

# Our plastics journey

– make, use, recycle!

## Chemical Recycling: Accelerating Circularity

Durable, lightweight and safe:  
Plastics play an important role  
in a **sustainable and  
resource-efficient economy**.  
They are used in different  
industries like:



Food  
Packaging



Packaging



Automotive



Textile



 **BASF**

We create chemistry

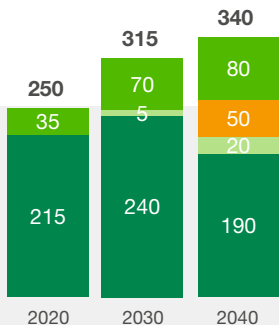
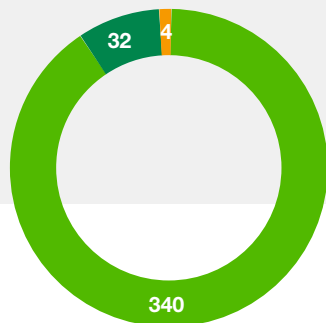


**And plastics have a lower total greenhouse gas contribution than alternatives in most applications, according to an LCA study by McKinsey.\***

But plastics are still predominantly fossil-based:

In 2020, around 340mt (90%) of the world plastics production was **fossil-based**, while post-consumer recycled plastics and bio-based/bio-attributed plastics accounted for 36mt (less than 10%).\*\*

- Fossil-based plastics
- Post-consumer recycled plastics
- Bio-based plastics



What happens after plastics have reached the end of their life cycle?

When it comes to end-of-life management of plastic waste, only a **small proportion** of plastic waste **was recycled in 2020**, with the bigger portion being energetically recovered or landfilled.\*\*

- Non-Recycling
- Gasification
- Chemical Recycling
- Mechanical Recycling

By 2040 however, the share of recycled plastic waste is expected to increase to more than 40% because **Chemical Recycling and Gasification** as well as **Mechanical Recycling** will process larger volumes.

\*Source: McKinsey – Climate impact of plastics – 2022

\*\*Source: Plastics Europe – 2021

# Chemical recycling and the circular economy

As a complement to mechanical recycling, **chemical recycling** plays an important role for the circular economy. Why?

Because it can **turn plastic waste** that is not recycled mechanically for technological, economic or ecological reasons **into raw material for chemical production**.

### Chemical recycling (pyrolysis)

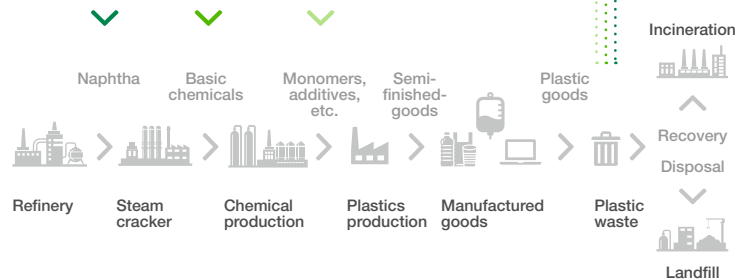
- Waste to chemicals
- Can handle mixed plastic waste
- Products are “virgin-grade”

### Other chemical recycling (depolymerization)

- Polymer to monomer
- Single-stream waste needed
- Products are “virgin-grade”

### Mechanical recycling

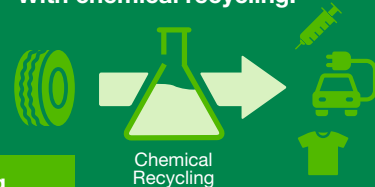
- Polymer to polymer
- Clean single-stream waste preferred
- Products are not “virgin-grade”



Chemical recycling can help recycle post-consumer plastic waste streams that would otherwise end up in landfill or be used for energy recovery. Examples are plastics with residues or mixed plastic waste fractions, consisting of different plastic types, which are not suitable for further sorting.

**For example, end-of-life tires that would otherwise be burned can be turned into pyrolysis oil that serves as raw material for new products for various industries – from automotive to packaging for sensitive products to textile.**

**40%** of all used tires in Europe are burned. We give them a new life. **With chemical recycling.**



**Chemical recycling is therefore a logical complement to mechanical recycling.**

Source for figure: ETRMA (2021): End of Life Tyres Management – Europe – 2019

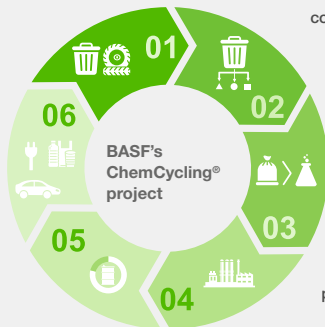
# BASF's ChemCycling® business

In ChemCycling®, BASF uses **feedstock from chemical recycling of plastic waste** for its broad Cycled® product portfolio. The recycled feedstock is attributed to the certified Cycled® products **through a mass balance approach**.

Consumers use and dispose plastic products (e.g. packaging, tires)

Our customers use these chemicals to make their own products

BASF can attribute the recycled feedstock to all chemicals produced in this Verbund via a certified mass balance approach



Waste companies collect and sort the waste and supply BASF's technology partners with it

Our partners convert the plastic waste into pyrolysis oil through a thermochemical process

Pyrolysis oil is purified to be used as feedstock at the beginning of BASF's Verbund production

BASF customers have successfully introduced Cycled® products in various industries like food or medical packaging, sports and lifestyle as well as automotive. **They value the circularity contribution of chemical recycling.**

## Circular Economy contribution of ChemCycling®

- Complementary approach to existing recycling methods, increasing overall recycling rates of plastic waste
- Our technology partners pyrolyze mechanically hard-to-recycle or otherwise incinerated mixed plastic waste and end-of-life tires generating feedstock for chemical production
- Replacing fossil resources and saving CO<sub>2</sub> emissions against conventional plastics production
- Process and products are third-party audited and certified according to a mass balance approach



## Is pyrolysis an energy-efficient technology?

Pyrolysis is a highly efficient thermochemical process carried out at temperatures between 300-700 °C.

75%

of the plastic waste can be converted into secondary raw materials.

Source: LCA End of Life Tires by Fraunhofer UMSICHT for Pyrum



Through further processing, around 2 metric tons of plastic waste will yield 1 metric ton of new plastic.



## Pyrolysis is also self-sufficient. How so?

The part of the waste that cannot be turned into oil is pyrolyzed into gas which is used to generate the energy required for the process.

<1%

Low external thermal energy demand, e.g. for start-up processes.

Finally, pyrolysis is better than incinerating waste:

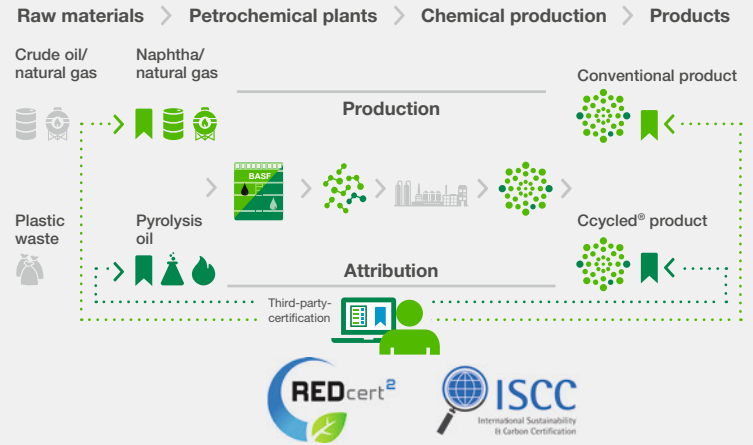
50%

Pyrolysis of mixed plastic waste emits 50 percent less CO<sub>2</sub> than incineration of mixed plastic waste.





## Attribution of recycled feedstock

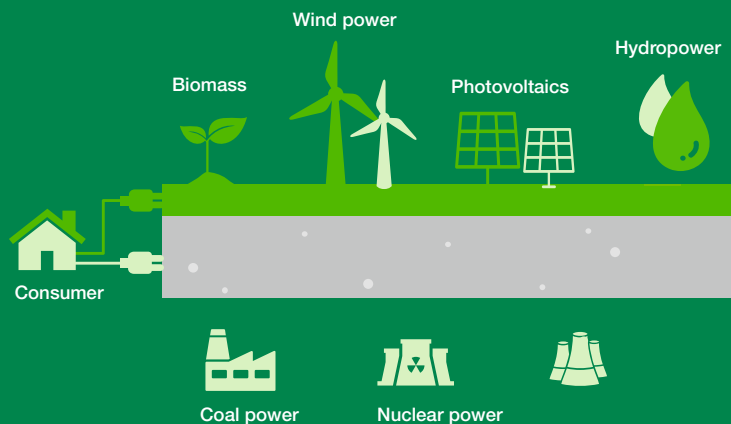


## How the mass balance approach contributes to the circularity transformation

The mass balance principle is a widely used chain-of-custody method that is applied in certification schemes like ISCC PLUS and REDcert<sup>2</sup> in different industry sectors.

Due to the simultaneous processing of recycled and fossil raw materials in BASF's chemical production, the feedstocks cannot be directly assigned to the resulting derivatives. That's where the mass balance approach comes into play.

The principle is very similar to that of green energy: Alternative feedstock is fed into the grid according to customer demand.



- In the production of new plastics, recycled raw materials from pyrolysis of mixed plastic waste or end-of-life tires are fed in at the beginning of BASF's Verbund production.
- The proportion of recycled raw materials is attributed to the certified products manufactured in the production network using a mass balance approach.
- Fossil raw materials are thus replaced and saved.
- Although mass balanced products cannot claim recycled content, their sustainability impact is comparable to products made of recycled feedstock.

## BASF's Cycled® portfolio – accelerating circularity in key industries

What started with a small pilot project in 2021 is now a portfolio of more than **200 mass balanced Cycled® products certified** according to REDcert<sup>2</sup> or ISCC Plus.

### Benefits of Cycled® products

- **Commercial applications** realized by our customers in **industries** like food and medical packaging, textile and automotive
- **Virgin-quality material for sensitive products**, including food contact, temperature-sensitive and safety-relevant applications
- **Reduced product carbon footprint** compared to conventional grades according to LCA

Together with our customers, we realize **commercial applications** in industries like food and medical packaging, textile and automotive.



### Food Packaging

#### Südpack

Mozzarella and sausage packaging with Ultramid® Cycled®

#### Vartdal / Ekornes

Fish box with Styropor® Cycled®

#### STEPAC

Fresh produce packaging with Ultramid® Cycled®

#### Imballagi Alimentari

Remaxigel ice-cream boxes made of Styropor® Cycled®

### Packaging

#### BSH

Protection packaging with Styropor® Cycled®

#### Hirsch / Eutecma

Pharma box with Styropor® Cycled®



### Textiles

#### VAUDE

Outdoor gear with Ultramid® Cycled®

#### Fulgar

A new way of making yarns with Q-CYCLE® by Fulgar

#### Pompea

Underwear with Ultramid® Cycled®

### Transportation

#### Mercedes-Benz

Door handle from mass balanced Ultramid® in a combination of biomass balance and ChemCycling®



### Engineering Plastics

#### Zell-Metall

Engineering Plastic Stock Shapes ZELLAMID®

### Technical Film

#### Bowcraft

Roof underfelt membrane with Prima Klima Greenline

