

## **Chemical Recycling**

From plastic waste to virgin-grade products

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## Sustainability @ BASF

#### Key measures

#### Climate protection

Decouple our CO<sub>2</sub> emissions from organic growth through a Carbon Management program. Create transparency for our customers by providing product carbon footprints for the entire BASF portfolio.

#### Sustainable product portfolio

Further increase our sales from "Accelerator products", which make a substantial sustainability contribution in the value chains.

#### Circular Economy

Invest in cutting-edge technologies to speed up the transition to a circular economy, such as our ChemCycling<sup>™</sup> project.



#### **Our purpose:**

# We create BASE chemistry for a sustainable future



## **Plastics production today**

Plastics Industry needs to adapt to a changing legislative environment

# Highly efficient production of high-performance plastics

- Optimized system over 50 years
- Crude-oil based
- Large variety of specialized plastics for demanding applications



#### Challenges

- Public pressure to reduce plastic waste (marine littering, landfill)
- Ambitious legislation targets
  - Reduce GHG emission
  - Increase recyclability of plastics
  - Increase recycled content in plastics

Chemical recycling can handle the challenges while maintaining process efficiencies and plastics performance





# Today's recycling landscape for plastic waste

End-of-life treatment of 29mn tons of plastic waste in EU28+2 in 2018



Only one third of all plastic waste is kept in the materials cycle in EU28+2.



Source: Conversio "Circular Economy of Plastics 2018 EU28+2", p. 68

# Chemical recycling complements mechanical recycling and can contribute significantly to achieve EU recycling targets



Closing the recycling loop for more plastic waste fractions by chemical recycling will improve perception of plastics



## All players of the plastics value chain are facing similar challenges

We need to act now and join forces to develop solutions for plastic waste which is not recycled today



## **Excursus: Allocation of recycled feedstock** with the mass balance approach

#### Feedstock

#### BASF Production Verbund







#### **Products**

Conventional product (Ultramid®)





#### Recycled

Use of recycled feedstock in very first steps of chemical production (e.g., steam cracker) Utilization of existing Production Verbund for all production steps Mass balance product (Ultramid<sup>®</sup> Ccycled<sup>TM</sup>)

Allocation of recycled feedstock to selected products





# Mass balance principle is widely used in certification schemes in different industry sectors



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## **Regulatory support for chemical recycling needed**

- Chemical recycling needs to count towards recycling targets
- Incentives for recycled content should apply to all kinds of recycling
- Acceptance of mass balance approach: mass balanced recycled content should be supported to the same extent as single sourced recycled content

Joint industry efforts should concentrate on technology open definition of recycling



# LCA demonstrates that chemical recycling is a sustainable way to close the loop for plastics

#### Approach

Life Cycle Assessment (LCA) study commissioned by BASF, performed by a third-party in consistence with international LCA standards and reviewed by three independent and recognized experts

#### **Results**

- Pyrolysis of mixed plastic waste emits ~50% less CO<sub>2</sub> than incineration of mixed plastic waste.
- Manufacturing of plastics via chemical recycling (pyrolysis) or mechanical recycling of mixed plastic waste results in similar CO<sub>2</sub> emissions\*.

# LCA results should be used as a multiplier for the acceptance of the method

 \* Differences in product quality (virgin-grade quality for chemical recycling / non-virgin-grade quality for mechanical recycling) as well as differences in sorting losses are included in the calculation by applying the 10 *Circular Footprint Formula* of JRC / EU Commission.

#### **Comparison of CO<sub>2</sub> emissions of the life cycle of 1t of virgin plastics with three end-of-life options**



Fig. 3: Production and end-of-life treatment of 1t of plastics via pyrolysis emit 2,100 kg CO2e, whereas production and end-of-life treatment of 1t of plastics via mechanical recycling emits 2,000 kg CO2e. Production and incineration of 1t of plastics emits 3,700 kg CO2e.

\*\* The error bar reflects the diffe quality factor and the material lo The value can vary +/-25%



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### Today's capacities and quality of pyrolysis oil by far not sufficient to meet the demand Example: Plastic packaging recycling Pyrol

- Out of 17.8 mn tons of plastic packaging waste in Europe ~ 7.5 mn tons (42%) are recycled\*
- With the EU target that 55% of plastic packaging waste has to be recycled by 2030, recycling demand for another 2.3 mn tons of plastic packaging waste arises

Assuming an equal contribution of mechanical and chemical recycling to address the increased recycling rate (volume), approx. 100 pyrolysis plants of current average scale are required

# Commitment from big plastic producers to continuous investment in chemical recycling capacities needed

\* Source: PlasticsEurope, Plastics – the Facts 2019

**Pyrolysis plant landscape in EU** 



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commercial plastic waste pyrolysis plants (in operation by end of 2020) non-commercial demo plants (no complete overview)

## **Summary**

- Chemical recycling can handle the challenges ahead of today's plastics production while maintaining process efficiencies and plastics performance
- Chemical recycling is complementary to mechanical recycling and is needed to achieve EU recycling targets
- The players of the plastics value chain should join forces to improve the acceptance and master the technical challenges of chemical recycling
- Joint advocacy efforts should concentrate on technology open definition of recycling
- Life cycle analysis demonstrates that chemical recycling is a sustainable way to close the recycling loop for plastics. It should be used as a multiplier for the acceptance of the method
- Today's capacities and quality of pyrolysis oil is by far not sufficient to meet the demand
- We believe, the big plastics producers should be open towards cooperation with other industry players and should show commitment to continuous investment in chemical recycling capacities and technology to achieve the needed economy of scale faster.



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