



Solutions for a Better Tomorrow

The LyondellBasell Focus on Advanced Recycling and MoReTec

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Pipe Customer Event

Bonn October 12, 2023

Agenda for Today

- LYB Sustainability Goals
- Brand Owners, Retailers and Demand for Recycled Content
- Circularity Value Chains and LYB Integrated “Hubs”
- Advanced Recycling Strategy
- MoReTec



LYONDELLBASELL SUSTAINABILITY APPROACH



ENDING PLASTIC WASTE



ADDRESSING CLIMATE CHANGE



SUPPORTING A THRIVING SOCIETY

Our Future Focused Sustainability Goals

ENDING PLASTIC WASTE

2MMT¹

of recycled and renewable-based polymers will be produced and marketed annually by 2030

FOR EVERY \$

we invest in venture funds that address the plastic waste challenge, we help catalyze another 5 dollars from co-investors

ZERO

plastic pellet loss to the environment from our facilities

ADDRESSING CLIMATE CHANGE

NET ZERO

greenhouse gas emissions from operations by 2050²

42%

absolute scope 1 and 2 greenhouse gas emissions reduction from operations by 2030³

30%

absolute scope 3 greenhouse gas emissions reduction by 2030³

50%

minimum of electricity procured from renewable sources by 2030⁴

SUPPORTING A THRIVING SOCIETY

ZERO

incidents, injuries and accidents

ACHIEVE

gender parity in senior leadership globally by 2032

INCREASE

the number of people from underrepresented groups in U.S. senior leadership roles to reflect the general population ratio by 2032

ASSESS

a minimum of 70% of our key suppliers globally using sustainability criteria by 2025

¹ 2 millions metric tons

² Our 2050 net zero greenhouse gas emissions goal includes scope 1 and 2 emissions

³ Relative to a 2020 baseline

⁴ And a minimum of 75% from low-carbon power by 2030

Our *Circulen* brand of products enable customers to deliver sustainable consumer products



Polymers made from plastic waste through a **mechanical recycling process**



Polymers made by converting plastic waste into feedstock to produce new polymers using an **advanced recycling process***



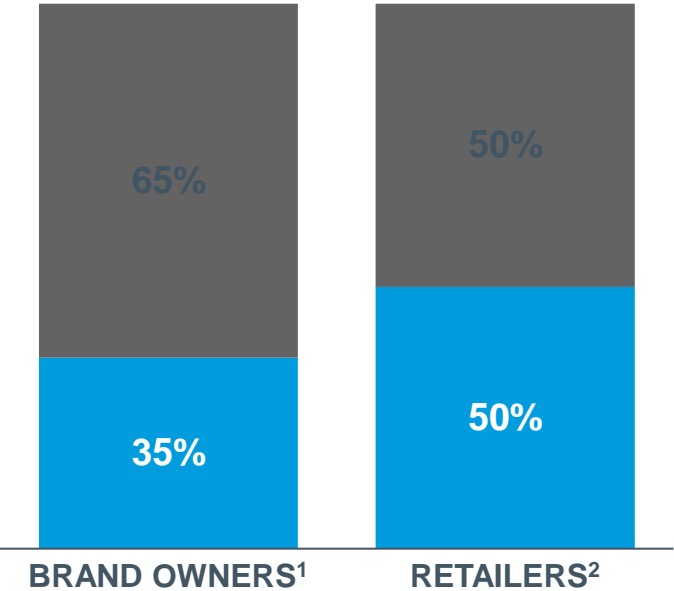
Polymers made from **renewable feedstocks** such as used cooking oil*

*based on a mass balance approach

URGENT DEMAND FOR RECYCLED AND RENEWABLE-BASED PACKAGING

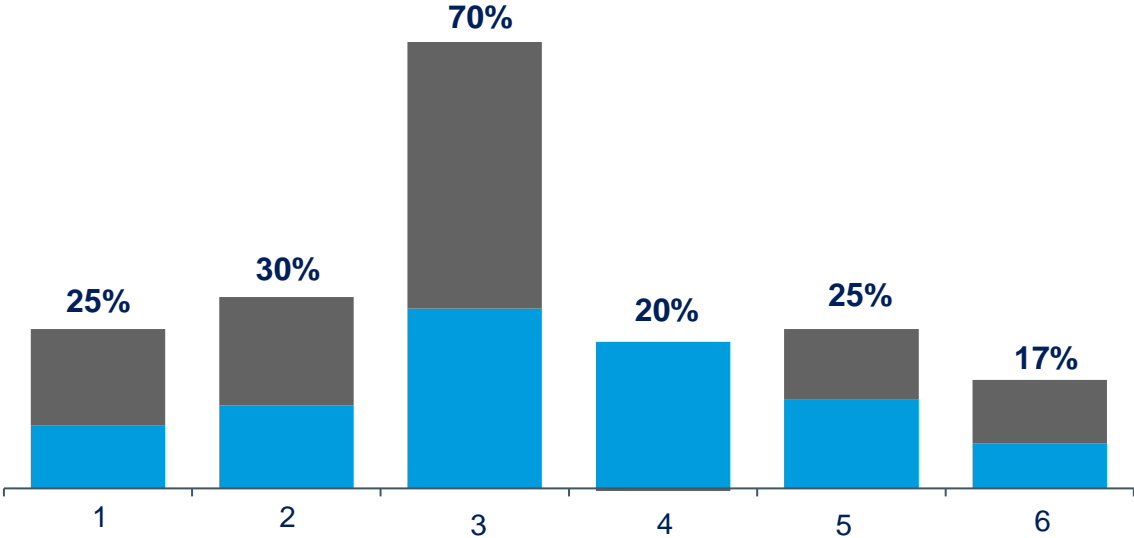
Brand owners and retailers both facing substantial gaps to 2025 targets

SUBSTANTIAL SHORTAGE TO MEET 2025 TARGETS



RETAILER COMMITMENTS²

Major Retailer Recycled Content Targets by 2025
% of total packaging content



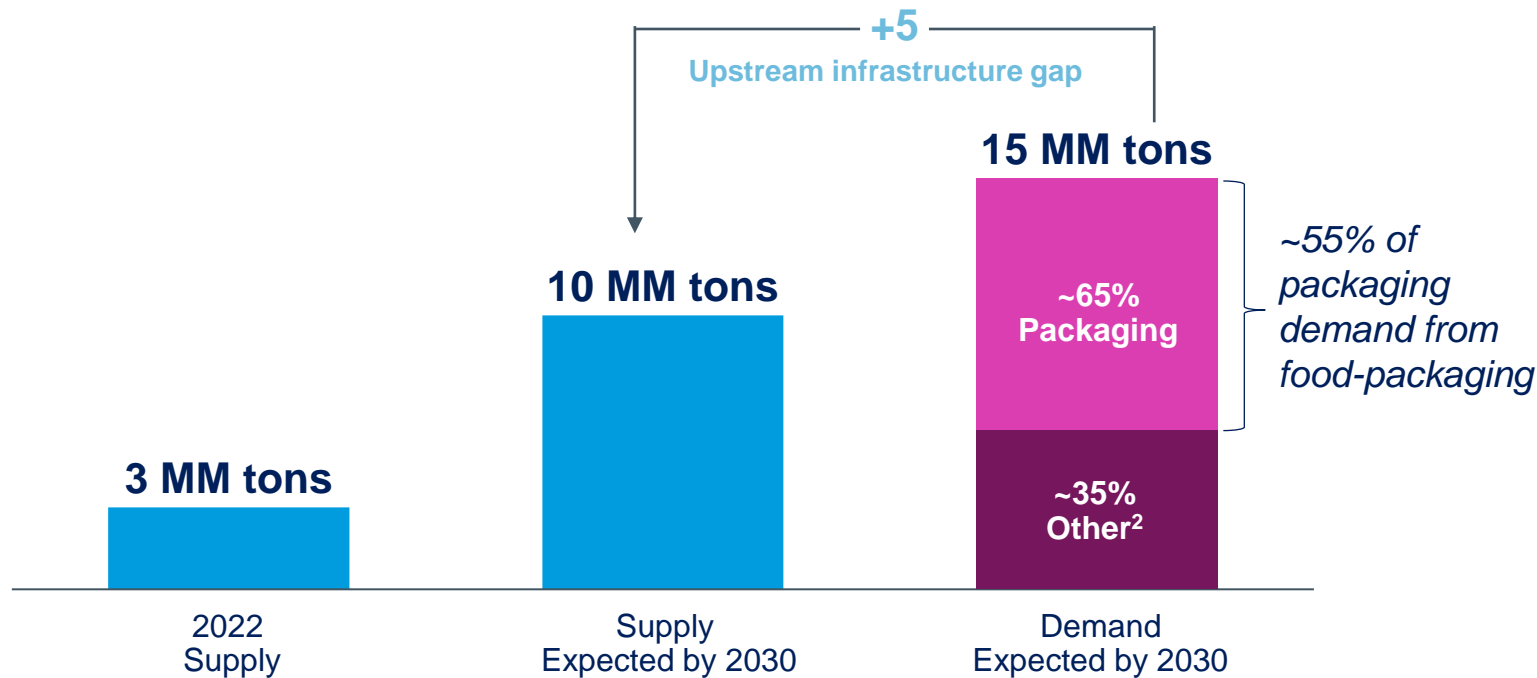
■ 2021 recycled content ■ Gap to 2025 target

1. 10 top brand owner's' commitments represent ~12% of total recycled content demand in packaging by 2025
 2. Leading retailers including Ahold Delhaize, Carrefour, El Corte Inglés, Kesko, Schwarz Gruppe, Walmart
 Source: Ellen MacArthur Foundation Global Commitment 2022 Progress Report

PERSISTENT SUPPLY SHORTAGE CREATING A STRONG BUSINESS CASE FOR INVESTMENT

Our target of 2 MM+ tons per year of recycled and renewable-based polymers by 2030 would establish our market leadership in North America and Europe

UPSTREAM INFRASTRUCTURE GAP IS CREATING A SIGNIFICANT SUPPLY SHORTAGE¹



1. Sources: McKinsey Chemical Insights, IHS Markit. Supply and demand for recycled and renewable-based polyethylene and polypropylene in North America and Europe.

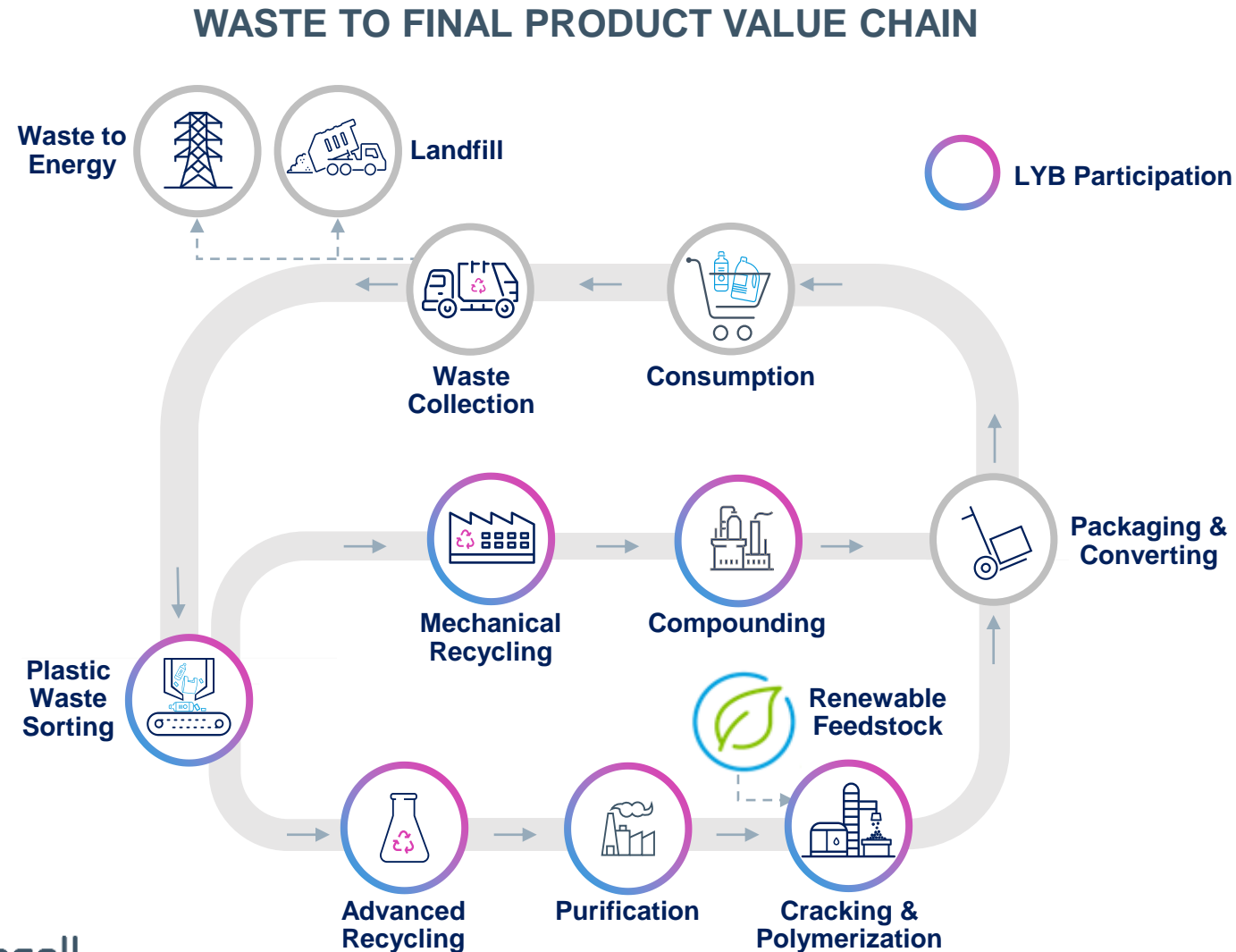
2. Other includes automotive, durable goods and construction.

MARKET ASSESSMENT

- More than 50% of total demand growth for PE/PP driven by recycled and renewable-based content¹
- Consumer packaging sector has the highest growth in demand for recycled content
- New capacity is needed to bridge the supply gap
- Persistent shortage of supply is expected to sustain healthy margins
- Customers (food packaging, healthcare etc.) are increasingly seeking higher quality recycled content from plastic waste that only advanced recycling can address

TODAY'S CIRCULARITY VALUE CHAIN

LyondellBasell is participating across complex and complementary value chains



KEY DYNAMICS

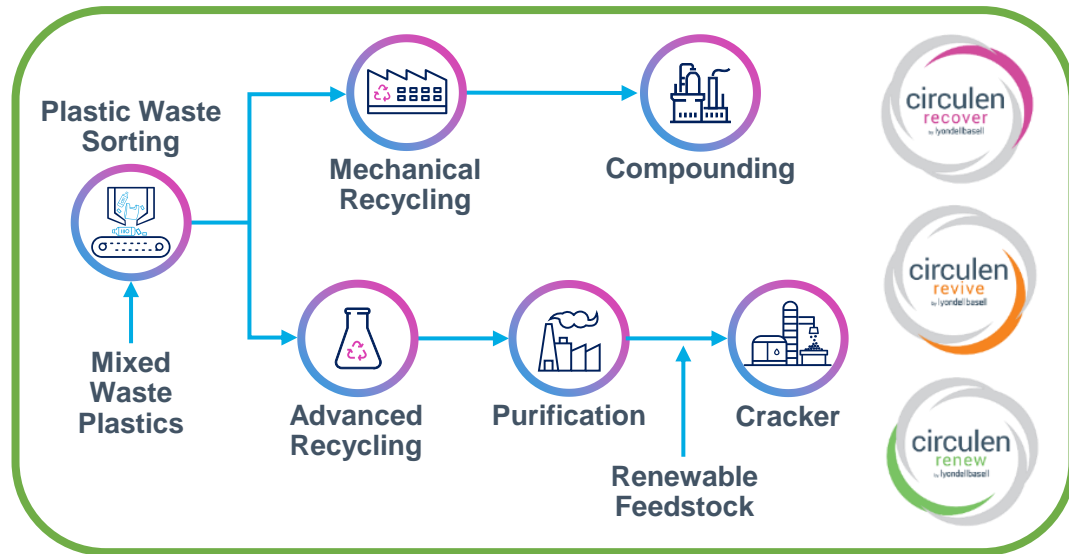
- Plastic waste is localized and extremely fragmented
- Regulations vary by region
- Opportunity to divert plastic waste from incineration and landfills
- Underdeveloped sorting technologies in highly populated areas do not optimize the value of recyclable feedstock at scale
- Mechanical recycling is complementary to advanced recycling
- Existing advanced recycling technologies are in early stages and face higher cost, smaller scale, and lower energy and carbon efficiency








LYONDELLBASELL'S INTEGRATED HUB MODEL PROVIDES ADVANTAGE

Building scale, reducing cost and capturing value to establish leadership in circular solutions

Integrated Hub Concept

- Regional hubs to access and supply feedstock into integrated hubs
- Preferred strategic partner to feedstock owners
- Leveraging existing capabilities at Cologne and Houston sites
- Differentiated and advantaged technologies (e.g., *MoReTec*)
- Collaborating with brand owners to provide a range of optimal solutions via *Circulen* brands



	Cologne, Germany	Houston, Texas
 Plastic waste Sorting	<ul style="list-style-type: none"> Source One JV EEW partnership 	<ul style="list-style-type: none"> Cyclyx agreement Houston Recycling Collaboration
 Advanced Recycling	<ul style="list-style-type: none"> Semi-industrial pilot plant running in Ferrara <i>MoReTec</i> 50 KTA completion by end of 2025 Third-party pyrolysis oil offtakes in place 	<ul style="list-style-type: none"> Studying <i>MoReTec</i> 100+ KTA Third-party pyrolysis oil offtakes in place
 Purification	<ul style="list-style-type: none"> Pursuing various options 	<ul style="list-style-type: none"> Potential repurpose of Houston refinery
 Cracker	<ul style="list-style-type: none"> LYB cracker and polymer sites 	<ul style="list-style-type: none"> LYB cracker and polymer sites
 Mechanical Recycling	<ul style="list-style-type: none"> QCP 100% ownership APK investment AFA Nord JV 	<ul style="list-style-type: none"> Third party offtake Mechanical recycling options in progress
 Compounding	<ul style="list-style-type: none"> Mepol acquisition APS sites 	<ul style="list-style-type: none"> APS sites
 Renewable Feedstock	<ul style="list-style-type: none"> Multiple renewable diesel feedstock agreements 	<ul style="list-style-type: none"> Multiple renewable diesel feedstock agreements

MoReTec: FOCUSED ON SCALE TO MEET SOCIETY'S NEEDS

LyondellBasell's integrated hub model provides meaningful cost advantage

MoReTec is designed as a large single-train unit while many competing technologies are smaller and rely on modularization

- Modular designs could have roles in small advanced recycling units located at waste sorting facilities
- Difficult to scale numerous small modular units as part of a large integrated chemical hub
- Modular designs are typically less efficient due to higher capital and operating costs

Purification of pyrolysis feedstock enables increased scale

- Low-quality post-consumer waste contains many contaminants
- Ethylene crackers can tolerate modest levels of impurities, but higher ratios of pyrolysis feedstocks requires purification
- LyondellBasell is incorporating purification into our commercial scale-up for *MoReTec-1* and beyond



MoReTec's innovative design enables commercial scale and supports LyondellBasell's goal to produce and market at least 2 MM tons/year of recycled and renewable-based polymers by 2030

MoReTec: FURTHER ADVANTAGED BY LYB'S CATALYST TECHNOLOGY

Proprietary catalyst differentiates *MoReTec* relative to traditional pyrolysis processes



Utilizing LyondellBasell's deep expertise in catalyst technology for polymers and chemicals

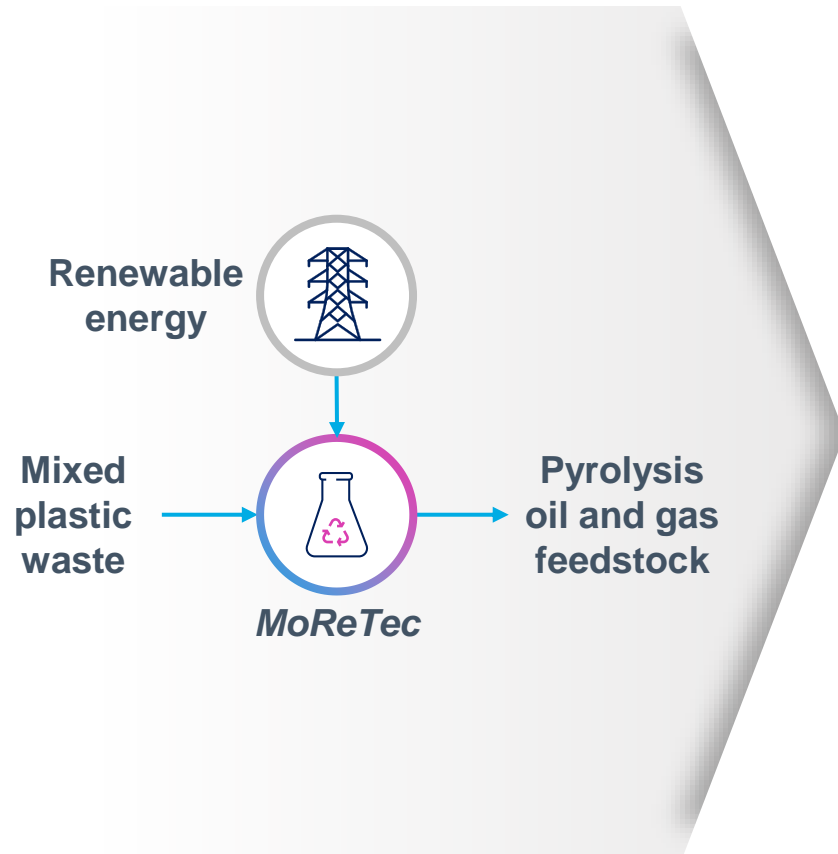
- LyondellBasell has decades of multidisciplinary leadership in polymer, monomer and feedstock technologies
- Leveraging our existing catalyst systems and intellectual property

Catalysis lowers the activation energy and improves the yield of valuable pyrolysis oil and pyrolysis gas

- Improved energy efficiency through lower reactor temperatures
- Reduced residence time and improved scalability with lower capital costs
- Higher plastic-to-plastic yield with lower production of low-value by-products

MoReTec: SUPPORTING OUR NET ZERO GOALS

LyondellBasell's unique process design allows for electrical heating and reduced emissions



SCOPE 1 IMPACT

Pyrolysis gas is used as feedstock to integrated ethylene cracker as opposed to fuel



SCOPE 2 IMPACT

Electrical heating of the process allows for utilization of renewable electricity from solar, wind or other sources

Catalysis reduces energy consumed during pyrolysis of plastic waste



SCOPE 3 IMPACT

Plastic waste displaces fossil-based feedstocks and diverts plastic waste from incineration, landfills or leakage into the environment

MoReTec-1 process estimated to have less than 50% the carbon footprint of fossil-based process¹

MoReTec: PATH TO COMMERCIALIZATION

LyondellBasell's innovation capabilities and integrated assets accelerate commercial scalability

Leveraging LyondellBasell's unique innovation capabilities

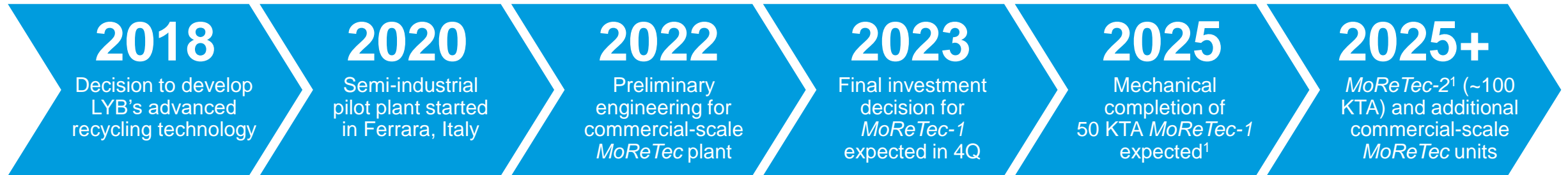
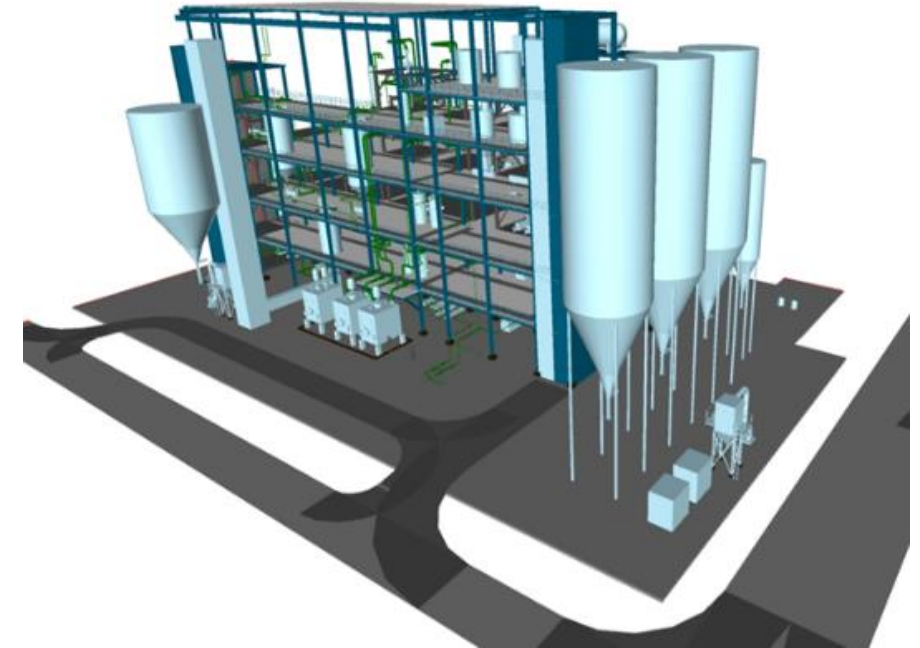
- Integrated R&D team rapidly developed *MoReTec* from concept to pilot scale to address the urgent need for scalable circular solutions that do not exist today

Utilizing LyondellBasell's integrated hub model

- *MoReTec-1* to be built at our Wesseling site near Cologne, Germany with benefits for plastic waste sourcing, carbon yield and energy integration¹
- *MoReTec-2* planned for Houston hub and expected to be double the size of *MoReTec-1*¹

Potential licensing opportunities

- Technology drives value and global growth for LyondellBasell through partnerships





Thank you

www.lyondellbasell.com/en/sustainability


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