Chemical Recycling

From plastic waste to virgin-grade products

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Plastics play an important role in a sustainable and resource-efficient economy

Packaging
Plastics ensure food safety and reduce food waste

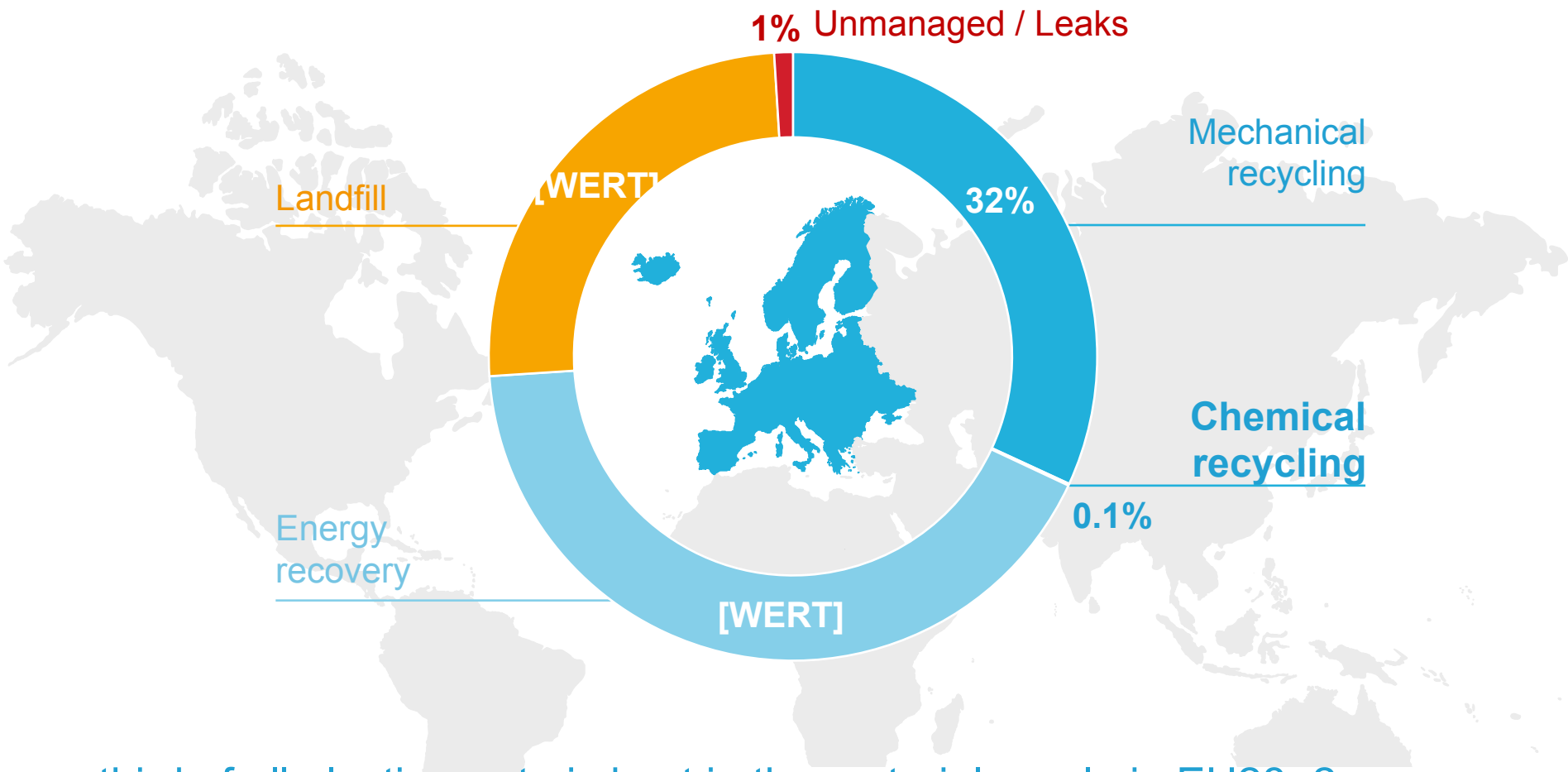
Building & Construction
Plastics ensure energy savings and long product life span

Automotive
Plastics ensure weight reduction, fuel-efficiency and safety

We must address end-of-life challenges to make full use of plastics' benefits

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.

Sources: Conversio “Circular Economy of Plastics 2018 EU28+2”, p. 68

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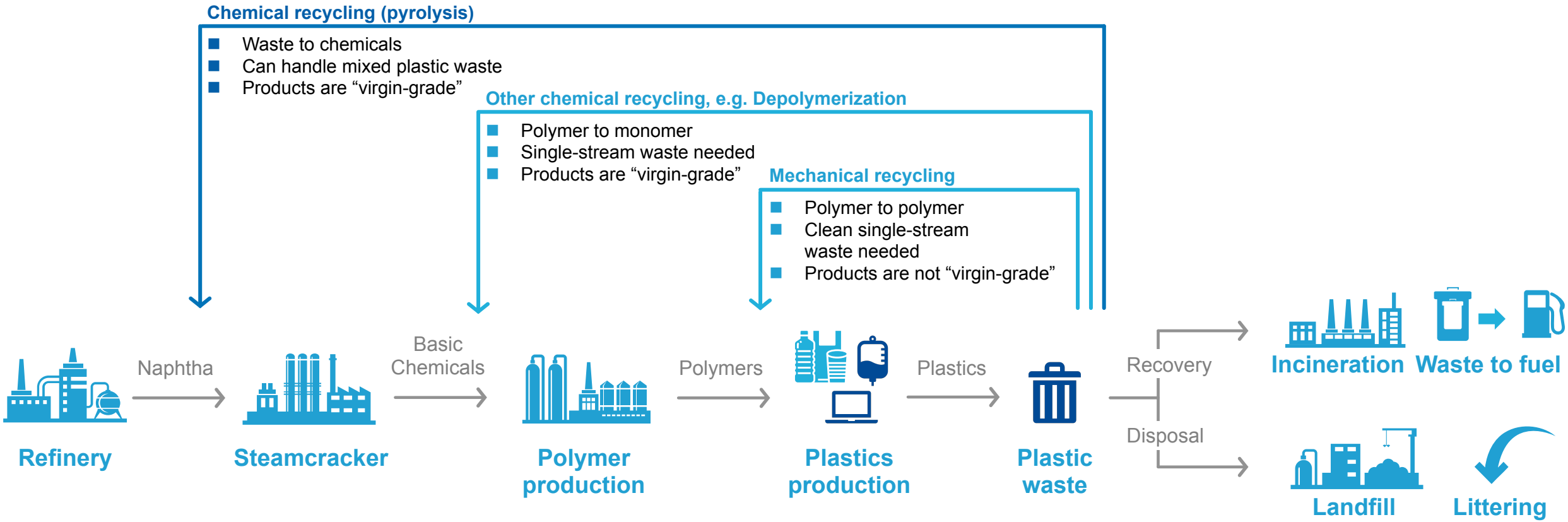
Chemical recycling complements mechanical recycling and can contribute significantly to achieve EU recycling targets



Chemical recycling is one of many measures needed to reduce fossil resource consumption & to achieve a world free of plastic waste

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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_2 than incineration of mixed plastic waste.**
- **Manufacturing of plastics via chemical recycling (pyrolysis) or mechanical recycling of mixed plastic waste results in similar CO_2 emissions*.**

LCA results should be used as a multiplier for the acceptance of chemical recycling

* 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 *Circular Footprint Formula* of JRC / EU Commission.

Comparison of CO_2 emissions of the life cycle of 1t of virgin plastics with three end-of-life options

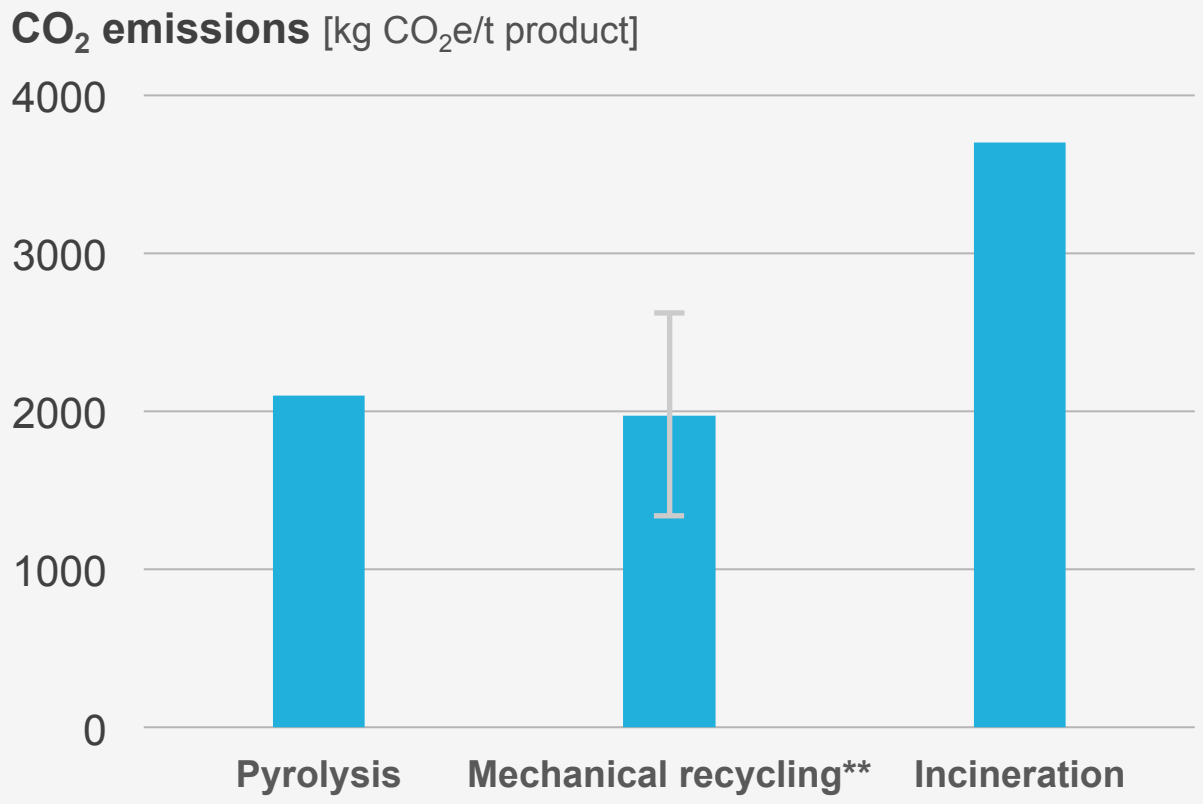

Fig. 3: Production and end-of-life treatment of 1t of plastics via pyrolysis emit 2,100 kg CO2e, whereas production and end-of-life treatment of 1t of plastics via mechanical recycling emits 2,000 kg CO2e. Production and incineration of 1t of plastics emits 3,700 kg CO2e.

** The error bar reflects the different scenarios by changing the quality factor and the material loss rates after sorting of waste. The value can vary +/-25%

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Chemical recycling technology is ready for large scale industrial use

Challenges remain to make technology more broadly applicable and to meet demand

All major plastics producers have engaged in partnerships to overcome technical challenges

Partnering is Key

Example BASF & Quantafuel

- Quantafuel owns a unique integrated process of pyrolysis of mixed plastic waste & purification of the resulting oil
- Start-up of plant with a capacity of 16,000 tons in Q3 2020; optimization ongoing (according to plan)

QUANTAFUEL

Challenge 1: Quality & Efficiency

- Quality of pyrolysis oil is crucial for use as feedstock in chemical production network
- Need for continuous improvement of pyrolysis & purification processes to
  1) increase overall efficiency
  2) to address a greater variety in quality of mixed plastic waste (purification)

Challenge 2: Volumes

- Today's capacities of pyrolysis by far not sufficient to meet the demand
- It is estimated that in the next twenty years several hundred chemical recycling plants will be required globally*

Long-lasting commitment from big plastic producers to investment in chemical recycling capacities & technology is growing

* Source: The PEW Charitable Trusts, Systemiq "Breaking the plastic wave", p. 32

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

Technology open definition of recycling is key to address the plastic waste problem

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