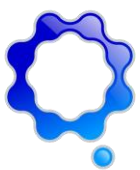
Qenos

Circular Plastics from Advanced Recycling



Ending Plastic Waste Symposium
23 May 2023, Sydney
Dr Jeroen Wassenaar

Why plastics circularity matters

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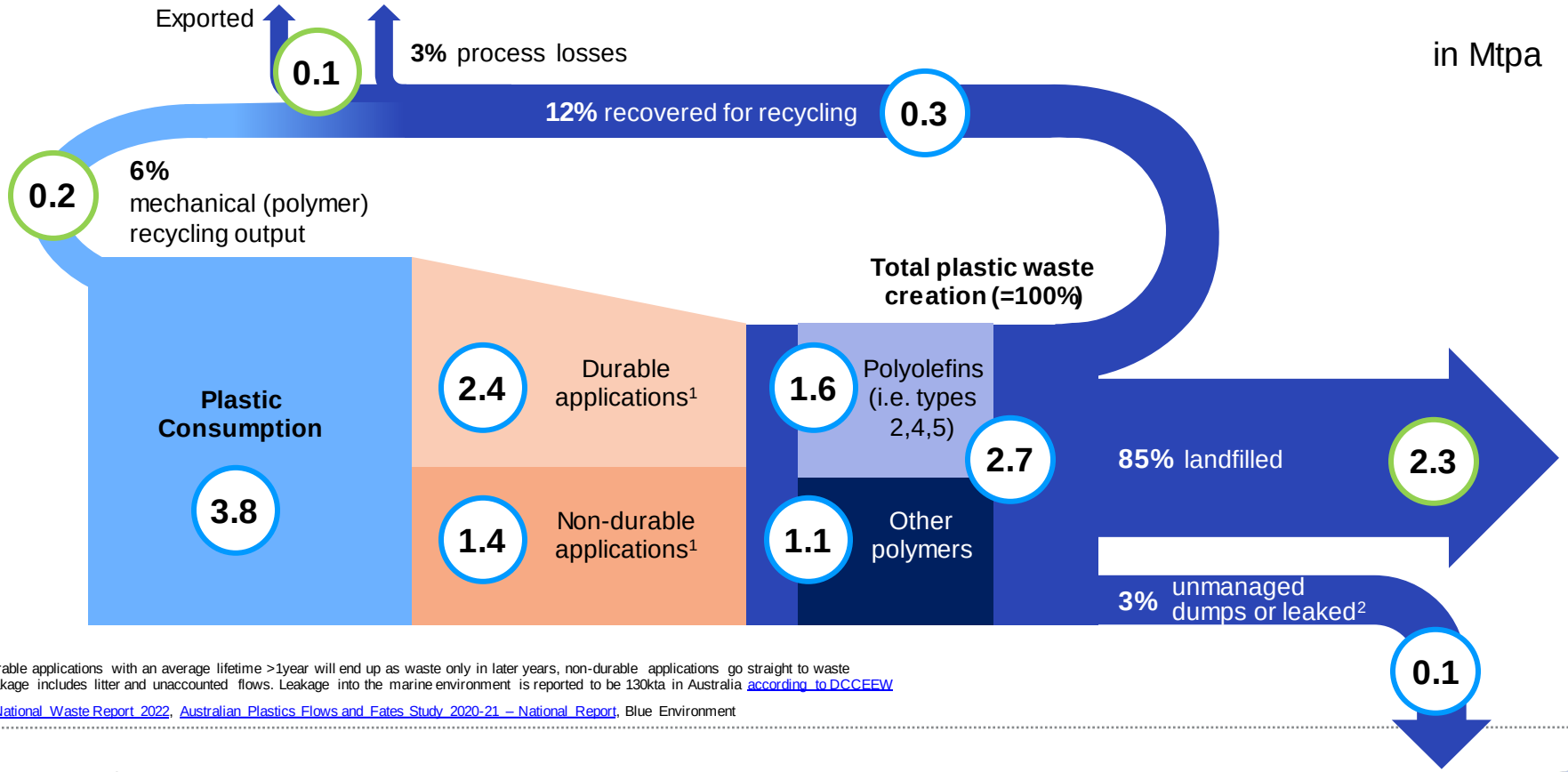
The Australian plastics industry was only 6% circular in 2021



1. Durable applications with an average lifetime >1year will end up as waste only in later years, non-durable applications go straight to waste
2. Leakage includes litter and unaccounted flows. Leakage into the marine environment is reported to be 130kta in Australia according to DCCEEW

Source: National Waste Report 2022, Australian Plastics Flows and Fates Study 2020-21 – National Report, Blue Environment

Governments, NGOs, manufacturers and brand owners have set ambitious targets for plastics circularity by 2025/2030

Source: APCO

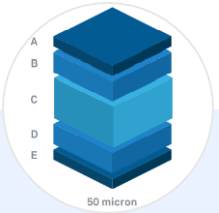
How to achieve circularity?

1. **Reduce consumption**
   - Downgauge, reuse, substitute, eliminate
2. **Design for recycling**
   - Materials, pigments, additives
3. **Increase recycling rate**
   - Source separation, advanced sorting, build mechanical and advanced capacity
4. **Incorporate recycled content**
   - Create drop-in materials, avoid downcycling

Challenges in plastics recycling

Contamination

- Many plastic types
- Food/oil/chemical residues
- Non plastics
- Food grade only in some applications



Multi material

- Al/paper laminates
- Barrier layers (PA, PET, PVDC)
- HD/LD/PP layers
- Variety of grades

Pigments & additives

- Colour control challenging
- Legacy additives
- Stabilisation not designed for recycling

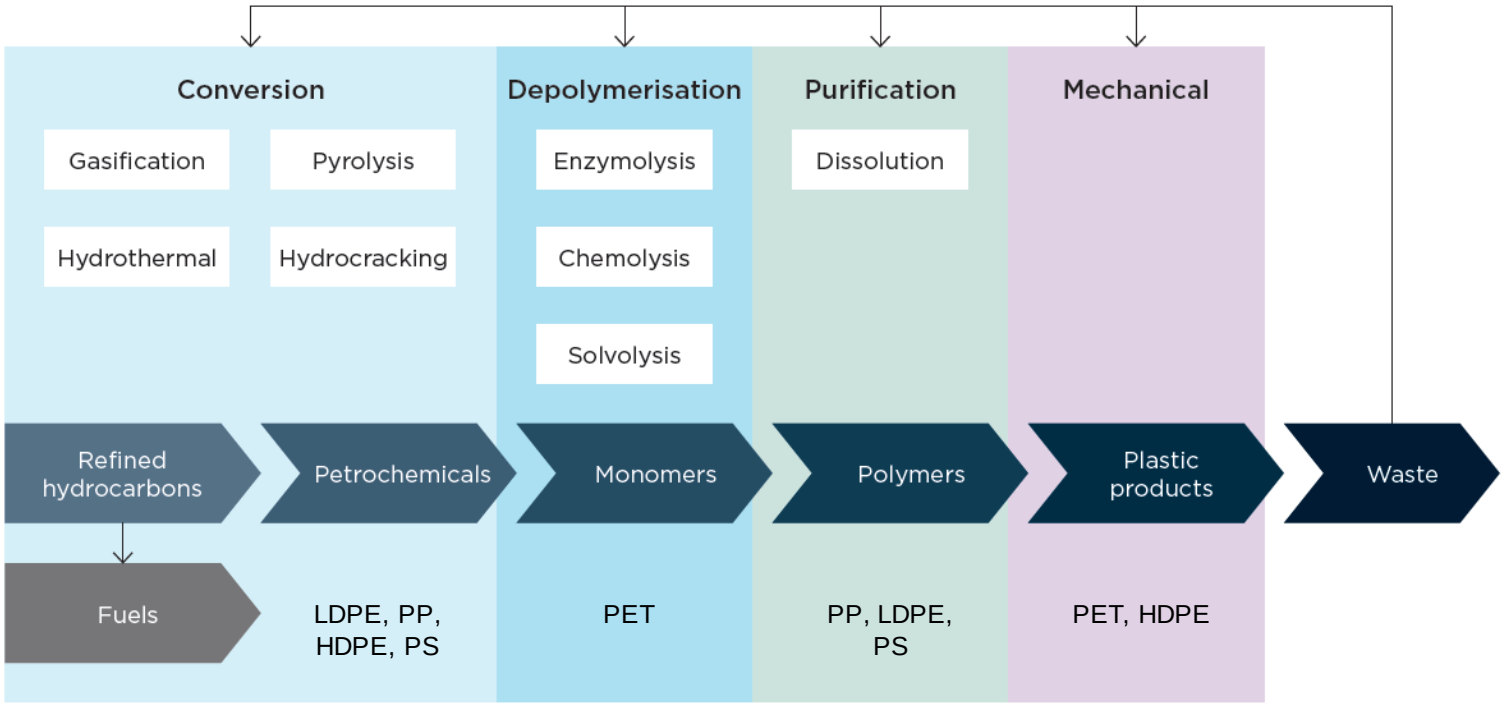
Degradation

- Oxidation/UV
- Cross-linking
- Chain scission
- Yellowing

Mechanical recycling is advancing to address these challenges but alternative approaches are needed to achieve circularity targets

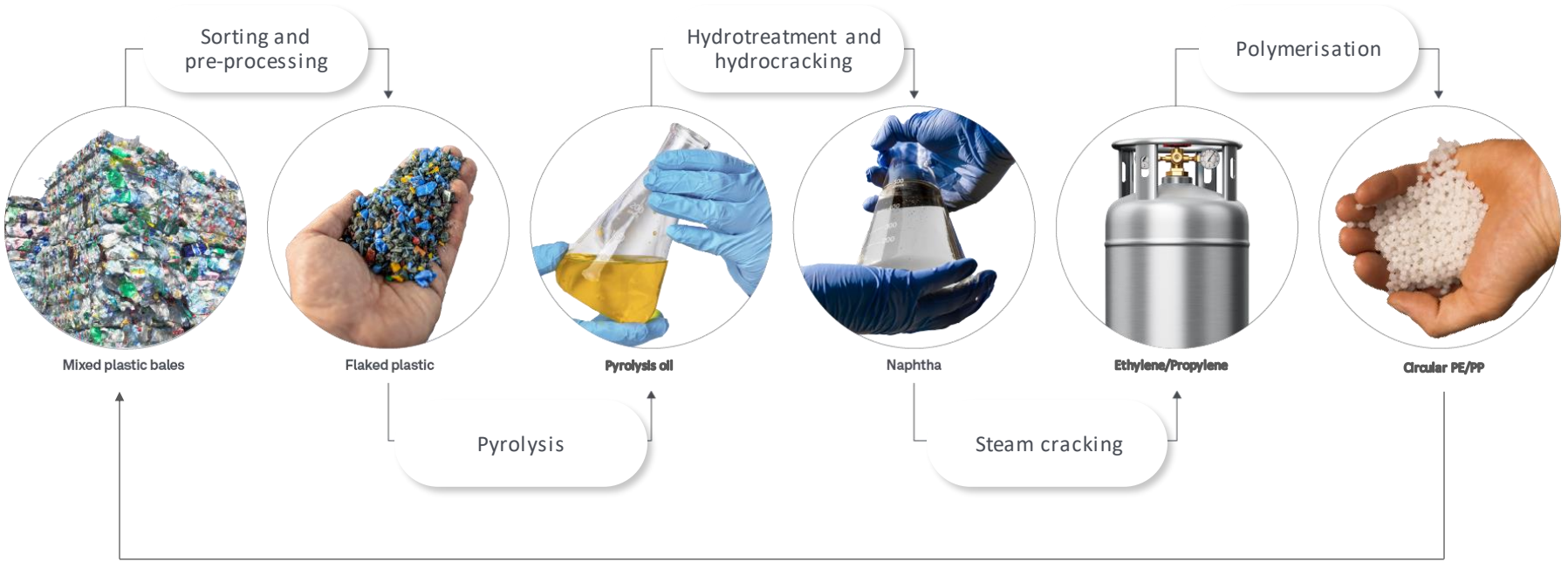
Source: Qenos white paper Mechanical Recycling of Polyethylene

Advanced recycling can complement mechanical recycling



Source: CSIRO report Advanced recycling technologies to address Australia's plastic waste

Pyrolysis in combination with hydrocracking is able to produce circular polyethylene and polypropylene at high yield of ca. 60%

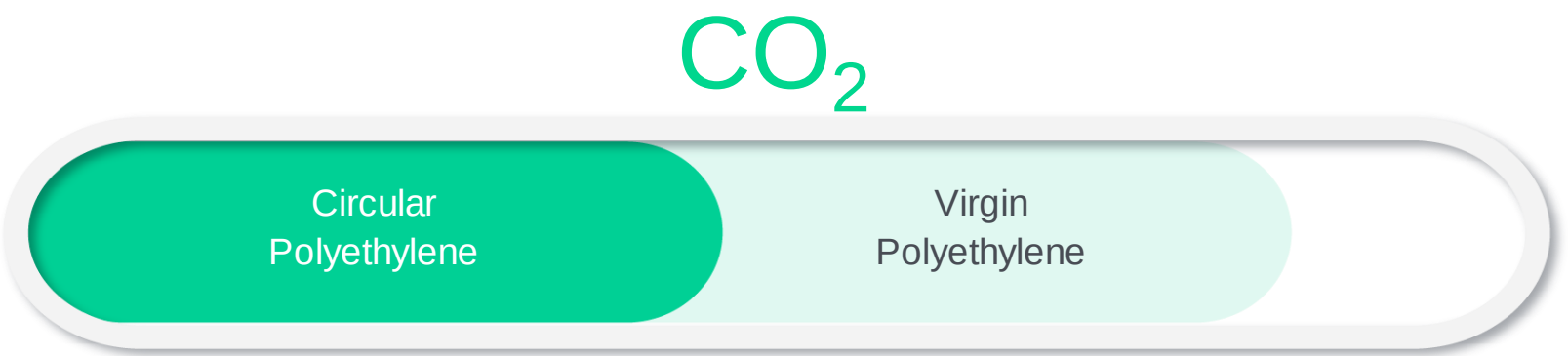


Source: Qenos white paper Circular Advanced Recycling of Plastics through Pyrolysis

Qenos | Ingenious Transformations

Circular polyethylene has identical properties to virgin resin and is a drop-in replacement to achieve recycled content targets

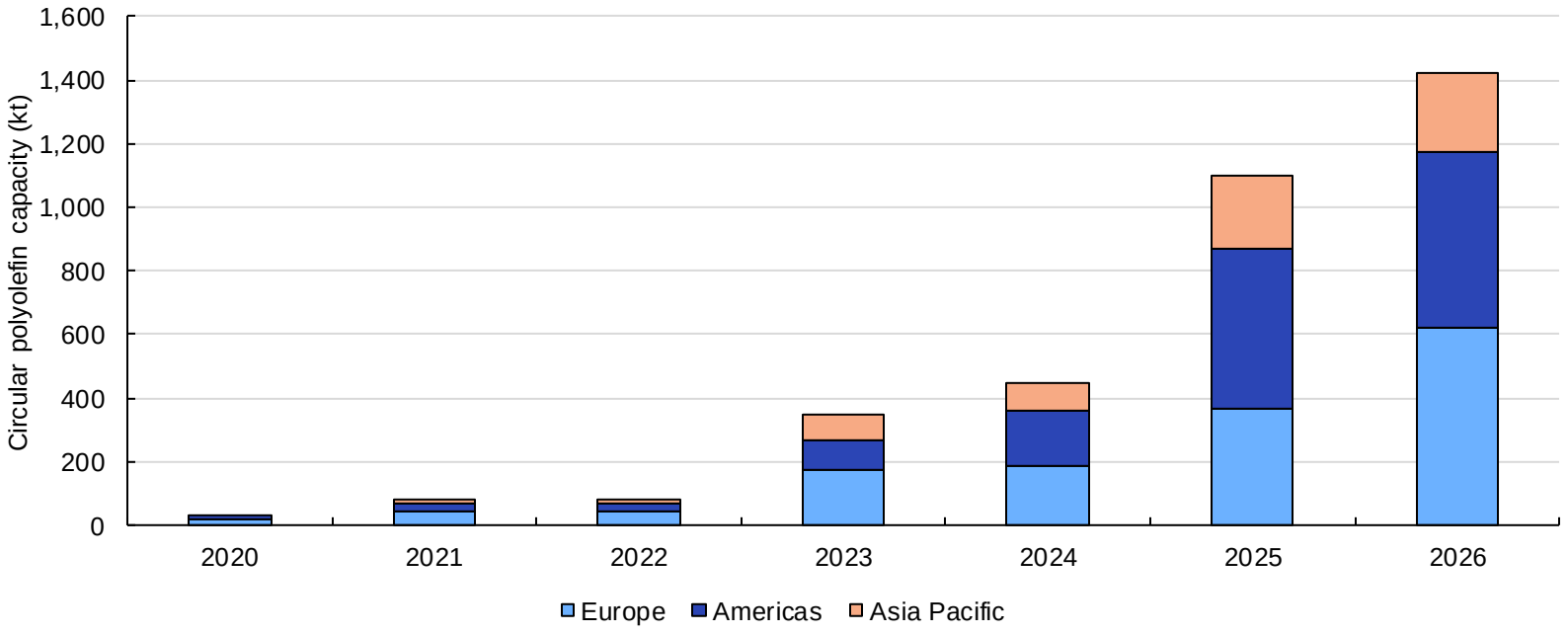
Lifecycle analysis results from multiple studies indicate a significant reduction in carbon emissions of circular vs. virgin LDPE



Study	Climate Change impact Circular vs. Virgin LDPE*
Quantis / Plastic Energy, 2020	-55%
Sphera / BASF, 2020	-40%
Sphera / Consumer Goods Forum, 2022	-43%**
CSIRO / Qenos, 2023	-98%***

* Base case of each study is taken. ** Functional unit is food grade film containing equal mix of LDPE and PP. *** Compared to waste to energy

With over 50 projects in the pipeline, circular polyolefin capacity is expected to exceed 1 million tonnes globally in 2025



Source: Qenos white paper Circular Polyolefin Capacity set to reach 1 Million tonnes globally in 2025

The only local circular PE project in Australia

- Increasing overall plastics recovery rate by >50%
- Increasing post-consumer recycled content rate in soft plastics from 2% to 20%

100kt of plastic waste diverted from landfill per annum

- 38 million garbage bins
- 3 MCGs full of soft plastics
- 10 billion bread bags

Jobs created

185 direct jobs created*

* Up to 2,900 indirect jobs created – estimated based on total employment multiplier, NSW Treasury TPP09-7