Safripol Sustainability Conference 2024

Sustainable Plastics. NOW!

Maarten Stolk

Ioniqa Technologies b.v. / Denua

Denua

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Potential of a Circular Economy

And the role of plastic recycling

Circular Economy

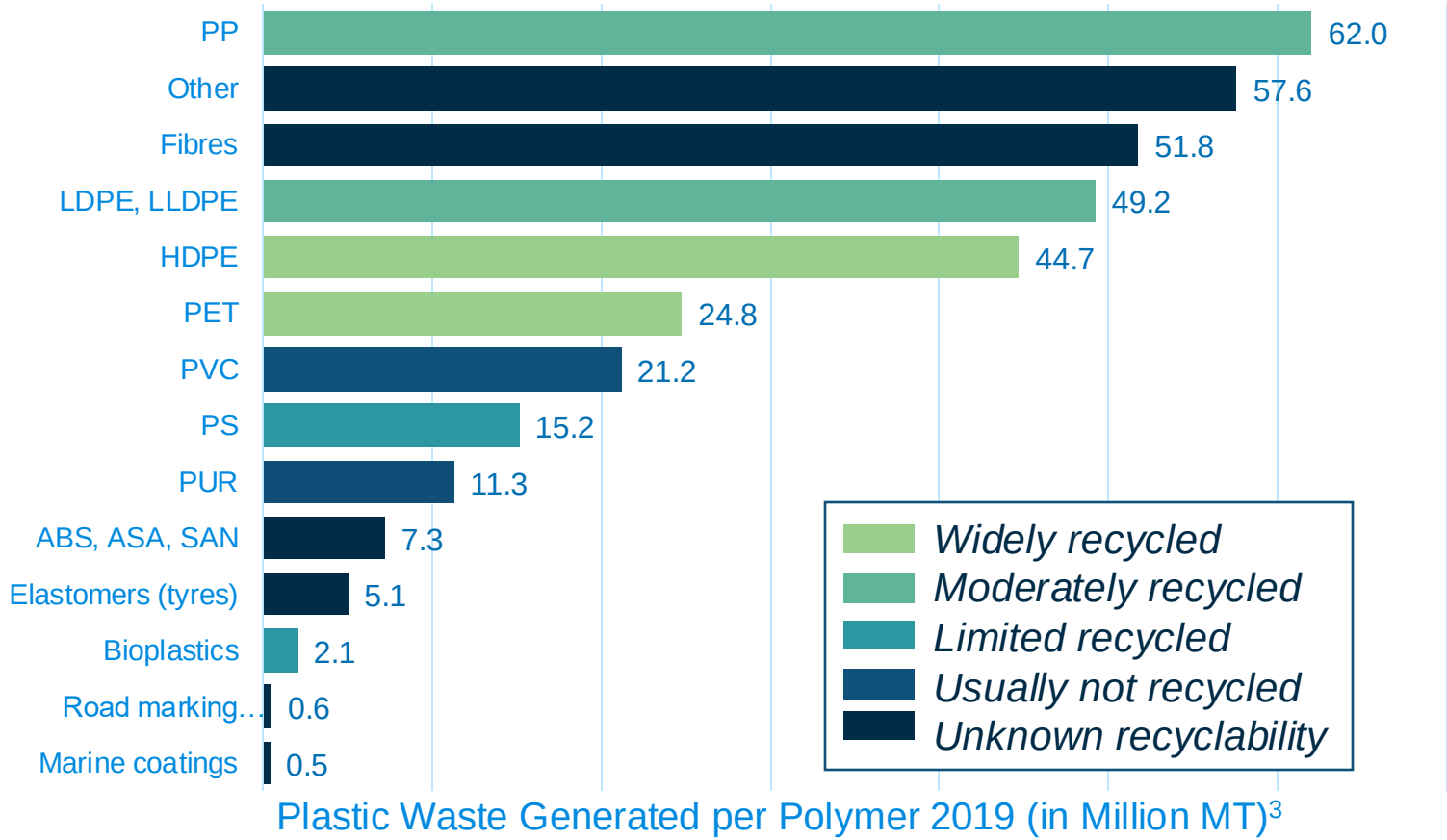
1. Preserve and Enhance Natural Capital
2. Optimize resource use by maximized circulation of products, components and materials
3. Eliminate unintended negative consequences of production

Current situation

1. Every year, some $2.6 trillion worth of material in fast-moving consumer goods – 80 percent of the material value – is thrown away and never recovered.[1]
2. The OECD states that in 2019 we generated over 350 MM MT of plastic waste globally.[2]

What do we throw away

Globally ~10% recycled



Plastic Waste Generated per Polymer 2019 (in Million MT)[3]

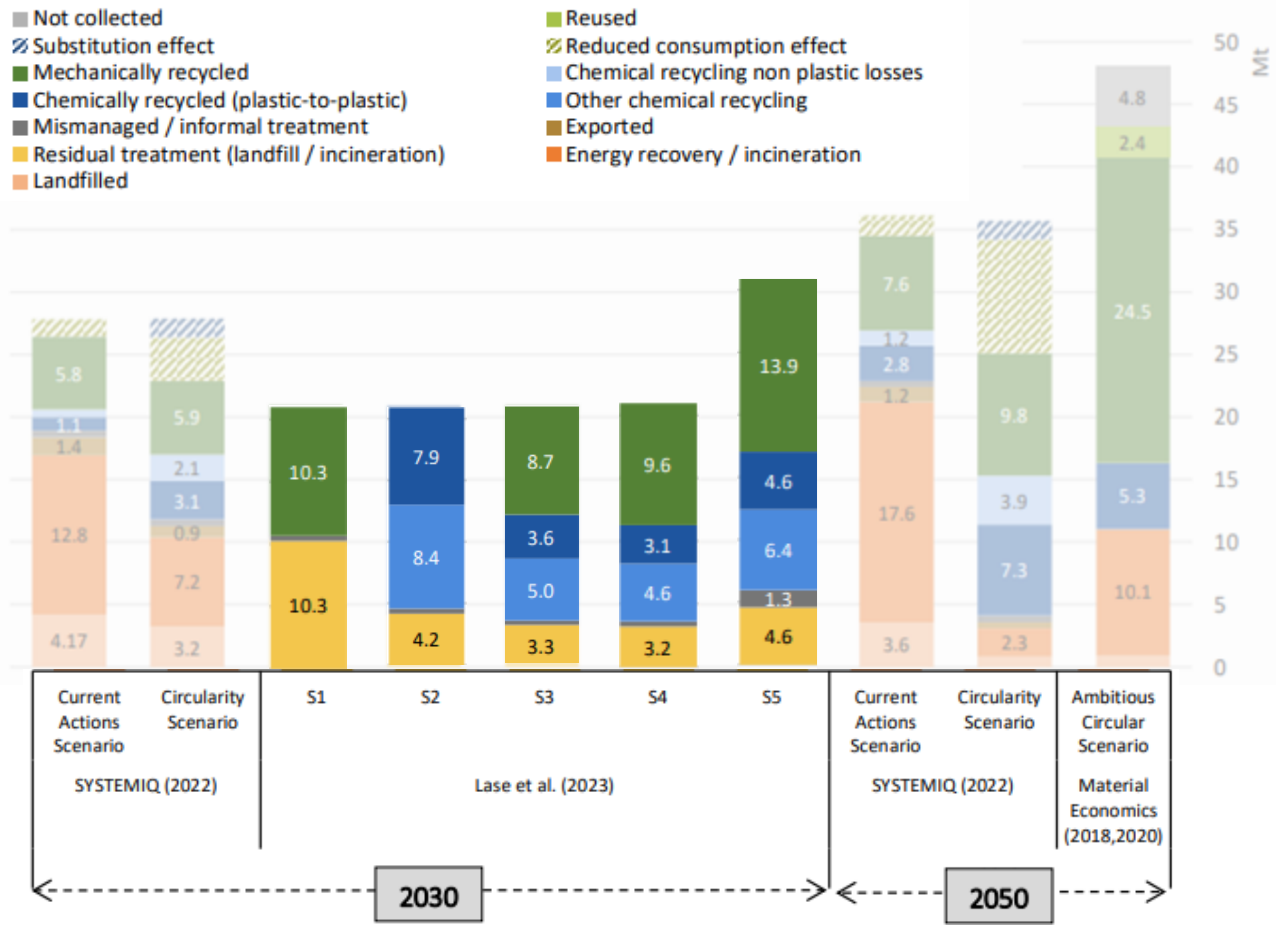
Est Price[4] USD/kg	Value waste (resin based) Bln USD	Green premium 15[5] – 45%[6]
1.40	86.8	13.0 – 39.1
-	-	-
1.52*	78.7	11.8 – 35.4
1.40	68.9	10.3 – 31.0
1.40	62.8	9.4 – 28.2
1.52	37.7	5.7 – 17.0
1.23	26.2	3.9 – 11.8
2.22	33.6	5.0 – 15.1
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

** = assumption made that fibers are PET*

Potential of Plastic Recycling

And the role of enhanced recycling[7]

1. **Recycle more**
2. **Less incineration / landfilling**
3. **Enable upcycling, that can be easier recycled**
4. **Contribute to reducing CO_2 emissions[8]**



Increasing recycling: long way to go

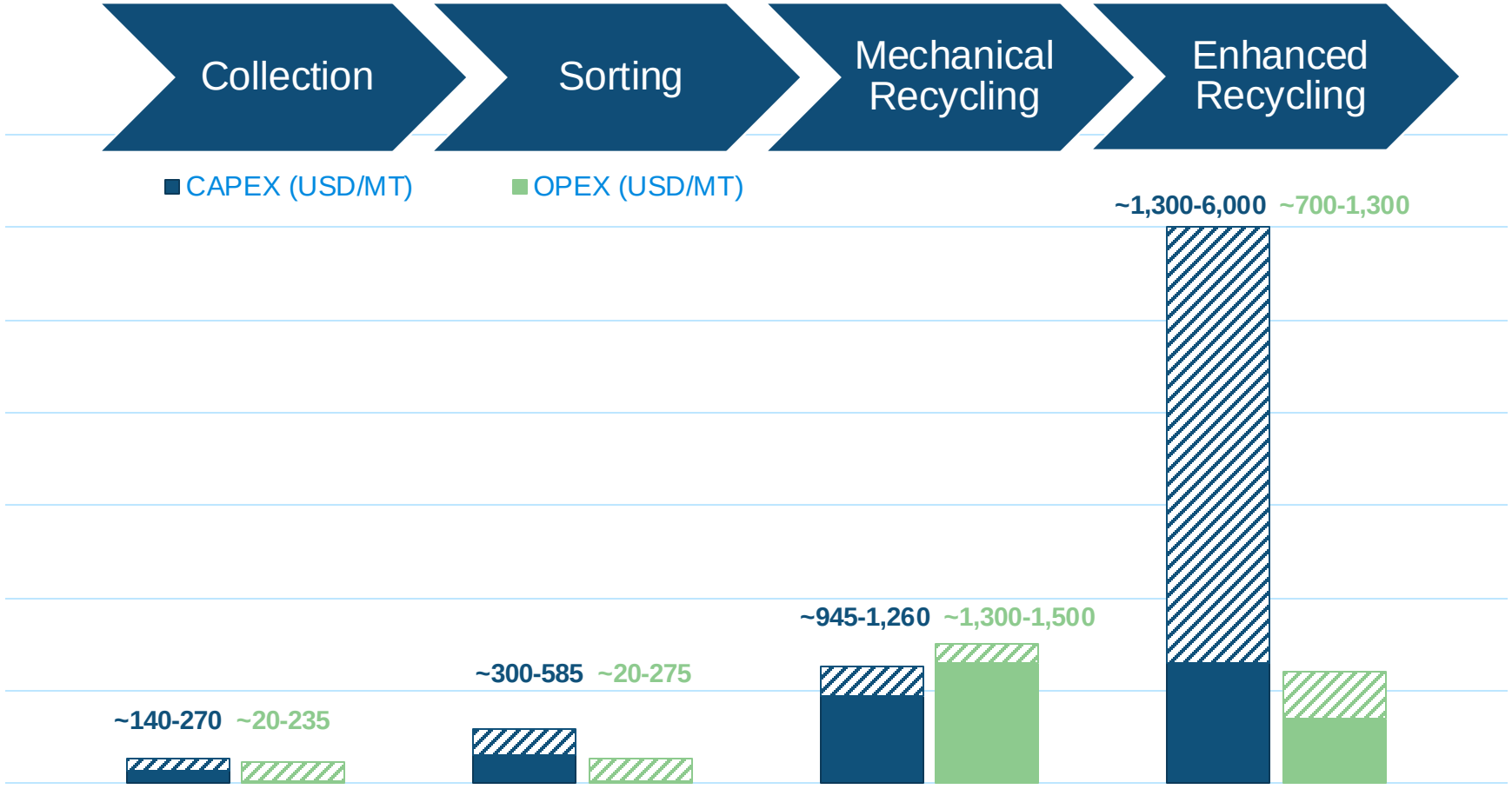
‘Globally 20-30% recycled content for packaging in 2030, not realistic’

2030 Target	**~27 Mln MT/A** additional capacity		**~8 Mln MT/A** additional capacity	**~14 Mln MT/A** additional capacity
Needs: Increase recyclate content to ~4% to 13%	• Triple 2020 capacity to meed demand • Promote separated collection • Material focussed MRF (eg PRF)	• Develop sorting beyond bottles	• Double 2020 capacity to meet ~42% of the required global recycling capacity • Promote and improve closed loop recycling when possible	• Most enhanced recycling capacity to be build by 2030

McKinsey study[9], focussed on Packaging

Investments needed

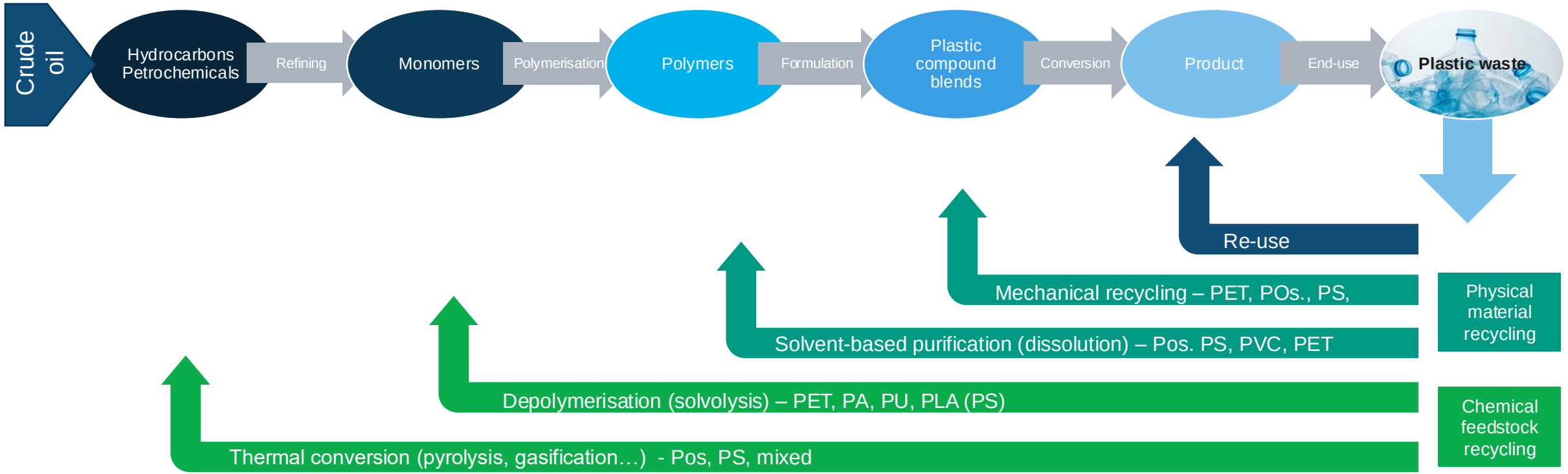
Nothing comes for free



McKinsey study[9], focussed on Packaging

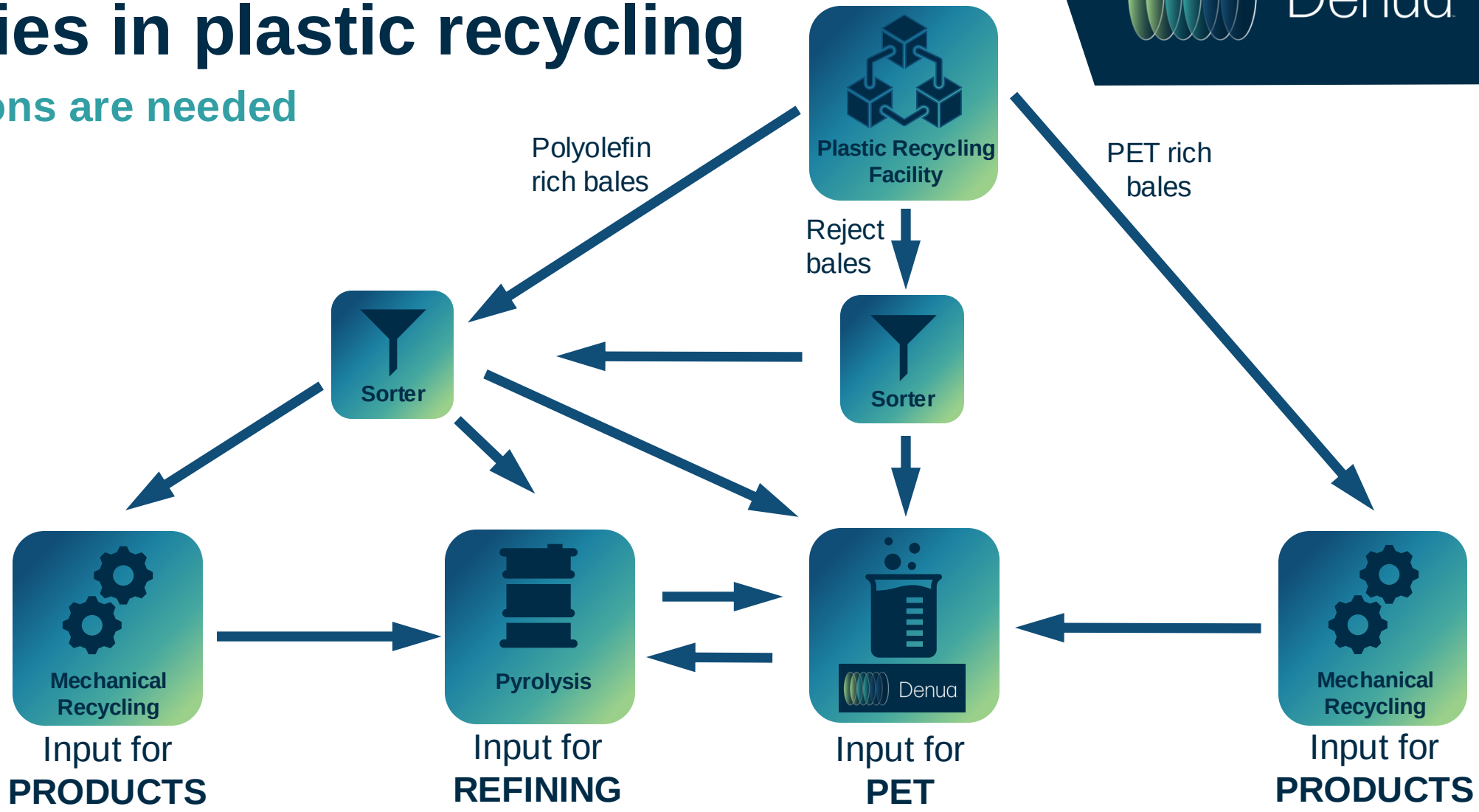
Plastic recycling

Not that simple



Synergies in plastic recycling

Collaborations are needed



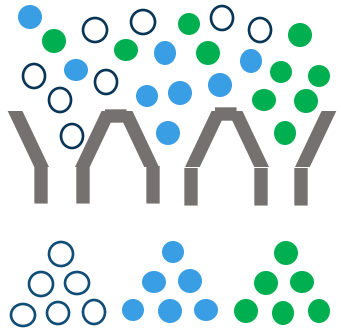
Limitation Mechanical Recycling

Down-cycling of PET material

Max. 6 times

Like for Like

No Multilayer
No Non-Food Material
No Mixed Colours

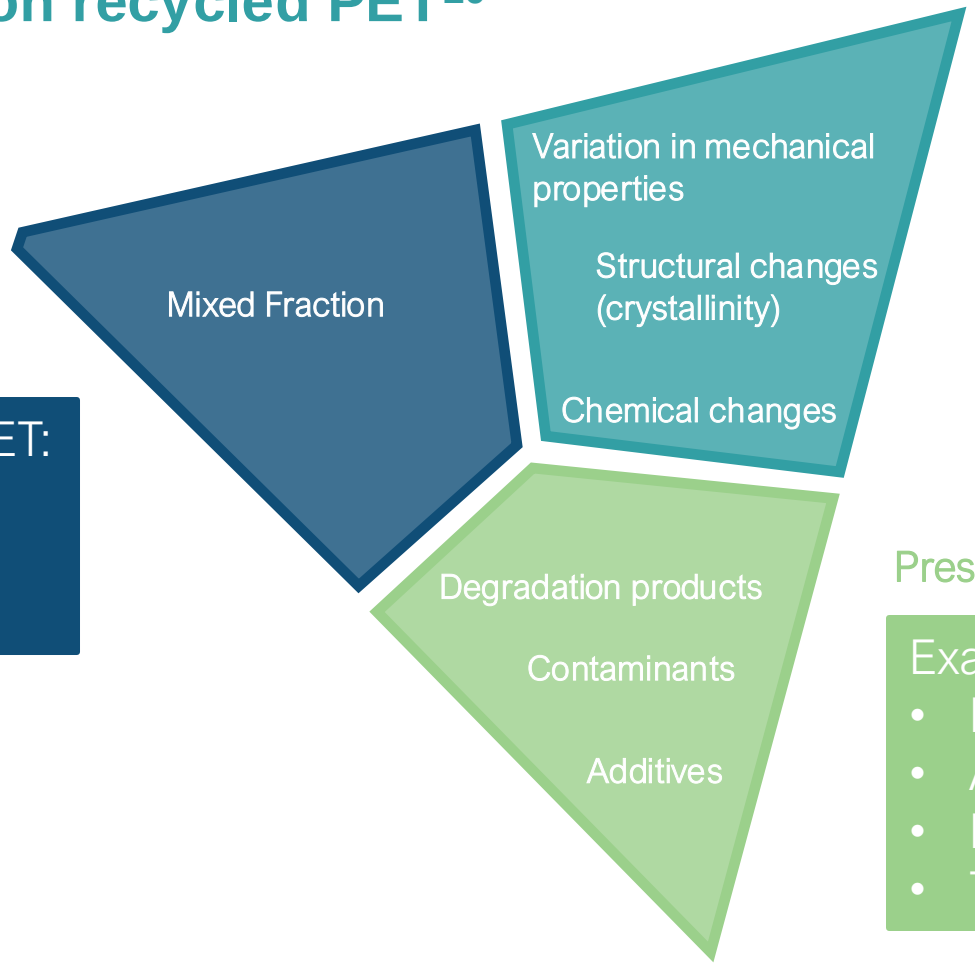


Bottle to Bottle Traceability of high-quality materials
Only flakes

Limited Volumes

Contaminations in PET waste streams

Impacting factors on recycled PET[10]



Degree of Mixing

Examples of non-PET:
- PE/PP
- Aluminium
- Wood/paper

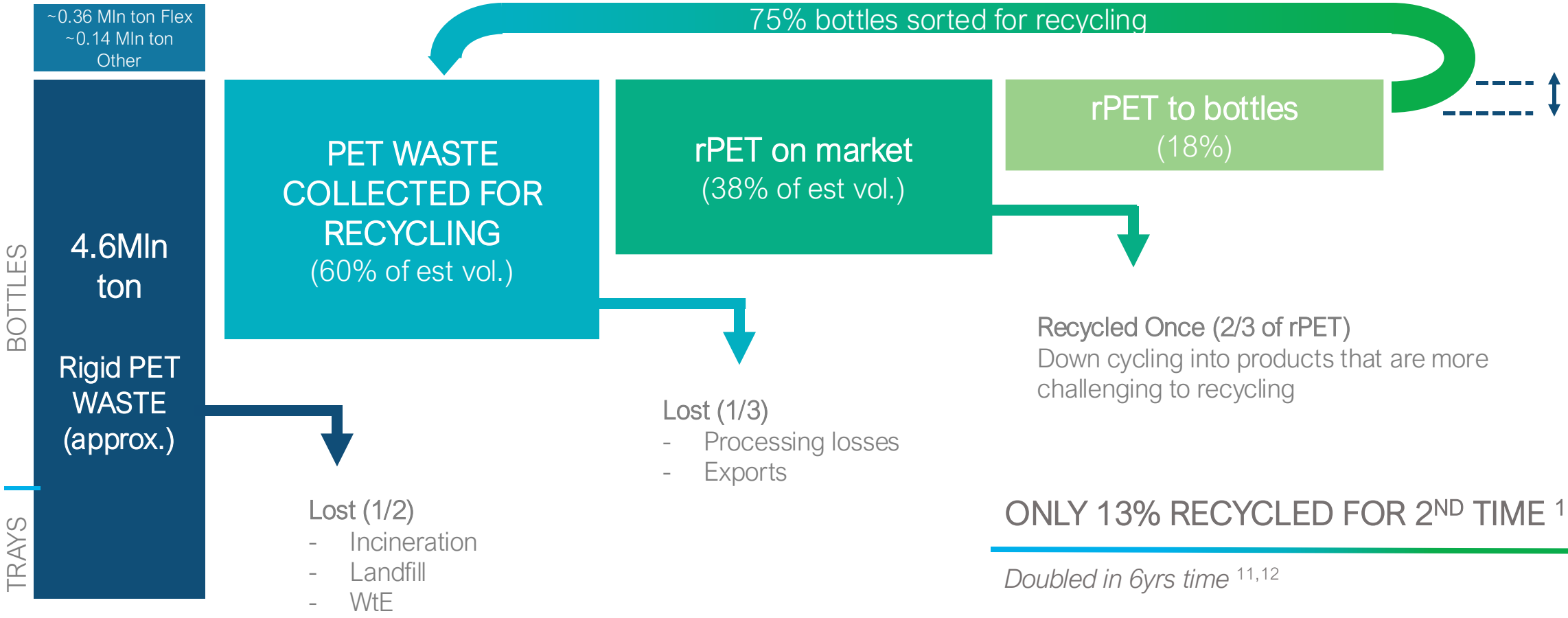
Degradation

Examples of degradation:
- Photolytic, UV light
- Hydrolytic, water

Presence of low Molecular Weight

Examples of low mol compounds
- Dyes (mainly anthraquinone)
- Acetaldehyde
- Polymerization catalysts (Sb)
- Titanium Dioxide (turbidity)

Europe and PET recycling



ONLY 13% RECYCLED FOR 2ND TIME [11]

Doubled in 6yrs time [11,12]

European Market

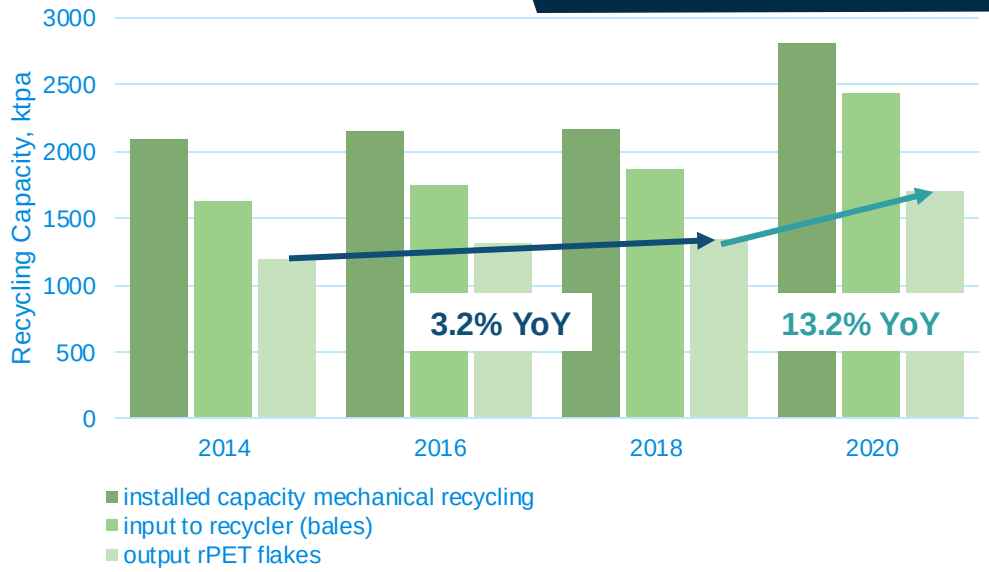
Utilise more waste streams [11]

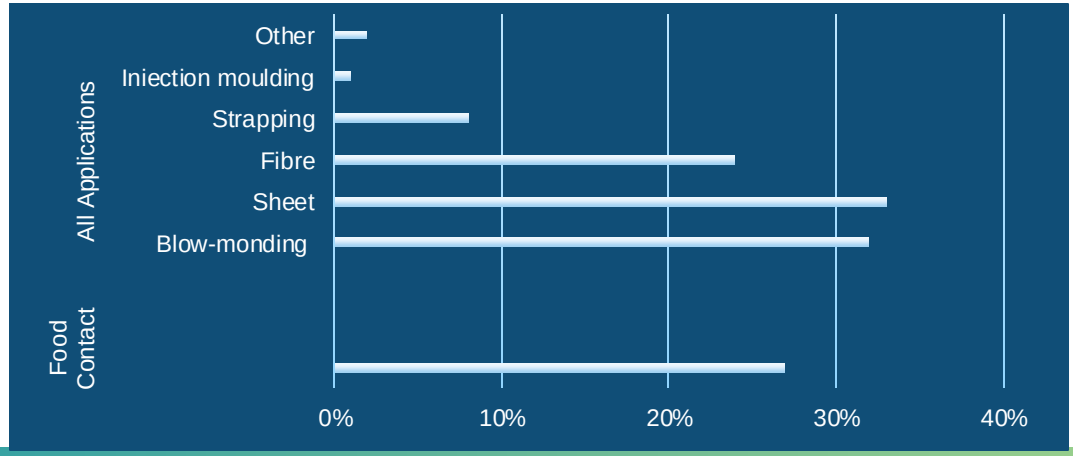
Europe is making progress

- Increasing installed capacity mechanical recycling
- Increased collected volume

Is it enough?

- To meet 2025 targets an additional 1 Mln MT rPET is needed
- To make EU target of 90% of PET bottles recycled by 2030, installed capacity need to increase with 1/3.
- When ALL BOTTLES are collected and recycled, 25% rPET target can be reached ONLY when demand in other markets will significantly decrease.

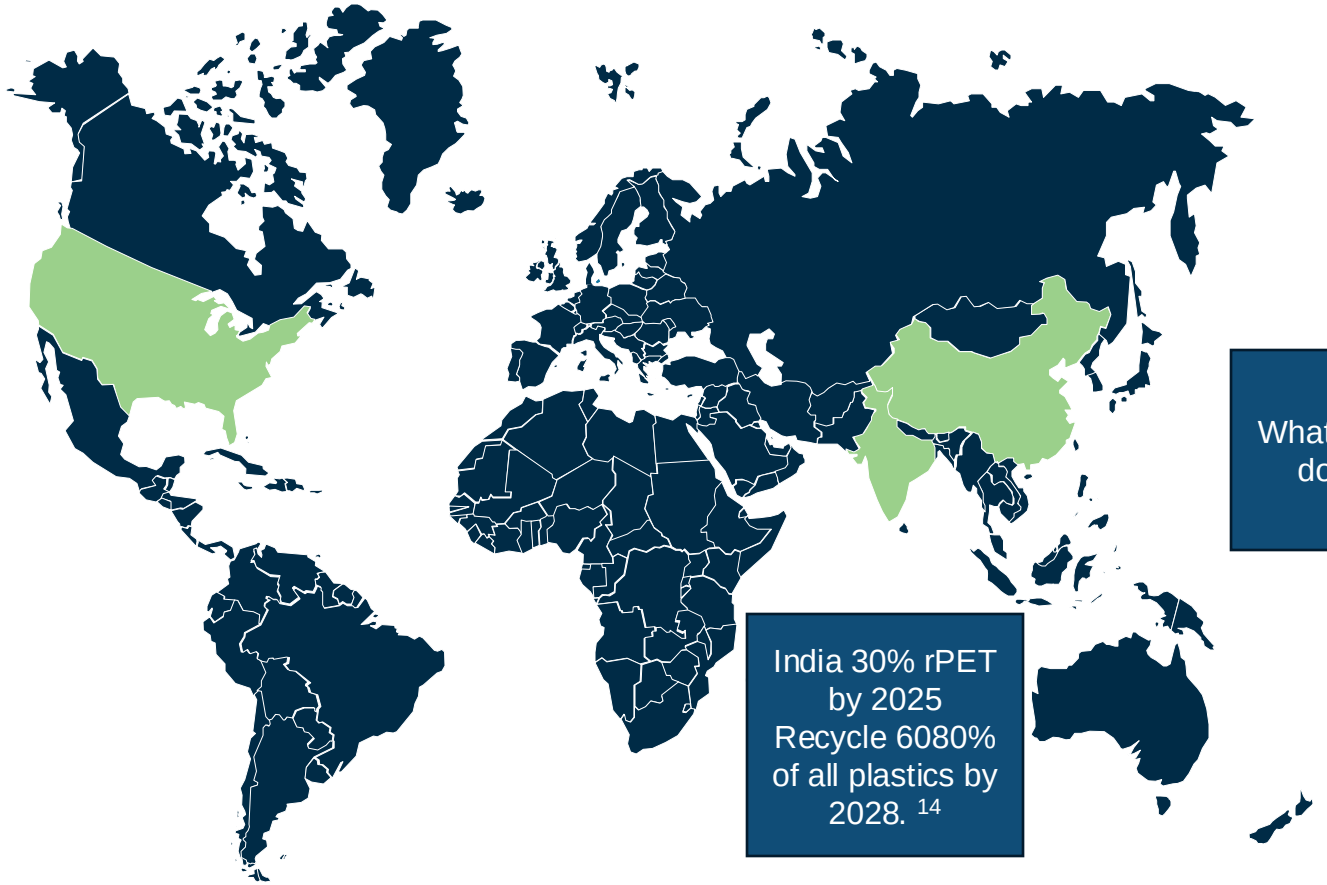




Global legislation

Key Developments

US PET Industry joined lobby for federal bottle bill [13]



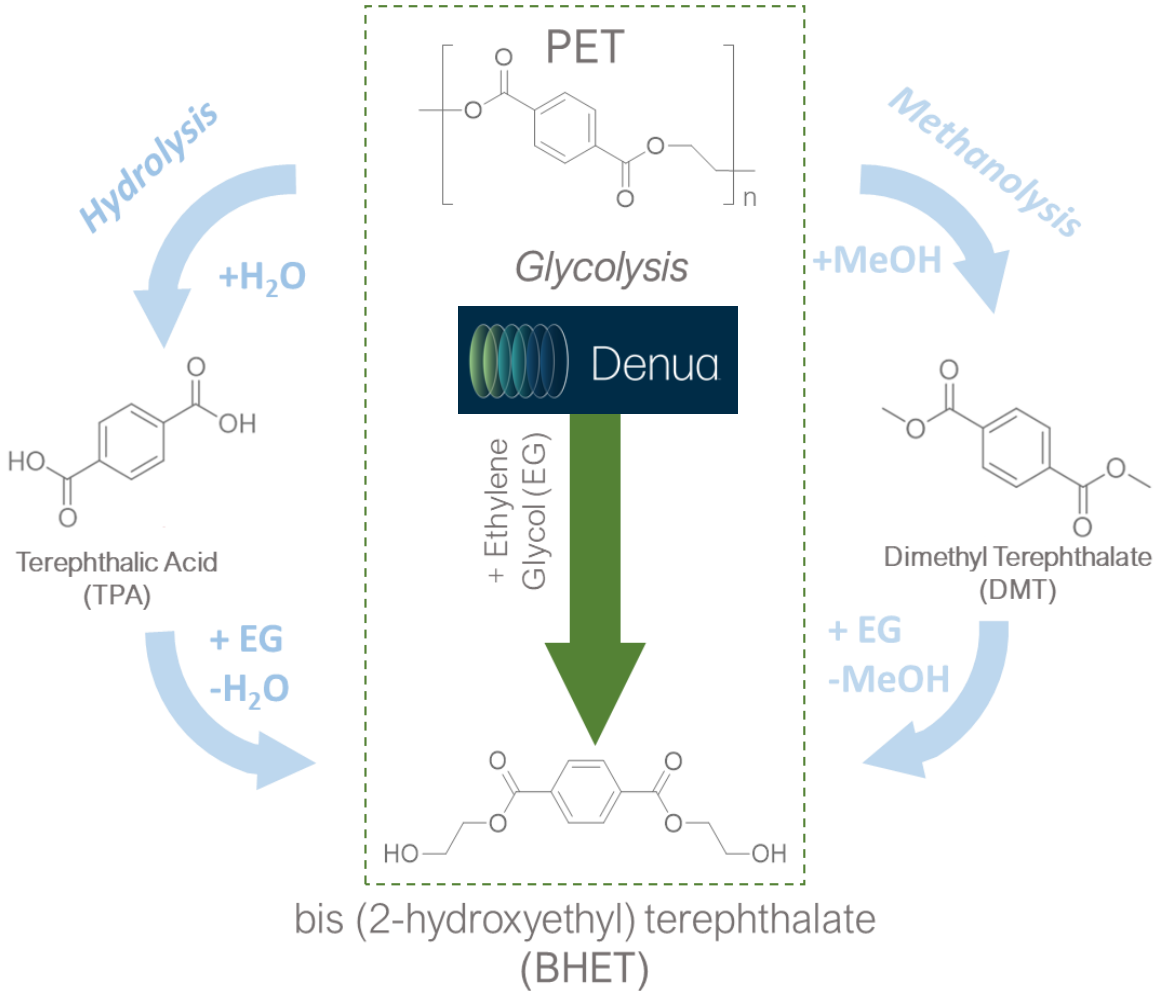
India 30% rPET by 2025 Recycle 6080% of all plastics by 2028. [14]

What is China doing?[15]

Impact legislation India:

- As of 2025 30% rPET content in bottles[14]
- India consumes 2 Mln MT of PET resin, 60% beverage[16]
- Creates a demand of 0.4 Mln MT of recycled PET
- This is approx 2% of Global PET resin consumtion
- Current total PET recycling capacity of 1.8 Mln MT PET (all applications) [17]

PET depolymerisation via Glycolysis



Advantages Glycolysis:

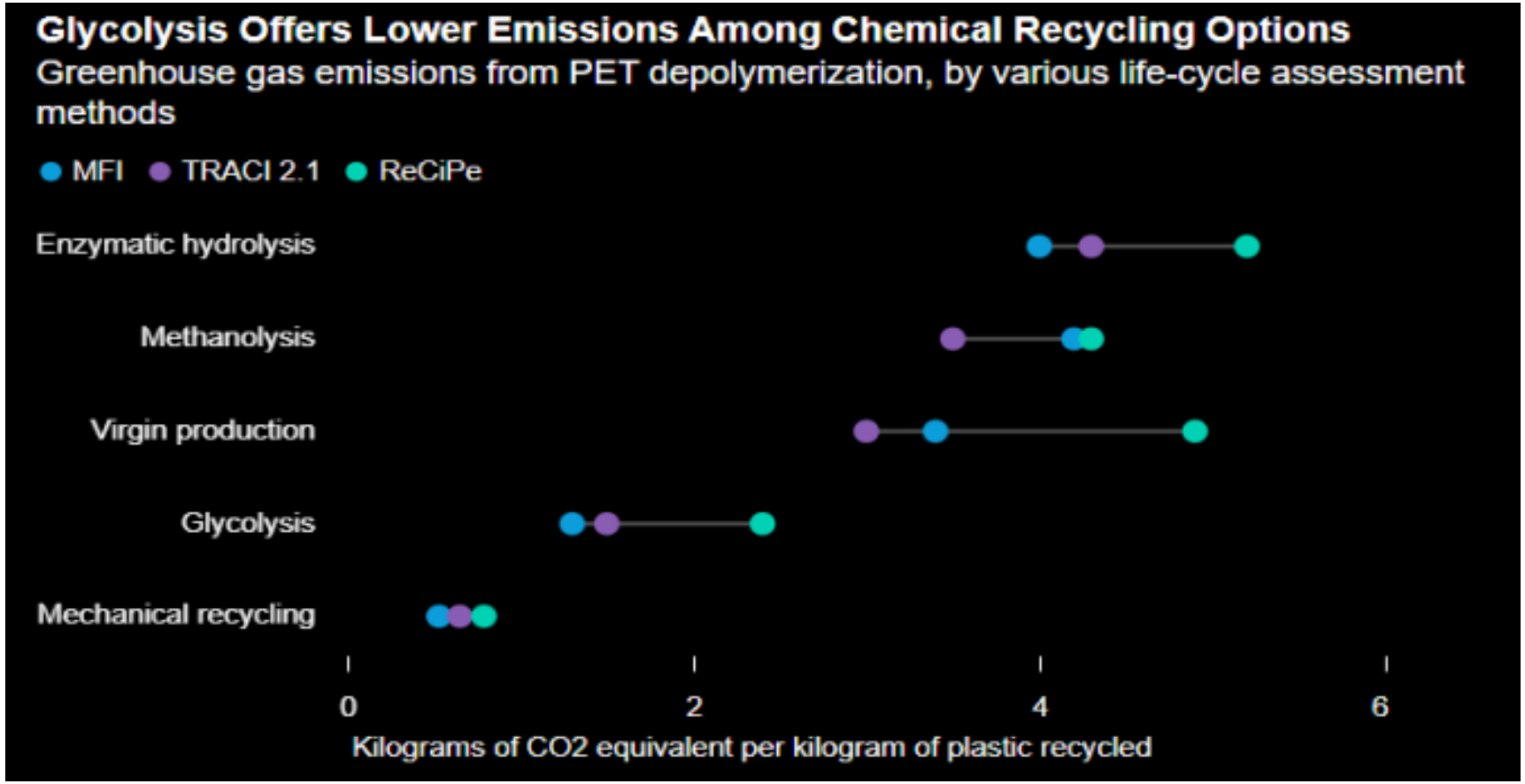
- Simple process with mildest process settings.
  -Low SHE risk, lower OPEX, lower CAPEX
- Doesn't break ester bond (vs methanolysis and hydrolysis) and therefore less energy intense.
- Less CO_2 emissions, lower OPEX.
- Low CAPEX investment.
- Reduced water effluent and energy consumption in the PET plant

Challenges Glycolysis:

- BHET is 'new' monomer; requires additional work on legislation.
  - REACH approved in Europe
  - Progressing EFSA approval

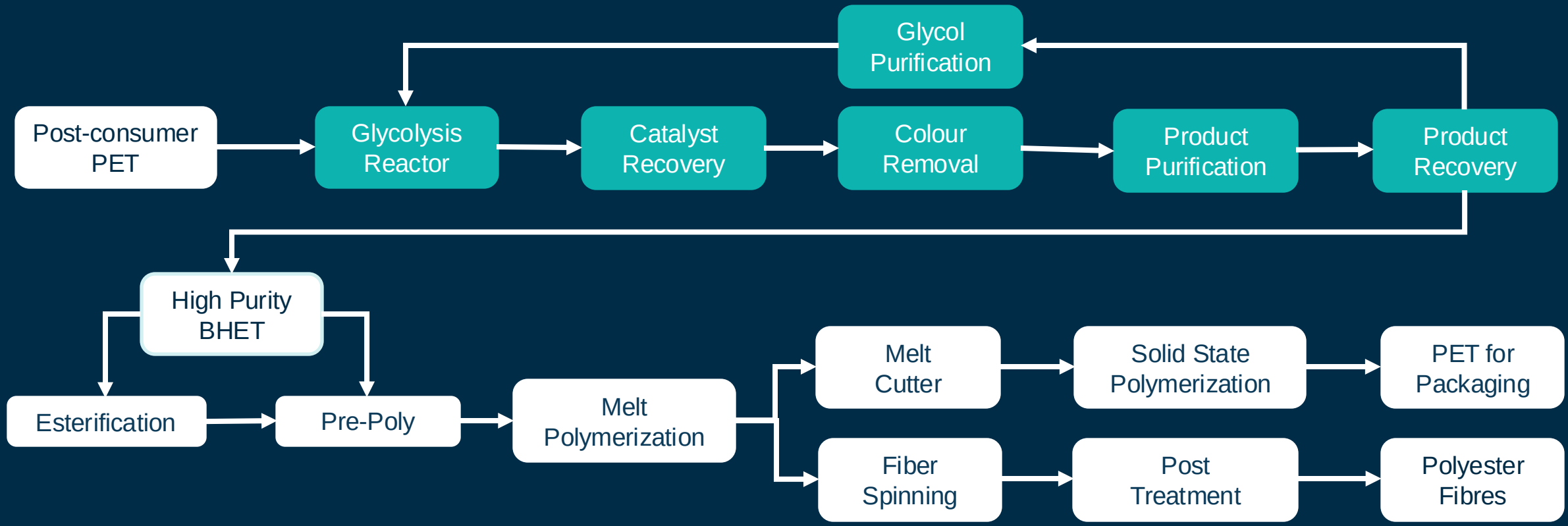
Glycolysis: The sustainable solution!

Denua™: a solution providing 50% lower carbon footprint



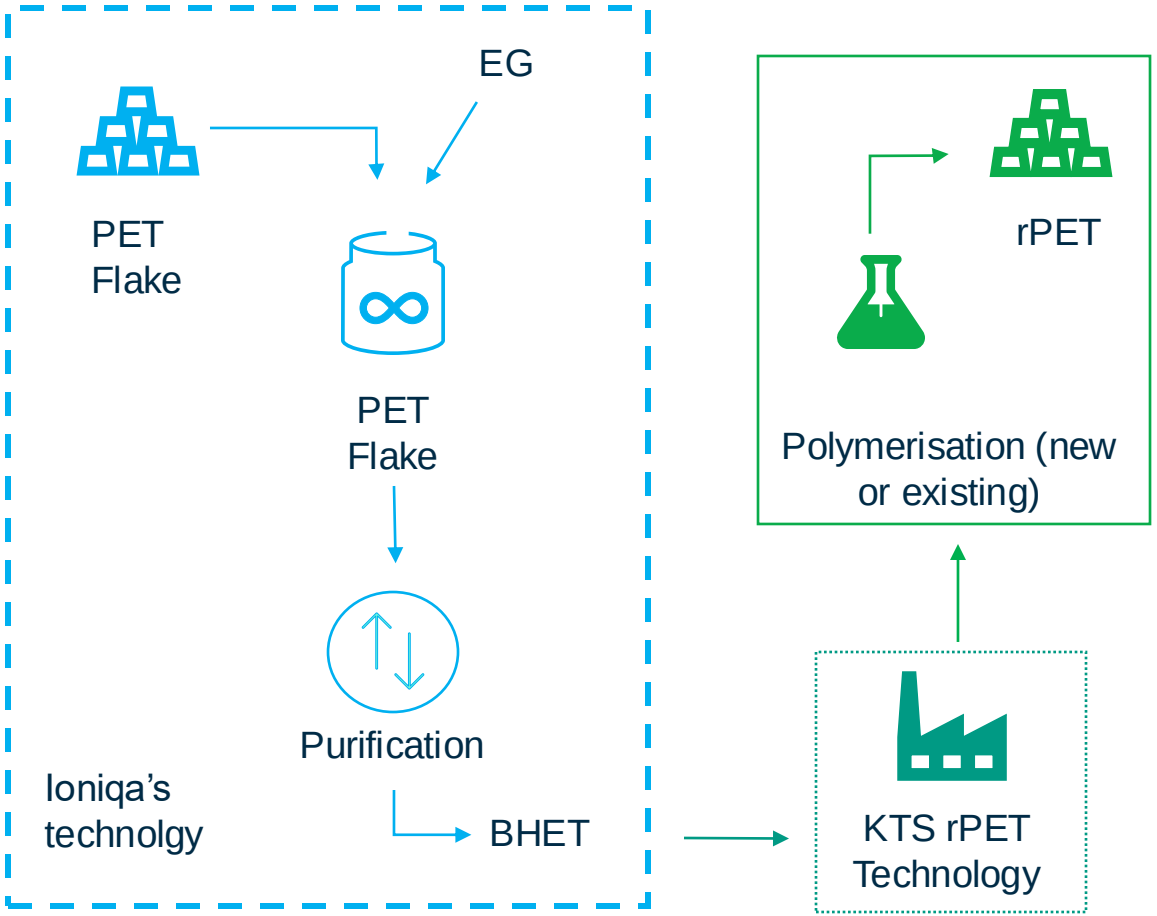
13,14

Our solution



100% recycled content

without compromise



- Denua™ enables 100% recycled content at virgin quality;
- Denua™ monomer is suitable for food grade application as well as fiber production;
- Denua™ will safeguard capacity of existing assets;
- Technology based on 5 years operational experience on Industrial Plant;
- KTS and Ioniqa are ready to initiate commercial discussions to license Denua™.

What makes us stand out

Denua

Lowest CAPEX investment compared to rest of market

Converts low-cost, low-quality postconsumer PET into high-purity BHET monomers with high conversion and yields

Excellent colour, clarity and mechanical performance of the PET produced

Optimising integration into existing PET operations or built as a standalone unit for sales or distribution of BHET

Approximately 50% carbon emissions reduction vs vPET

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Denua

Making PET recyclable without compromise

ioniqa

Focused on PET depolymerisation

Workforce:
Chemistry 80**%**
Engineering 20%

KOCH TECHNOLOGY SOLUTIONS

Focus on value engineering & scaling and polymerization know how

Workforce:
Chemistry 10%
Engineering 90%

Partners as of September 2022

- Bring 2 market leaders together; technology developers in PET recycling and PET production.
- Jointly further scale and improve the existing technology
- KTS will take responsibility on the engineering and design part towards the client
- KTS will also assist PET producers with integration of BHET as a feed to their process

Koch Technology Solutions:

track record

49 years of continuous licensing

50+ plants licensed with PTA technology

45+ plants licensed with BDO/PTMEG technology

100+ Polyester plants licensed around the world

1.2 Billion dollars of licensing revenue since transition to Koch in 2004

KTS heritage

DuPont acquired ICI's polyester businesses in 1998, and integrated PTA and PET licensing into the Technology Transfer Group ("DuPont TTG")

2004 INVISTA acquired by Koch Industries

2021 INVISTA Performance Technologies moves to KES as Koch Technologies Solutions

- Transfer technology to enable our customers to build and operate process units
- Develop and continually improve chemical process technology
- Originate and acquire technologies
- Profitably commercialise a new technology

Ioniqa

- Dutch scale up company founded in 2009
- Started as spin-off from Technical University of Eindhoven
- Specialised in the advanced depolymerisation of PET
- Uses propriety catalyst and purification process to produce high quality PET monomer
- Team of 60+ employees currently in production facility and R&D
- Increased its patent portfolio to 21 patent families with global coverage
- Licensing business model delivered by KTS, a leading global technology licensor

Denua™

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Thank you

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