MNEXT

LUNCH &LEARN

Bridging the gap:

The potential and challenges of PHA

March 28, 2024

WELCOME!

WE WILL START AT 12:15H

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LUNCH &LEARN

Program

12:15h: Introduction by Martijn Zieverink – Lector Biobased Transitions – MNEXT

12:20h: Guilherme de Souza Reis – Researcher Biobased Resources & Energy – MNEXT

12:45h: Questions/discussion

13:00h: Closure

Please ask your questions via the chat

Presentation slides will be shared afterwards

This Lunch & Learn will be recorded

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Lunch & Learn

Bridging the Gap:

The potential and challenges of PHA bioplastics

March 28, 2024

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UNIVERSITY OF APPLIED SCIENCES

Who am I?

Guilherme de Souza Reis

Brazilian

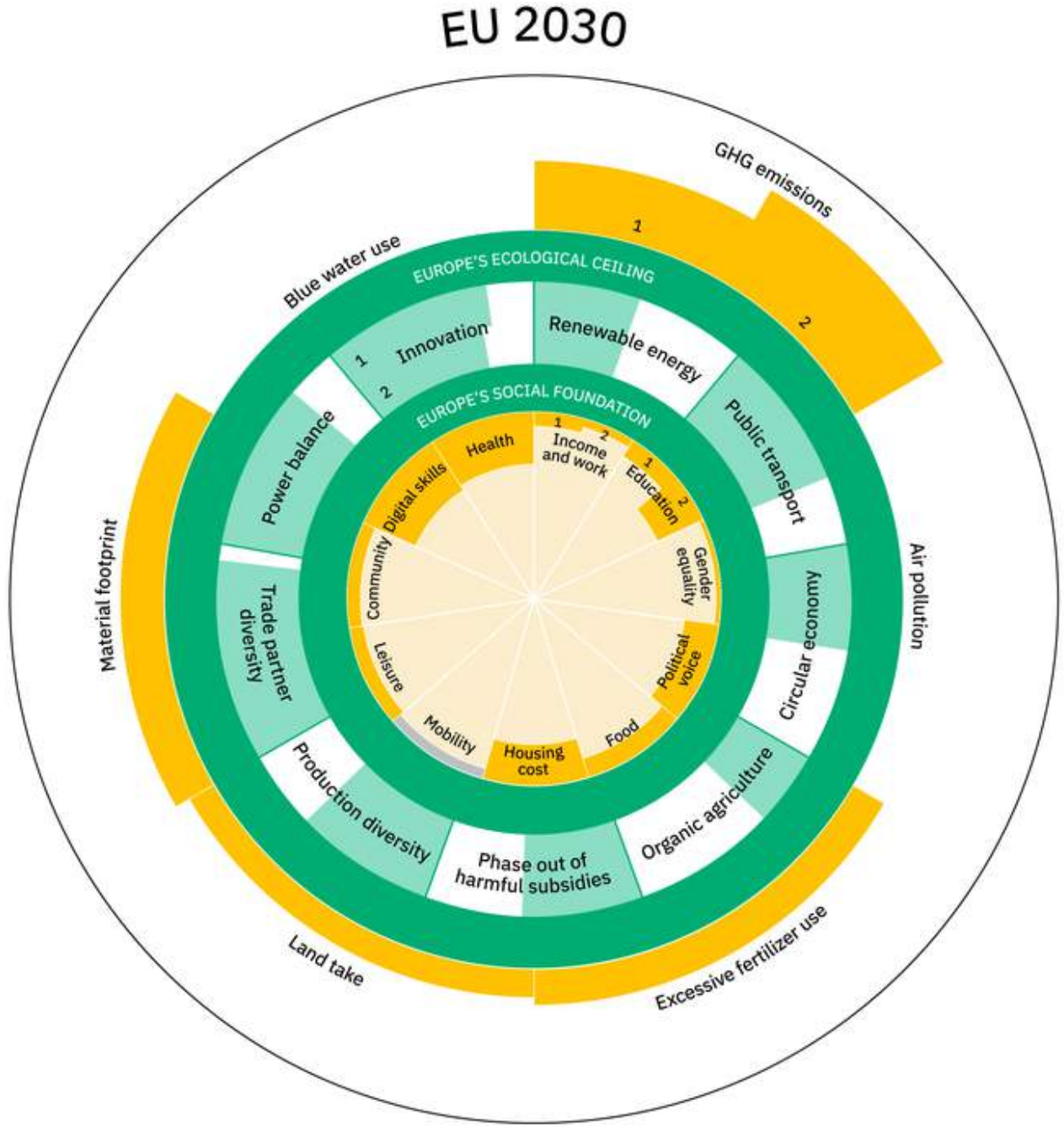
Chemical Engineer

Erasmus Mundus Master in Biorefinery

Researcher at Biobased Resources and Energy/MNEXT

Agenda

- Context
- What is PHA?
- Why PHA?
- How is it made?
- Competitiveness
- Product-market fit
- Discussion

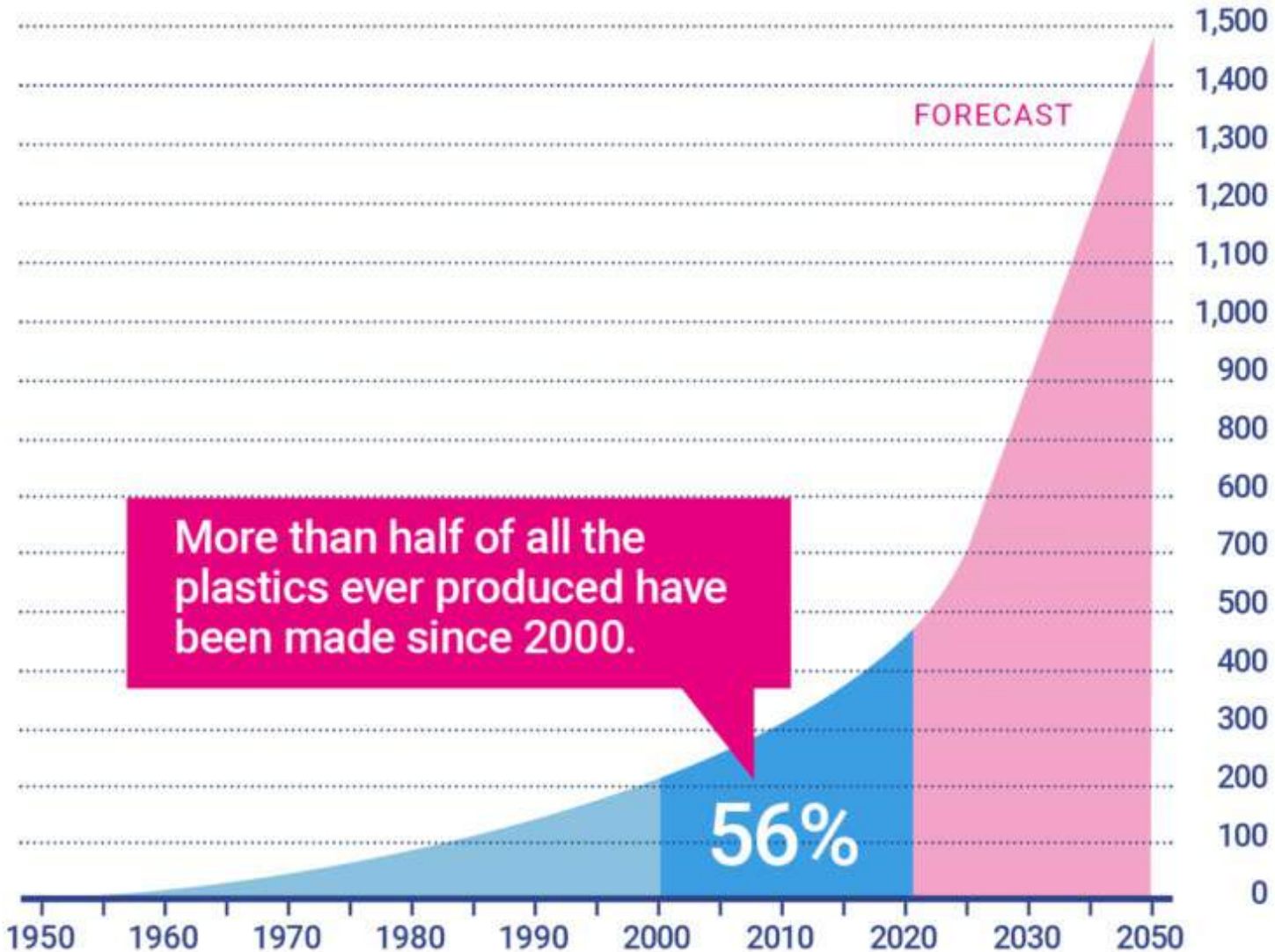


The EU 2030 Compass

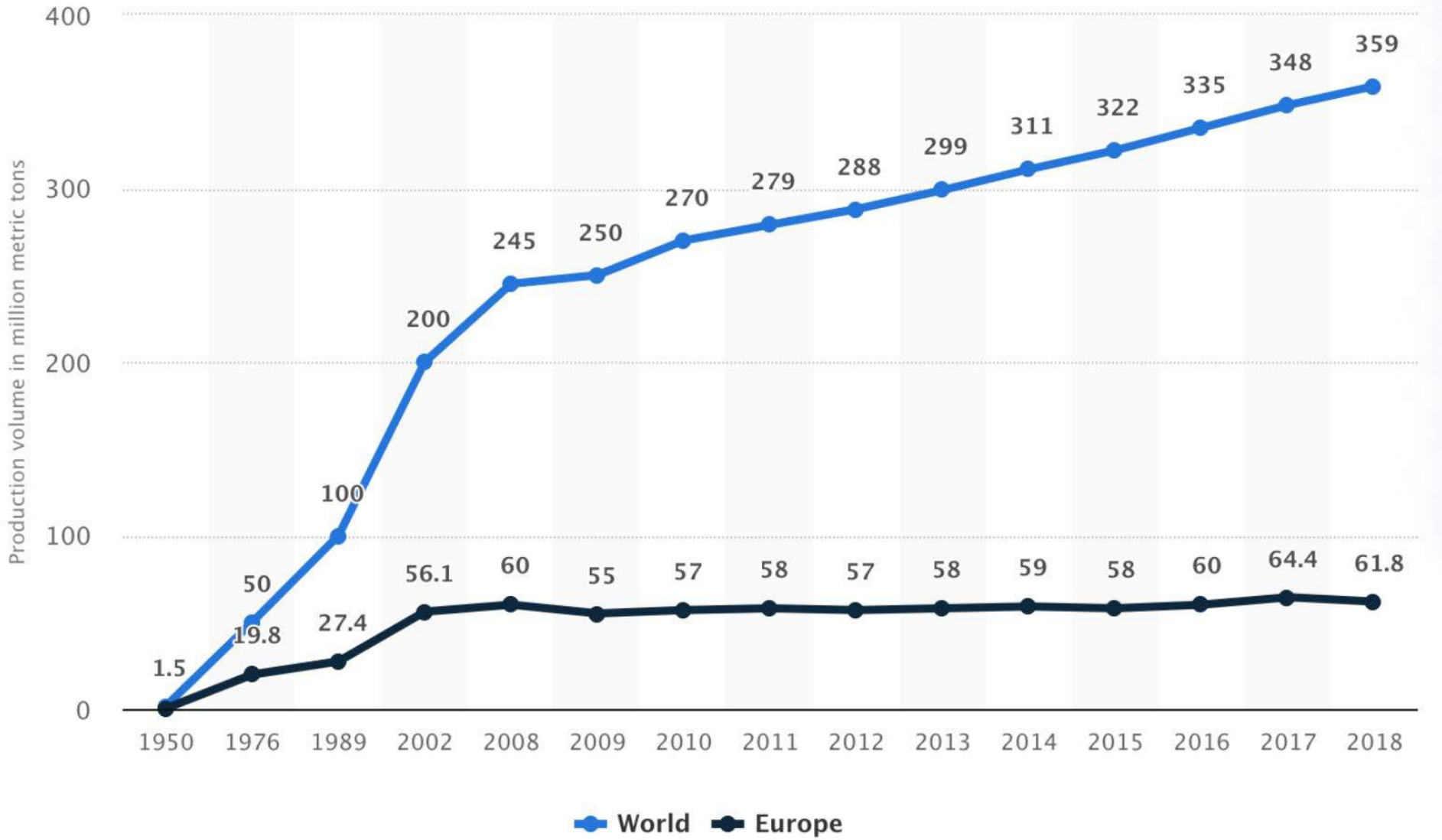
Credits: ZOE Institute

PRODUCTION OF PLASTIC

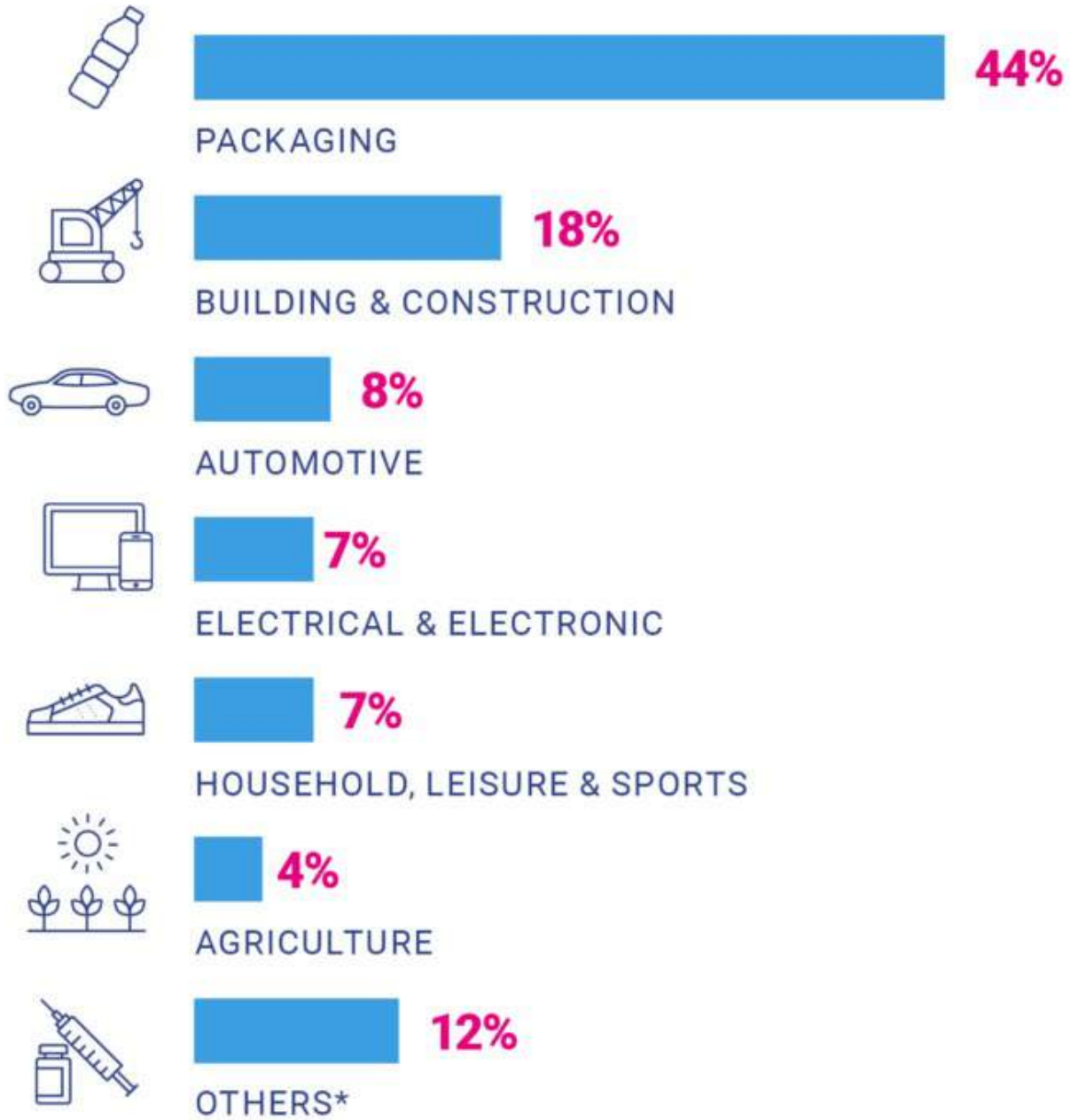
Global annual plastic production in million tonnes.



SOURCE: PLASTIC ATLAS, ASIA EDITION, 2021 | © PLASTIC SOUP FOUNDATION



Source: Statista.com, Oct. 2019

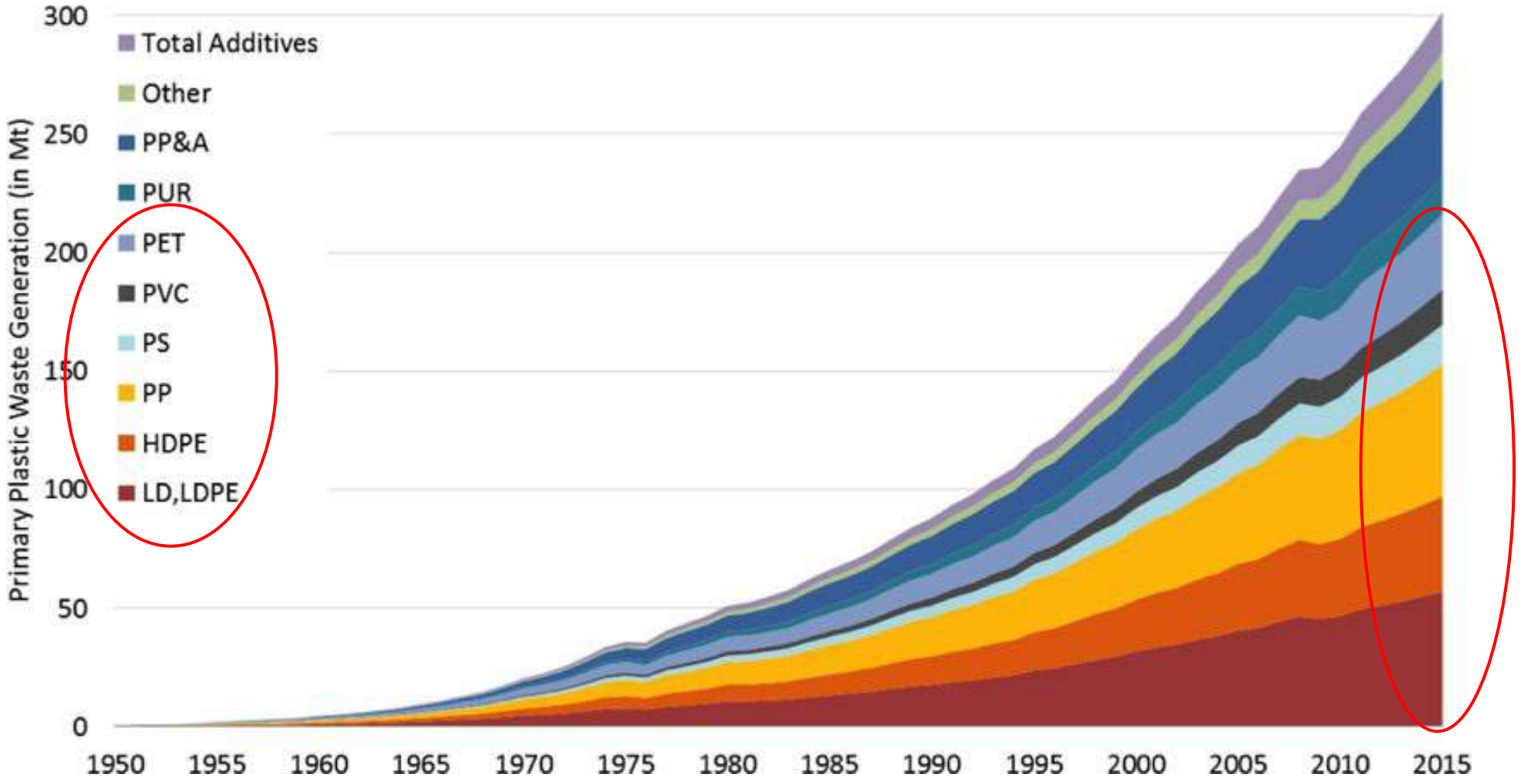


USE OF PLASTIC

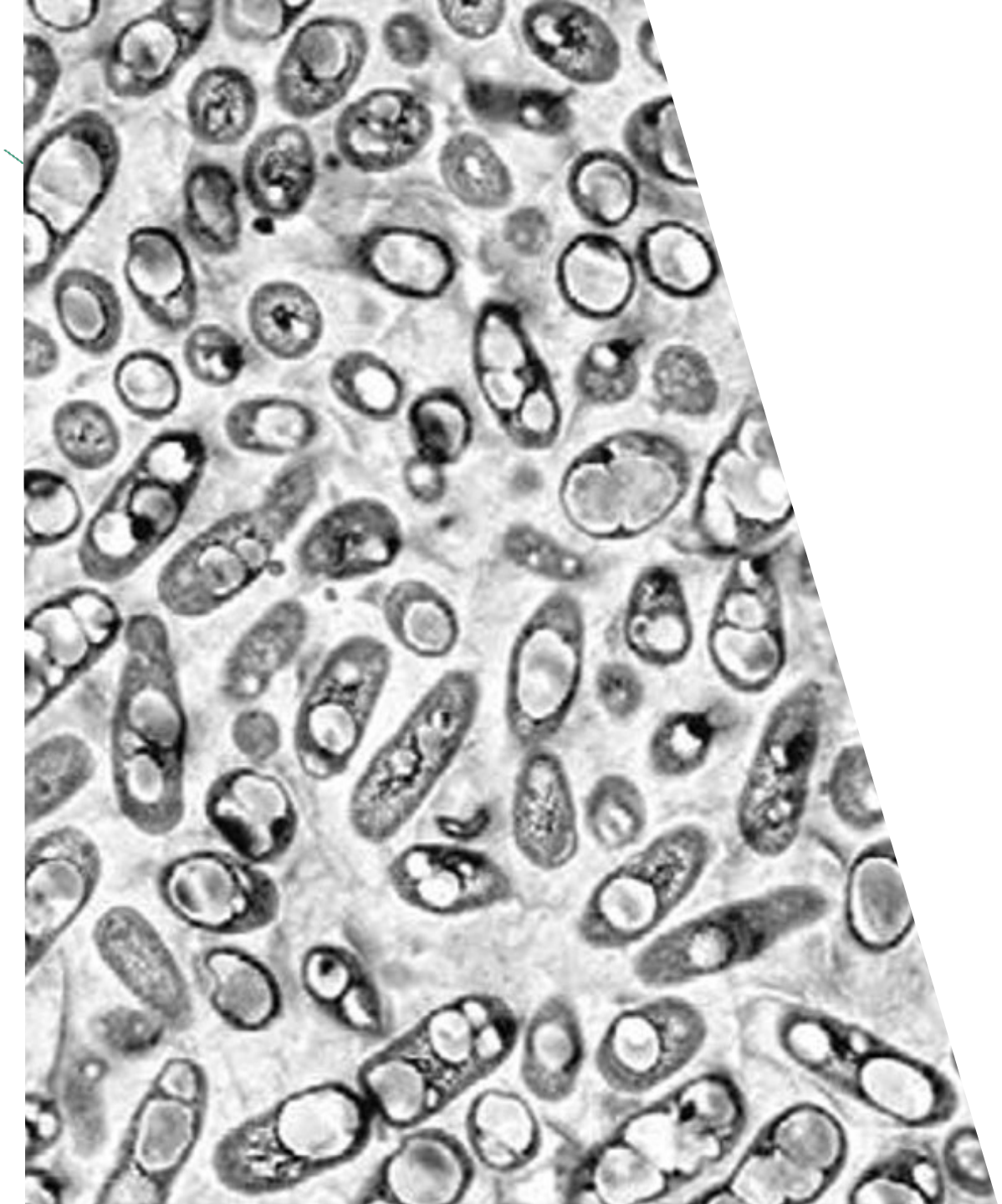
Major users of plastic in the 27 EU member states plus Norway, Switzerland and the United Kingdom per sector in 2021.

*Others include appliances, mechanical engineering, furniture, medical, etc.

SOURCE: PLASTICSEUROPE | © PLASTIC SOUP FOUNDATION



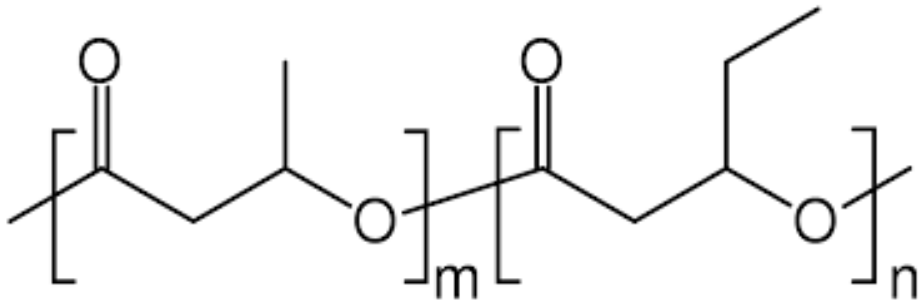
Kumagai, Shogo & Nakatani, Jun & Saito, Yuko & Fukushima, Yasuhiro & Yoshioka, Toshiaki. (2020). Latest Trends and Challenges in Feedstock Recycling of Polyolefinic Plastics. Journal of the Japan Petroleum Institute. 63. 345-364. 10.1627/jpi.63.345.



What is PHA?

- Polyhydroxyalkanoates
- Polyester
- Bacterial energy/carbon storage
- Family of co-polymers: HB, HV and HH

PHBV



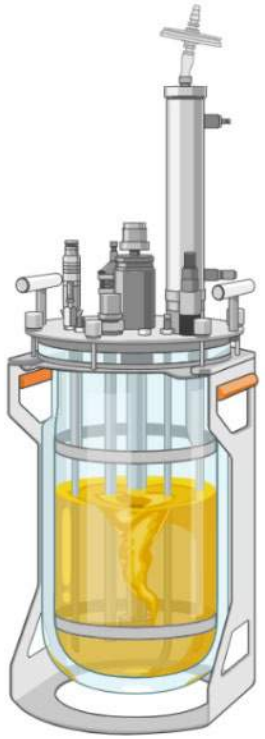
Why PHA?

- Biobased & biodegradable (soil and water)
- Biocompatible & recyclable
- UV stable & low permeability
- Wide range of applications

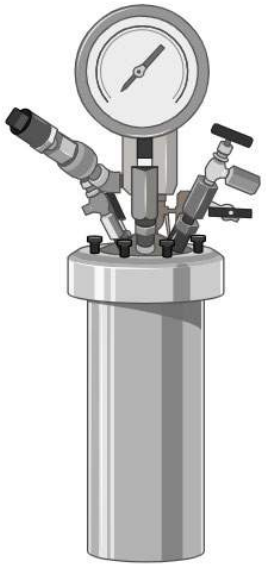
Immediate role in material transition

How is it made?

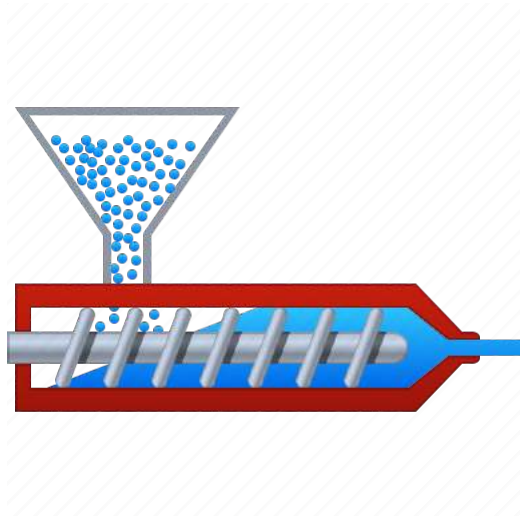
Substrate →



PHA-rich biomass →

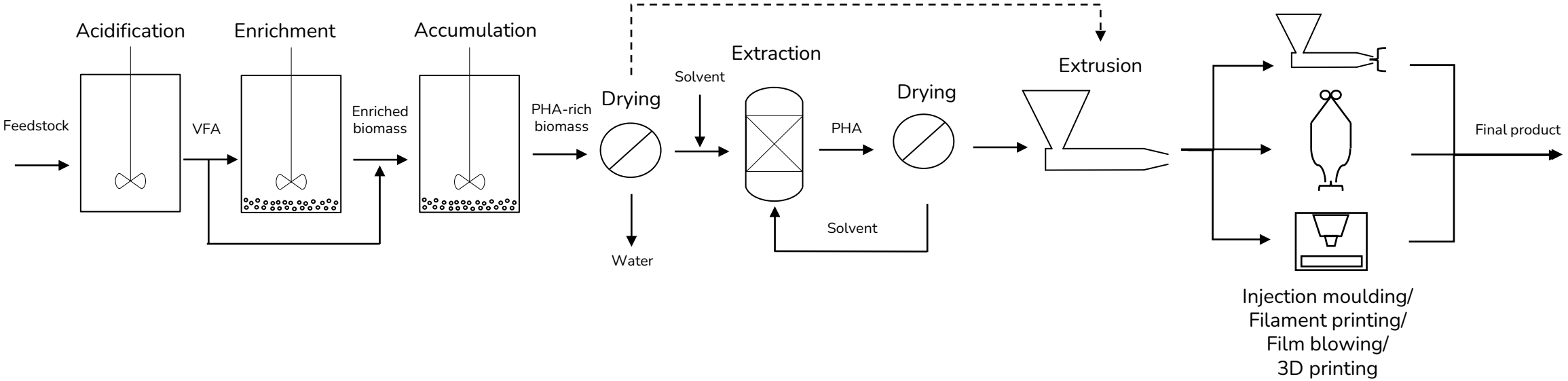


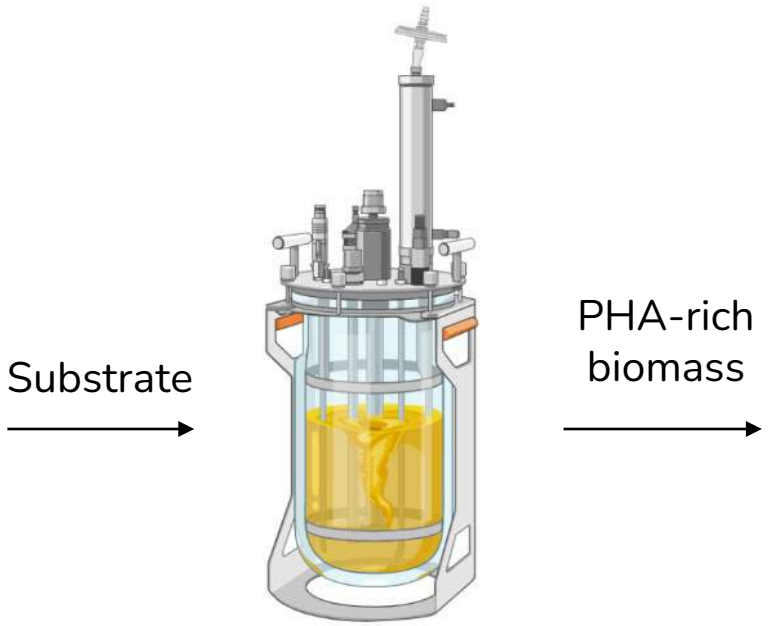
PHA →



Product →

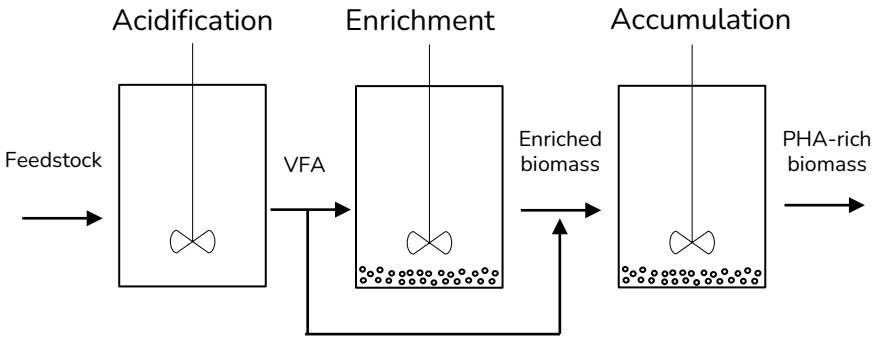
How is it made?





How is it made?

- Use of MMC
- Residual streams as feedstocks
- Fermentation strategy/optimization
- Predictable monomeric composition



Organic Acids

Formic Acid

Lactic Acid

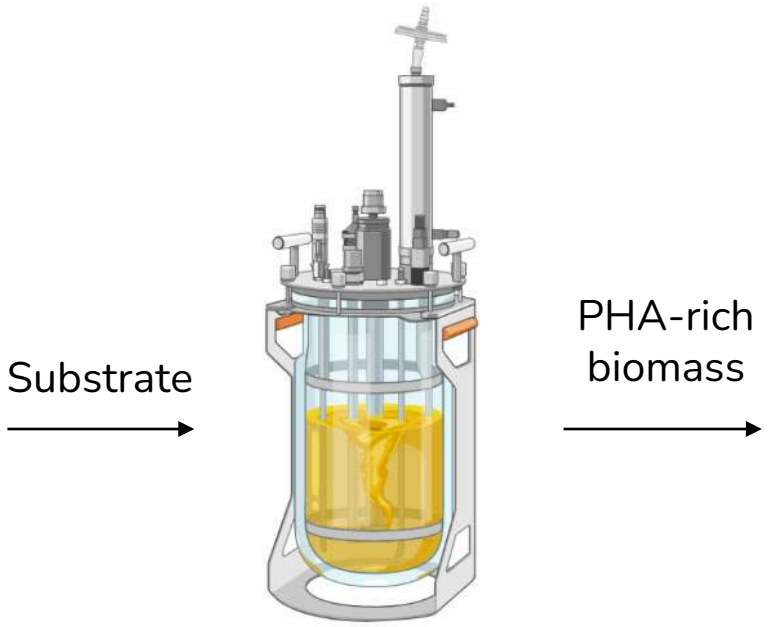
Acetic Acid

Propionic Acid

Butyric Acid

Valeric Acid

Caproic Acid



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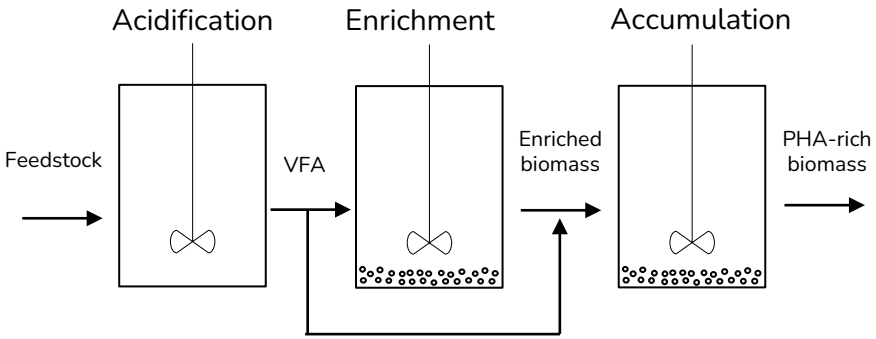
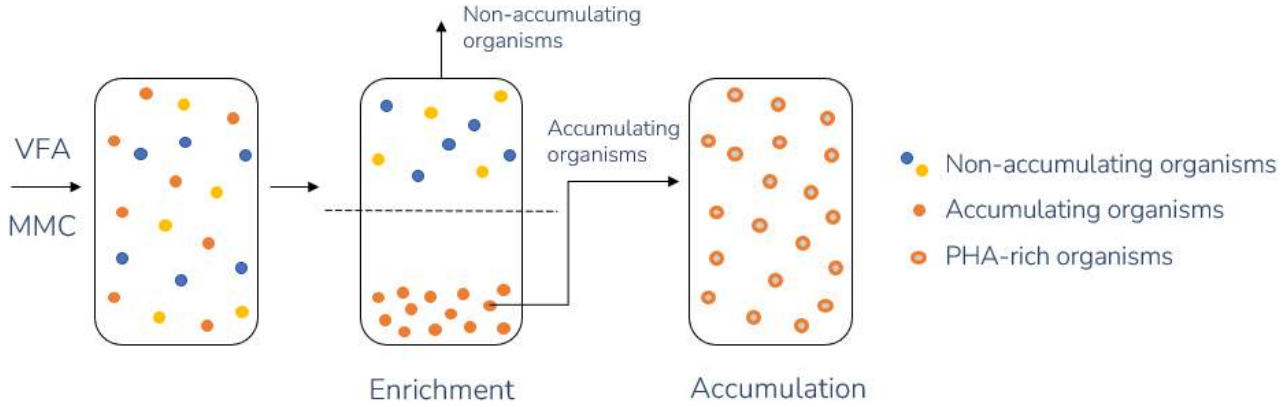
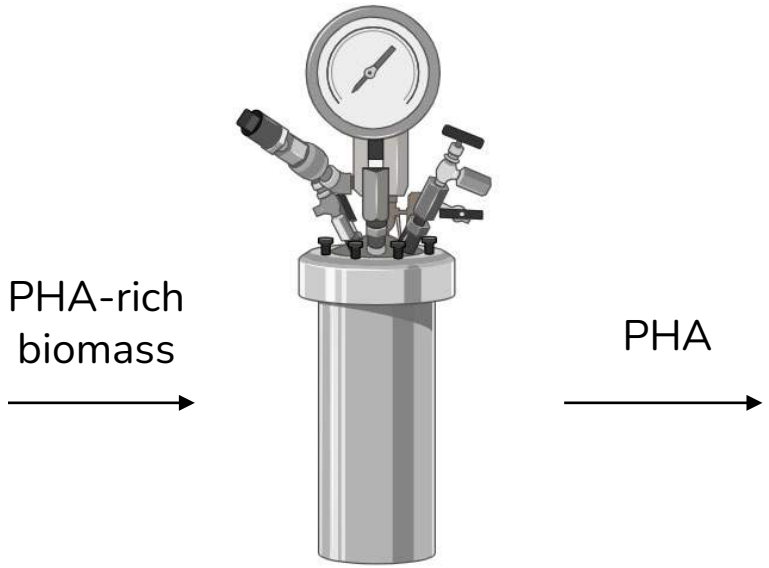
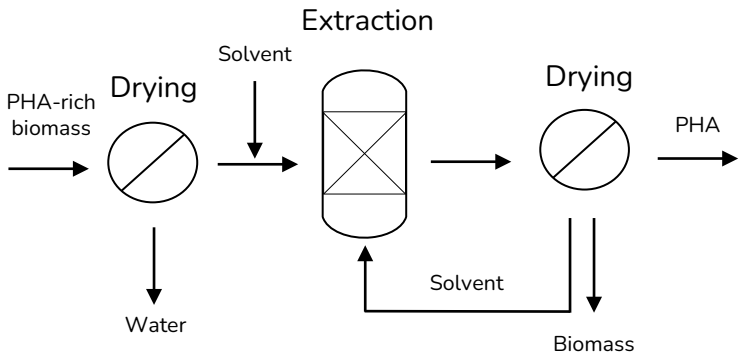


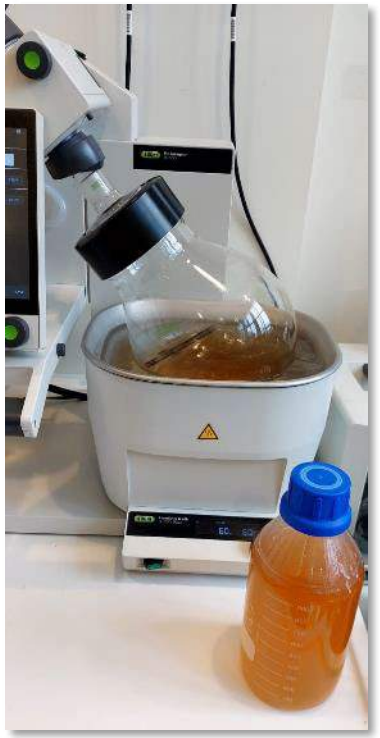


How is it made?

- Use of green solvents
- High energy demand
- Human health hazard

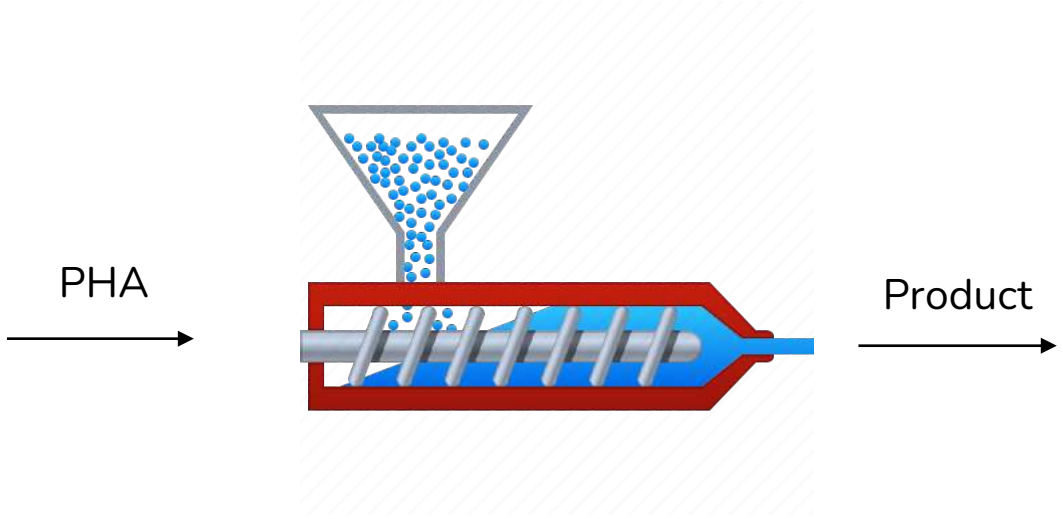


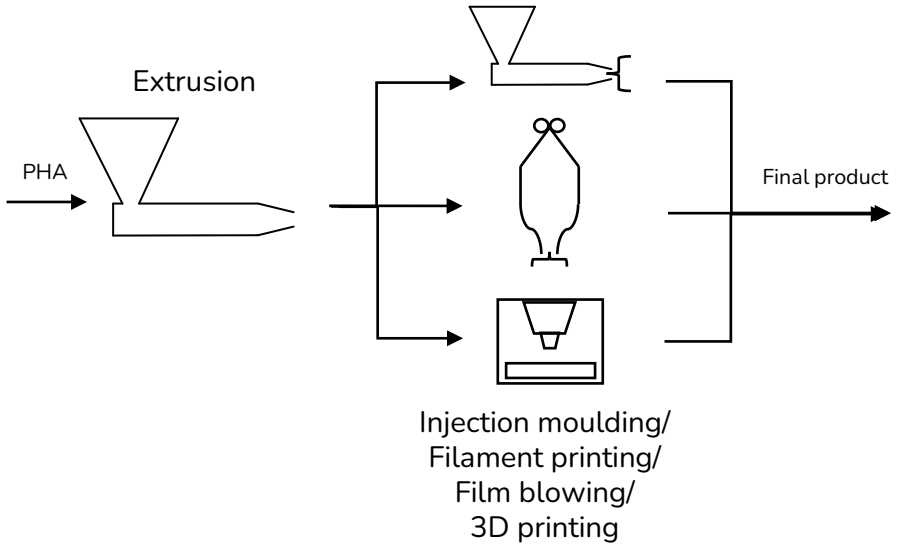




How is it made?

- Material properties
- Blends
- Targeted applications





Achieving competitiveness

Production set up:

- Feedstock costs
- Process optimization
- Fermentation technologies
- Predictable composition

↓ costs

Accessibility

Market integration

Market

- Multiple applications
- HB, HV and HH monomer
- Potential to replace conventional plastics

NEWLIGHT

danimer scientific llc

CJ BIOMATERIALS

CRAZE®

KANEKA

Green Planet

PAQUES biomaterials

Bluepha

MANGOMATERIALS

Caleyda made by nature

NaturePlast L'expert en Bioplastiques

TerraVerdae BIOWORKS

Helian Polymers Home of PHA

Product-market fit

Strict environmental regulations

Strong consumer emphasis

➢ Demand for biodegradability
- Mulching films
- Textiles
- Single-use

High-end applications = ↑ prices

➢ Requires tailored properties
- Cosmetics
- Pharma
- 3D printed materials

↑ Diverse applications = ↓ risks

➢ Stable PHA market
- Agriculture
- Medical devices
- Pharma
- Food industry
- Packaging

Heavy focus on research for PHA applications

Product-market fit

Example:

- Fertilizer coating and denitrification systems (agriculture)
- PHA leather and wigs (human contact/textile)
- Paper coating (single-use)

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Product-market fit

Example:

- PHA nanocomposites (microchips)
- Hydrogels and microspheres (cosmetics)
- Contact lenses and plastic surgery (medical)

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Heavy focus on research for PHA applications

Scaling up

- Direct supply chain to application space
- Proximity and availability of feedstock
- Heavy focus on research for PHA applications

Remark on legislation: how to tackle this issue?

What is your view?

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From lignin to bio-aromatics: Challenges and Prospects

Sandra Corderí Gándara,
Researcher Biobased Building Blocks and Products

Thursday April 18, 12:15h

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