



# PEference

The Renewable Innovation

PEREFERENCE - FROM BIO-BASED FEEDSTOCKS VIA DI-ACIDS TO MULTIPLE  
ADVANCED BIO-BASED MATERIALS WITH A PREFERENCE FOR  
POLYETHYLENE FURANOATE

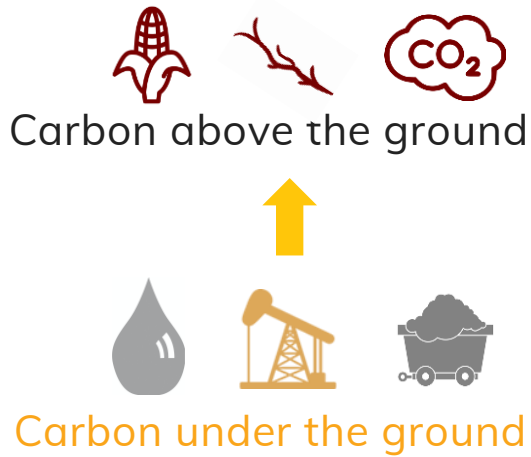
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ONLINE



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# Inevitable transition of the chemical industry



# Avantium's role in this transition

- Lead the transition of the chemical industry to renewable chemicals and polymers
- Develop breakthrough technologies to make sustainable, plant-based products that compete on performance and costs
- Commercialise these technologies in partnership with industrial companies





# Two renewable chemistry business units supported by an established catalysis R&D business

## Renewable Polymers

- Catalytic conversion of plant-based sugars into FDCA
- Polymerization from FDCA into PEF
- PEF: 100% plant-based & recyclable packaging material
- Addressing >\$200 billion markets (packaging, textiles, films)



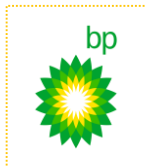
## Renewable Chemistries

- DAWN : industrial sugar from non-food biomass
- RAY: 1-step conversion to plant-based MEG
- Volta: CO<sub>2</sub> to chemicals via electrochemistry



## Catalysis

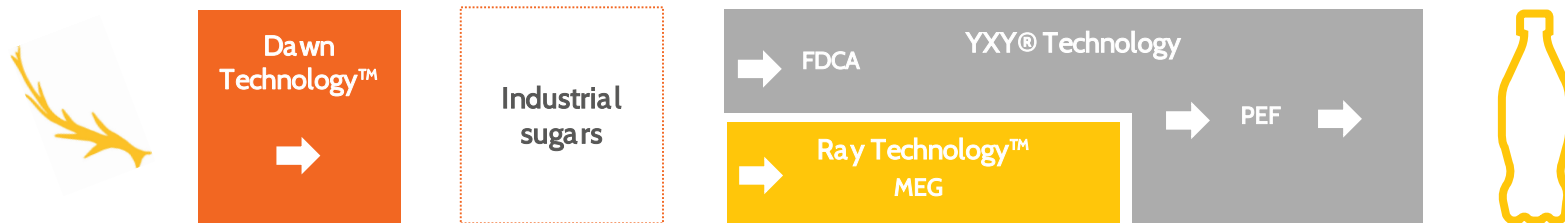
- Leading service and systems provider
- Blue chip clients



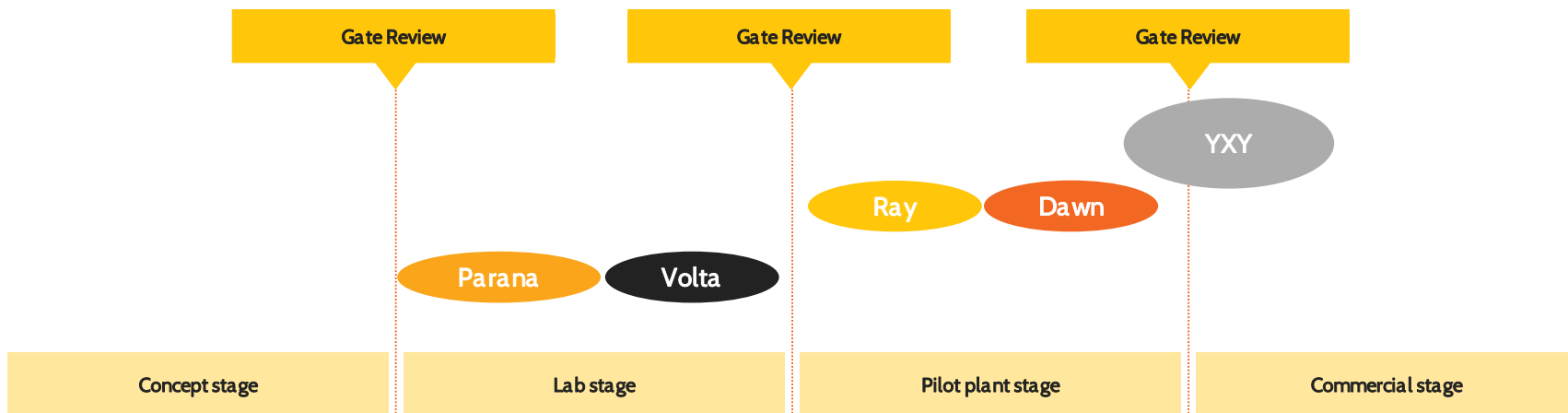


# A coherent portfolio of technologies

Coherent portfolio, each targeting blockbuster markets



Pursuing the most attractive opportunities through stage gate process





# High-value PEF applications



## Multilayer packaging

Replace with single material PEF layers, reducing cost of packaging while enabling recycling



## Enhanced bottles

PEF in small volume soft drink/beer bottles or as barrier layer providing performance and enabling recycling



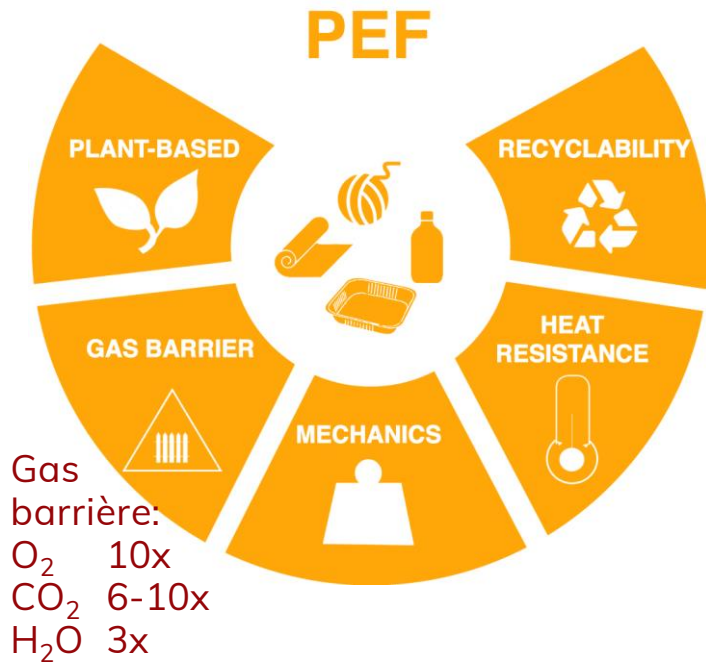
## Optical film

Enable thinner LCD/OLED displays



# PEF benefits

*A novel plant-based plastic material with superior properties*



## What is PEF?

PEF is 100% plant-based, 100% recyclable plastic with superior performance properties compared to today's widely used petroleum-based packaging materials

Market potential of PEF > € 200 billion



Packaging material  
>€150 billion



Film  
€8 billion



Textile  
€41 billion

Source: Canadean (2013)



## PEF benefits – After use

### Designed for recycling and reuse

- Proven fit with existing sorting and recycling facilities
- 100% recyclable, incl. the enhanced small size bottles – which is not the case for PET
- Addressing goals set by governments (e.g. in the EU, all plastic bottles will need to contain at least 30% of recycled material by 2030)

### What happens if PEF ends up in nature?

- Degradation tests by Organic Waste Systems (OWS) show that PEF is degradable under industrial composting conditions (250-400 days with air / oxygen @ 58°C in soil)
- Degradability of PEF under ambient conditions is currently under investigation in an Avantium-led 10-year field trial



# Objectives of PEference project

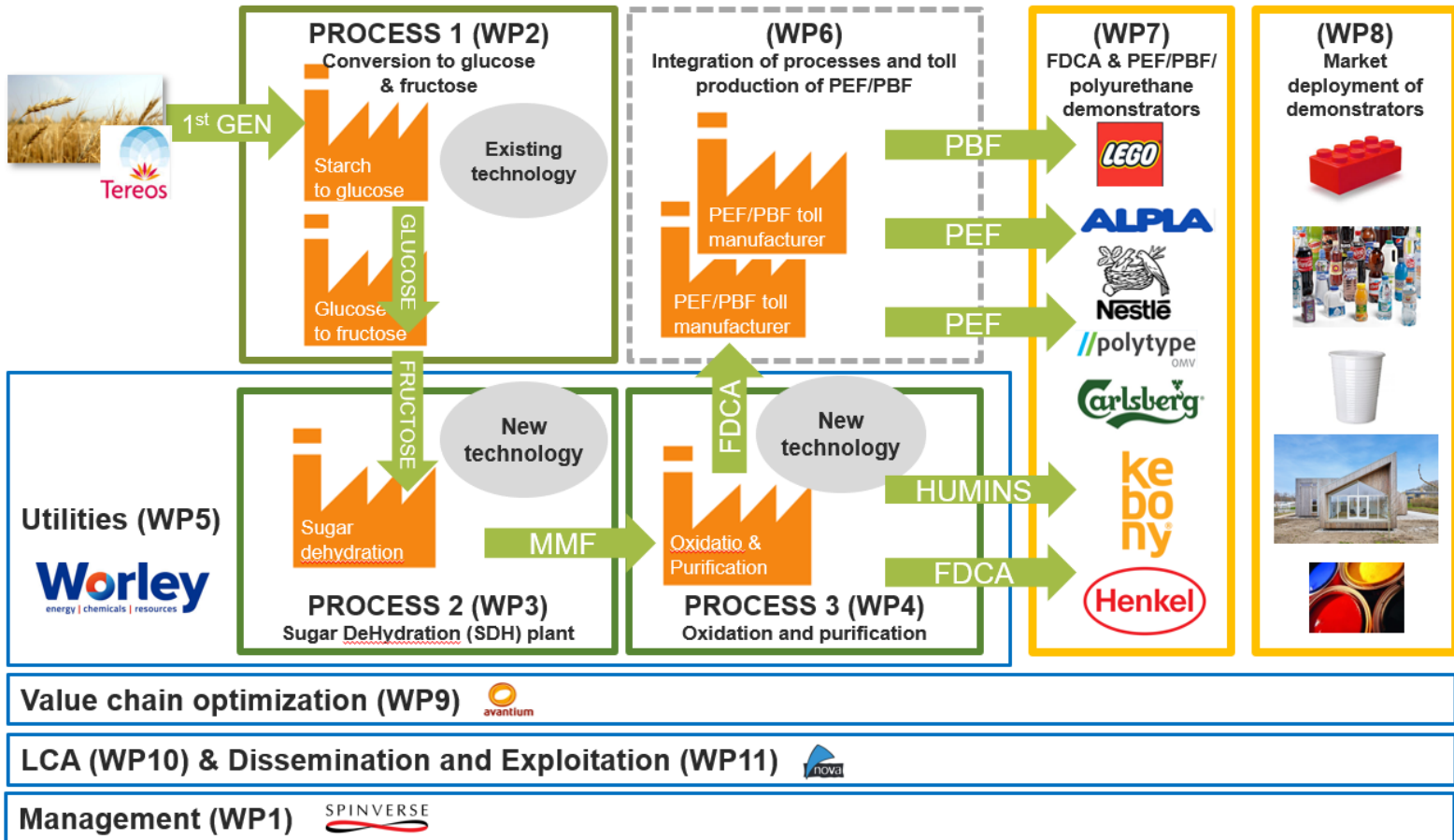
- Engineer and build the flagship plant for the production of purified FDCA (5,000 tonnes/year)
- Demonstrate and validate at least three 100% bio-based materials in end user applications
- Commercialize the 100% bio-based end products demonstrated in the project
- Demonstrate and optimize the new local bio-based value chain from raw material sourcing to PEF end products
- Evaluate the environmental and socio-economic performance of the developed products

# PEference: Project Target and Value Chain Partners

Project Purpose: Contribution to the build of the PEF flagship plant and market launch of PEF with project partners, including sustainability assessments



# PEference Consortium



# Flagship Plant – rendering



Information materials

- Brochure, roll-up banner with QR code



## Published press releases, newsletters, social media



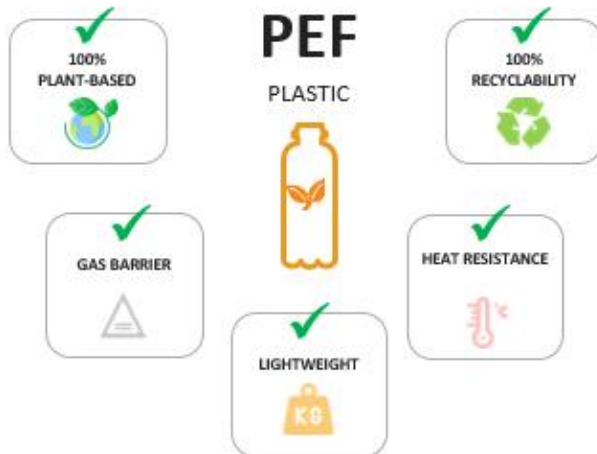
# More information on PEF(erence)

- Video explaining the technological background of PEFerence flagship project: <https://youtu.be/e7zOKHE03tA>



- Business plan focusses on superior performance of PEF to target high-value applications

## Highly differentiated performance plastic



## High-value PEF applications



### Multi layer bottles

PEF as barrier layer providing performance and enabling recycling



### Single layer bottles

Single layer PEF in small bottles for soft drinks, beer and juice; replacing glass bottles, aluminum cans and multilayer bottles, enabling closed-loop recycling



### Film

PEF film in recyclable flexible packaging or as film used in electronics applications (e.g. displays)



## Some Current Activities

- Iso-certified LCA to be completed in Q2 2021
- Upscaling of the demonstrators
- Starting the EPC
- Additional off-take agreements
- Intensifying dissemination activities

# Overall conclusions

- PEference is on track to engineer and build the first-of-a-kind FDCA flagship plant
- Initial results of bio-based materials and end products are promising
- The interim results of the environmental performance of the developed products shows a clear benefit of using PEF in place of PET in multiple applications
- More information: [\*\*ed.dejong@avantium.com\*\*](mailto:ed.dejong@avantium.com)