PAQUES
biomaterials

K-Pitch

Challenges in Business Development of Caleyda

João Sousa
Richard Schrama

18-06-2025

Microplastics are everywhere!

WWF

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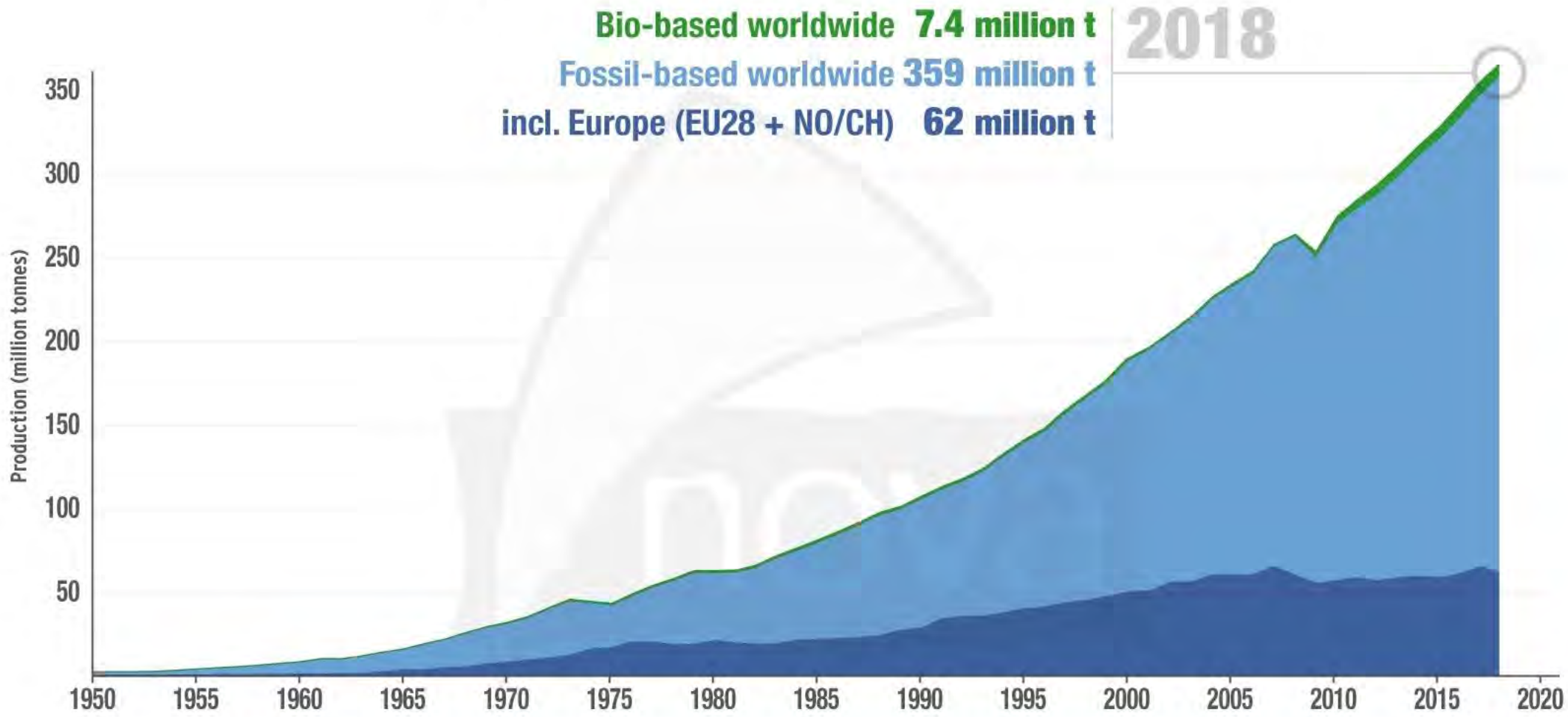
Plastics production from 1950 to 2018



All figures available at
www.bio-based.eu/graphics

Includes thermoplastics, polyurethanes, thermosets, elastomers, adhesives, coatings and sealants and PP-fibres. Not included PET-, PA-, and polyacryl-fibres.

Data sources: PlasticsEurope, Consultic and nova-Institute

Our solution:

Caleyda

a natural replacement to plastic.

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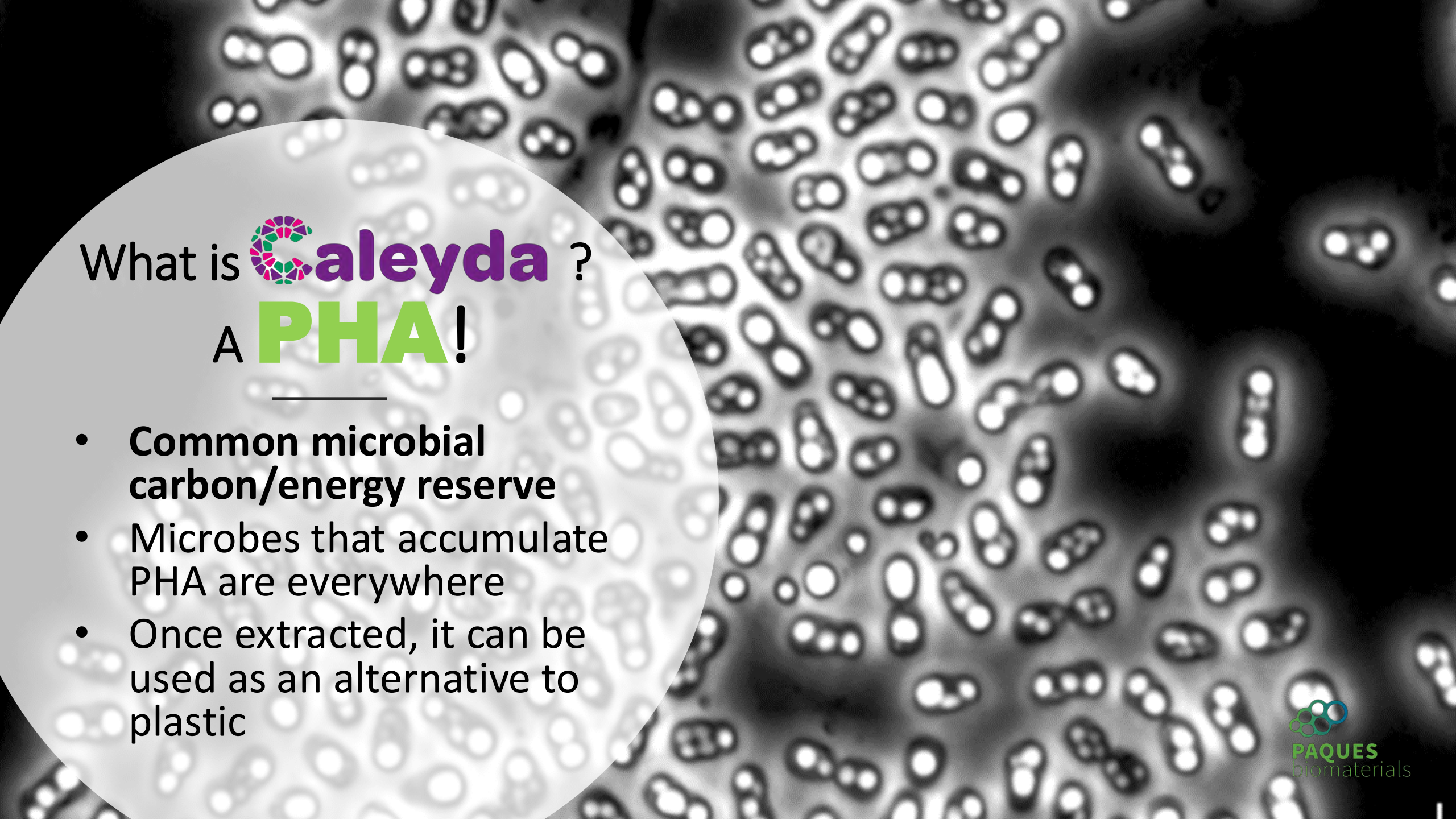

What is Caleyda ? A PHA !

- **Common microbial carbon/energy reserve**
- Microbes that accumulate PHA are everywhere
- Once extracted, it can be used as an alternative to plastic

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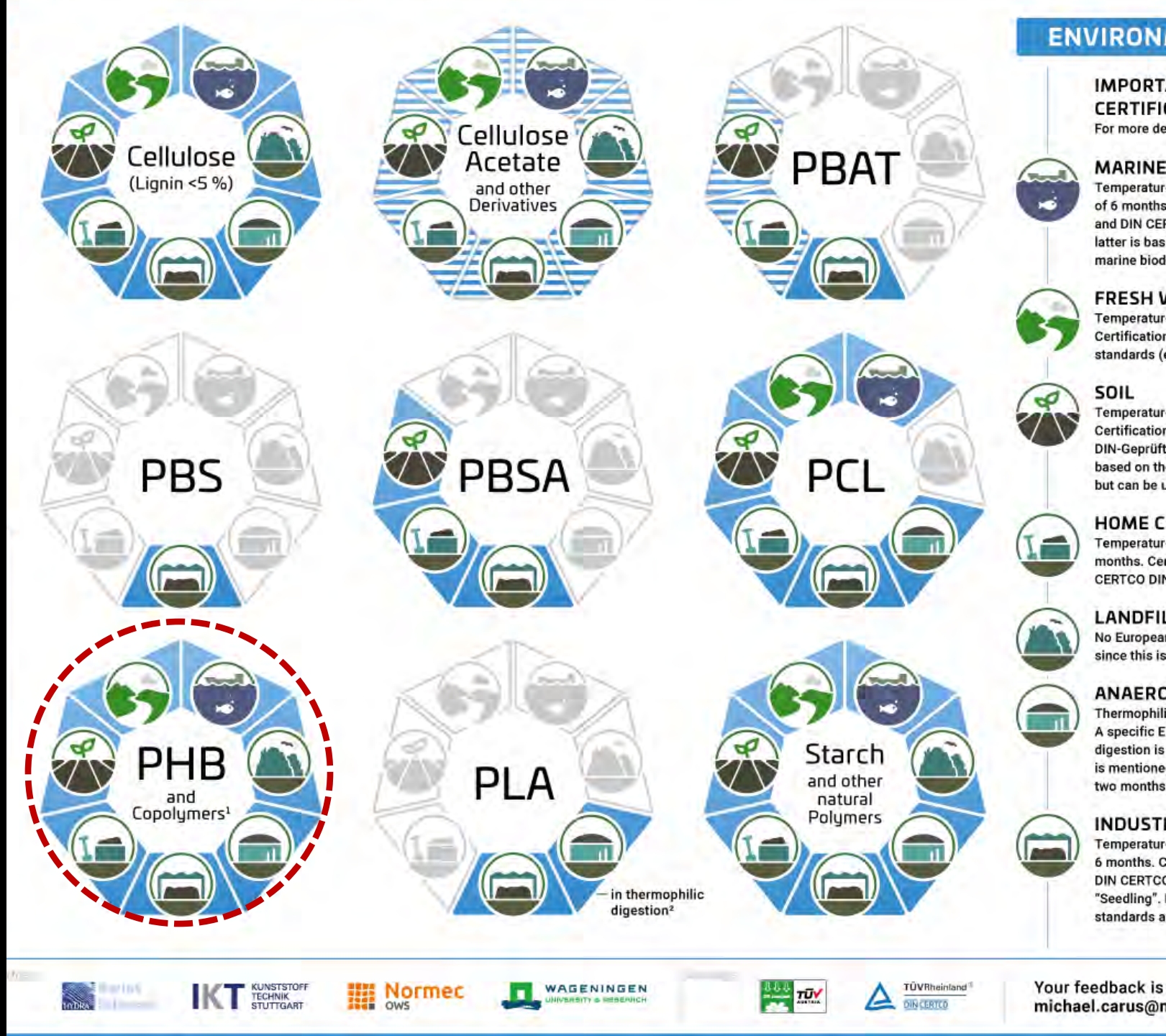
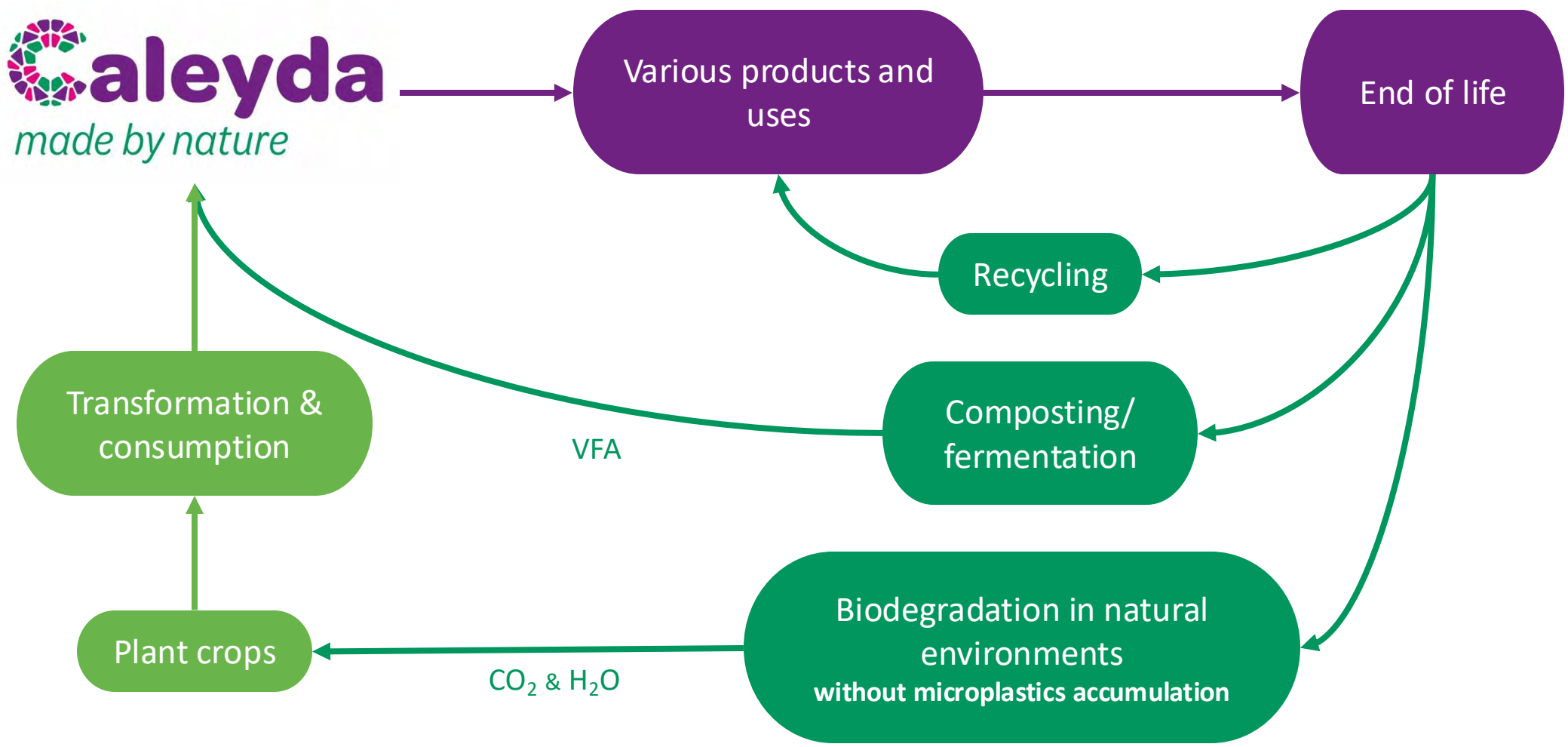
PHAs have superior biodegradability!

Also, in soil and marine conditions – on par with cellulose and starch!

No harmful microplastics!





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PHAs are commercially produced using crop feedstocks

PAQUES biomaterials

Timeline for Caleyda® availability

PHA biomass (PHA.X)

Start of development
2011

Caleyda®


We can do it from waste feedstocks!
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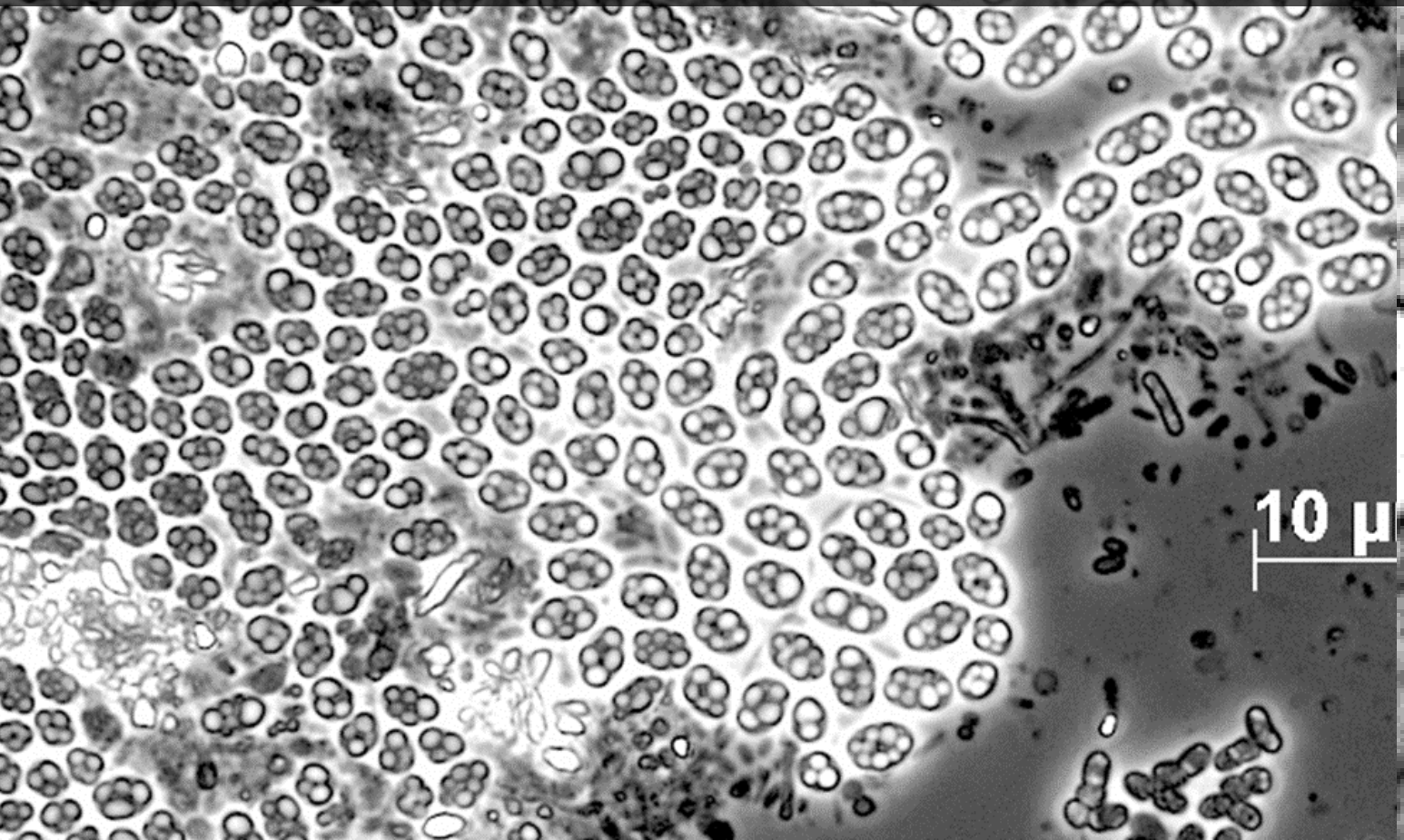
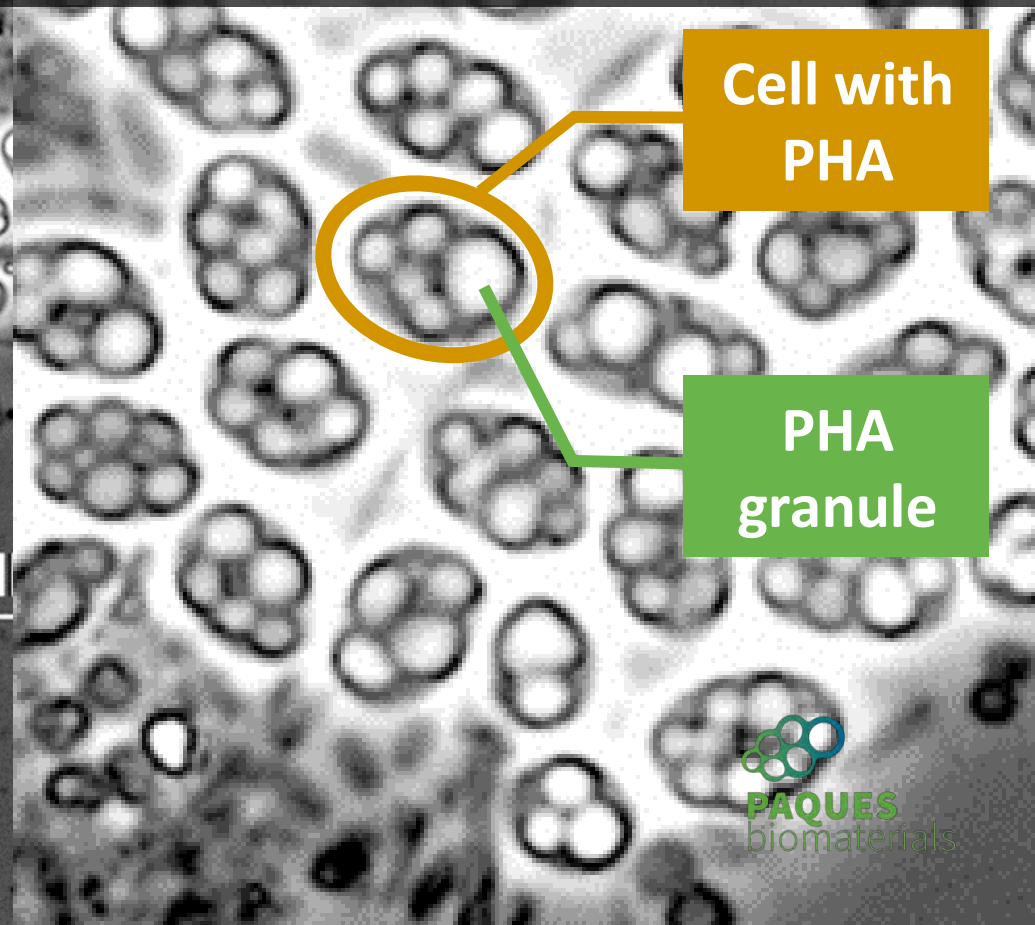
PHA producing microbes can be found in several wastewater treatment plants and can be enriched!

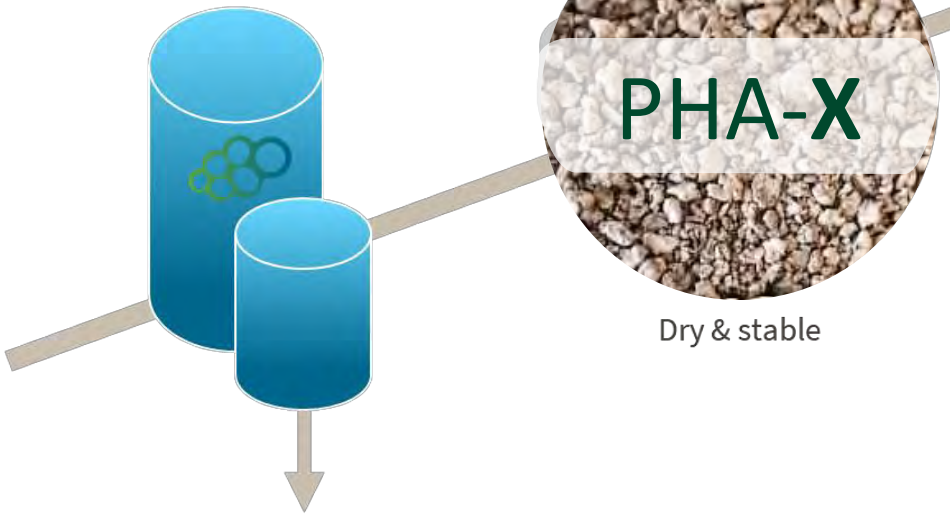




How to produce Caleyda®

PHA-X production with direct participation of industries or utilities is key to keep commitment on feedstock.

PHBV biomass production
@ the industry site.



Treated wastewater

PHA-X

Dry & stable

Caleyda® production
@ centralized site from Paques Biomaterials

A fully natural & biodegradable alternative to plastic.

Centralized Caleyda® production acts as quality control gate and allows better economy of scale.

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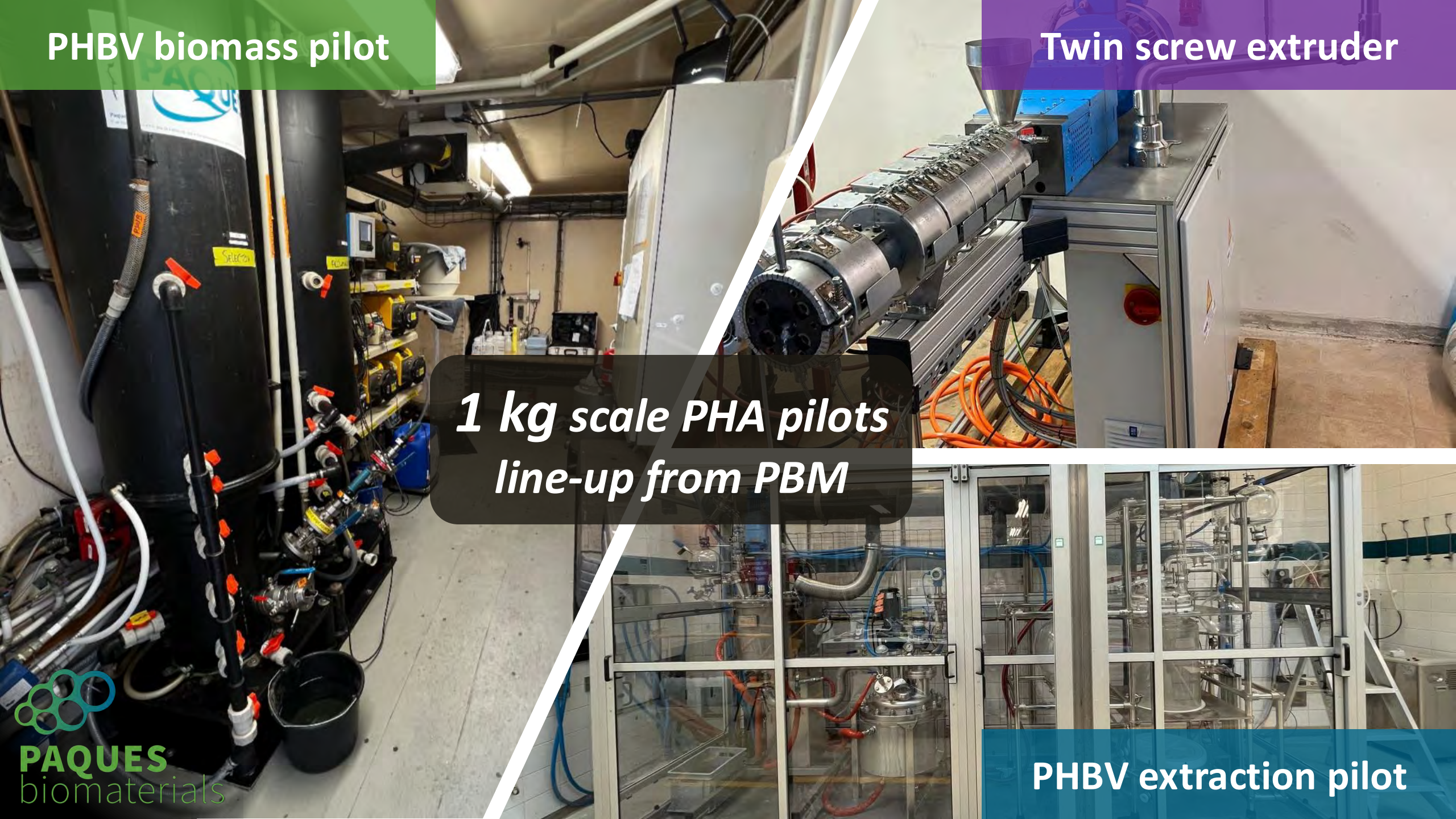
MARS Smurfit Kappa
ESKA PHARIO
renewi

Pilot tests
2012-2023

Switch to solvent approach
2018

Caleyda®


PHBV biomass pilot
Twin screw extruder
1 kg scale PHA pilots
line-up from PBM
PHBV extraction pilot
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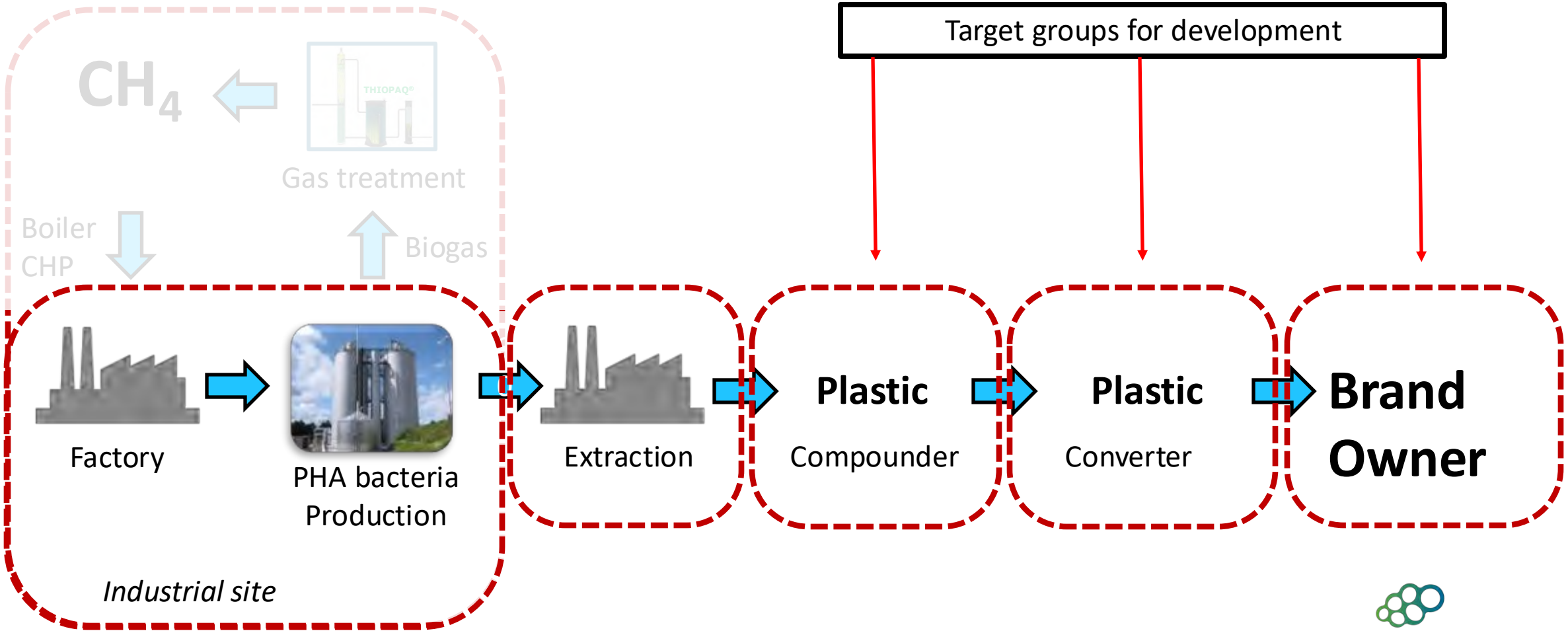
The value chain of PHA is much more complex



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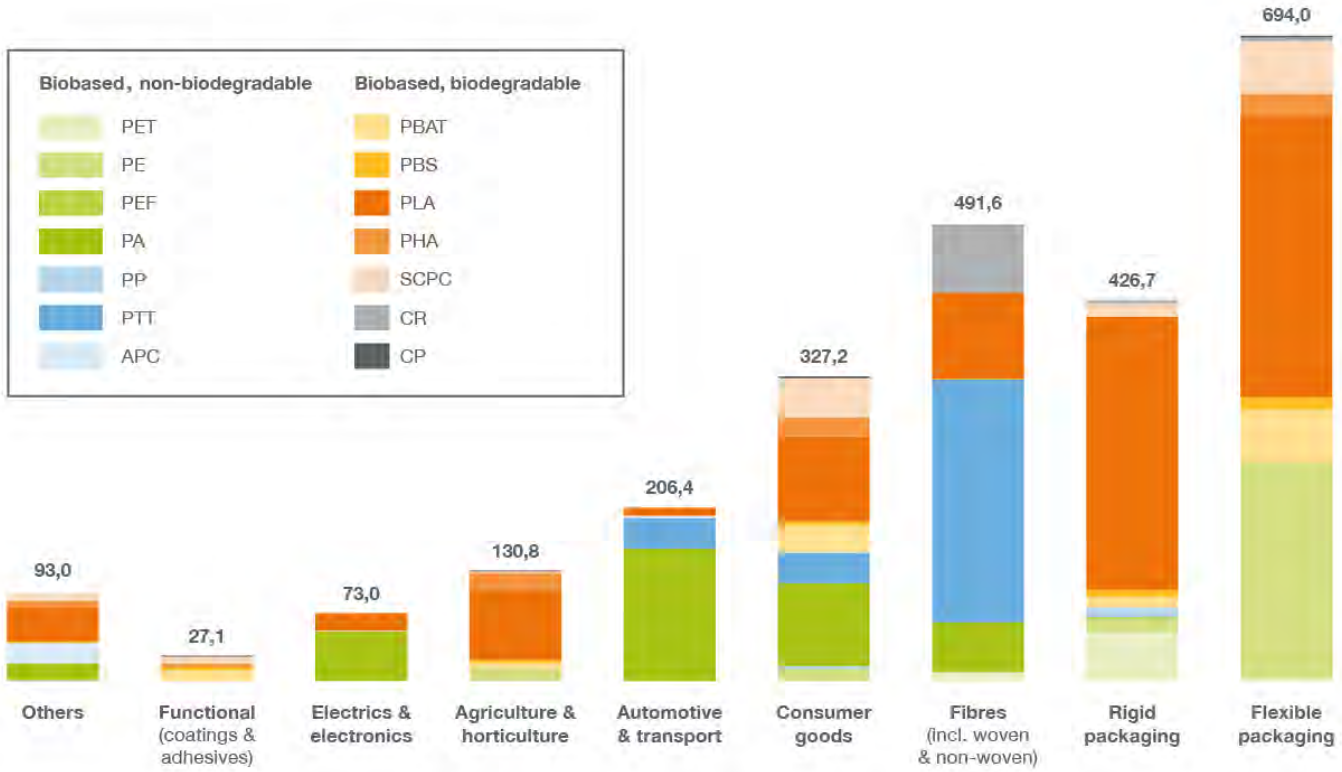
Defined segmentation

Global production capacities of bioplastics 2024 (market segments by polymers)

in 1,000 tonnes



Our Criteria:

- High risk for harmful microplastics
- **Directives in place**
- Non-Food
- Willingness-to-pay
- Material properties

Target Plastic Segments

- Coating & Adhesives
- Agri & Horti
- Fibres (textile)
- Non food, high end packaging
- Others (e.g., 3D printing, ecosystem restoration)

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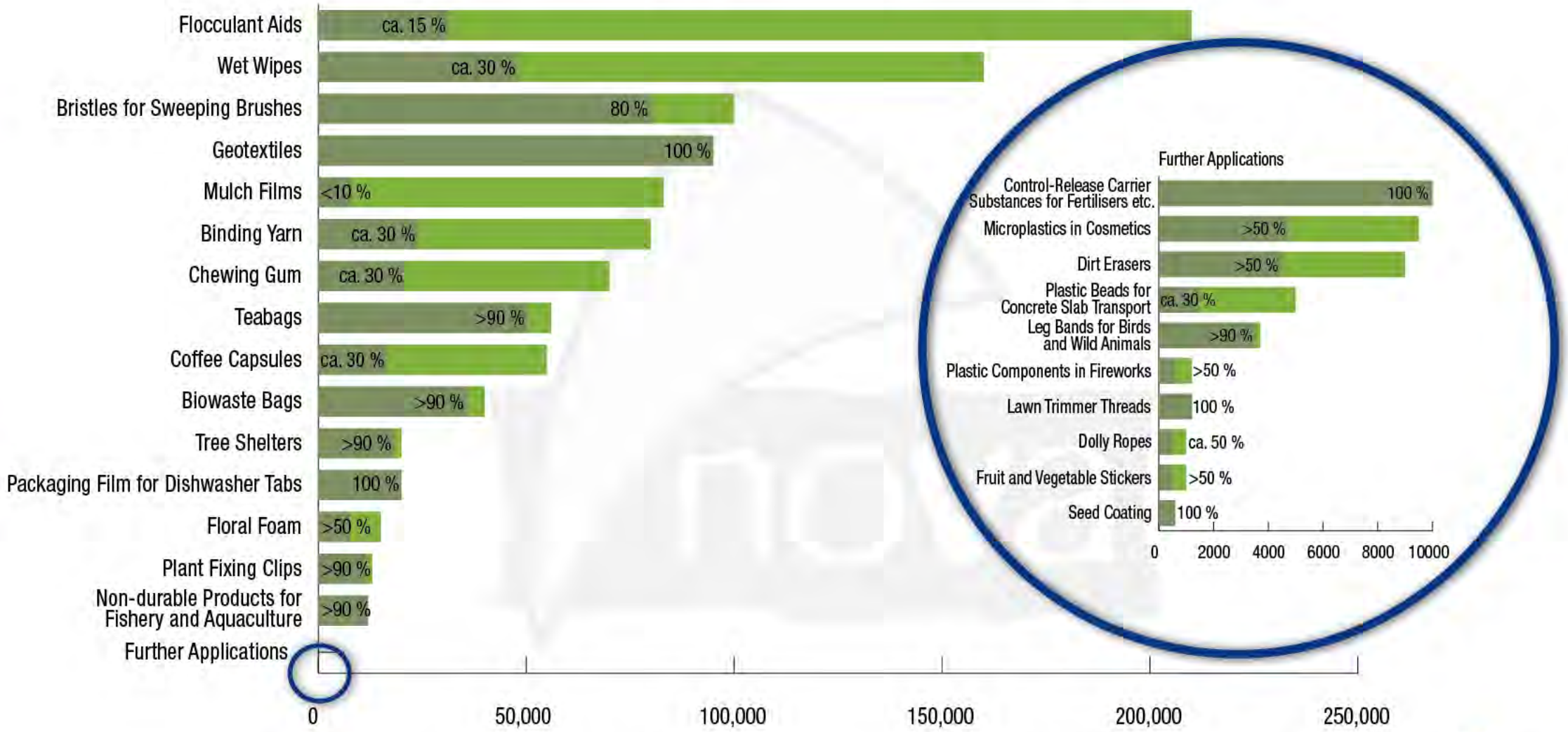
Overview of Market Volumes EU28



available at **www.renewable-carbon.eu/graphics**


Caleyda
made by nature
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Is 1 kg enough to take final steps???

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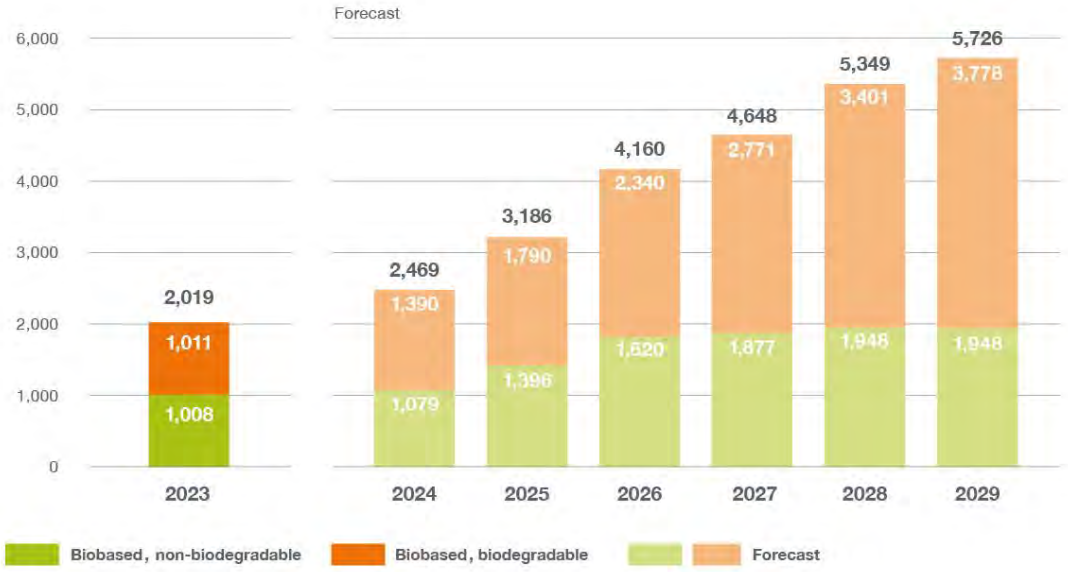
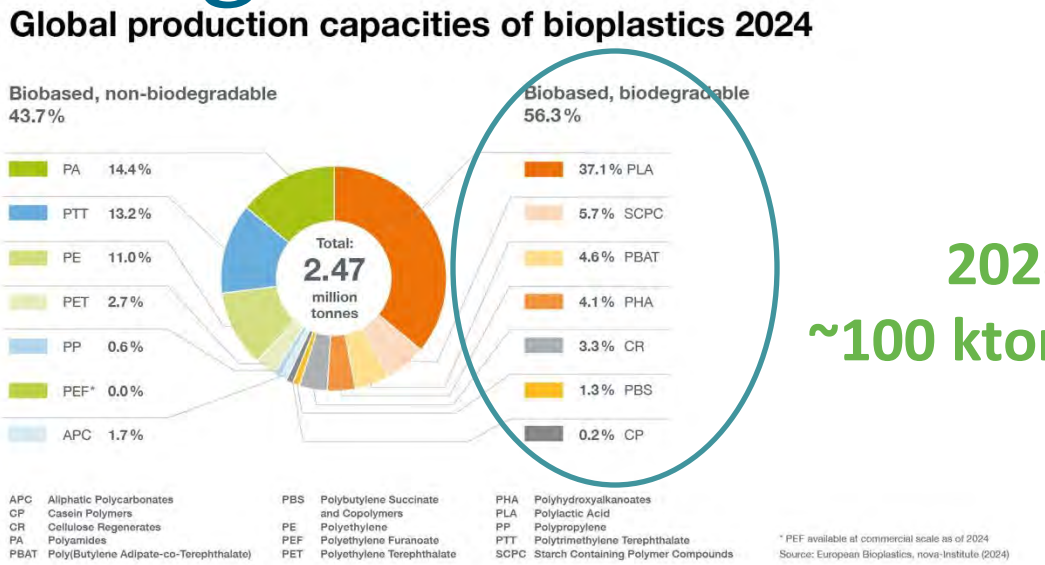
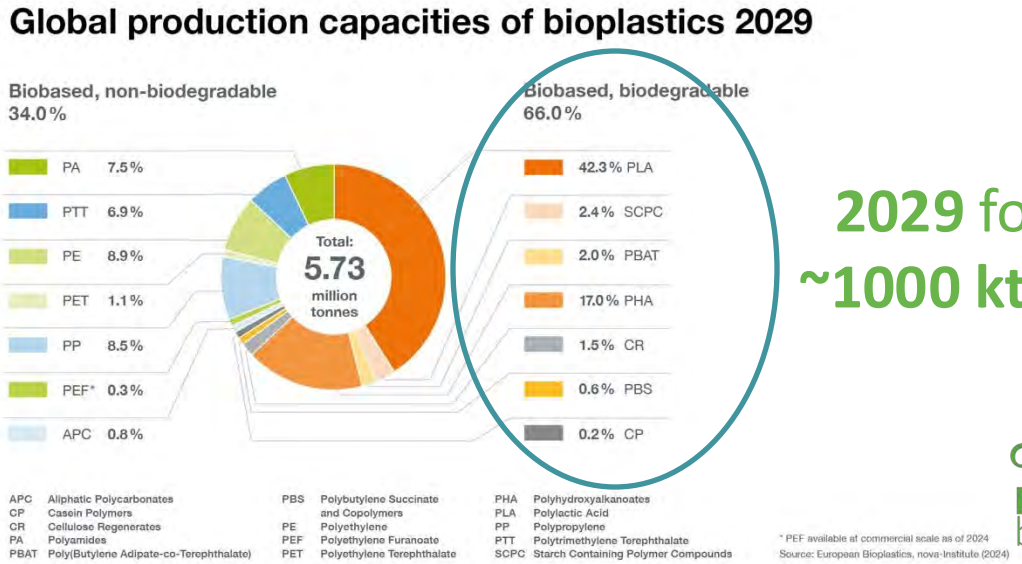
The PHA market is growing fast



Source: European Bioplastics, nova-Institute (2024)



2024
~100 kton PHA



2029 forecast
~1000 kton PHA

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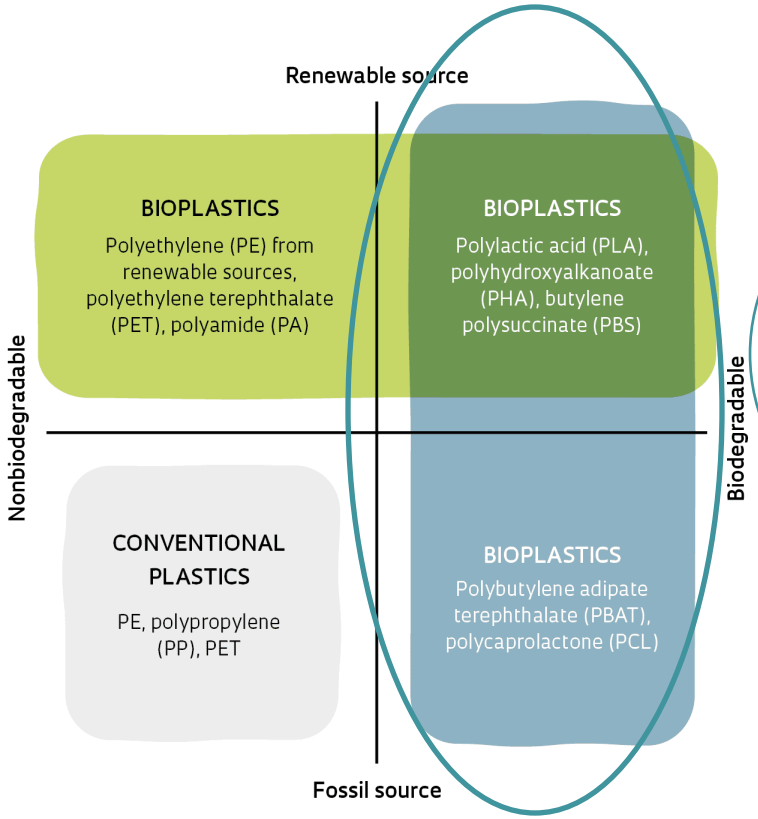
Who are the players

Bioplastic or conventional plastic?

The two are differentiated by the origin of their raw materials and whether or not they are biodegradable



SOURCE EUROPEAN BIOPLASTICS

PLA

NatureWorks LLC
TOTAL
Corbion
futerro

PHA

TianAn Biopolymer
PAQUES biomaterials
CJ BIOMATERIALS
kaneka
Bluepha

PBAT

NOVAMONT
TUNHE 蓝山屯河
KINGFA
BASF We create chemistry
PBAT AN PHAT COMPOSTABLE RESINS

PBS

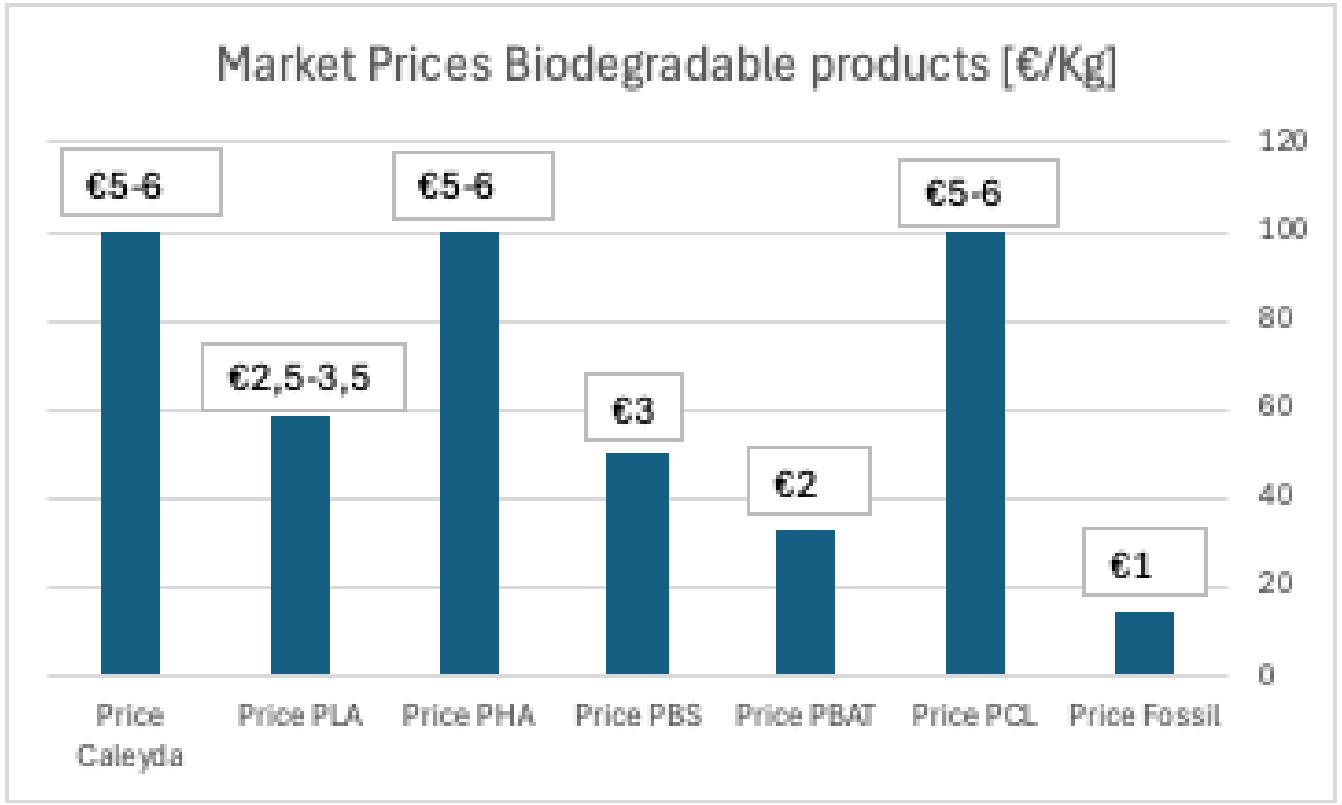
ptt MC Biochem
TUNHE 蓝山屯河

PCL

ingevity
eSUN

PAQUES biomaterials

Market prices of biodegradable biopolymers



- Bio-based plastics are currently hardly competitive on the European market mainly due to their high production costs compared to fossil-based alternatives.
- But, since less than 1% is part of the entire plastic production volume, and niche markets are demanding for sustainable alternatives, growth rates of biobased and biodegradable products are significant.
- This material transition shall take time, but economy of scale in biobased production shall support the demand of biobased and biodegradable plastics in many markets.

PAQUES biomaterials

Timeline for Caleyda® availability

PHA biomass (PHA.X)

Start of development
2011

Pilot tests
2012-2023

Carve out of Paques Biomaterials From Paques
2021

PHA2USE Demo
2022

Caleyda®

Switch to solvent approach
2018

Pilot tests (1-2 kg samples)
2021

External large pilot tests
2021

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Apllications PHA-X & Caleyda®

Initial contacts For Caleyda
2022/2023

Sampling
2023/2024

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2023/2024

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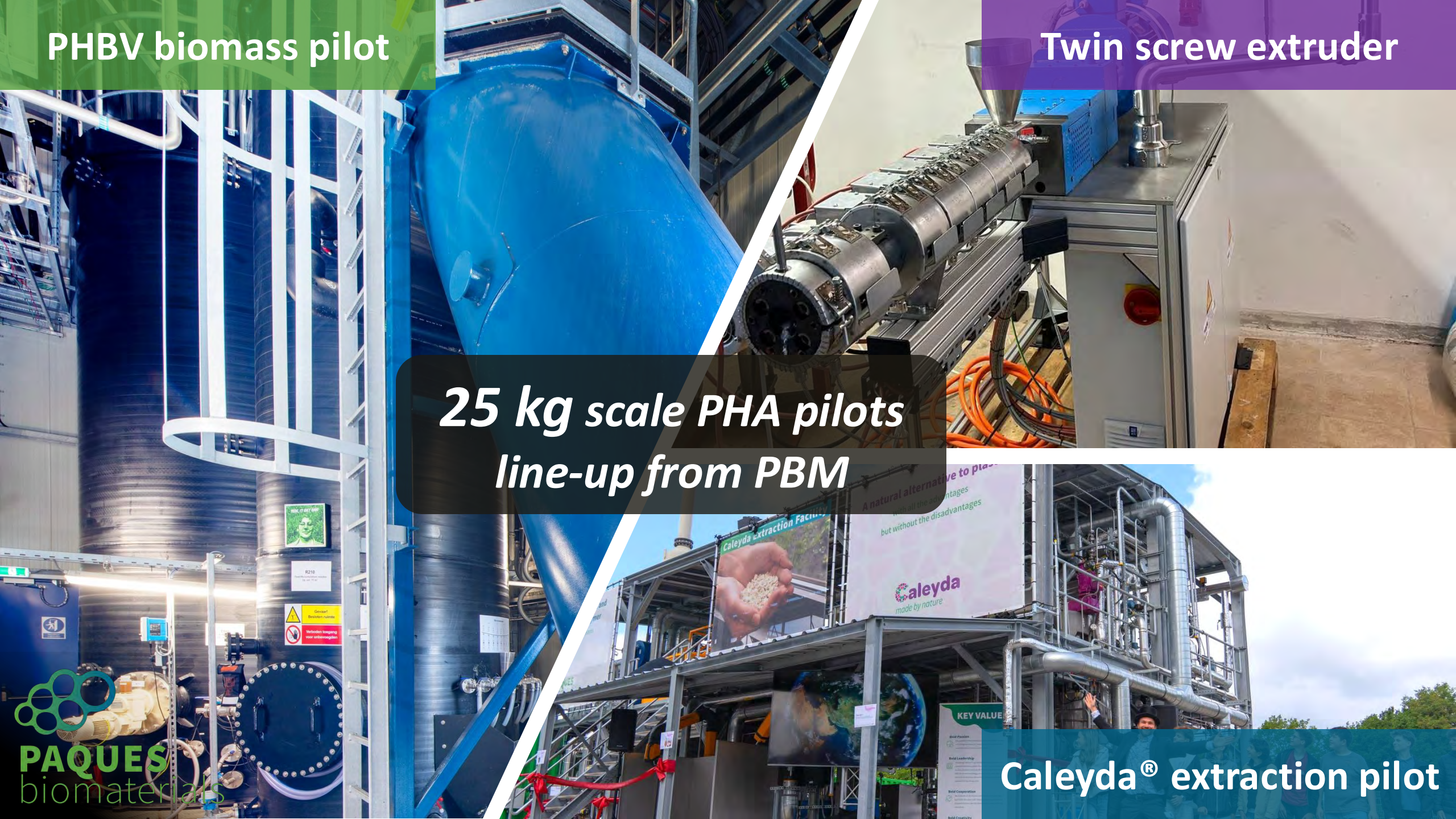
2024

Own large pilot test (25-100 kg samples)
2025

Caleyda®


PHBV biomass pilot
Twin screw extruder
25 kg scale PHA pilots
line-up from PBM
Caleyda® extraction pilot
PAQUES
biomaterials

Business development process

Initial contact	Prototyping	Cond. offtake agreement	Business validation	Final off take agreement
• Identify the problem • Idea generation • Crafting the solution • Draft an NDA	• Make a prototype • Evaluate prototype • Conceptualizing the idea • Evaluate high level commercials • Perform scaling in case needed	• Make an MOU or LOI • Sign-cond. offtake agreement • Prepare business validation or POC*	• Prepare POC* • Discuss POC* • Plan & Execute POC* • Evaluate POC* with client • Prepare for take/pay offtake agreement	• Discuss take/pay offtake agreement • Agree and sign take/pay offtake agreement
1-3 months	3-9 months	9-12 months	12-21 months	21-24 months

*POC= Proof of concept / Technical and commercial business validation

Scale-up the application development team!

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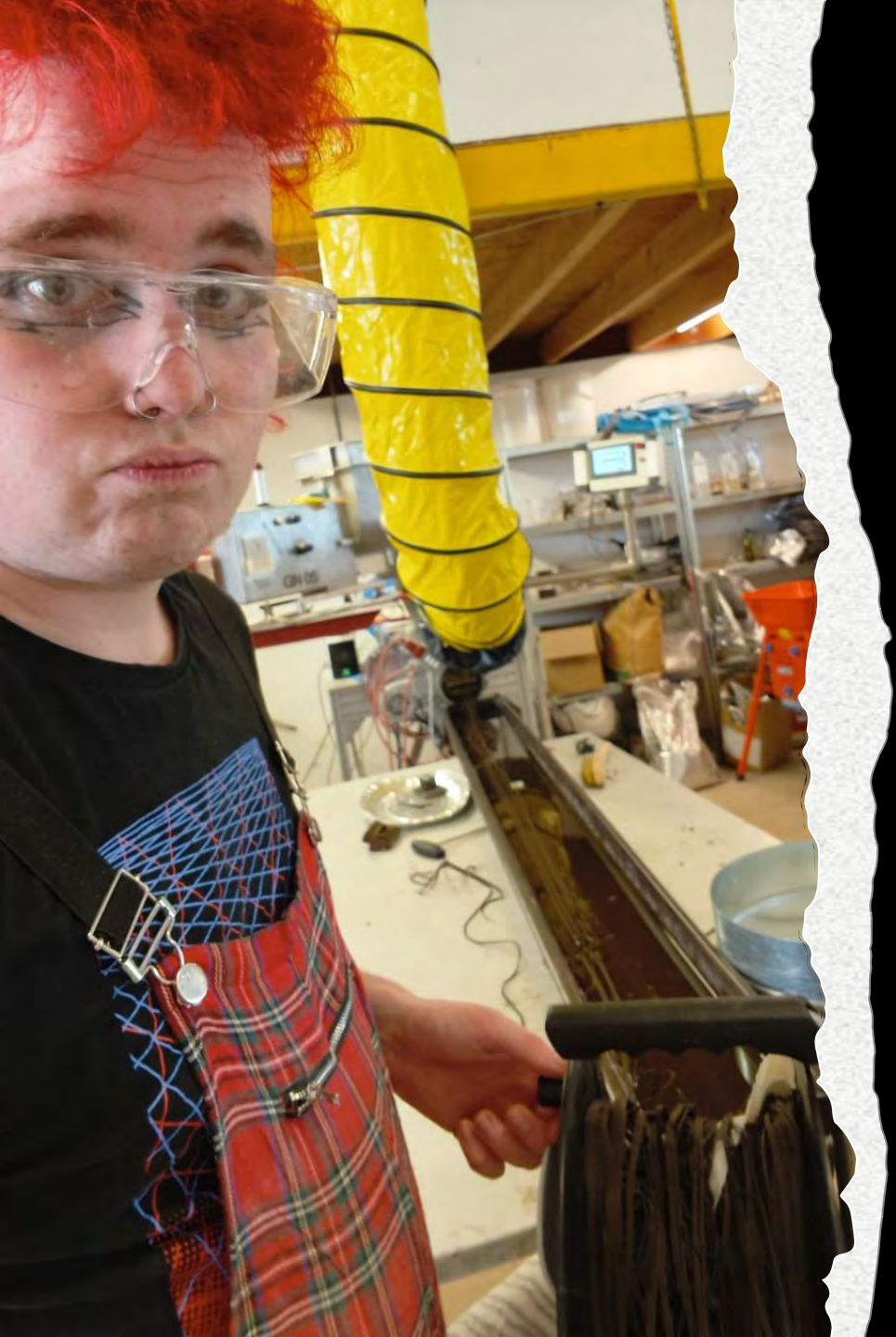
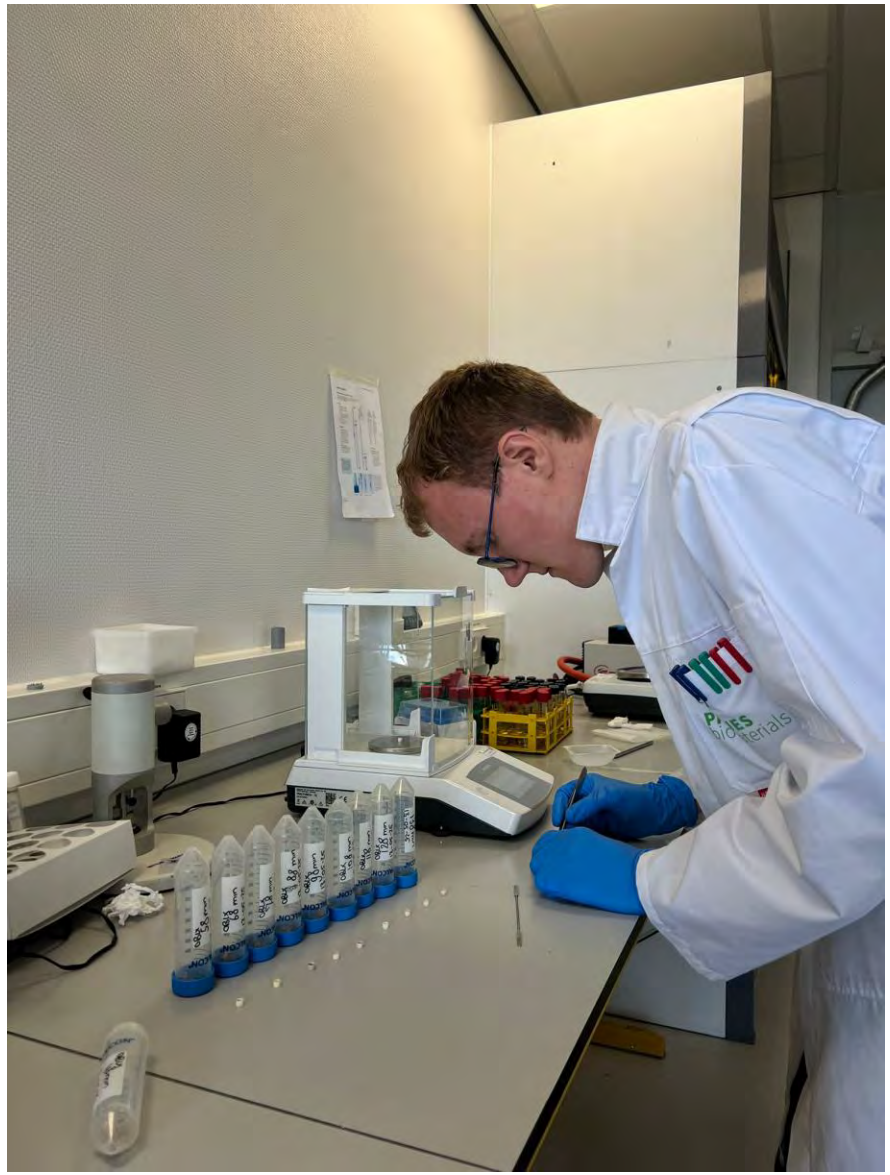
Sales & Marketing & Communication



Application technology

Analytics



Business Development

QA & QC

The value proposition

PHA production in the EU

Use of secondary feedstocks

Circular production

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Communicating this value is key!

PHA production in the EU

Branch organization

Exhibitions

Website

Communicate

Social Media

Congresses

Use of secondary feedstocks

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PAQUES biomaterials

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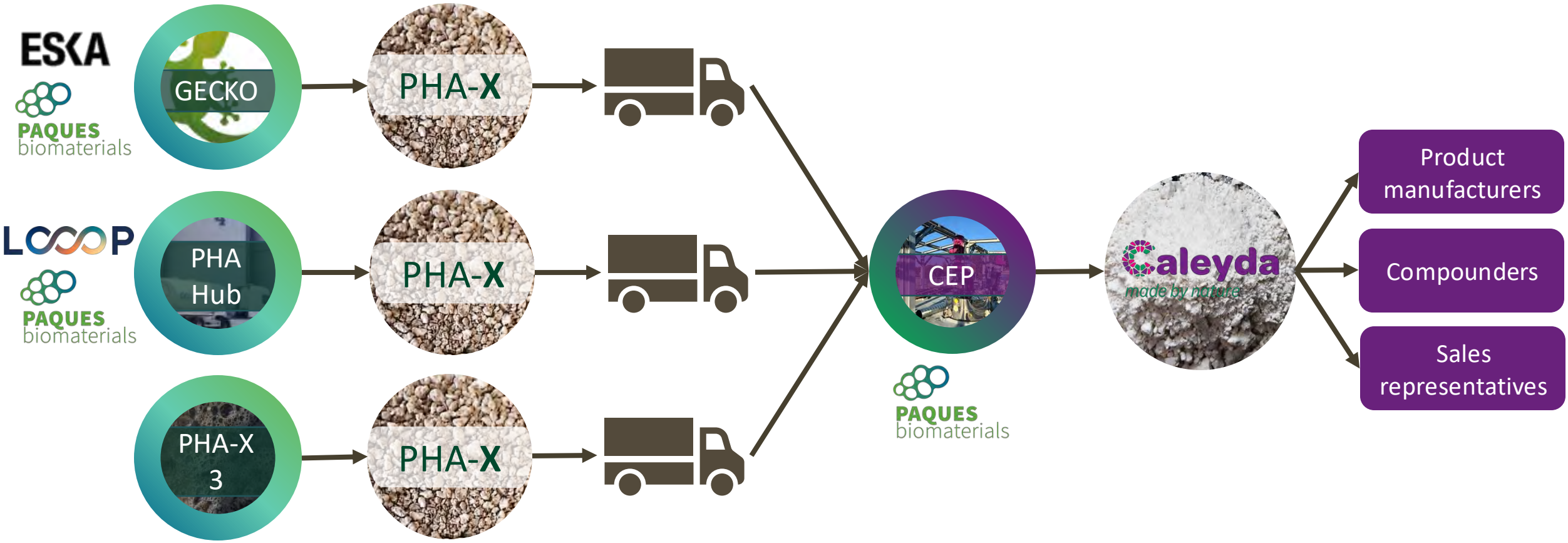
Caleyda®

Implementing Caleyda® production in NL



PHA-**X** plants built on feedstock site or centralized using Hub concept.

PBM provides off-take of PHA-X to extract PHA and produce Caleyda®.

PBM commercializes Caleyda®

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Gecko plant (1.5 kton)
2027

Apllications PHA-X & Caleyda®

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2023/2024

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2024

Prototyping
2025/2026

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2025

Caleyda®

GECKO
DRIVING WATER CIRCULARITY WITH SUSTAINABLE BIOPOLYMERS

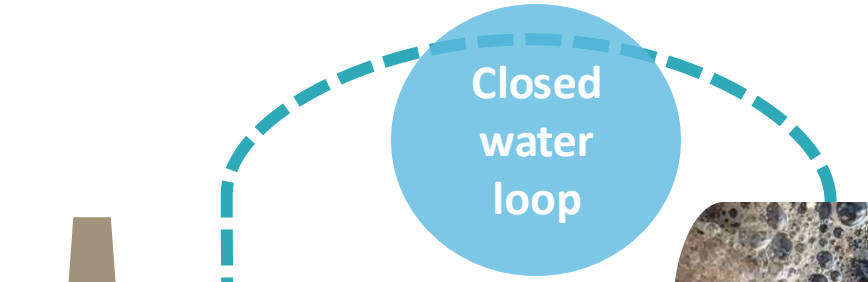
ESKA
PAQUES biomaterials

On site PHA-X plant + WWTP

Our first PHA.X plant – *GECKO* project

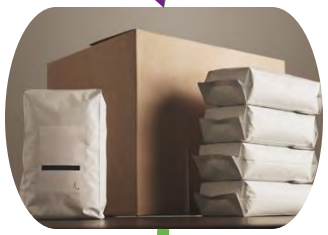
Paper cycle case
Creating closed cycles!

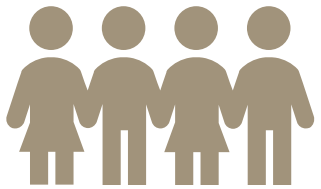
GECKO



Caleyda
made by nature

Full
material
recycle





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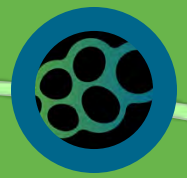

PHA2USE Demo
2022

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PHA Hub plant (3-6 kton)
2027

PHA.X supply
2027

Apllications PHA-X & Caleyda®

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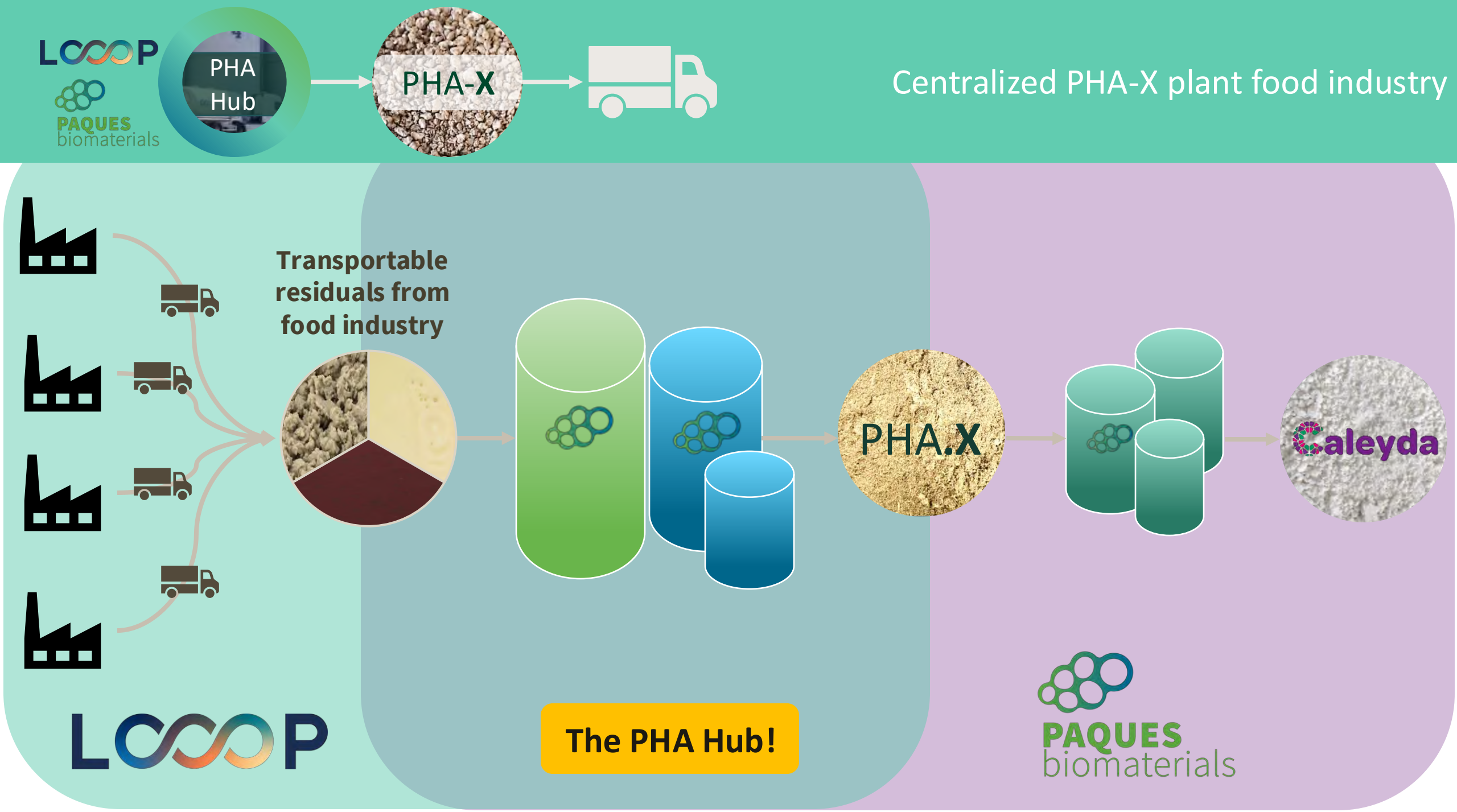
Caleyda®


PHA Hub
PHA-X
Centralized PHA-X plant food industry
Transportable residuals from food industry
PHA.X
Caleyda
The PHA Hub!
PAQUES biomaterials

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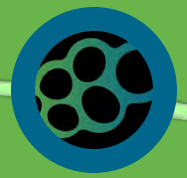

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Caleyda® Extraction plant (6 kton)
2027

Caleyda® supply
2028

Caleyda®

PHA Hub & Caleyda® extraction plant in Emmen

Caleyda

2028

(6000 tpa)

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The final investment decision

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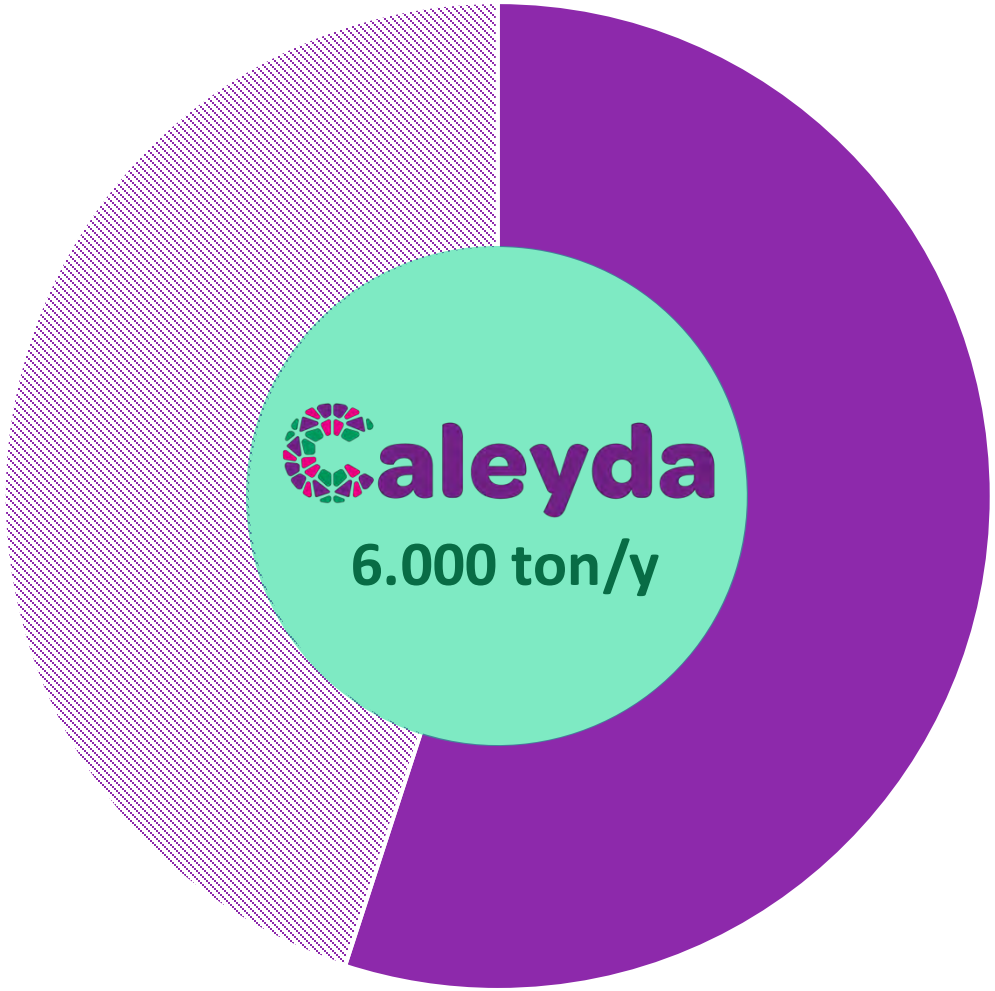
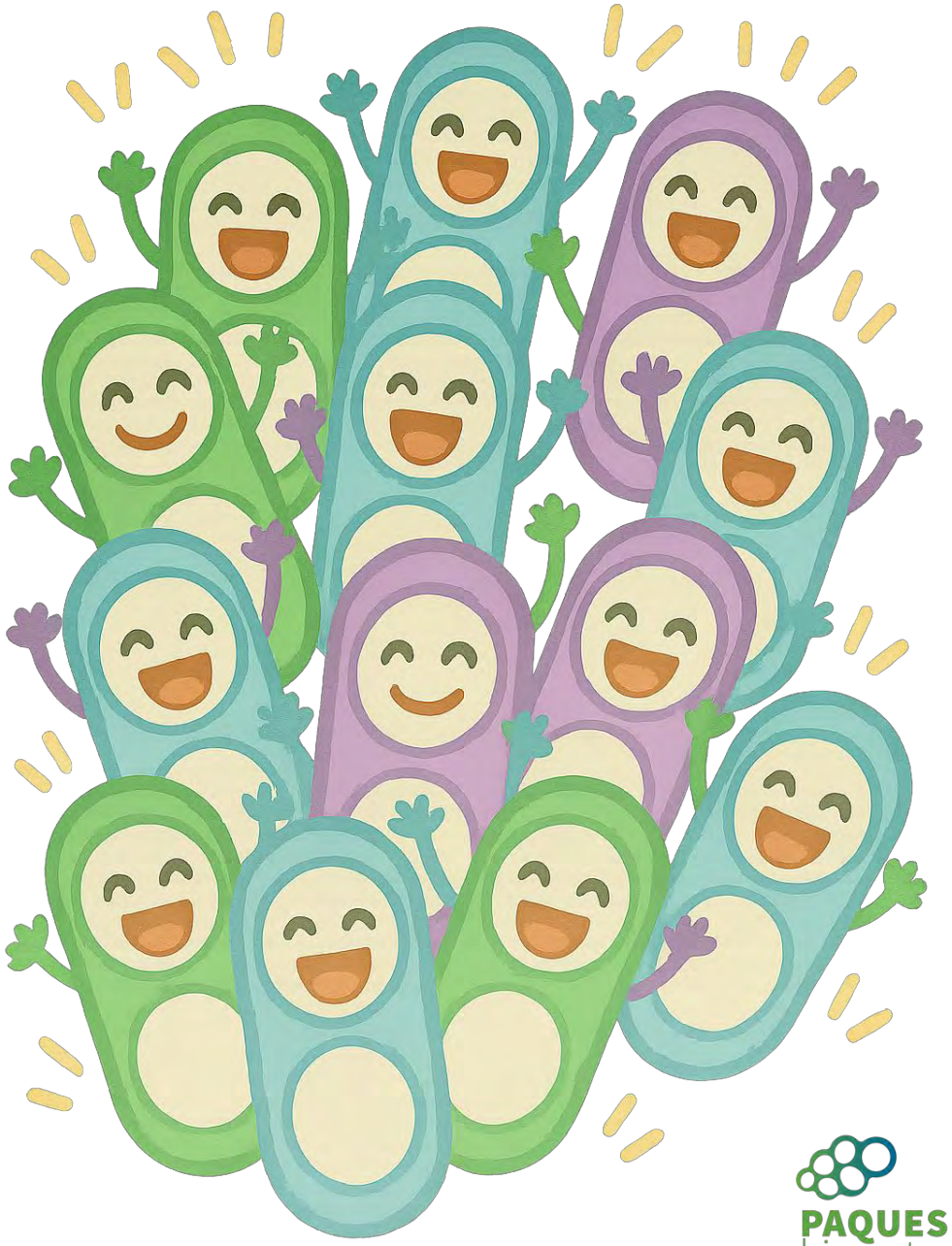
Secure market off-take!





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Prototyping
2025/2026

Market acceptance
2025/2026

Caleyda® Extraction plant (6 kton)
2027

Off Take Agreements
2026/2027

Sales
2028

Caleyda® supply
2028

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r.schrama@paquesbiomaterials.nl