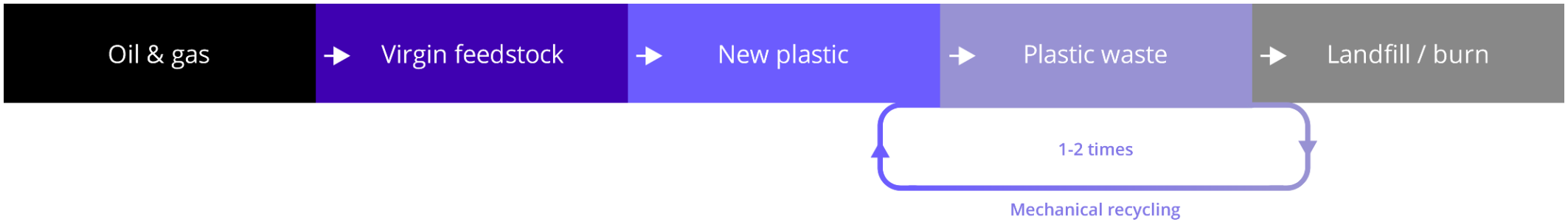
enzymity

bio-platform for true circularity of plastics

Entrepreneurship
World Cup

Contents

The global plastics economy is highly linear



Most of new plastic is still made from fossil fuels

2.5% 

Global plastic demand growth in 2018-2019

>90% 

New plastic derived from hydrocarbons

... what about recycling, doesn't it solve the problem of virgin plastic?

Recycling ≠ circularity (yet)

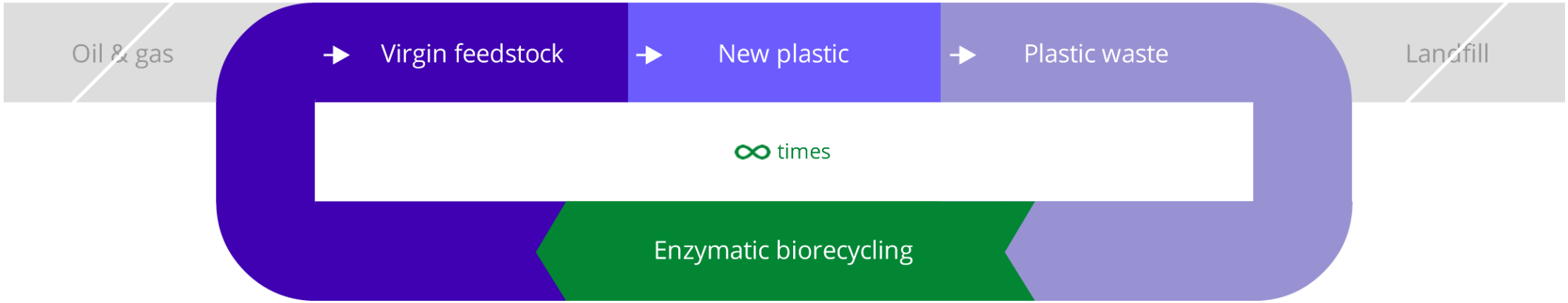
Case: EU plastics (2019, million tons)

Bio-recycling can safely replace virgin plastic

Type of recycling	Mechanical	Chemical (pyrolysis)	Chemical (depolymerization)	**Biological**
Description	Downcycling into low-value applications (1-2x)	Converting to hydrocarbons for energy recovery	Breaking down with chemical agents	Breaking down with the help of enzymes
Process outputs	Lower-quality plastic	Oils, gasses, char	Reusable monomers	Reusable monomers
Environmentally friendly?	No	No	No	Yes
Mixed plastic inputs?	No	No	No	Potentially yes
Process speed	Fast	Fast	Fast	Currently slow
Process cost	Low	Low	High	Currently high

Our goal is to increase the speed and reduce the cost

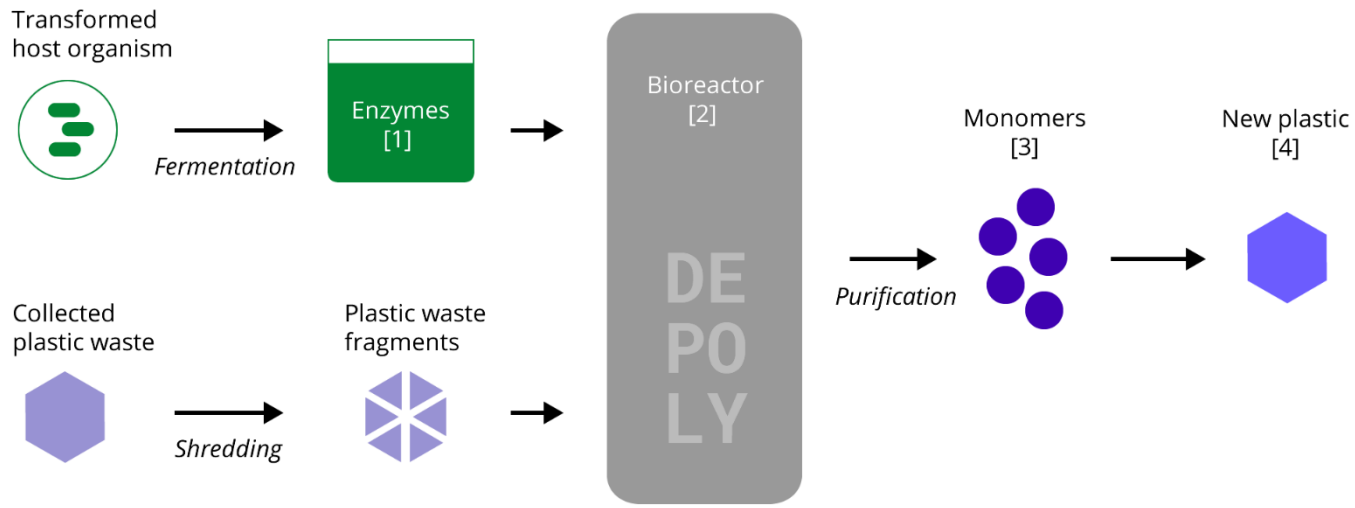
Closing the plastics loop with biotechnology



Enzymatic biorecycling using recombinant protein expression

1. Produce heterologous enzymes
2. Treat plastic waste with enzymes
3. Recover individual monomers
4. Use monomers to make new plastic

Run the cycle [2 → 4] *ad infinitum*



Making biorecycling of plastics commercially competitive

Optimize depolymerization process

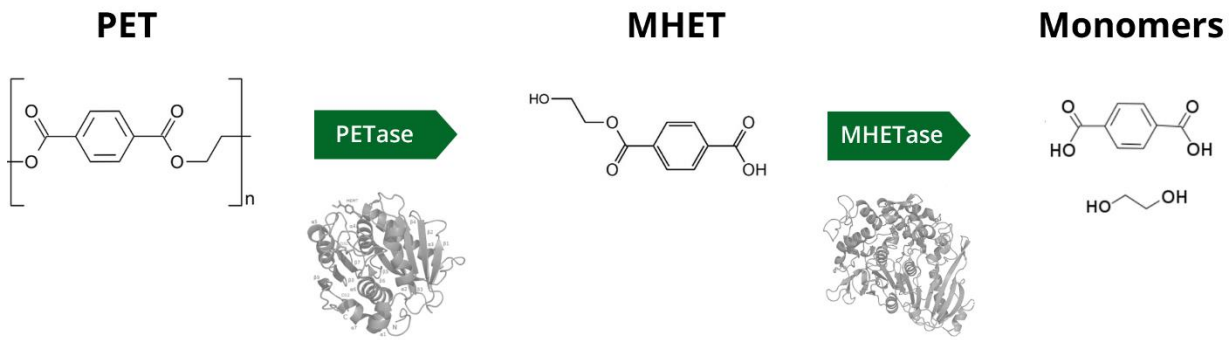
- Raise the efficiency of the enzyme mix
- Ensure reusability + stability of enzymes
- Set depolymerization reaction conditions
- Separate and purify resulting monomers

Optimize production of enzymes

- Explore host organism options
- Maximize protein expression in host
- Find the best fermentation conditions
- Ensure optimal enzyme purification

Pilot case: PET depolymerization

- Allows converting PET waste into high-quality virgin PET, **without** involving fossil fuels
- Improving on the existing body of research on the topic to take the technology to the market
- Clear **demand** from large brands with existing sustainability pledges (→ publicity, funding)



Converging pressures for better plastics recycling

Consumers agree that limiting plastic waste and increasing recycling is very important (96% EU, 43% US).

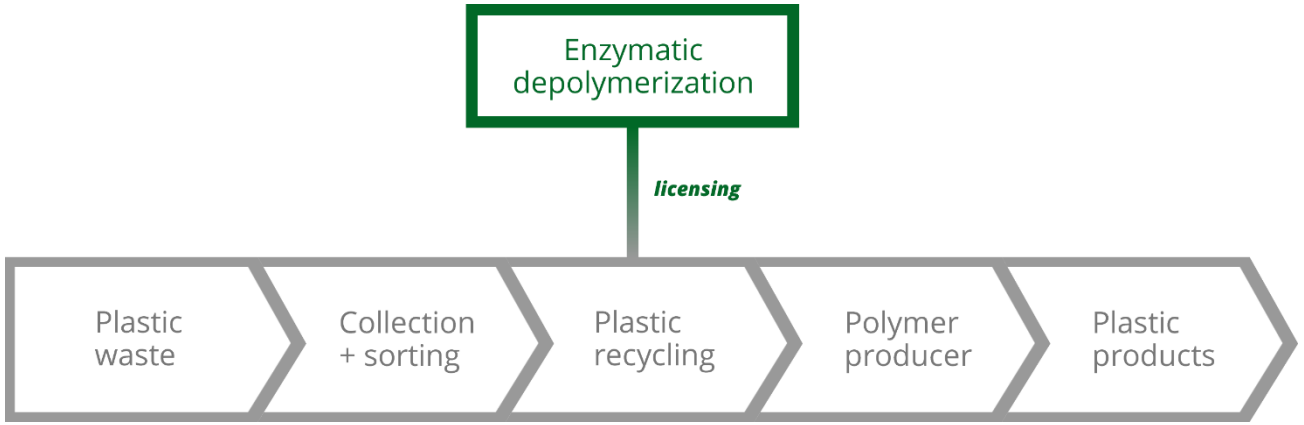
Governments are implementing plastic packaging recycling targets (50% EU, 30% US by 2025)

Brands are committing to recycled content targets:

pepsi	Nestlé	Coca-Cola	evian
25% by 2025	**30%** by 2025	**50%** by 2030	**100%** by 2025

Technology Licensing Business Model

- Secure **intellectual property** rights on core processes
- **Monetize** IP through licensing to recyclers or producers
- Expand **horizontally** to other plastic types (long-term vision)
- Potential for **vertical** integration, e.g. own recycling plants



Long-term goal: bio-platform for plastics circularity

Making any plastic waste (truly) recyclable

- Enzyme combinations for **different plastic types**
- Monomer recovery from **any plastic waste mix**

Ultimate goal – safely closing the plastics loop:

- Minimize production of new fossil fuel based plastic
- Redirect all plastic waste back into the economy

1. solve plastic recycling
2. make plastics truly circular
3. recover historical plastic waste (?)

2021 Goal: lab-scale prototype /TRL6

Q3 2020: Background research, market analysis

Q4 2020: Assembling the team, expert consultations, feasibility studies

Q1 2021: Preparatory work for product demonstration

Q2 2021: Producing enzyme samples (case: PET)

Q3 2021: Optimizing enzyme mix and recombinant production for PET depolymerization

Q4 2021: Optimizing depolymerization process parameters

2022: Seed financing; pilot plant for mid-scale demonstration, first customers

2023: Extending technology to other types of plastics (PE, PP, PVC); scaling up

Interdisciplinary team based in Riga

Andrii Shekhirev

Startups, business development

M.Sc. International Business & Finance

Aleksejs Kolpakovs

Cross-functional leadership, finance

M.Sc. Innovation Management

Elina Dace

Circular economy and sustainability

Ph.D. Environmental Engineering

Egils Stalidzans

Computational systems biology

Ph.D. Computation & Automation

Janis Liepins

Microbial growth and metabolism

Ph.D. Microbiology & Biotechnology

Filips Oleskovs

Heterologous protein production

M.Sc. Biotechnology & Molecular Biology

Access to key infrastructure, knowledge, and talent

UNIVERSITY OF LATVIA

Institute of Microbiology and Biotechnology at the University of Latvia, 7 research groups

Biotehniskais Centrs

Biotehniskais Centrs, leading producer of lab and industrial bioreactors in Eastern Europe

BIOCATALYST INNOLAB

Biocatalyst Innovation Lab, the first biotechnology enthusiast community in the Baltic States

Why Invest

Enzyme based bio-platform for true plastics circularity

- Full plastic **upcycling** into reusable monomers
- **Patentable** technology, building on existing research
- Growing **pressure** to improve recycling from consumers and governments worldwide
- High **demand** for better plastics recycling technologies from some of the largest brands
- Globally **scalable** with potential for decentralization
- Experienced, interdisciplinary team **passionate** about solving the plastics challenge
- Significant long-term **sustainability** benefits (United Nations SDGs #12, #13, #14)

Thank you!

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Sources & References

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