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Chemical Recycling

Possibilities for chemical Industry

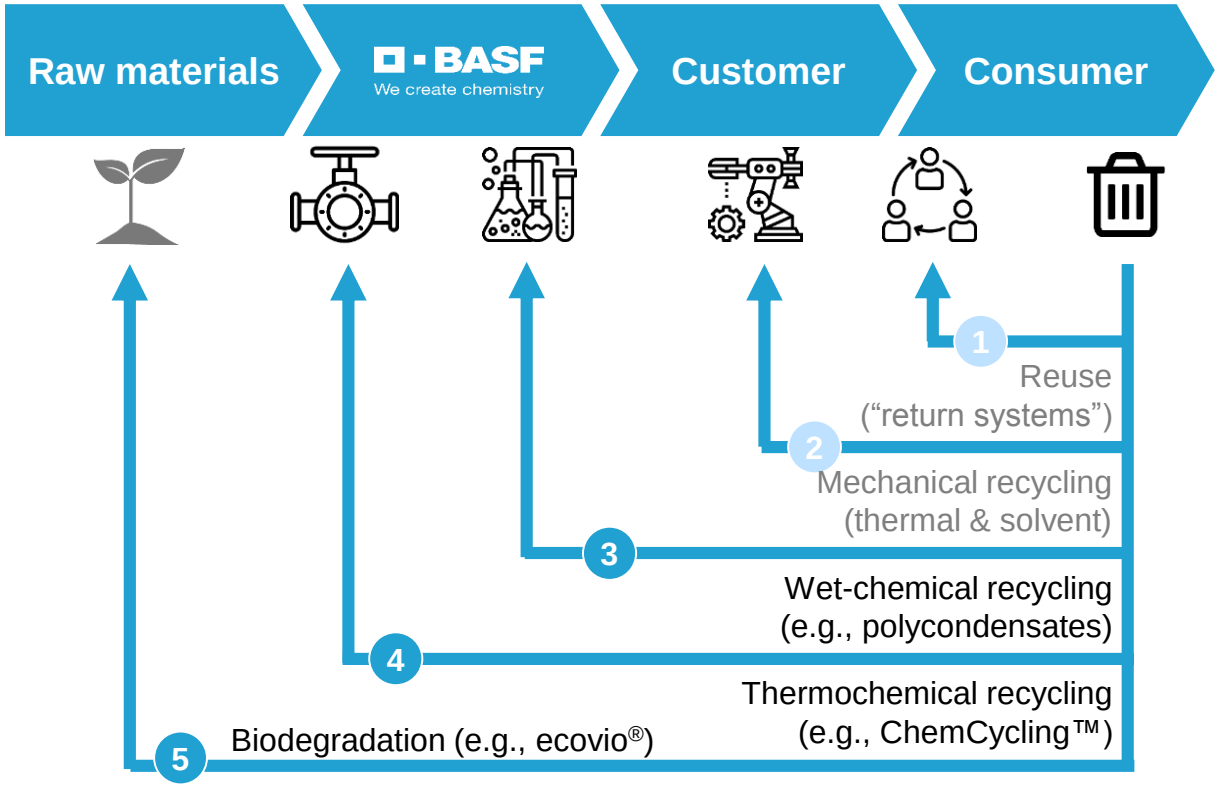
Dr. Andreas Kicherer, Director Sustainability Strategy

Stuttgart, Oct 2019

Elements of the circular economy concept for plastics

A circular economy is based on employing a mix of recycling processes to maximize resource circulation

All recycling processes convert waste into feedstocks



Sources: Adapted from Accenture/CEFIC “Taking the European chemical industry into the circular economy”; Icons erstellt von Eucalyp, mynamepong, srip auf www.flaticon.com

What is the value add of new recycling technologies?

- Recycling of waste that would be otherwise incinerated or landfilled, e.g., “non-recyclable” waste, such as foams, highly-stressed polymers, additive products, laminates, etc. or for organic waste
- Realization of higher recycling rates by complementing conventional mechanical processes
- Wet-chemical processes (3) provide higher-value recyclates with purer streams, e.g., polycondensates (PU, PA, PET, PBT…)
- Thermochemical recycling (4): Suitable for inseparable mixed wastes that are returnend to common general building blocks for HQ products
- Composting/Soil biodegradation/Biogas production (with composting) (5) simplifies organic waste collection for composting or biogas production and enables prevention of microplastics in agriculture

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Chemical recycling represents a missing link to close the loop

Recovery – close the loop

ChemCycling

Mechanical recycling

ChemCycling
+ can handle mixed plastic waste
+ produces virgin-like raw materials

Recovery – utilize the energy

Waste to fuel

Incineration

Linear economy

Landfill

Littering

BASF is breaking new ground in plastic waste recycling

1 Waste companies supply recyclers with plastic waste

2 Plastic waste is converted into feedstock by third parties through thermochemical processes

6 The waste is collected and sorted by waste companies

ChemCycling: Turning plastic waste into new products

3 This feedstock can be used in the BASF Verbund as an alternative to fossil feedstock to create all kinds of chemicals and products, including new plastics

5 Consumers and companies use and dispose of products

4 Customers use these to make their own products

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Chemical recycling is currently tested with first pilot products. BASF intends to develop the technology on an industrial scale

With ChemCycling we can:

Recycle plastics for which there are no recycling solutions today

Remove undesired substances in the process

Turn waste into feedstock for the chemical industry

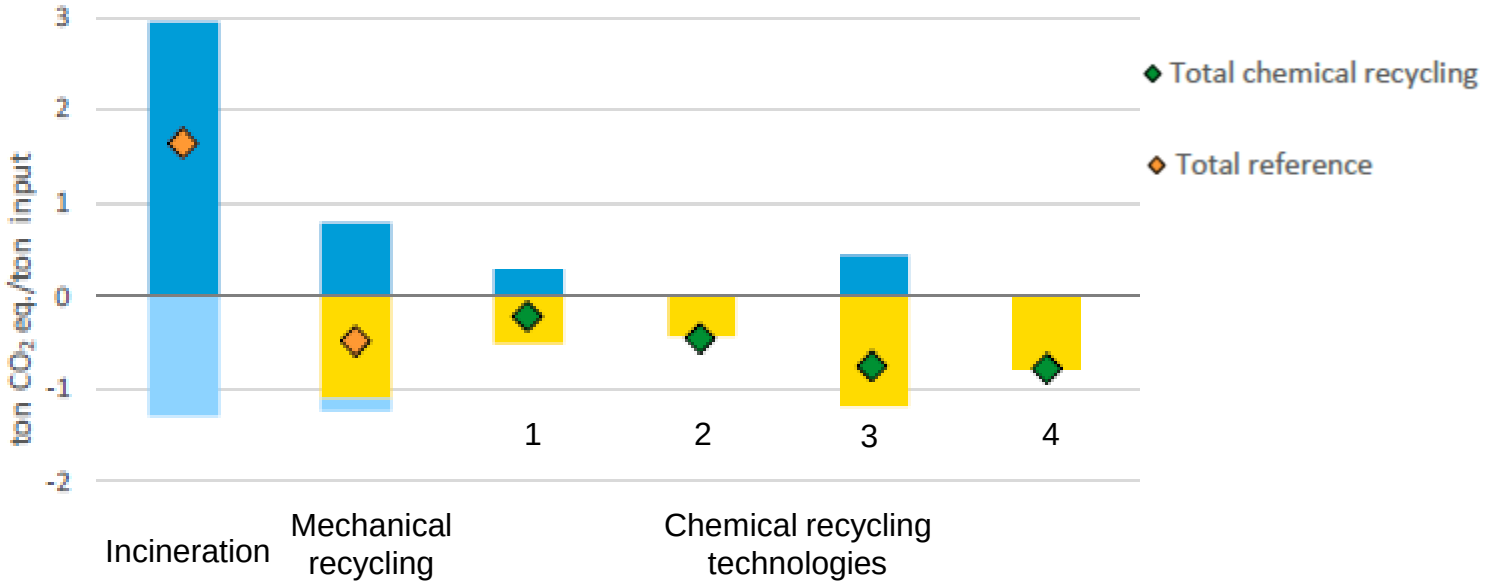
Produce virgin-grade recycled material

A third party certified system allocates the proportion of recycled resources in each product

Chemical recycling is an attractive alternative to waste incineration and a comprehensive option to mechanical recycling

- Chemical recycling saves GHG emissions in comparison to waste incineration
- Chemical recycling technologies have comparable GHG saving potentials than mechanical recycling
- Comparability of the different recycling approaches is limited:
  The calculation ends with the recycled material (syngas, pyrolysis oil, granulated plastics) and does not consider the different product values.

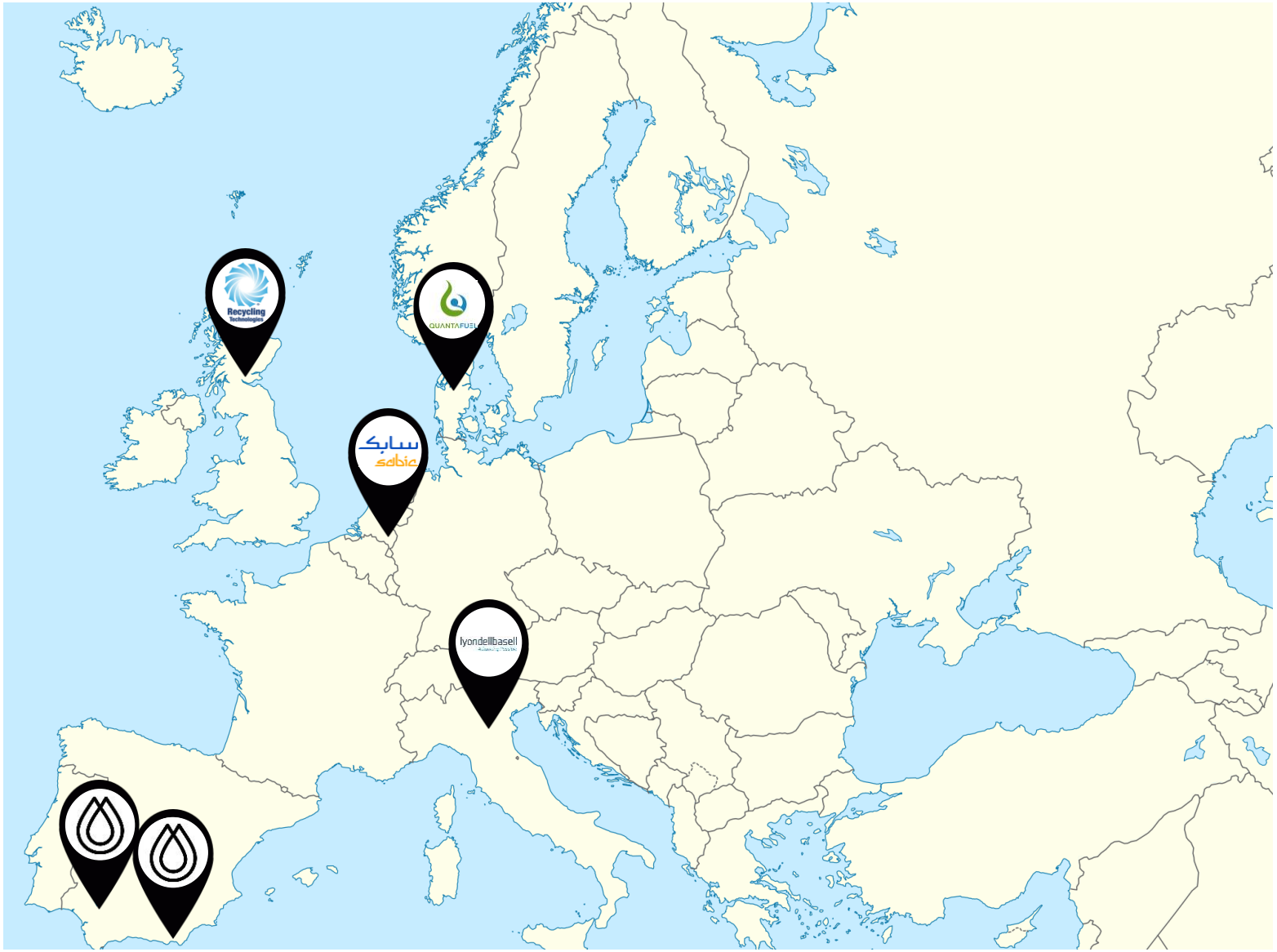
Product Carbon Footprint



1 Pyrolysis (e.g. Plastics Energy)
2 Integrated hydropyrolysis
3 Low temperature gasification
4 Integrated hydropyrolysis (future)

Source: CE Delft on behalf of Dutch government (Sep 2018)

Pyrolysis plants for plastic wastes in EU (operating, in construction, planned)



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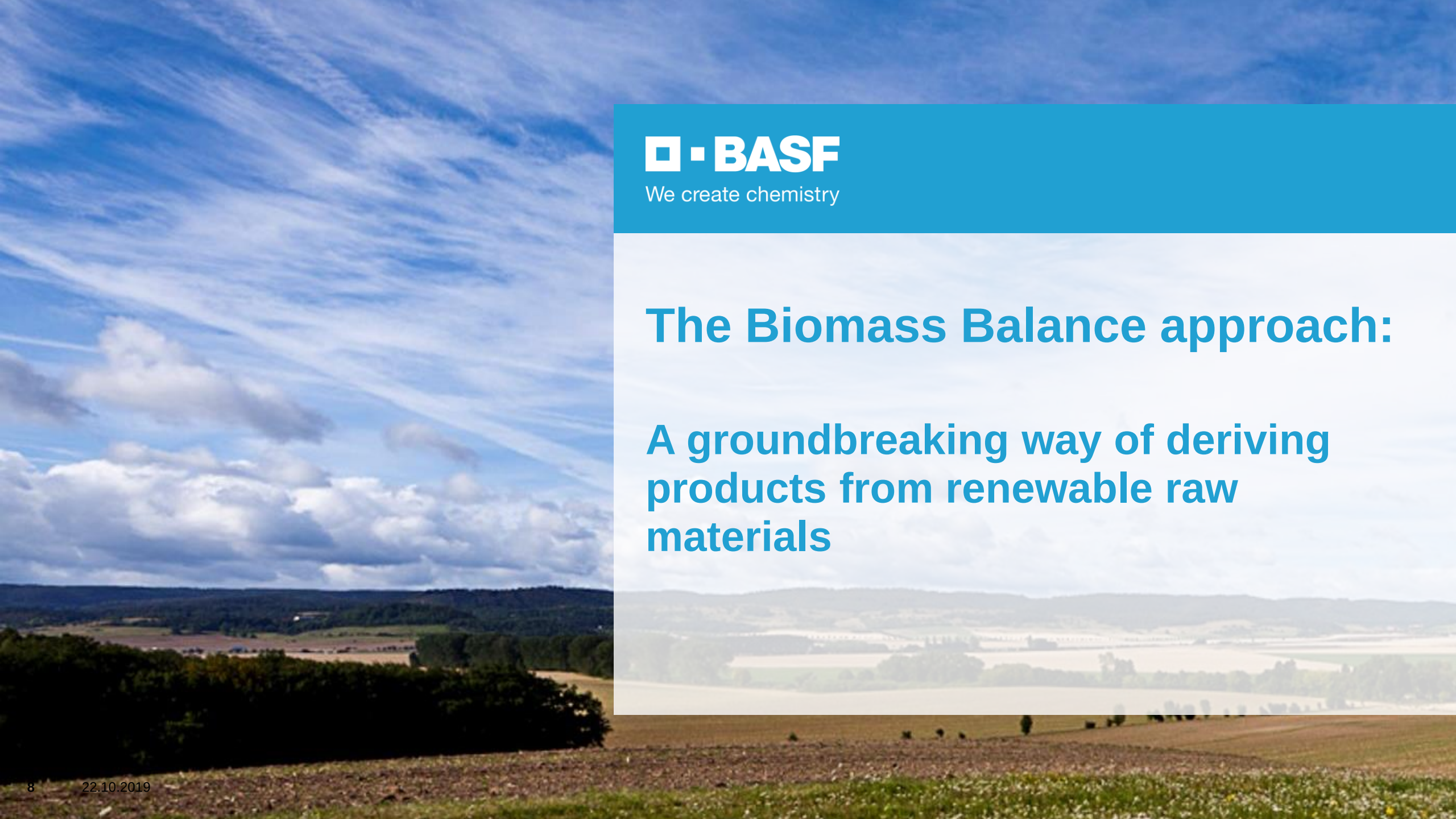

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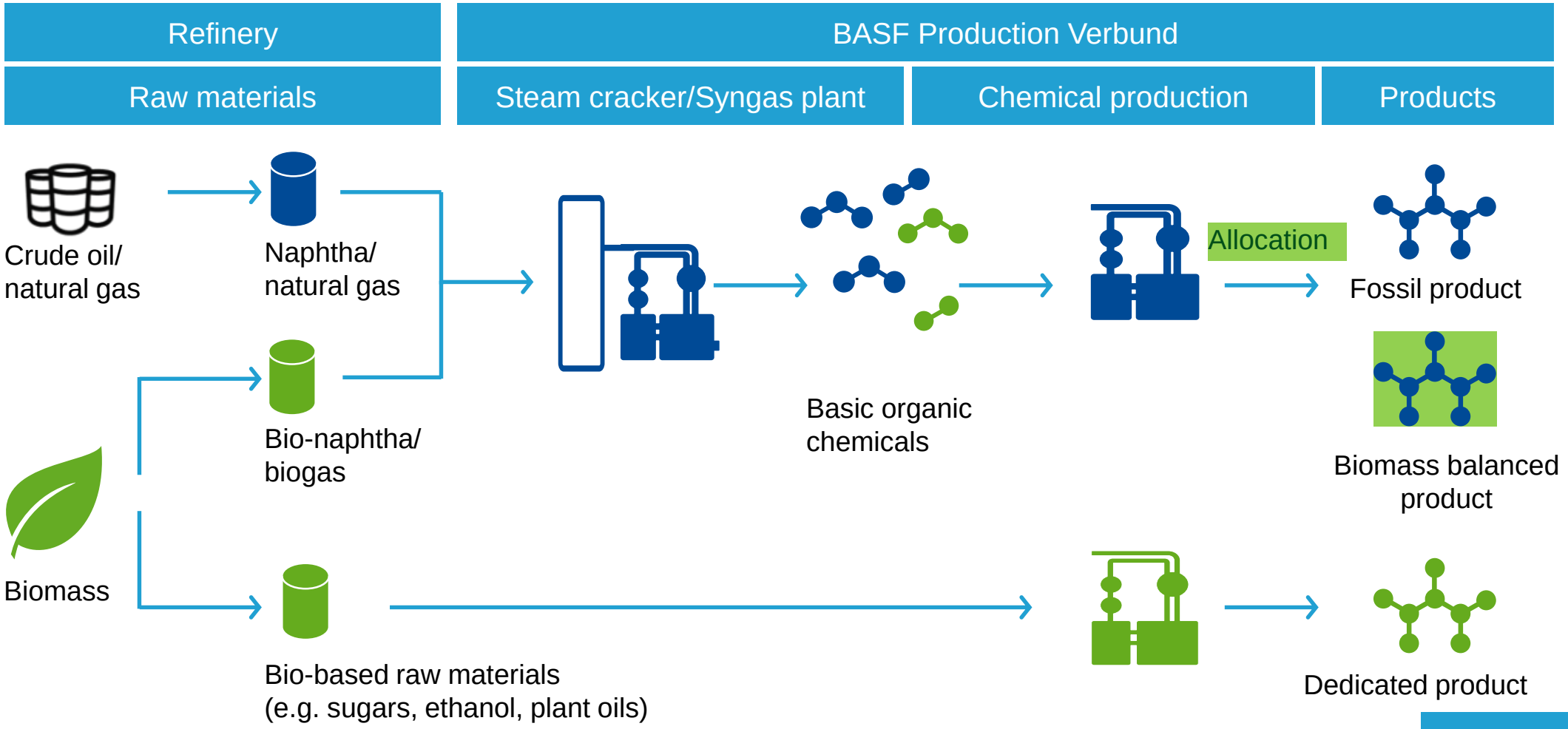
The Biomass Balance approach:

A groundbreaking way of deriving products from renewable raw materials

Biomass balance approach versus dedicated production



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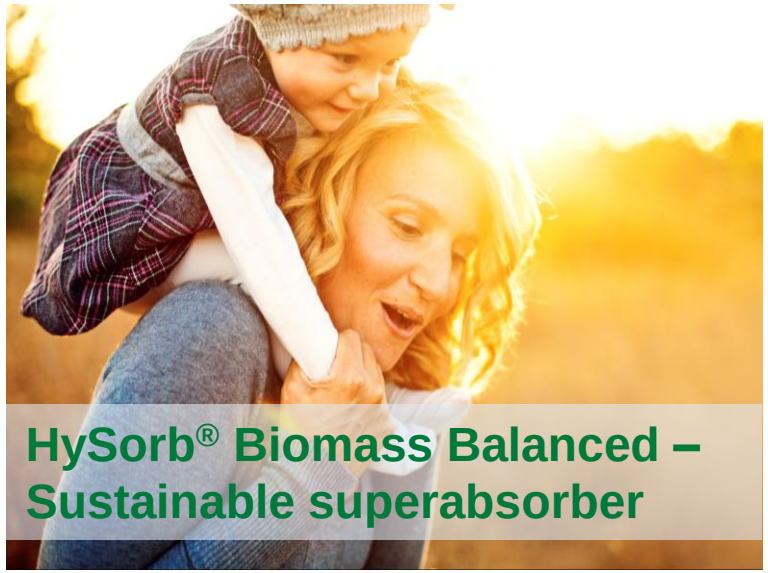
Many Industries already benefit from our Biomass Balanced products



HySorb® Biomass Balanced – Sustainable superabsorber

Glasurit® automotive refinish products

Construction elements containing BASF's Elastopir® systems

Acronal® binders for interior paints

Ultramid® for the packaging industry

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ALLIANCE TO END PLASTIC WASTE

Officers

Representing each sector of the value chain

lyondellbasell

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DSM

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versalis

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Henkel

Mitsui Chemicals

NOVA Chemicals

OxyChem

PolyOne

Reliance
Industries Limited

sasol

SCG

SUMITOMO CHEMICAL

Interest expressed, as of January 15, 2019

Our Purpose:

We create chemistry for a sustainable future

Path forward….

Martin Brudermüller
CEO BASF

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