Energy from Waste Middle East

Waste to value through circularity

- High-efficiency waste-to-energy

- Plastic chemical recycling

Today’s speakers

Pasi Lestelin

Head of Sales and Service Operations,
Pulp, Energy & Circularity Business, SEMEA

Pasi Lestelin is responsible for sales and service operations in Valmet Pulp, Energy and Circularity Business across SEMEA and has extensive experience from international assignments in establishing, developing and leading sales and service operations in Asia-Pacific, UK and SEMEA regions

pasi.lestelin@valmet.com

Jukka Lehtinen

Senior Sales Manager,
Energy and Circularity

Jukka Lehtinen is Senior Sales Manager at Valmet, responsible for energy capital sales projects across EMEA. He holds a Bachelor of Engineering in Power Plant and Marine Engineering and has over 15 years of experience in the energy sector.

jukka.lehtinen@valmet.com

Jouko Latva-Somppi

Senior Concept Sales Manager,
Circularity Growth

Jouko Latva-Somppi is responsible for the commercialization of pyrolysis technology and has extensive experience in energy conversion technologies and air pollution control methods. He holds a PhD (Tech) in Energy Technology from the Helsinki University of Technology.

jouko.latva-somppi@valmet.com

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Valmet in brief

Progress built on 225 years of industrial history

From cloth making to high-tech processes

1797 Jokioisten Verkatehdas
1841 Götaverken
1856 Tampella
1858 Beloit
1860 KMW
1868 Sunds Defibrator

1942
Rauma-Raahe

1951
Valmet

1968–1996
Several M&As:
1986 KMW
1987 Wärtsilä paper finishing machinery
1992 Tampella Papertech

1999
Metso created through merger of Valmet and Rauma

Acquisitions
2000
Beloit Technology
2006
Kvaerner Pulping
Kvaerner Power
2009
Tamfelt

End of 2013
Demerger to Valmet and Metso

2015
Metso Process Automation Systems to Valmet

2019
Valmet acquired GL&V and J&L Fiber Services Inc

2020
Valmet acquired PMP Group

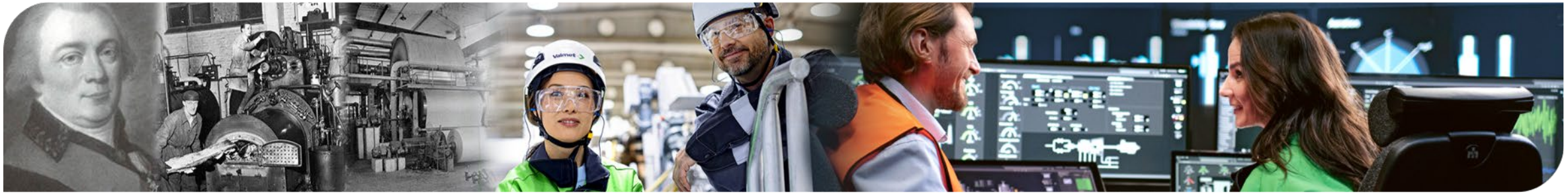
2021
Valmet acquired EWK Umwelttechnik and ECP Group

2022
Neles merged into Valmet

Valmet acquired Coldwater Seals

2023
Valmet acquired NovaTech Automation's Process Solutions business and Körber's Business Area Tissue

2024
Valmet acquired Siemens' Gas Chromatography Business and Demuth



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A strong financial profile and balanced business portfolio

2024 key figures of Valmet

- **Orders received**
  EUR 5,837 million
- **Net sales**
  EUR 5,359 million
- **Comparable EBITA**
  EUR 609 million
- **Comparable EBITA margin**
  11.4%
- **Order backlog**
  EUR 4,452 million

>19,000
employees

>110
service centers

76
production units

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Valmet's R&D addresses customer needs and global megatrends

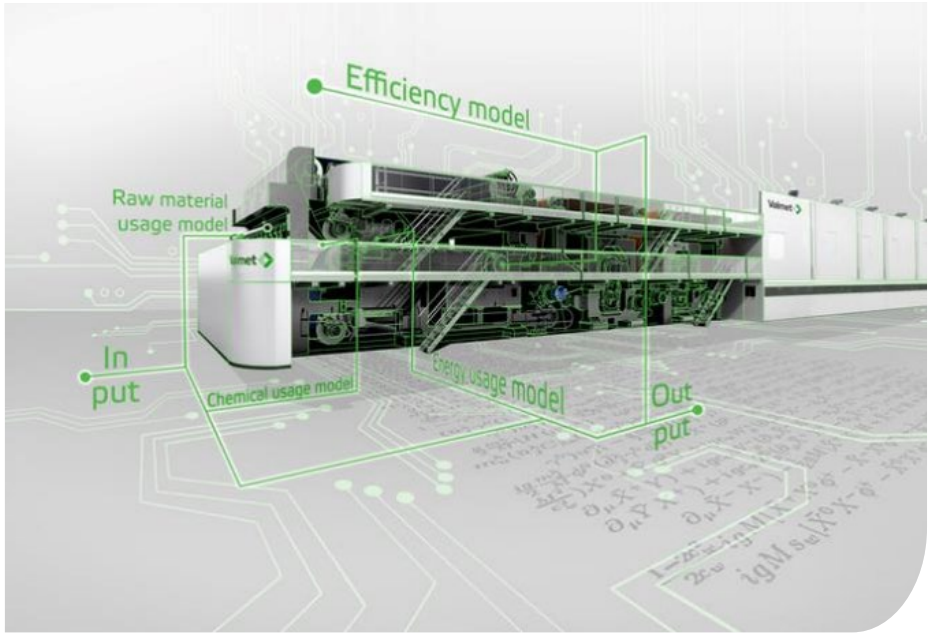
R&D focus areas

- Promotion of renewable materials
- Raw material, water and energy efficiency
- Emission reductions
- Circularity
- Productivity and environmental improvements with digitalization

34
research and development centers

EUR **123** million
R&D spending in 2024

1,400
protected inventions



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Our mission – Advancing Circularity

End-products

- Biogas
- Biofuels
- Biochemicals
- Biomaterials
- Recycled raw materials
- Textiles
- Dissolving, chemical and mechanical pulp
- Fiberboard
- Electricity
- Heat

Services

Automation

Technologies

Raw materials

Customer industries

- Pulp
- Fiber board
- Energy production
- Biofuel refining
- Textile fiber

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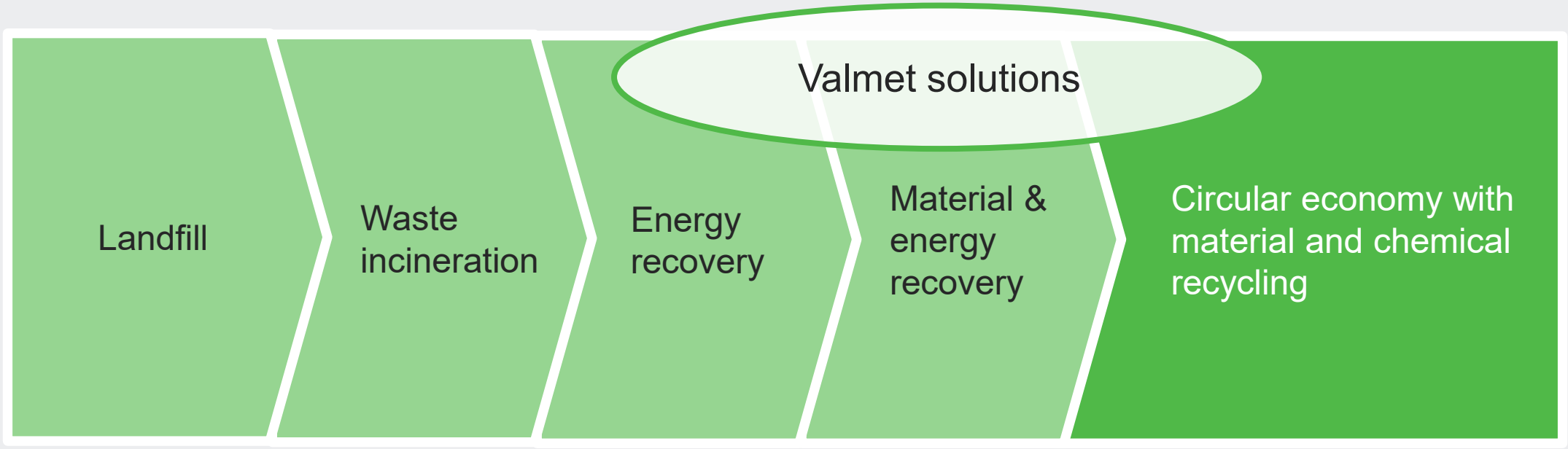
Valmet Waste to Energy offering

Evolution of waste management

Technologies are developing to move away from dumping and destroying towards resource recovery and chemical recycling.



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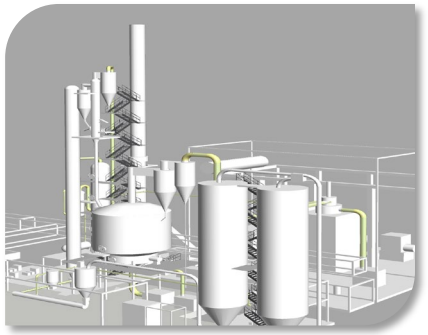
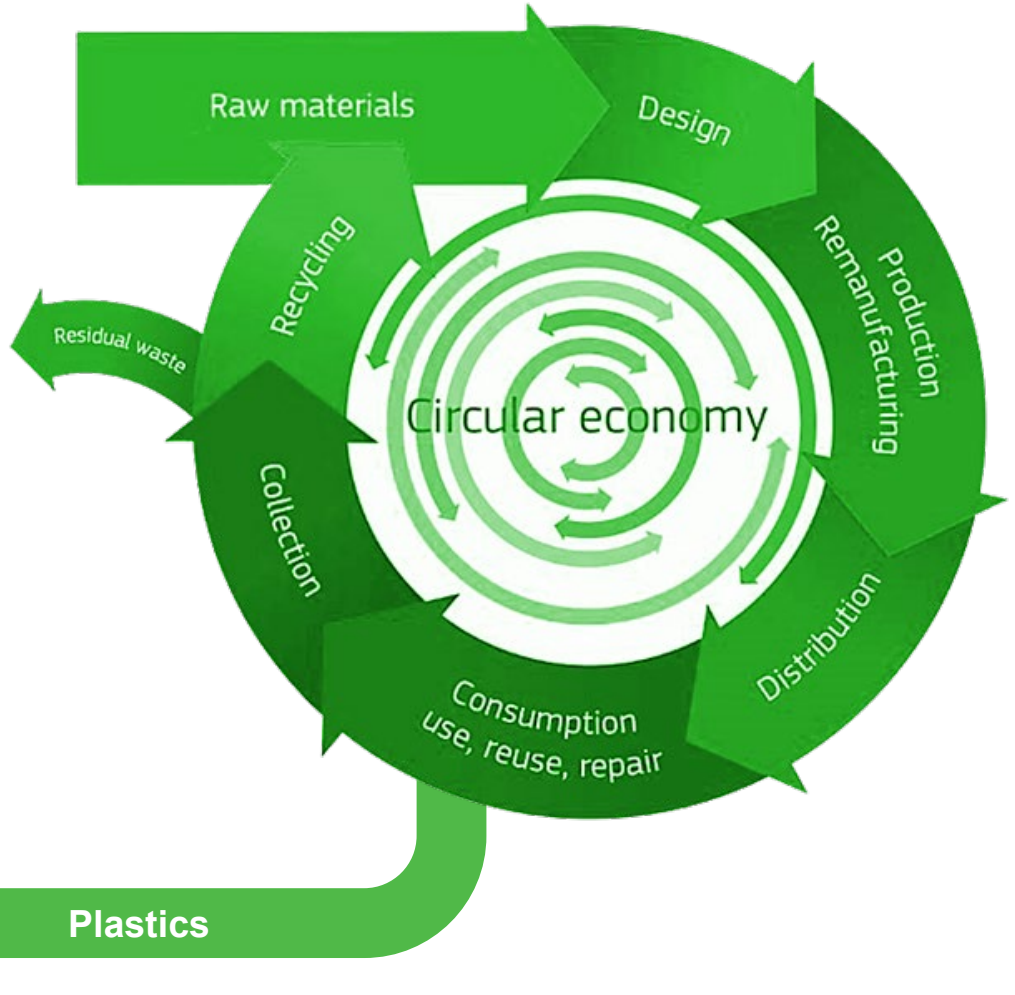
Valmet’s unique technology offering in material value circle

Multifuel Wte



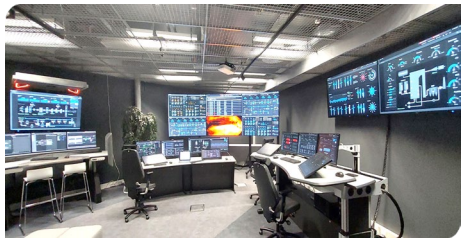
Pyrolysis



Valmet Lifecycle Services

Valmet Performance Center

DNAe Process Automation



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Why CFB – Fuel flexibility to minimize future fuel risk

Co-firing option

Waste co-firing

- 100% RDF
- or up to 100% any other solid fuel and anything in between

RDF

Asphaltene

Recycled wood

TDF

Wide range for waste fuel

in CFB 6-25 MJ/kg with no support fuel

Fuel flexibility

decreases future fuel risk

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Why CFB – Excellent reliability and emission performance

High reliability with low emissions

Steam 125 MWth, 45 kg/s, 60 bar, 475 °C
Fuels RDF (330 000 t/a)

8 years in row ~ 8300 h/a operation time

Low flue gas emissions:
Lower primary emissions in CFB and less flue gases than in grate

Project drivers

"Reliability and close-to-zero emissions"

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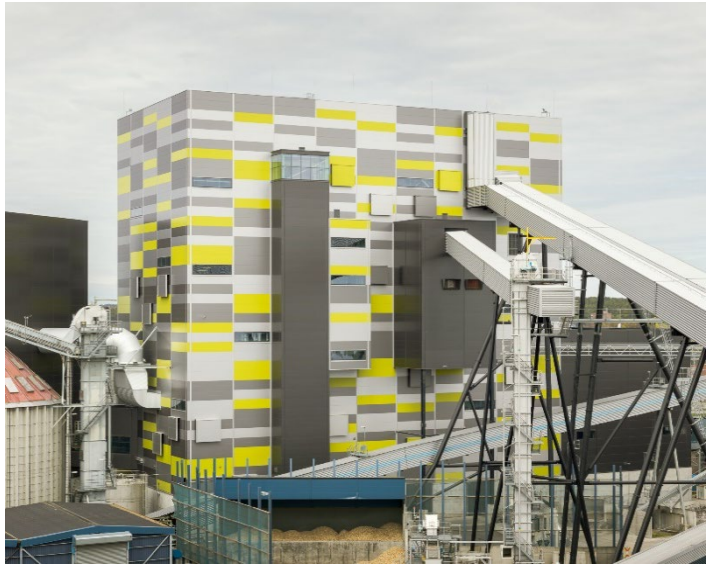
Valmet CFB for WtE – Selected references

Scalability single line 100-750 kt/a waste - More electric power from same amount of waste

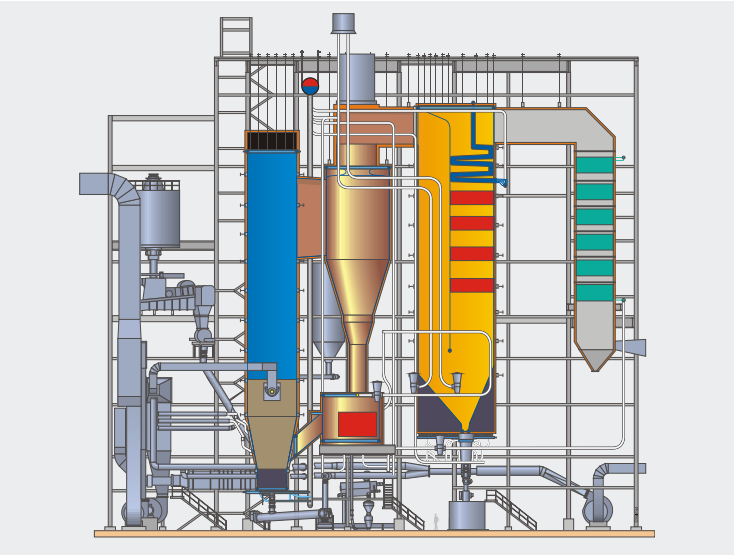


Mälarenergi AB
Västerås, Sweden

CFB boiler	155 MW_{th}, 74 bar, 470 °C
Fuels	480 kt/a MSW → 400 kt/a RDF
Start-up	2014
Driver	Large size

Thang Long Energy Environment
Vietnam

CFB boiler	40 MWth, 75 bar, 510 C
Fuels	RDF from MSW and ICW 500 + 100 TPD
Start-up	2024
Driver	FIT 11,6 MWe + Gate Fee



Urumchi Jinghuan Environmental
Urumchi, China

CFB boiler	2 x 125 MW_{th}, 74 bar, 470 °C
Fuels	2 x 350 kt/a RDF
Start-up	2021
Driver	Reliability, large size

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Valmet Pyrolyzer for plastic waste chemical recycling

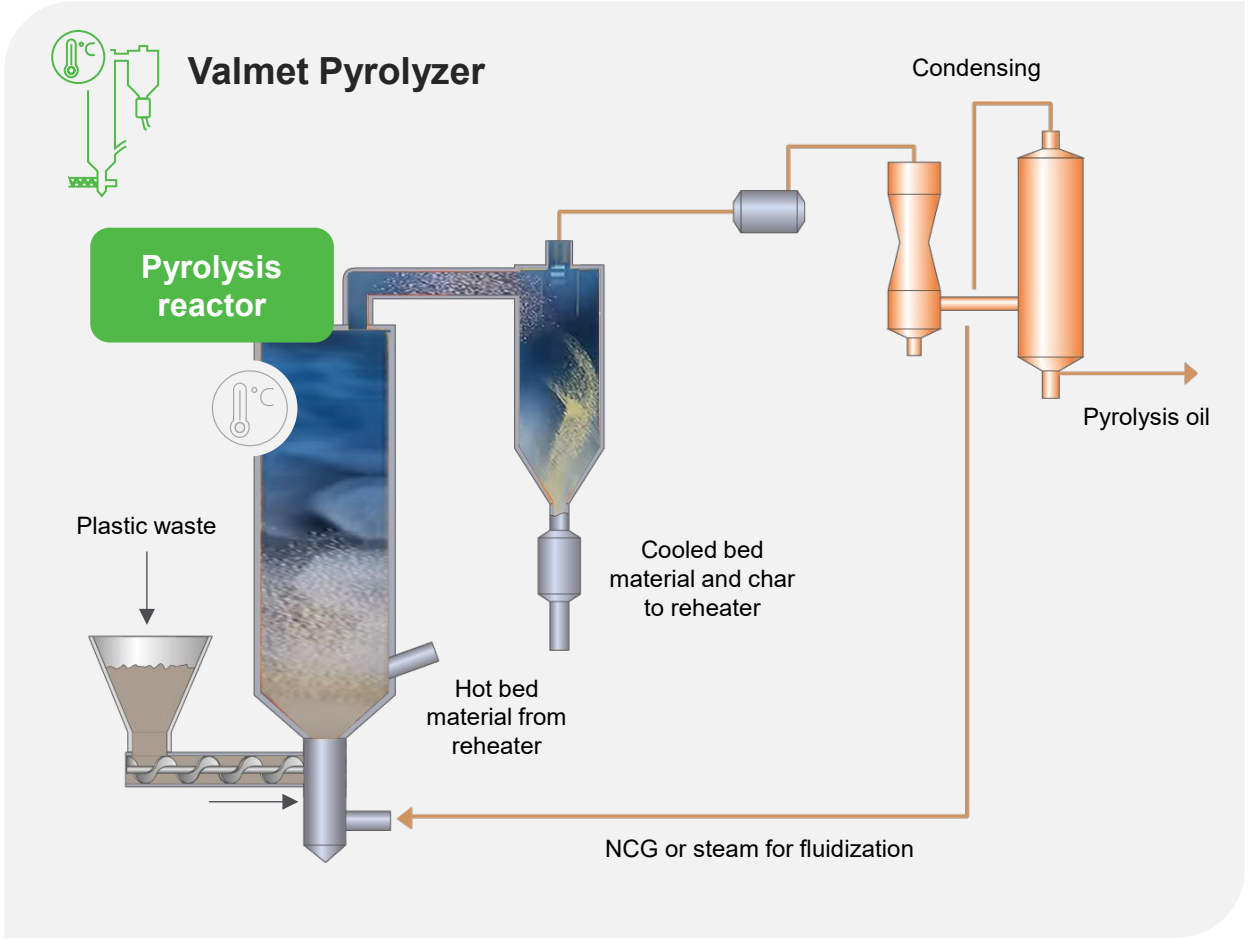
Pyrolysis converts plastic waste into high-value end products
(see in YouTube: Valmet Pyrolyzer)

Pyrolysis is the thermal or catalytic cracking of feedstock without the presence of oxygen

The process yields three main components
- Pyrolysis oil
- Char
- Non-condensable gas (NCG)

Suitable for most plastic feeds
- Polyolefins
  - Polypropylene (PP)
  - Polyethylene (PE)
- Polystyrene (PS)

Products
- Pyrolysis oil
  - Feedstock for refinery, co-feeding as naphtha for petrochemical plants
- Styrene
  - Feedstock for petrochemical plant



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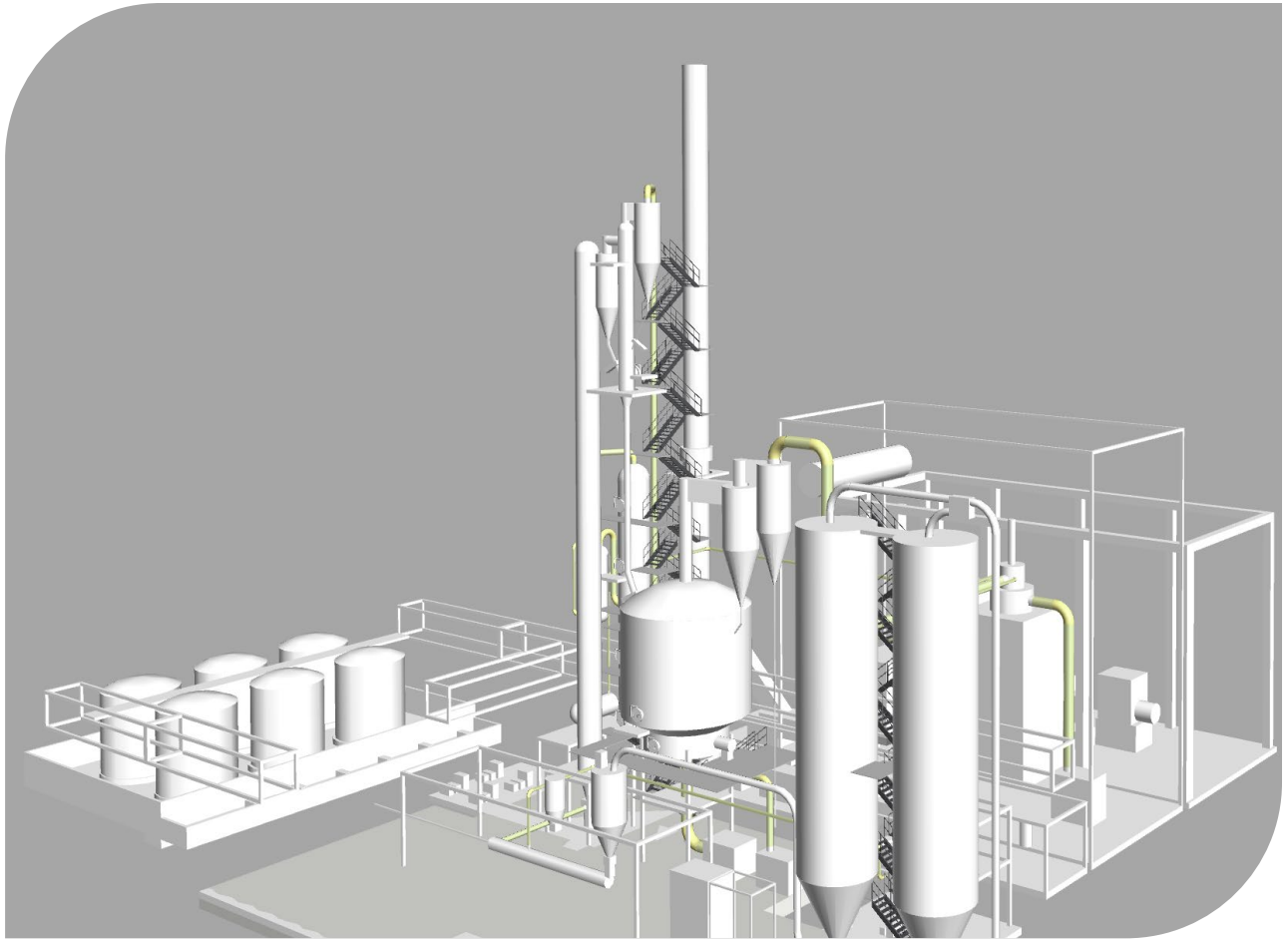
Valmet Concept for Mixed Plastic Waste Pyrolysis Plant

- Input capacity: 100 kt/a
- Target product: Plastic pyrolysis oil
  - Maximizing Naphta share
- Standalone or integrated solution
- Concept:
  - Feedstock day storage and feeding
  - Pyrolysis island
  - Product recovery
  - Energy island
  - Product storage



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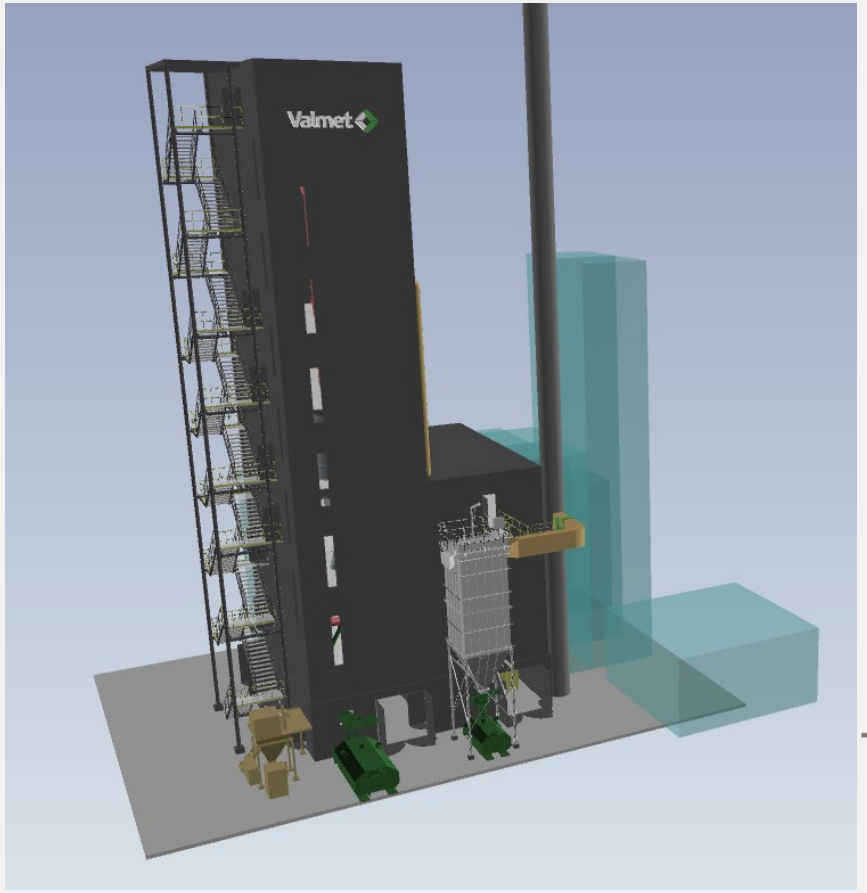
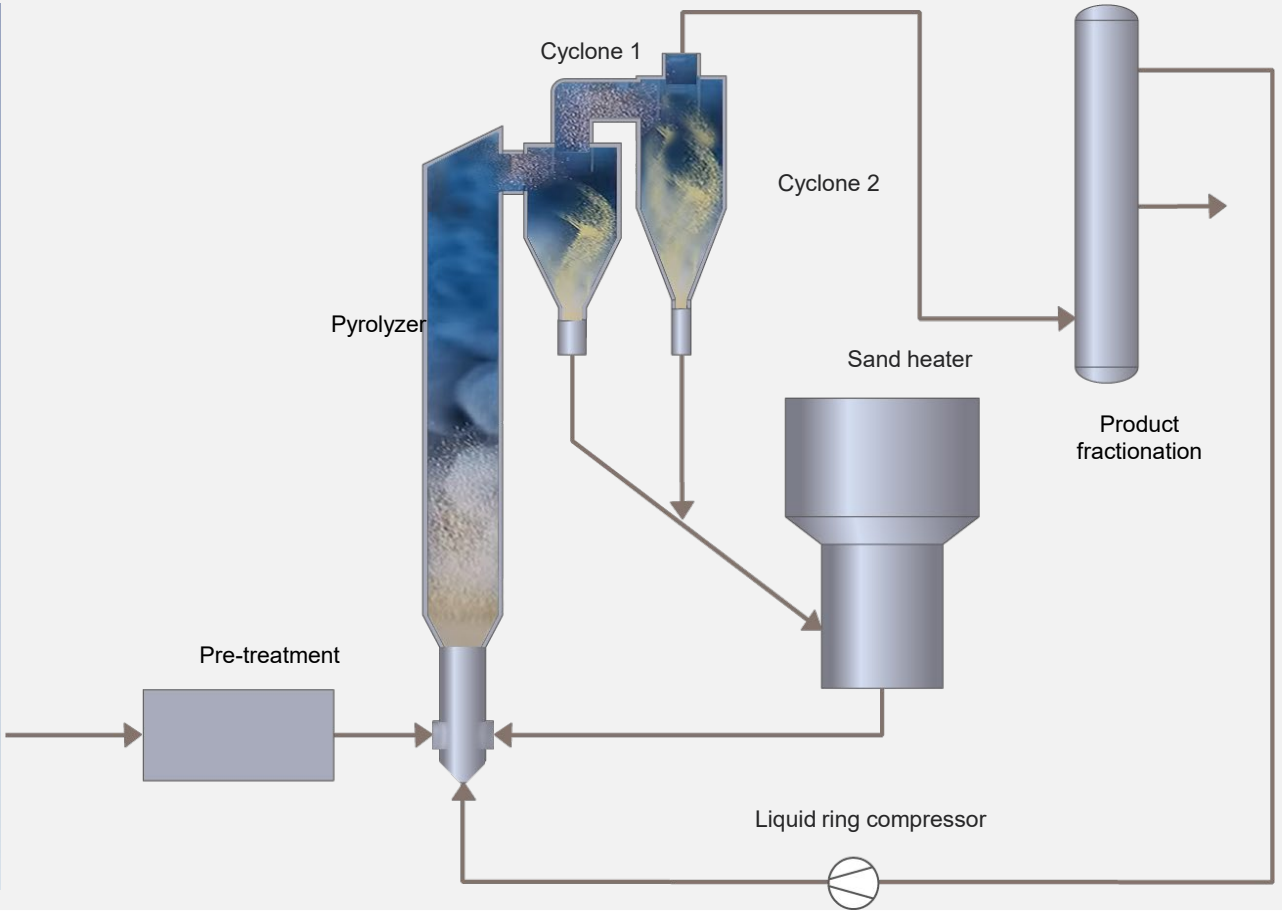
Polystyrene pyrolysis

Getting high yield and plant size scale-up





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Joining forces in polystyrene chemical recycling

Valmet's & Sulzer's complementary capabilities to deliver recycled styrene

Valmet

- Leading global developer and supplier of process technologies
- Extensive experience in WtE and Biomass to Energy
- Large pilot plant facilities in Tampere, Finland for fast pyrolysis with commercial references for fluidized bed technology

SULZER

- Leading global developer and supplier of process technologies
- Extensive experience in polymer recycling and polymer purification
- Commercial reference for purification of recycled styrene

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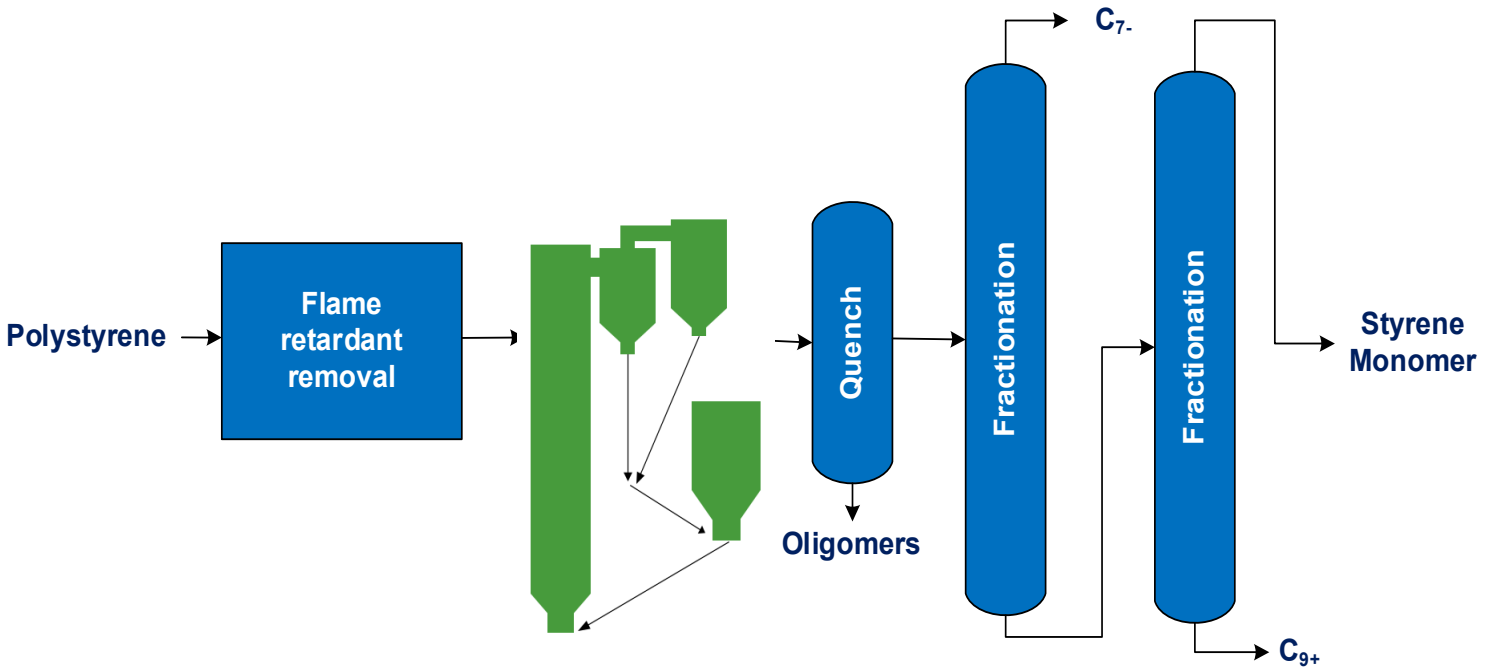
The joint process technology

Contaminated PS waste to styrene monomer

Process development from lab to pilot scale completed.

Individual unit operations proven within commercial applications.

Ready for scale-up to commercial scale.



SULZER

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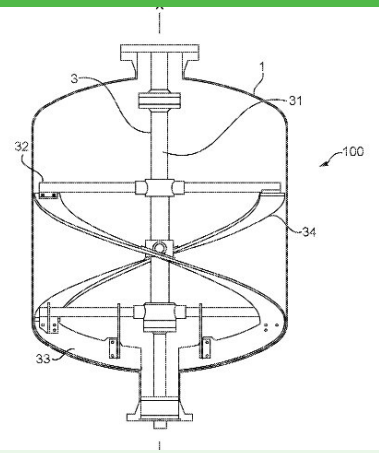
Reactor selection for polystyrene pyrolysis

Fluidized bed reactors are the best match for the highest yield and large scale

(C)STR



- Long residence time promotes secondary reactions generating more aromatics like ethylbenzene

Styrene yield approx.

55-60%

Screw reactor / Rotary kiln

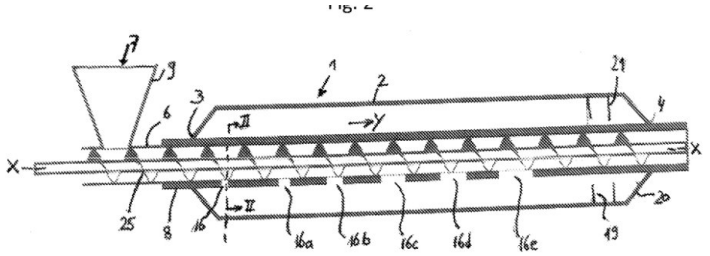


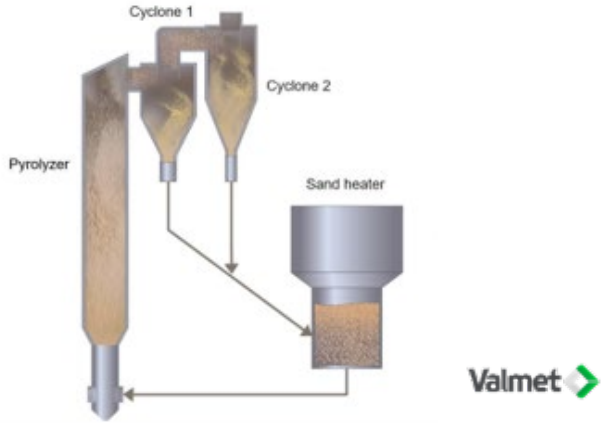
Fig. 3

- Polymer fed either melted or solid in a screw/kiln reactor and pyrolyzed along the screw resulting in moderate yields of styrene

Styrene yield approx.

47-65%

Fluidized Bed



- Short residence time and high temperature enables the highest styrene yield with mostly oligomers as side-products

Styrene yield approx.

70-80%

1 Azd Zayoud *et al.*, **Pyrolysis of end-of-life polystyrene in a pilot-scale reactor: Maximizing styrene production**
2. Yirong Liu *et al.*, **Pyrolysis of polystyrene waste in a fluidized-bed reactor to obtain styrene monomer and gasoline fraction**
3. Gerado Pérez-Bravo et al**., Catalytic Pyrolysis Process to Produce Styrene from Waste Expanded Polystyrene Using a Semi-Batch Rotary Reactor**

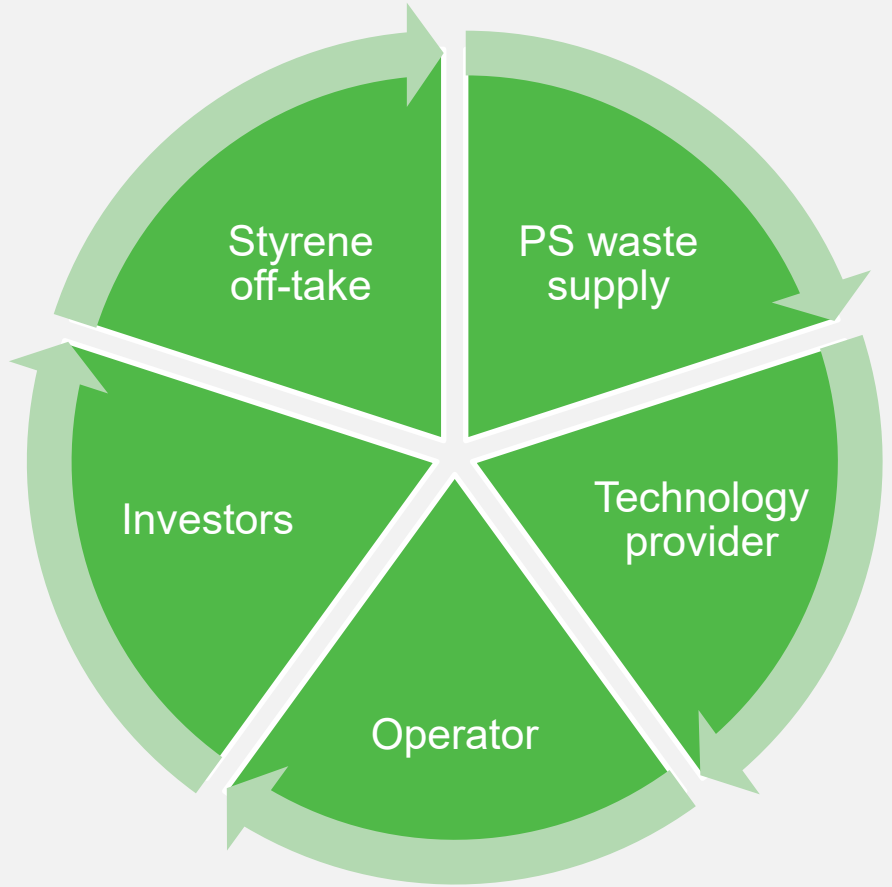
Looking for partners!

Building a polystyrene consortium

Established **supply chain from waste to polymer** is key to derisk project

We are working on building a consortium to enable the first demonstration project

We are **open for partners** across the full value chain.



SULZER

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Valmet value proposition in plastics chemical recycling

Making plastic chemical recycling feasible

- Using 1-2 reactors for large plants (>100 kta) leads to low-cost level and make plants feasible
- Optimizing temperature and retention time

Technological flexibility

- Fast pyrolysis is robust technology derived from WtE plants
- Readiness for catalyst provides low boiling point curve

Commercialization via testing

- Heading towards large plants via piloting and demonstration plant

Supporting evidence

- World leader in fluidized bed technology
- Over 20 years experience in fast pyrolysis with biomass

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FORWARD