

SULZER

Enabling Circularity via Plastics Chemical Recycling

Coming Full Circle



SULZER CONFIDENTIAL

Agenda



SULZER
at a Glance



Why Chemical Recycling of Plastics?
Market Drivers



SULZER
Chemtech
Plastic Recycling Technologies

The safe harbor statement under the US private securities litigation reform act 1995

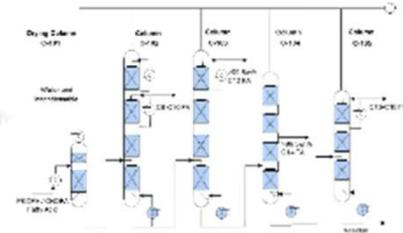
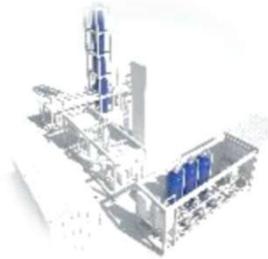
This presentation may contain forward-looking statements, including but not limited to, projections of financial developments, market activities or future performance of products and solutions, containing risks and uncertainties. These forward-looking statements are subject to change based on known or unknown risks and various other factors, which could cause the actual results or performance to differ materially from the statements made herein.

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Fluid engineering makes our lives safer,
smarter and more sustainable.



Sulzer Chemtech offering & the market segments we serve



Equipment & Services

Mass Transfer Components, Process Equipment, Modular Plants, Installation & Maintenance, Revamps, Weld Overlay

Technology & Licensing

Process Plant Solutions, Process Licensing, Proprietary Equipment, Chemicals

Chemicals

Our processes, equipment and services enable manufacturing and separating chemicals and pharmaceutical molecules with the highest purities

Renewables

Our innovations help our customers increase the use of bio-based molecules and recycled polymers as feedstocks. We have a strong track record in scaling-up and industrialization of novel bio-, renewables and recycling processes

Gas & Refining

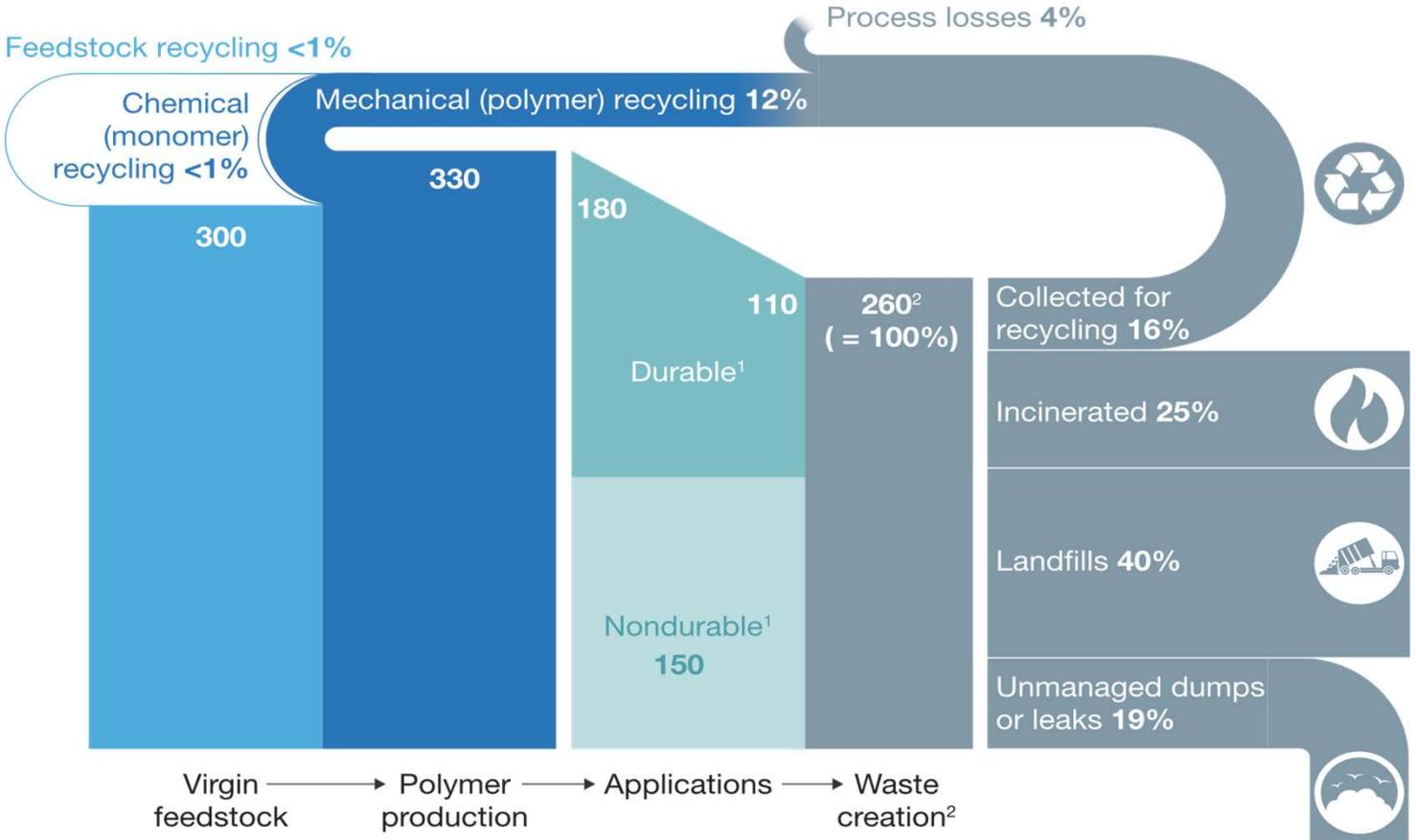
Our equipment & technologies help extract and purify a variety of natural resources. Our processes & solutions help refiners process crude and gas and separate products like clean fuels and petrochemicals for everyday use

Water

Our industrial wastewater treatment solutions are designed and engineered to deliver our unique technology with the best standalone equipment

Global plastics flows

- Global polymer flows: Millions of metric tonnes per annum 2016



1. Durable applications with an average lifetime > 1 year will end up in waste only in later years; non-durable applications go straight to waste.
 2. 150 million metric tons of mixed plastic waste from non-durable applications that end up as waste in same year plus 110 million metric tons of mixed plastic waste from previous years.

Source: McKinsey

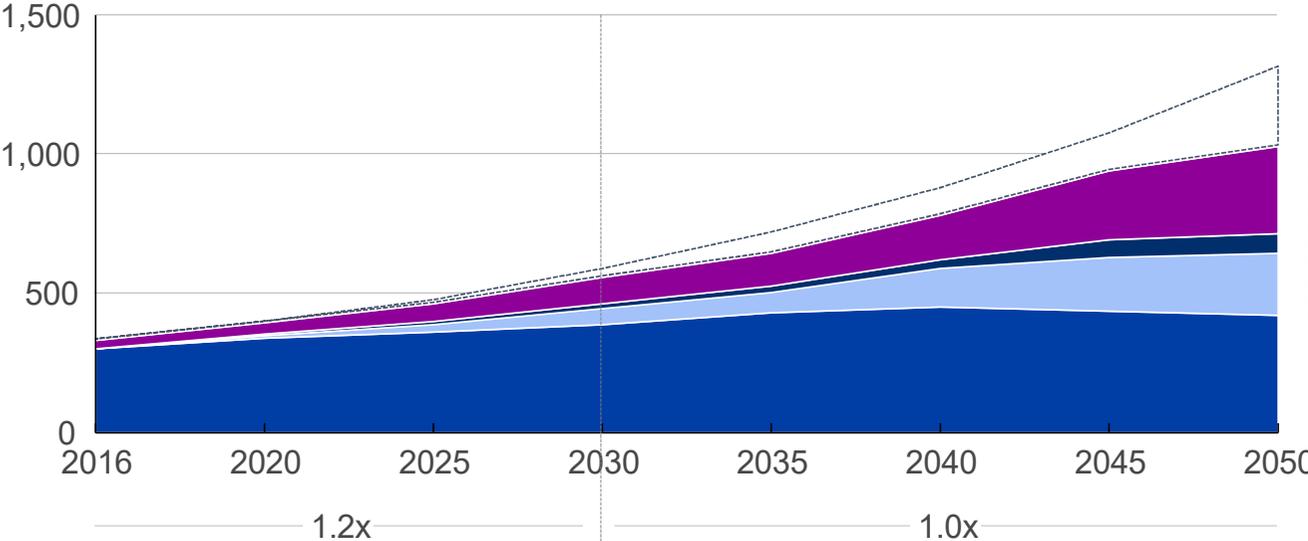
Feedstock recycling presents the highest growth potential

Global polymer demand 2016-50 from waste recovery

MTA

Share of total

2018 2050³



	2018	2050 ³
Demand reduction		
Mechanical recycling	12	30
Recycled monomers	~ 0	7
Feedstock recycling Pyrolysis	<1	22
Virgin liquid feedstock	87	41
Total	100	100

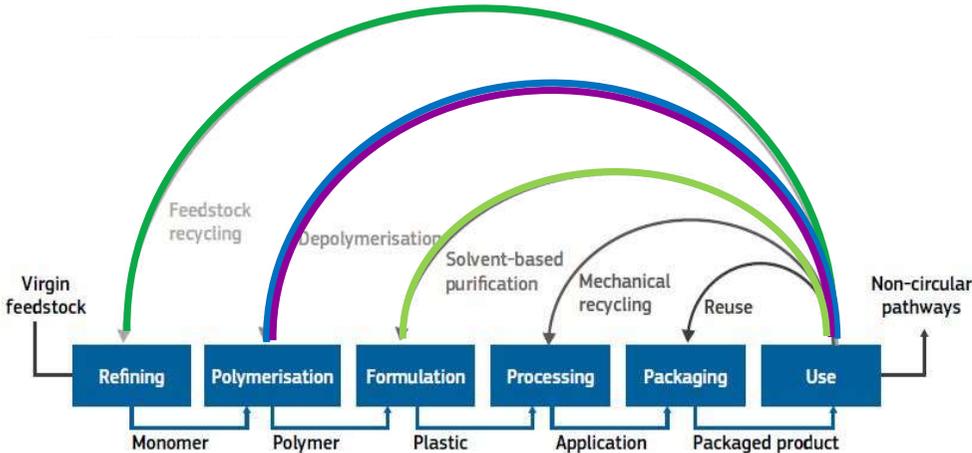
Polymer to GDP growth¹

1 Actual growth after demand reduction, assuming global GDP growth of 3.1% (IHS);
 2 IHS forecast, demand if current IHS projections until 2027 for plastic growth continue through to 2050;
 3 Mechanical recycling limited by downcycling and applicable materials, monomerization limited by applicability to condensates only, pyrolysis limited by likely rise in input costs;

Source: McKinsey plastic waste stream model

Sulzer's activities in polymer recycling

Various ways to close the loop and create circularity



Source: A circular economy for plastics; European Commission

Sulzer offers purification technologies for chemical recycling processes, allowing high-quality products and bridging the gap to the downstream processes.



Chemical PET Recycling

High-Purity Monomers from Post-Consumer PET

Different Technologies to Purify PET Monomers

- **Distillation**
 - Monomer recovery
 - Process solvent recovery
- **Crystallization**
 - Crystallization of monomers like DMT or BHET to achieve high purity products
- **Hydrolysis of DMT to TPA**
 - TPA is main monomer used for PET polymerization

Monomer purification for depolymerization processes

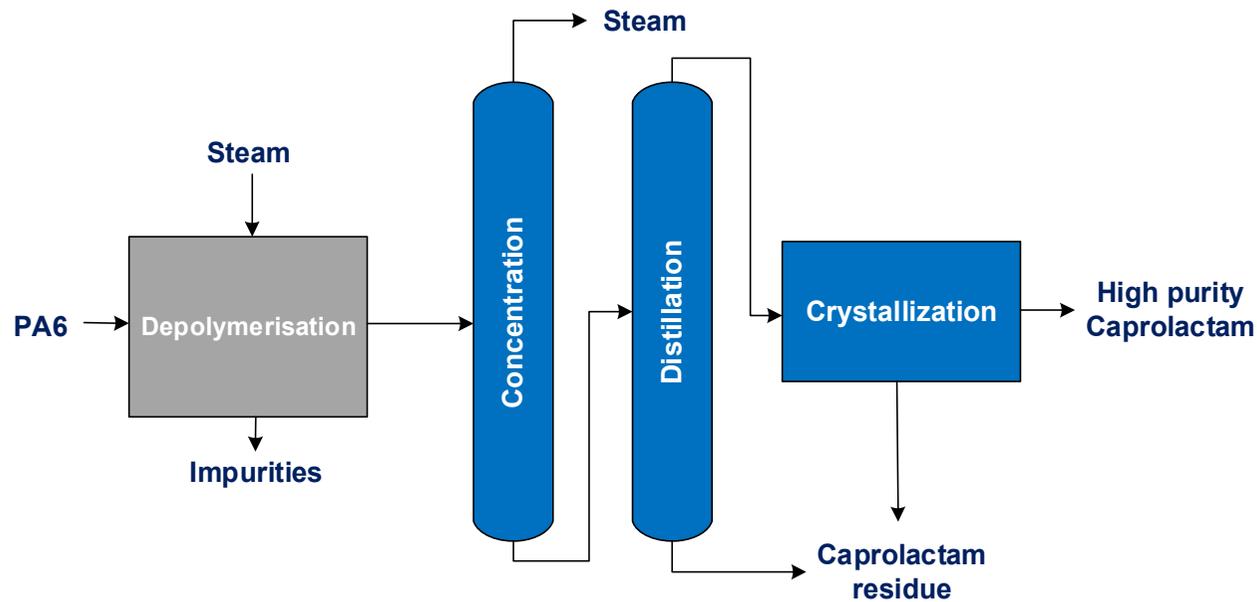
Hybrid Processes

For purification of PET monomers



Chemical Recycling of Polyamide 6

Hybrid technology with distillation and layer melt crystallization



- Hybrid removes close boiling impurities which cannot be removed via distillation.
- Capability to produce the highest grade Polyamide 6 with high purity caprolactam (Permanganate number > 16000 and Color APHA < 6)

Solvent-Based Recycling

Low VOC Polymers & Pure Solvents

Polymer / solvent separation

- Sulzer's devolatilization (DEVO) technology can separate polymer / solvent mixtures in a broad viscosity range
- Very low VOC levels can be achieved for all thermoplastic polymers

Solvent purification

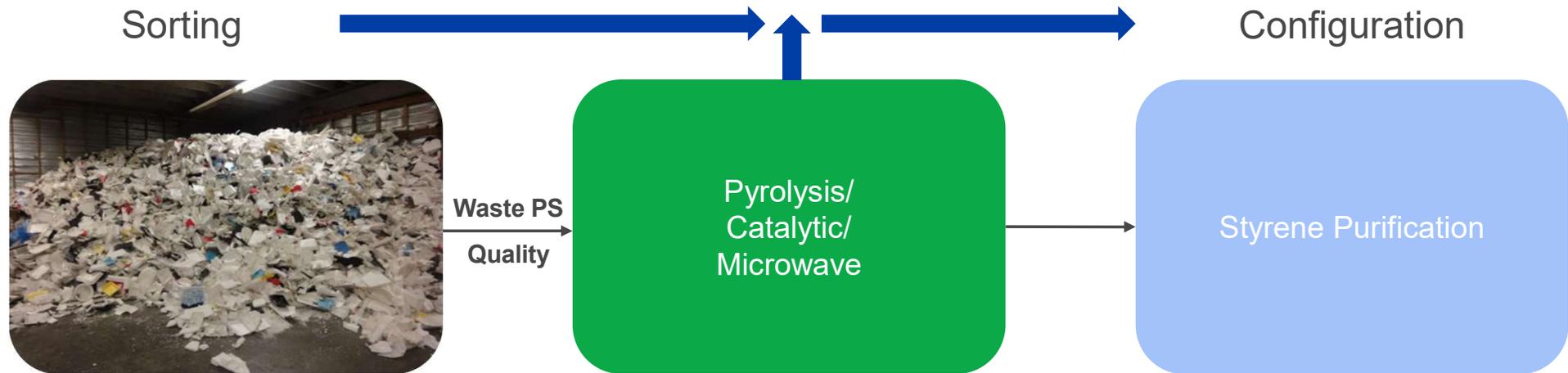
- Recovered solvents may need purification for the reuse in the dissolution stage
- Separation of impurities through evaporation, distillation or LL-extraction technologies.

worn again technologies

- UK based start-up has developed a genuine patented process to recover polyester and cotton from end-of-use textiles
- Sulzer is major shareholder and involved in process scale-up



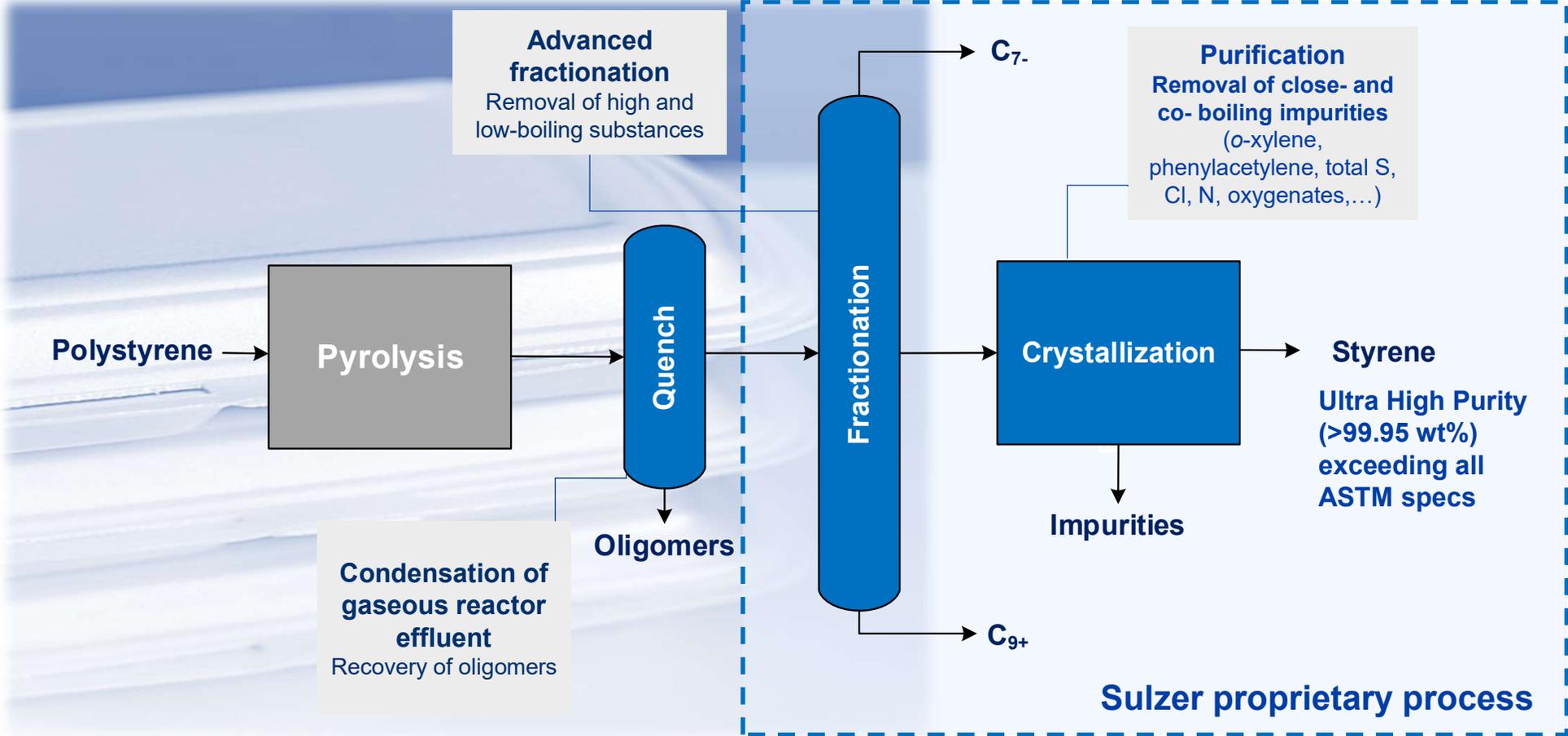
PS recycling



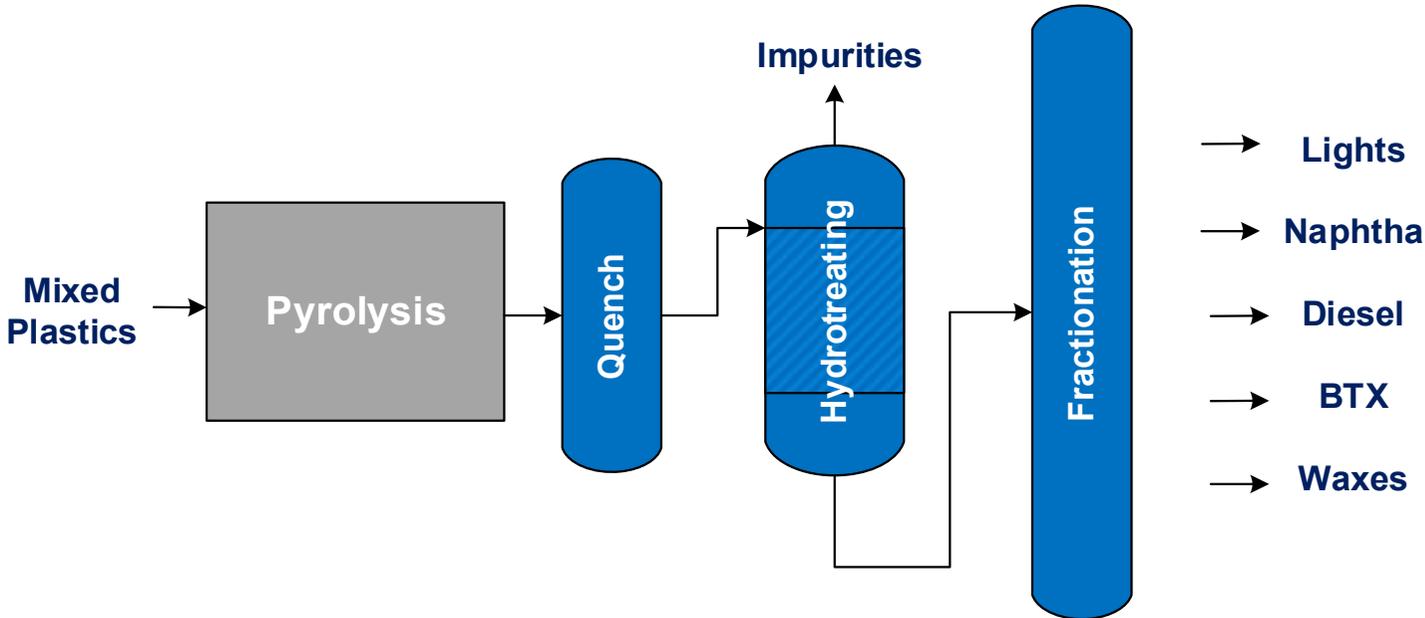
Need for styrene purification scheme which:

- Can accommodate relaxed waste PS quality: S, Cl, N, oxygenates, co-boiling impurities.
- Can remove co-boilers coming from depolymerization process.

SuRe Styrene - robust technology for Ultra High Purity recycled styrene from Polystyrene



Mixed plastics/tires recycling



Quench	Hydrotreating	Fractionation	Valuable Products Recovery
Skid mounted solution, tailor-made for your application. In-house simulation and testing capabilities.	MAXFLUX: 30-40% lower CAPEX and OPEX Removal of Total N, S, Cl, Oxygenates and saturation of olefins	Industry leading distillation technology, skid-mounted solution. Operating Reference: Quantafuel skid (20 kt/a)	Leading licensor for aromatics extraction. Technology to recover pure waxes.

Key take-aways



- ✓ We live in a world with high societal pressure for creating a cleaner planet
- ✓ Brand Owner and Legislative Push for sustainability generates pull on plastics recycling technologies
- ✓ Chemical recycling, as opposed to mechanical recycling, offers the capability to produce recycled polymers with properties parallel to virgin polymers
- ✓ Mechanical Recycling will continue to dominate but chemical recycling will increase exponentially in market share
- ✓ Sulzer has a broad range of offerings (process technologies and equipment) for following applications:
 - ✓ 1. Mixed Plastics/Tires
 - ✓ 2. Polystyrene
 - ✓ 3. PMMA
 - ✓ 4. PET
 - ✓ 5. Polyamide

Questions?

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