

The journey to renewable and circular plastics

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CPO Summit, 24-May-2023

Avantium at a glance: a leader in renewable chemistry

avantium



Who we are

A leader in the high-growth industry of renewable chemistry

Our mission

Commercialize disruptive technologies to accelerate the transition from fossil-based to renewable and circular plastics

Our ambition

Leading the transition to a fossil-free chemical industry by 2050

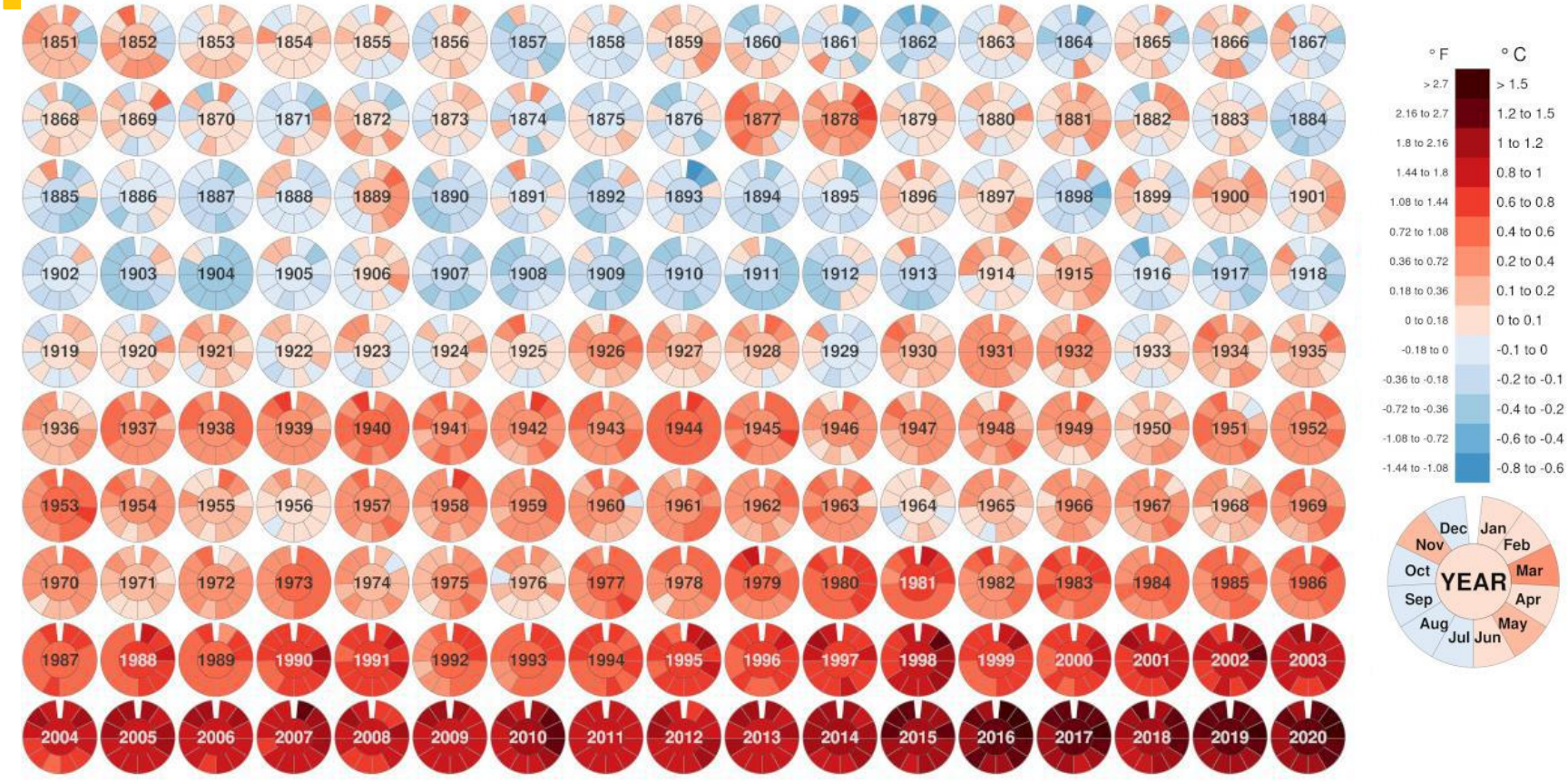



ALWAYS START with
WHY

Sense of urgency…

	1970	2021
Petroleum production(barrels/day)	50 million	95 million
Plastic production (ton/year)	50 million	370 million
CO_2 concentration (atmosphere)	325 ppm	417 ppm

Sense of urgency…









WFP

One third of all food produced globally goes to waste



While one in nine people goes to bed hungry every night

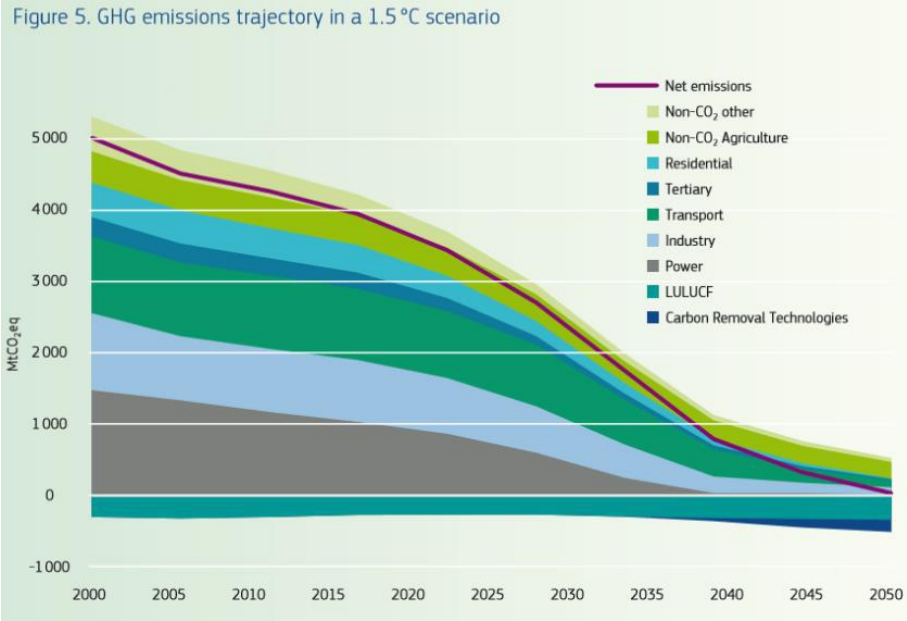
STOP THE WASTE
World Food Programme


NATIONAL GEOGRAPHIC
PLANET OR PLASTIC?
18 billion pounds of plastic ends up in the ocean each year. And that's just the tip of the iceberg.

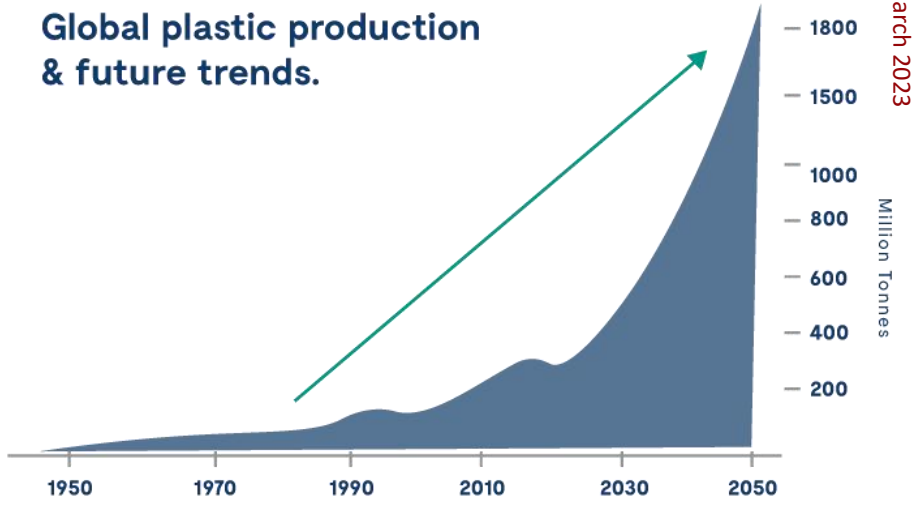




The Dilemma



Source:
European Commission, brochure on going climate-neutral by 2050 – a strategic long-term vision for a prosperous, modern, competitive and climate-neutral EU Economy (2018).



Source:
Ryan, A Brief History of Marine Litter Research in M. Bergmann, L, Gutow, M, Klages (Eds.), Marine Anthropogenic Litter, Berlin Springer, 2015; Plastic Europe.

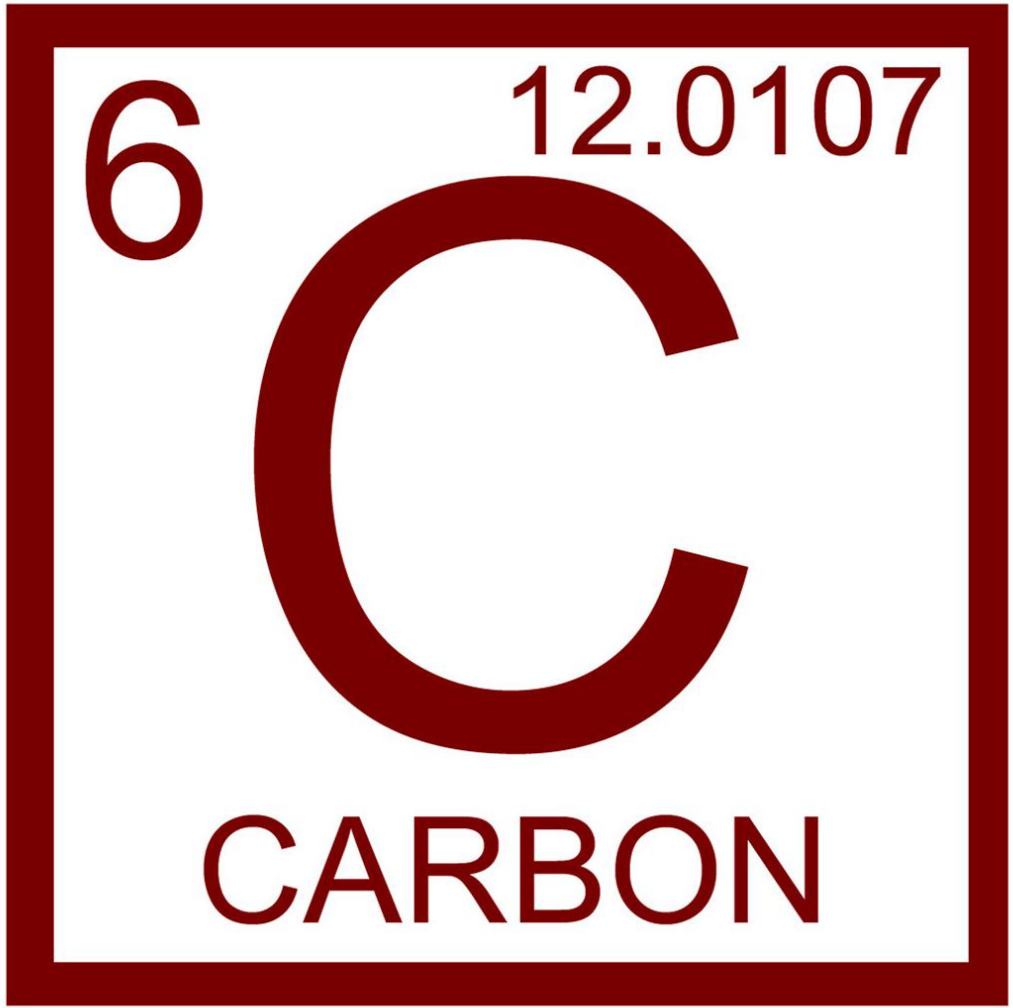
Chemical industry today and tomorrow

- Petrobased
- CO_2 intensive
- Linear

- Renewable
- Carbon neutral / negative
- Circular



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CARBON

The future of chemistry is above the ground

Plant-based carbon	Air-based carbon	Man-made carbon

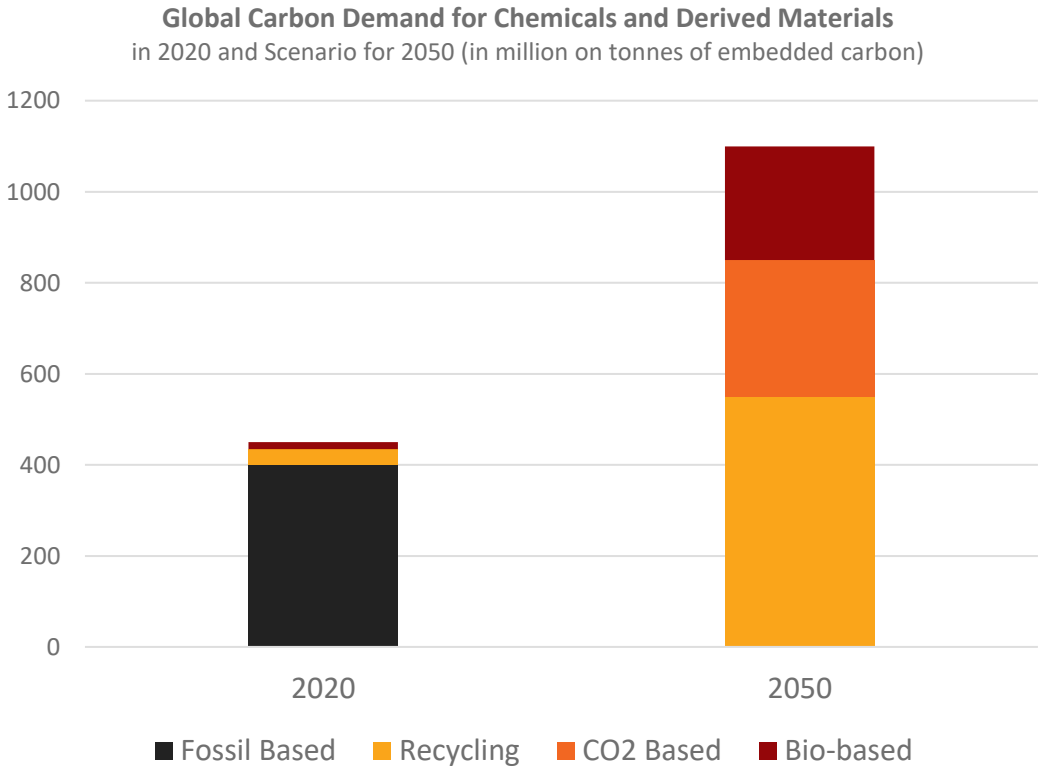






The three renewable carbon sources that enable a circular economy

Challenges cannot be solved by recycling only



Source: Nova Institute, 2020

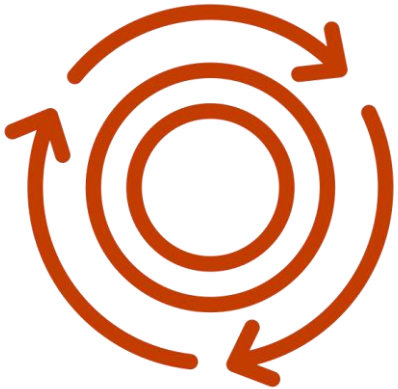
> America simply **does not have enough recycled PET** supply or processing capacity **to satisfy commitments being made by brand owners** to increase recaptured resin content in their bottles.
>
> *NAPCOR*[1]

> ***We won't recycle or dispose our way out of plastic pollution**… Future scenarios focused on collection, recycling, and disposal alone have been shown to fall short, with high ocean leakage and GHG emissions… **Upstream innovation offers opportunities** to rethink how products can be delivered to users without the need for single-use packaging.*
>
> *The global commitment 2021 Progress Report*
>
> ELLEN MACARTHUR FOUNDATION · UN environment

Note (1) National Association for PET Container Resources

The outlook of circular chemistry





Renewable feedstock

Circularity

Each biofeedstock has its pros and cons

- Availability
- Economics
- Sustainability
- Land use
- Public perception





PEF is a 100% plant-based plastic made from our two core products FDCA and plantMEG

Feedstock flexible

Unique technological platform centered around catalytic processing

Broad range of applications

Agri crops



Agri & forestry residue



Forest residues:
softwood and hardwood chips



Corn stover



Bagasse

Plant-based sugar



FDCA



plantMEG



PEF

Packaging



Film



Textile



Furniture | Textile | Automotive | Packaging | Solvent & Coolants

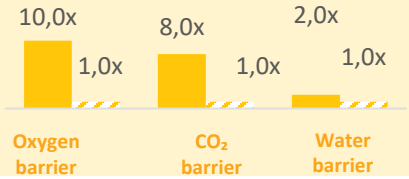


PEF's sustainability and performance profile resulting in strong commercial traction

Enhanced product properties

PEF PET

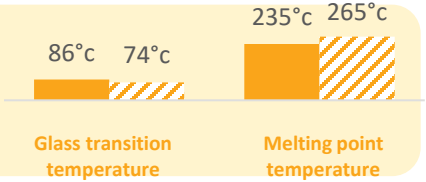
Strong gas barrier



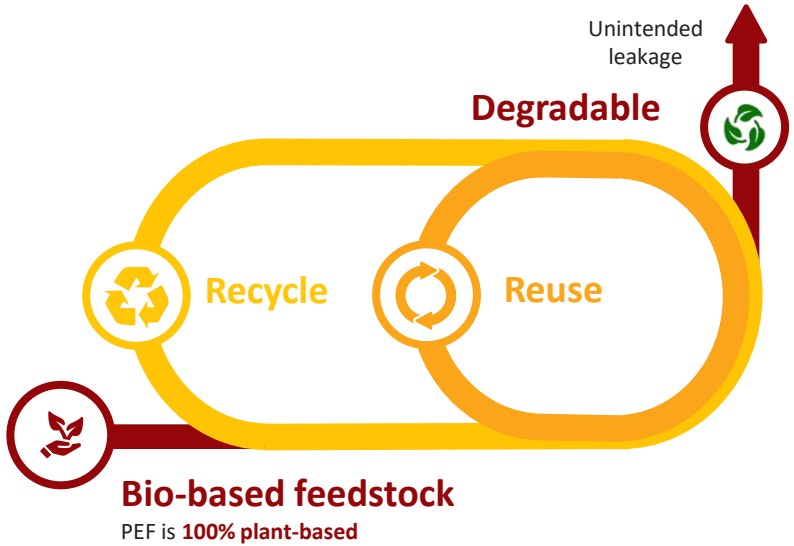
Lightweight

- Thinner applications
- Reducing weight by more than 20%

High heat resistance

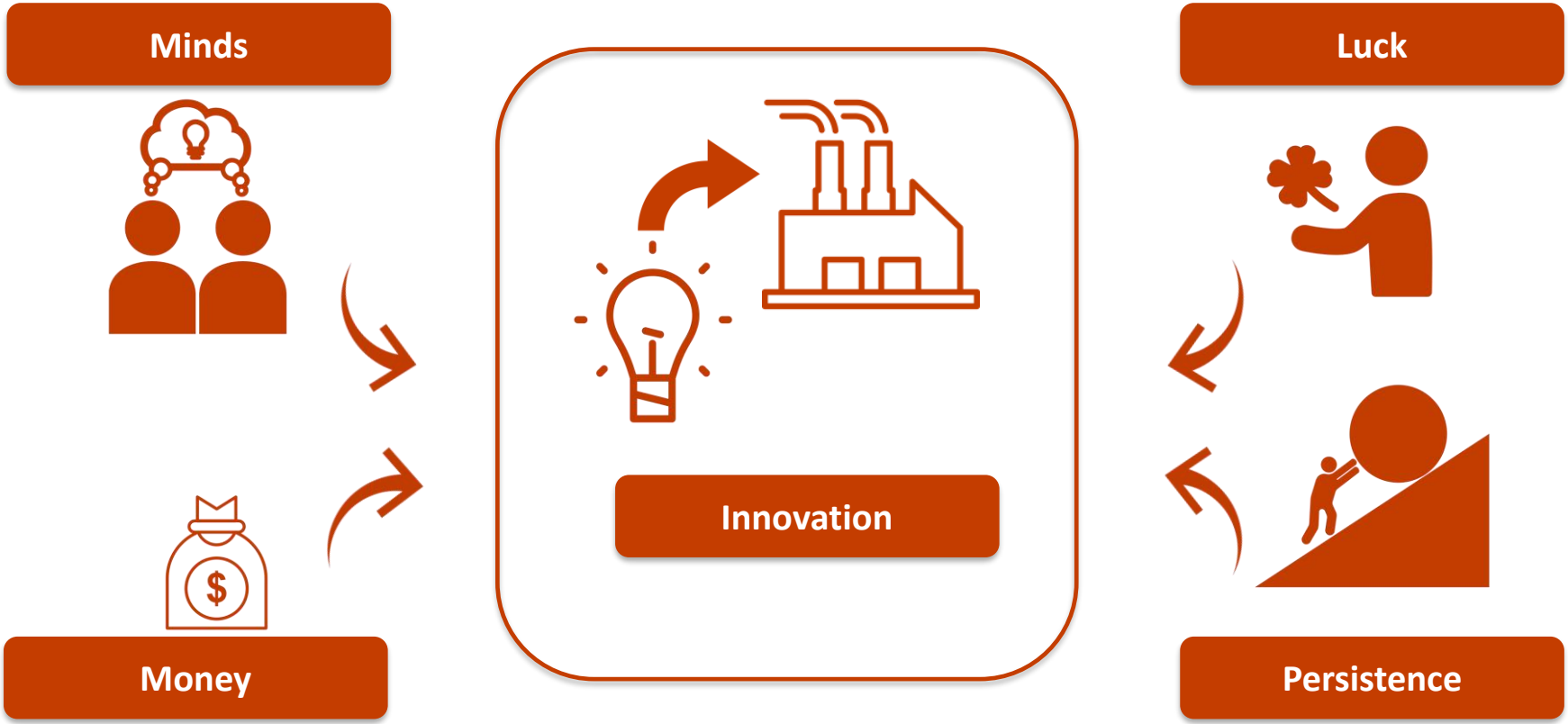


Food contact approval(1)



Note (1) In 2015, FDCA was adopted by the European Food Safety Authority (EFSA). In August 2016, FDCA was included in the Plastics Regulation as a food contact material. And in 2021, Avantium released PEF food contact grade, RP90Nx, that complies with the required regulations of food contact materials, which would allow the use of the PEF resin in direct contact with acetic foods and alcoholic drinks with an alcoholic strength less than 20% as well as with clear and cloudy drinks in the EU & UK.

Innovation drives sustainability transition



Sprint or marathon?





A new polymer from birth to adolescence to maturity



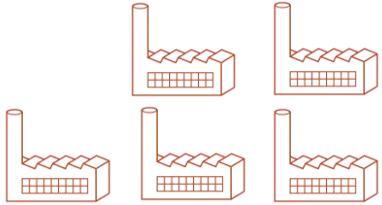
LABORATORY



DEMONSTRATION



FLAGSHIP PLANT



LICENSING

FDCA/PEF

- 2005
- Amsterdam
- Lab-scale samples

FDCA / PEF

- 2011
- Geleen
- Product samples (100 kg/ 1 ton)

FDCA/PEF

- 2024 startup
- Delfzijl
- 5 kta

FDCA / PEF

- On stream 27-29 (est.)
- Worldwide
- 100-300 kta

PlantMEG

- 2011
- Amsterdam
- Lab-scale samples

PlantMEG

- 2019
- Delfzijl
- 10 ton / year

Plant MEG

- 2027 (estimated)
- TBD
- > 100 kta

PlantMEG

- On stream 2029 (est)
- Worldwide
- >100 kta

2006: First FDCA experiment @Avantium

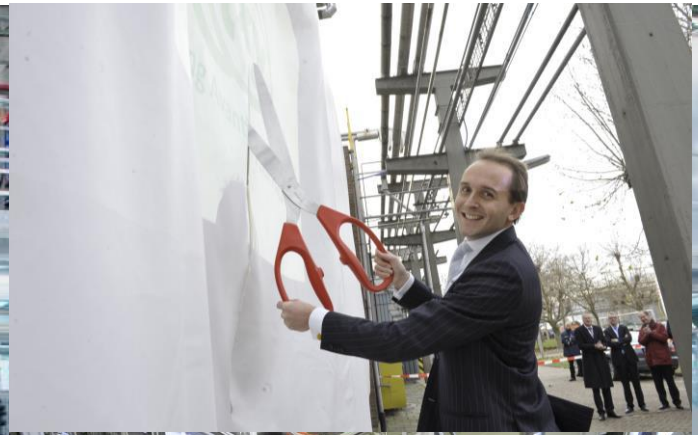


GERT-JAN GRUTER (AVANTIUM):

SLAPENDE REUS WAKKER GEMAAKT

Dit jaar start Avantium met de bouw van haar eerste commerciële fabriek. Vijftien jaar geleden werd het bedrijf opgezet als service provider voor de (petro)chemie en farmacie. Uiteindelijk ontwikkelde het bedrijf een eigen productieplatform voor FDCA, de biobased 'tegenhanger' van tereftaalzuur. 'We hebben een reus uit zijn winterslaap gehaald.'

2010: Opening FDCA pilot plant @Chemelot







Construction of FDCA Flagship Plant commenced in 2022

The world's first plant producing FDCA on a commercial scale (5 kiloton/yr)

Location:
Chemie Park Delfzijl (NL)

Progress:
- Construction halfway
- Start-up in 2024

Objective:
- Prove technology at 5 kta scale
- Sale of PEF & FDCA
- Unlock licensing business

Financing (EUR 150 mio):
Mix of equity, debt and grants







2023: Sale first technology license 100 kta FDCA plant



The future of our bottle is taking shape.



Look for the plantbottle™ logo on pack.
up to 30% plant-based
100% recyclable bottle

Off-take customers Avantium Flagship





















Fiber beer bottle: enabled by PEF



20-year journey to renew the polyester industry

