

Enzymatic Upcycling as a Key Driver for the Plastics Circular Economy



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ESTER Biotech



Foundation in Q1 2025

20 years research experience at location



EXIST *Forschungstransfer*

> 1 Mio. € public funding



5 Team Members

Interdisciplinary



2 Patents + 1 in Application

IP Transfer in realization



BioCity in Leipzig, Germany



Bioeconomy Accelerator

Bits & Pretzels Top 50



Bundesministerium
für Wirtschaft
und Klimaschutz



Funded by the
European Union

eXIST
Existenzgründungen
aus der Wissenschaft

Status quo of the plastics industry

Fossil-based sources

> 10 % of global oil and gas is used for plastic production



Geopolitical Risks due to Dependence on Fossil Fuels

Downcycling

< 10 % globally
< 20 % in EU



Negative Climate Impact
> 3 % CO₂ emissions

Incineration

> 80 mil. tons per year

Landfilling

> 100 mil. tons per year

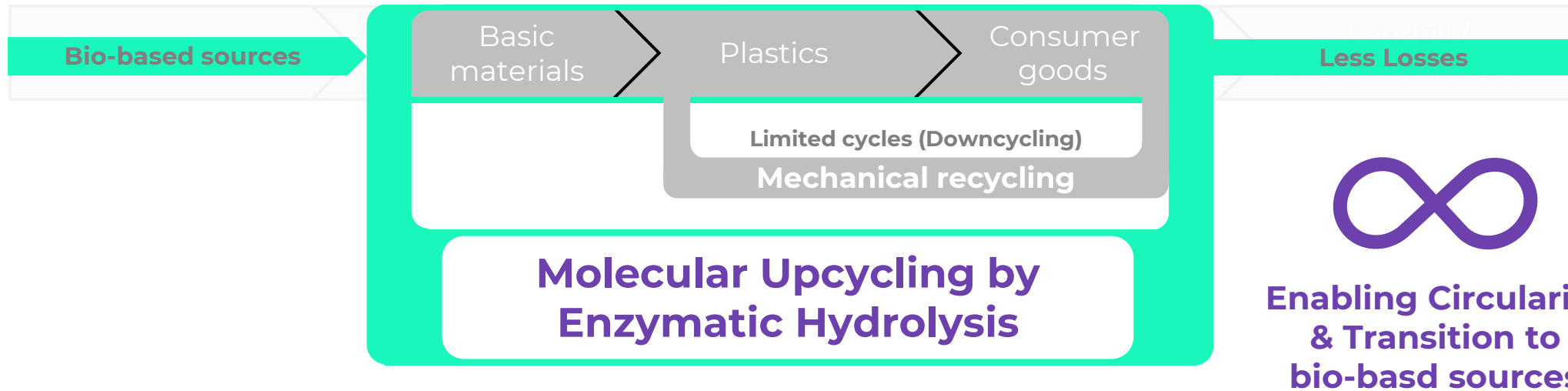
Environmental Losses

> 50 mil. tons per year

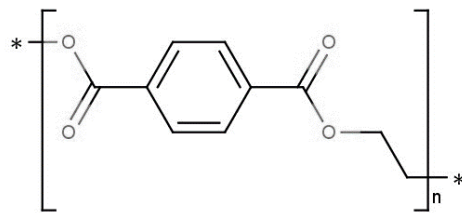


Pollution
~ 3 bn. tons in nature

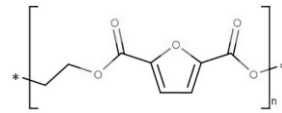
Plastics Circular Economy through Enzymatic Upcycling



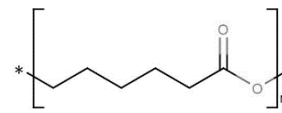
Suitable for all Types of Polyesters



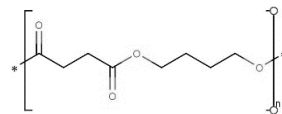
PET



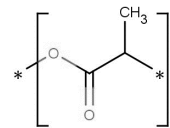
PEF



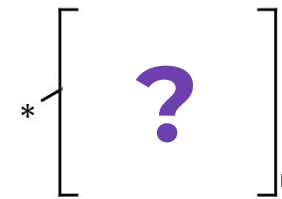
PCL



PBS



PLA



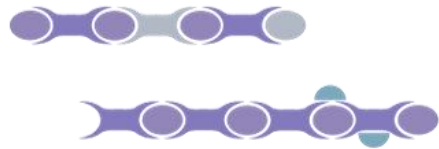
New Polymers

#Desgin4Recycling

Solution

Plastics

Polyester



Biocatalyst

Enzyme



Basic building blocks

Monomers



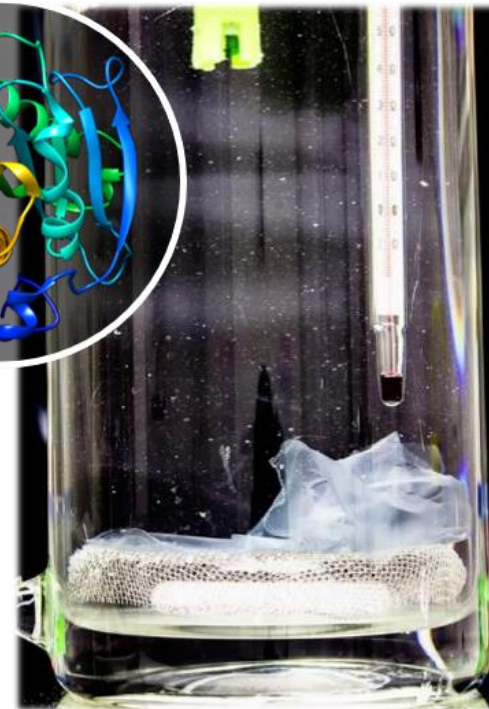
**Separated impurities /
Other plastic types**



1 h



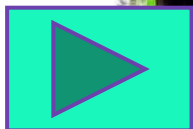
4 h



8 h



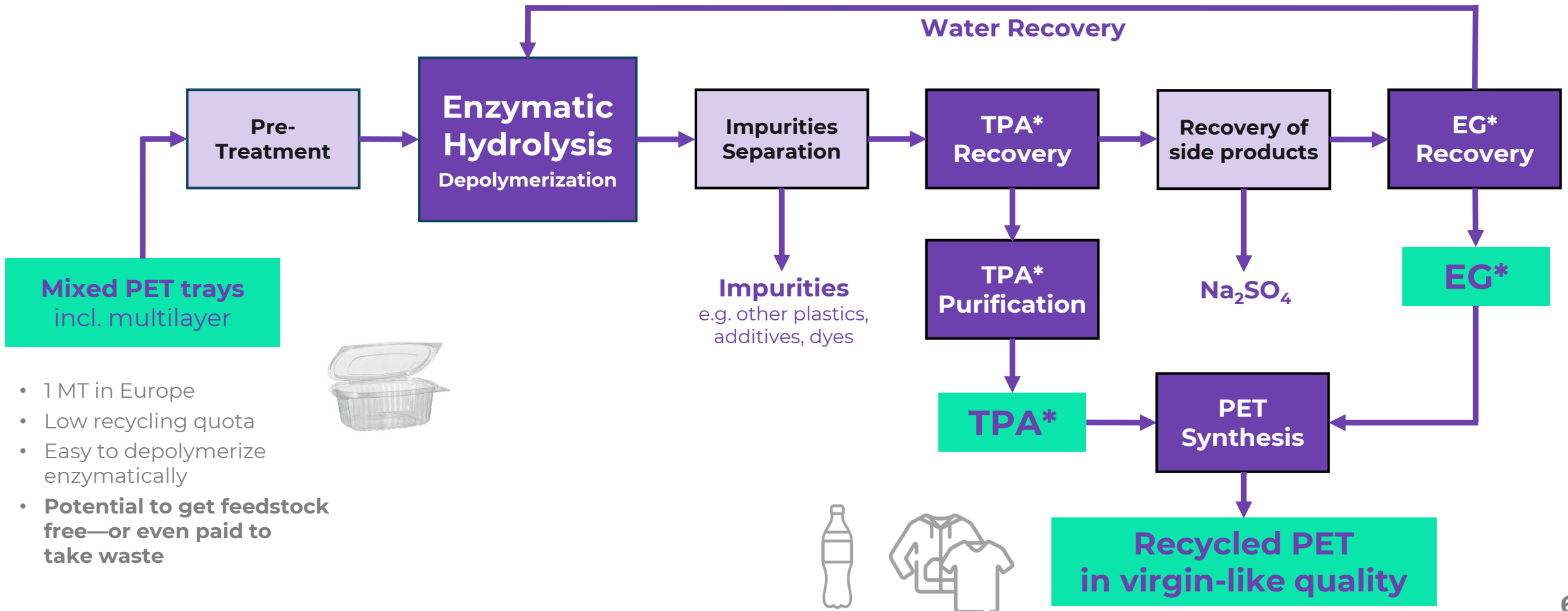
12 h



[Link to
video](#)

Enzymatic Upcycling Process Chain

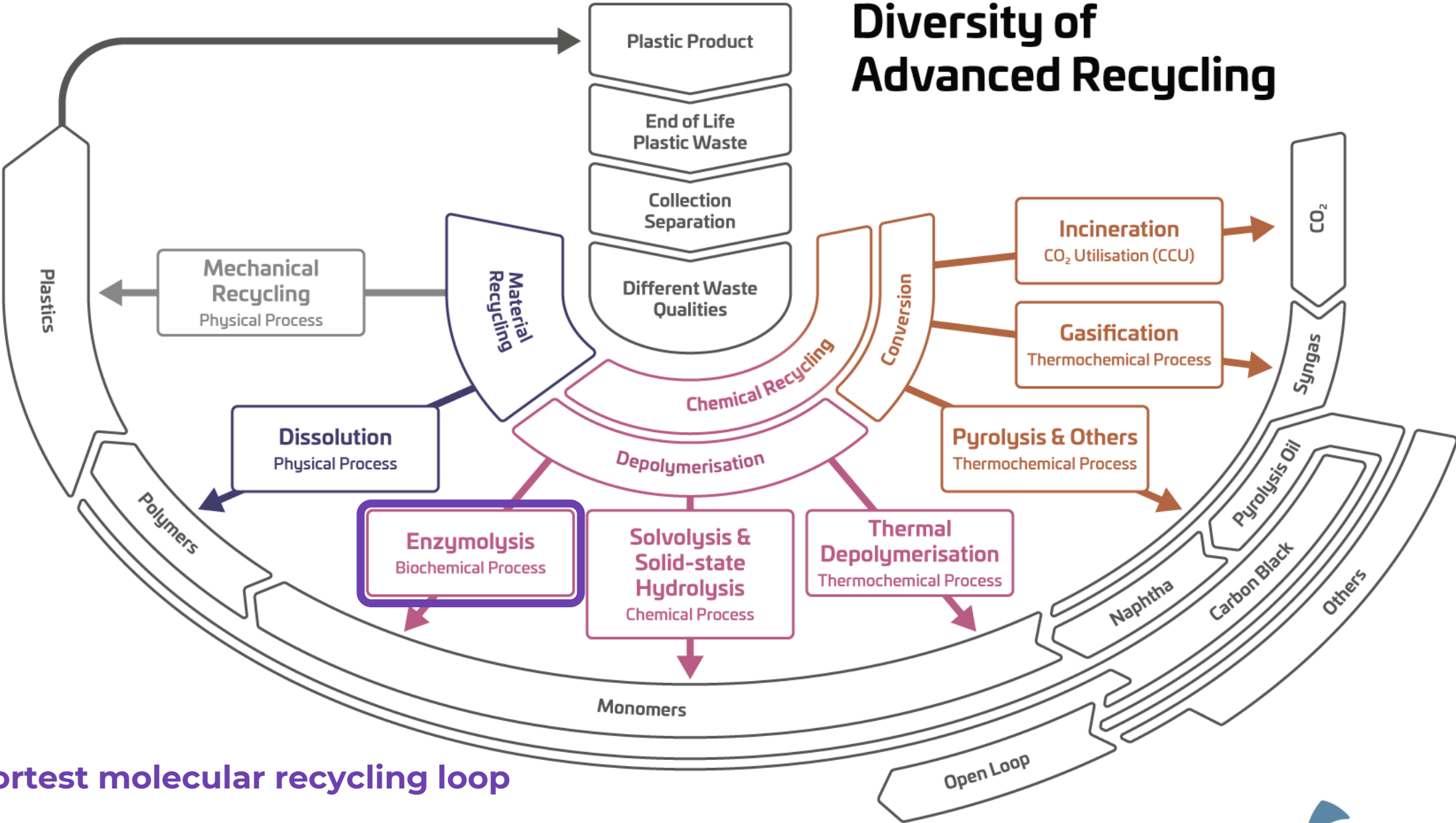
using the example of PET trays



- 1 MT in Europe
- Low recycling quota
- Easy to depolymerize enzymatically
- **Potential to get feedstock free—or even paid to take waste**

* TPA – Terephthalic Acid / EG – Ethylenglycol

Diversity of Advanced Recycling



Shortest molecular recycling loop

Advantages of Enzymatic Recycling



Recyclate in high Quality
Food-safe / full creditability to quotas



Low Energy Requirements
Waste heat suitable



Insensitive to Impurities
Separation of foreign material



Multilayer Capable
Proven for PE/PET



Lean Pre-Treatment
Focus on amorphous structures



Efficient Depolymerization
> 20 $\mu\text{m}/\text{h}$ für PET



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specific advantages

Enzymatic Hydrolysis has strong potential to become the most cost-efficient and eco-friendly molecular recycling process.

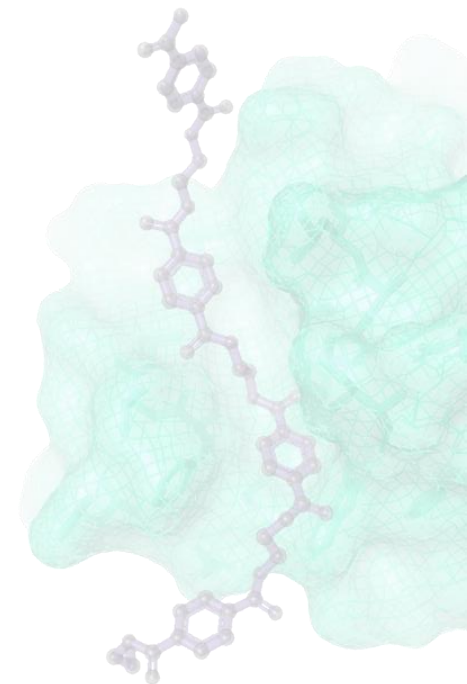


Cost parity with virgin PET realistic in the 2030s



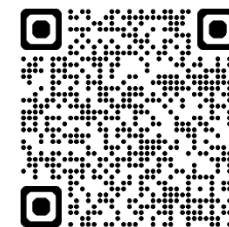
Net Zero Potential

Thank you for your attention!
Feel free to ask questions.



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