# Chemical recycling of plastics – Opportunities and challenges

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BOREALIS
Keep Discovering

# Chemical recycling, a part of the solution for closing the loop

## Renews plastic back to plastic


### The solution for high purity, high performance materials

- Borcycle™ C is our portfolio of **transformational chemical recycling solutions**, giving polyolefin-based, post-consumer waste another life.
- It offers all-round benefits, supercharging the transition to a circular polyolefin industry whilst creating **virgin quality plastic products.**
- A solution creating both virgin-level grade materials and high safety and performance qualities fit for demanding applications.
- Borcycle C renews plastic back to plastic; creating recycled materials with a level of purity fit for protective, food-safe and other demanding applications.

# Borealis expands its portfolio with circular PO solutions

## Complementary portfolio addressing challenges of plastic waste and climate change

EverMinds™ Thinking Circular

## BORCYCLE™

### Borcycle™ M

**Advanced mechanical recycling**

State-of-the art recycled material and rPO compounds in light colours which overcome challenges in terms of odour and impurities

**First generation launched**

### Borcycle™ C


**Chemical recycling**

Virgin equivalent
Food grade

For high demanding applications

**First generation launched**

## Bornewables™

**Renewable-based POs**

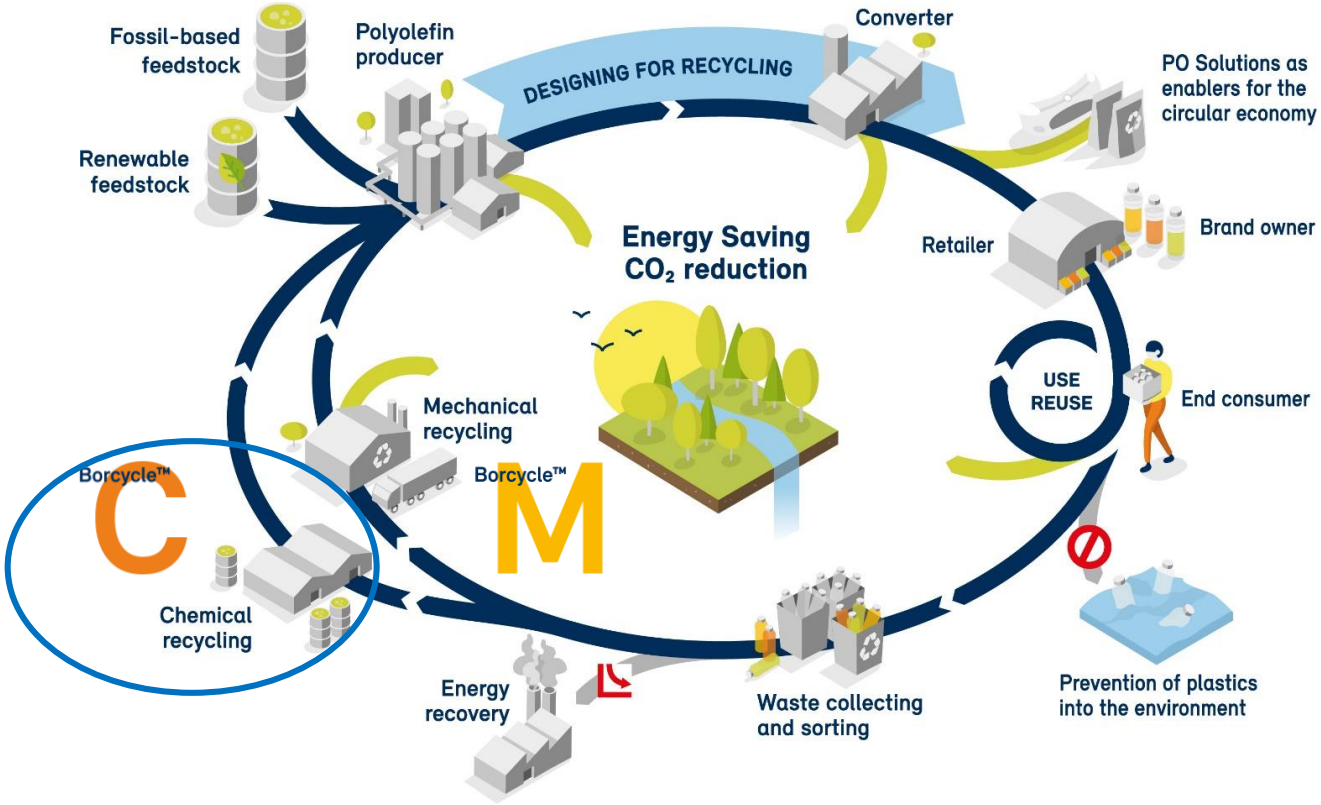
Virgin equivalent
Food grade

Carbon footprint reduction

**In commercial launch**

# To build up a Circular Economy, Borealis takes a wider view on the value chain

## Closing the loop with our Borcycle™ portfolio of recycling technology solutions



# What is chemical recycling of polyolefins?
## Pyrolysis process explained

- **Pyro means heat**
- **Lysis means ‘break-down’**

- Chemical recycling is a process which converts plastic waste **to monomers, synthetic oil or gas,** which are then consequently used as a raw material in the manufacture of new products. The right technology is dependent on the type of polymer being processed.
- Chemical recycling of polyolefins uses a **thermal pyrolysis process**. Thermal pyrolysis is burning-in-the-absence-of-oxygen (so no oxidation happens) at a temperature between 400°C and 600°C, resulting in a pyrolysis oil.
- The quality of the pyrolysis oil depends on the specific techniques and the composition of the input. Contamination and other type of plastics, like PET (rich in oxygen) and PVC (chlorides) disturb the pyrolysis process and will be separated from the plastic waste stream.

# Borealis is actively developing chemical recycling to add to its CES portfolio

## And actively involved in many public organisation and supportive to new policies

- Borealis actively studies new chemical recycling technologies for over 5 years, with the aim to select, develop and install technologies at **different Borealis production locations.**
- Borealis ambition is to offer **350,000 tonnes of recycled PO** annually by 2025.
- Active member of **Ellen MacArthur New Plastics Economy**, Plastics Europe and CEFIC working groups supporting the **EU Circular Plastics Alliance**
- Member of the **Issue Team on Chemical Recycling** to recommend necessary legislative & funding steps to enable 10 Mta recycled plastics use in EU by 2025
- Several **value chain collaboration** to make chemical recycling a reality

# Borcycle C 1.0 chemical recycling unit – Stenungsund, Sweden

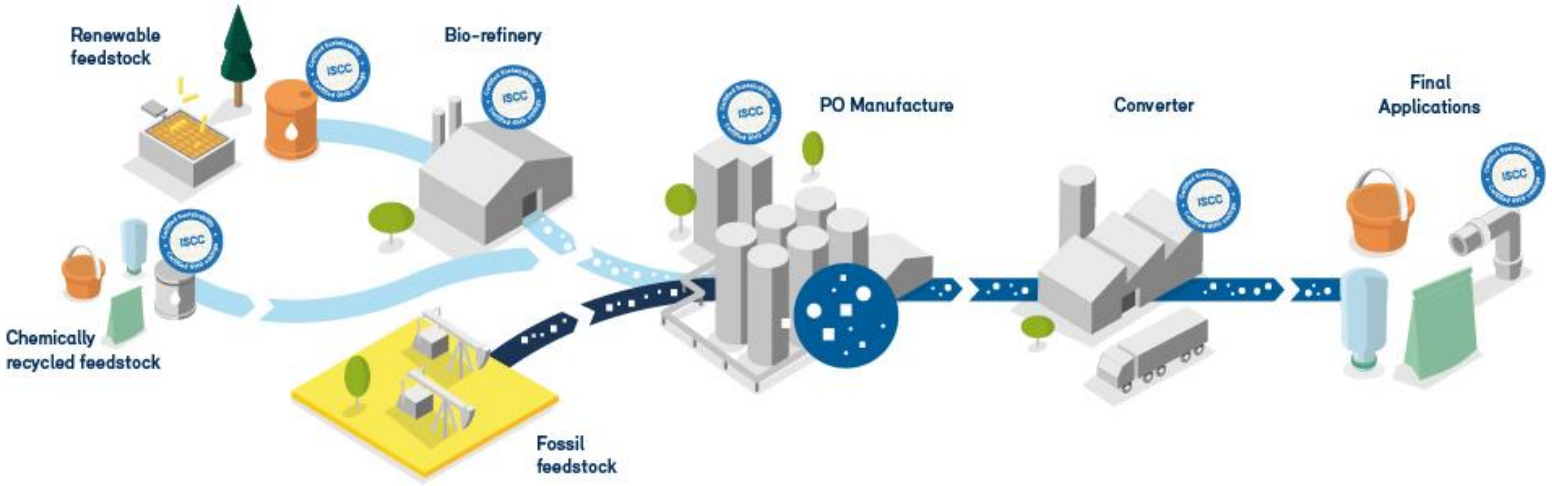
## New chemical recycling unit in Stenungsund expected to commence operations in 2024

- Borealis drives collaborative project in **Sweden** to increase supply of chemically recycled feedstock for the manufacture of more circular base chemicals and plastic products
- Collaboration with **Stena Recycling** and **Fortum Recycling and Waste**
- A feasibility study for a chemical recycling unit to be established at the Borealis production location in Stenungsund, Sweden is now underway.
- Provided a successful feasibility study and final investment decision, operations are expected to begin in 2024.
- Borealis Stenungsund has been ISCC PLUS certified since February 2021.

**Grant awarded by the Swedish Energy Agency to Borealis for feasibility study with project partner Stena Recycling**

# Borcycle™ C

## Based on the mass balance model



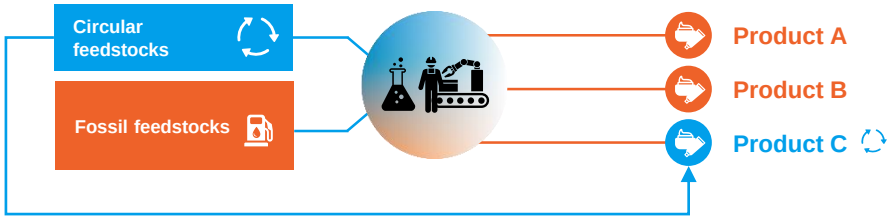

- All Borcycle™ C polymers are **sustainability certified by ISCC Plus –** a reliable global leading certification scheme.
- The plastic waste used to produce the chemical recycling feedstock for the Borcycle™ C polymers are traceable back to the first collection points.
- In the Borcycle™ C production, the mass balance model is used to save identical volume of fossil feedstock by replacing it with sustainable feedstock, produced from bio based wastes and residues.

# Borealis is using the globally leading certification system ISCC to increase uptake of chemically recycled and renewable polyolefins

## We believe in a full value chain approach to increase consumer trust and ensure traceability

**Inputs:**

Circular-Propane,
Circular-Naphtha &
Circular-Diesel




ISCC
www.iscc-system.org
MIX supporting certified sustainable material

**Outputs:**

Circular (‚Fossil-circular') Ethylene, Propylene, PE, PP, Butadiene, Phenol

***"Free attribution" of the sustainable share to one or several outputs***

- Mass Balance Approach allows mixed fossil / circular production **but separated in bookkeeping**
- ISCC is contributing to the implementation of **environmentally**, **socially** and **economically sustainable** production, fully traceable and deforestation free supply chains
- Enables on-product claims & logos
- Borealis' locations in Belgium, Germany, Finland and Sweden are ISCC Plus certified

# True circularity of plastics is the answer

## Our future is circular

- Our technologies are scalable and ever-advancing, using value chain collaboration and Borealis expertise, experience and innovative strength.
- Borealis focuses on the commercialisation and proliferation of recyclates manufactured by mechanical recycling. However, mechanical recycling does have limitations and, in this case, chemical recycling is a suitable alternative to close the loop.
- A solution creating both virgin-level grade materials and high safety and performance qualities fit **for demanding applications**.
- Borcycle C is at the heart of Borealis' drive for progress towards a circular future, captured in our **EverMinds™ platform** and its ambition for Accelerating Action on Circularity.

# EverMinds™

Thinking Circular