2) Danimer management includes: Novozymes, Croda, Vow, Corbion, GFL, Xectec, US Ecology
 3) Origin management includes: Danimer Scientific, Codexis, Avantium, Lonza, Corbion



We have an experienced dedicated chemicals investment banking team with coverage over key regions supported by strong product teams globally

The Global Chemicals Team at Stifel has successfully closed 30 transactions since 2018¹

Core Global Chemicals Team



Aamit Joshi
Managing Director
London



Global Co-Head of Chemicals

- c.20 years of helping global companies achieve their strategic initiatives via acquisitions, divestments & private equity fund raises
- Relationships with global and mid-market chemicals firms across Europe, North America and Asia



Dr. Bernd Schneider
Managing Director
Frankfurt



Global Co-Head of Chemicals

- Over 20 years of professional experience in mergers and acquisitions, corporate finance and business development
- Involved in over 50 transactions within the chemicals industry with a majority being cross-border transactions



Amitabh Ghule
Senior VP
London



Global Deal execution leader

- Nearly 20 years of investing, M&A, fundraising and consulting experience
- Advised major oil, petrochemicals and mining companies on a range of cross border transactions globally
- Operational experience in petchem



Atul Sehgal
VP
London



Global Deal execution leader

- Nearly 10 years of experience in chemicals investment banking
- Led and executed major chemical deals in the AIPAC region



Daniel Reynolds
Analyst
London



Lukas Holz
Analyst
Frankfurt



Michael Zero
Analyst
London



Stifel Global Locations



(1) Includes deals executed by Stifel Chemicals Team members as part of prior employer



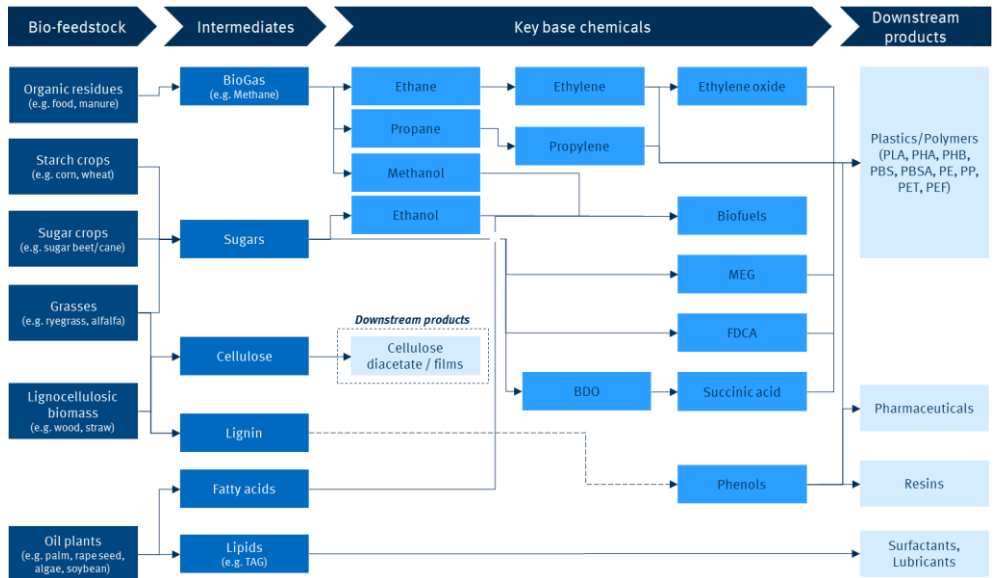
Appendix – Bio-based materials overview

What are bio-based materials?

A bio-based material is a product composed primarily of one or more substances produced from renewable biomass.

How are bio-based materials produced?

Mainly, bio-based materials are derived from raw materials such as plants and other renewable agricultural, marine and forestry materials such as corn, algae and wood. The processes vary from biological processes such as fermentation to common chemical reactions such as hydrolysis.



Biodegradable vs. non-biodegradable

A distinction is made between biodegradable and non-biodegradable. For the latter, plastics are not decomposed by nature. However, the term biodegradability does not provide any statements about the time frame of degradation.

Biodegradable vs. compostable

Manufacturers also distinguish between biodegradable and compostable. Both terms describe that the material is decomposed under certain conditions by nature. In contrast to the biodegradable designation, a clear time period is defined for compostable: Biodegradation within 180 days according to ASTM D6400.



Appendix – Selected privately owned companies



Headquarters:
Emmerich am Rhein (Germany)
Ownership:
Sphere S.A
Description:
Biotec produces biodegradable bioplastics made from plant-based renewable resources such as potatoes. Its usage range stretches from refuse and shopper bags to pharmaceutical capsules.



Headquarters:
Nagoya (Aichi, Japan)
Ownership:
Family owned business
Description:
Futamura manufactures flexible, compostable cellulose films derived from wood pulp. It can be used for food packaging such as twist-wrapped confectionery or for technical applications such as adhesive tapes.



Headquarters:
Minnetonka (Minnesota, USA)
Ownership:
Cargill, PTT Global Chemical
Description:
NatureWorks produces PLA based on sugar containing plants such as corn, cassava, sugar cane or beets. Its biopolymer can be used for a broad range of applications including 3D printing, construction, food packaging and electronics.



Headquarters:
London (UK)
Investors:
Sky Ocean Ventures, Climate KIC
Description:
Notpla produces and offers packaging solutions made from seaweed. It offers single-use plastic that naturally biodegrades in 4 to 6 weeks as well as edible and fully biodegradable sachets.



Headquarters:
Novara (Italy)
Ownership:
Investitori Associati, BCI
Description:
Novamont manufactures bio-based and biodegradable thermoplastic products based on renewable resources including vegetable oils and starch containing plants. It is mainly used for packaging.



Headquarters:
Barcelona (Spain)
Ownership:
Grupo Samca
Description:
Nurel manufactures compostable & biodegradable polymers called INZEA® based on renewable sources such as corn. It is mainly used for packaging.



Headquarters:
Lestrem (France)
Ownership:
Private
Description:
Roquette produces bio-based succinic acid which is a key intermediate for the production of polybutylene succinate (PBS).



Headquarters:
Figueira da Foz (Portugal)
Ownership:
United Group
Description:
United Biopolymers manufactures transparent, bio-based plastics that are mainly used for packaging and disposable plastic bags.

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