# Chemical recycling –
## Contributing to the plastics transition in unison with climate protection and resource conservation

covestro

### The circular economy as a guiding principle

Industrial activity based on fossil fuels, without recycling the raw materials used, is an ecological one-way street, the effects of which can be seen and felt in the consequences of climate change, the decline in biodiversity and pollution of the environment. The circular economy is an important driver for turning things around. As far as plastics are concerned, **the circular economy is key to achieving a plastic transition, in which fossil raw materials are consistently replaced by circular raw materials, in which business models take the second life cycle of materials into account from the outset, and in which the energy supply is fully renewable.** Covestro has recognized this and set itself the goal of **fully aligning itself to the circular economy** In doing so, we aim to comprehensively protect the climate and resources and further develop the sustainability of our high-performance plastics, which are making major contributions in areas such as building insulation, wind turbines and electromobility.

### What is chemical recycling?

The use of waste as a raw material through recycling replaces primary fossil raw materials in production, avoids waste incineration which is associated with $CO_2$ emissions, and avoids environmentally harmful landfilling. Comprehensive **recycling can thus make a decisive contribution to climate neutrality and the protection of natural resources and the environment.** Chemical recycling processes make it possible to recover and reuse the raw materials originally used in materials in the same as well as in other applications. In this process, plastics are converted back **into their monomers, i.e. the precursors of plastics.** The chemistry processes for plastics that have been developed for over more than a century are virtually reversed in this process in order to recover the production raw materials. This is by no means trivial, but **requires extensive expertise and experience in chemical process technology. Just as different processes are used in plastics production depending on the type of plastic, this is also the case in recycling.** In addition to mechanical recycling, Covestro also relies on the development of chemical processes to recover the plastic building blocks. We are developing **chemolysis** (reconversion of the plastic building blocks at mild ambient temperatures using catalysts), **smart pyrolysis** (in the absence of oxygen at temperatures between 300°C and 500°C) and **recycling with enzymes** (biological-chemical reconversion). We are also focusing on integrating recycled basic chemicals from upstream value creation into our production as a **drop-in solution via mass balance approaches**. It is our firm belief that the recycling of plastics can only be achieved with a broad technological approach and not with less choice of materials.

### Why do we need chemical recycling?

The wide range and **desired different properties** that plastics have (long life, soft or hard, malleable or solid, transparent or colored) mean that there cannot be a single recycling process for all plastics. Different manufacturing processes are used based on the polymer structure, i.e., the combination of different monomers to form polymers with different properties. Some polymers, such as flexible and rigid foam, are not meltable per se and thus unsuitable for mechanical recycling. Other plastics are meltable and can be mechanically recycled, but lose quality through cleaning, shredding and melting down – which often means that they can no longer be used for their original purpose. **Plastic can only be comprehensively recycled on a large scale with additional chemical processes.**

### How can policymakers support the transformation to a circular economy and thus the plastics revolution?

To the plastics industry, the development of chemical recycling processes involves a radical changeover from the linear production methods optimized over the course of more than a hundred years and the **establishment of new types of processes that compete with conventional production.** In terms of **complexity and impact on value creation, this is comparable to the transformation of the energy or mobility industries**. With their expertise and long-standing experience in chemical process engineering, the chemical industry and Covestro are predestined to shape and drive this plastics turnaround at a global scale. This calls for a smart policy framework and regulatory mix of instruments that support this transformation.  This includes:

- **Recognition of chemical recycling as a contribution to circular value creation.**

Chemical recycling should be explicitly recognized as recycling under waste legislation. Within the recycling stage, the balance of energy consumption and recycling output can be taken into account to decide which process makes the best contribution to climate protection and resource conservation. Life cycle analysis / life cycle assessment should be the principal criterion for assessing resource efficiency.

- **Enabling mass balance to use existing infrastructure**

To make efficient use of existing infrastructure and to promote the widespread use of recyclates, mass balance approaches to calculate recyclate content should be accepted.

- **Incentivize better collection, sorting and separation of plastics**

Plastics are used in many sectors, not only for packaging, but especially in the automotive, furniture, construction and electronics industries. Many recycling processes require pure and unmixed plastic streams. Here, tools should be developed that enable plastics in products to be sorted out as efficiently as possible at the end of their service life so that they can be fed into the targeted recycling process.

- **Considering the role of other alternative raw materials**

In addition to the use of recycled materials, the use of $CO_2$-based and bio-based raw materials also plays a crucial role for the chemical industry in achieving the objectives of the circular economy. A policy mix should also allow for the use of other alternative raw materials.

- **Technological research, development and demonstration support:**

There should also be an examination of how the Carbon Contracts for Difference (CCfD) currently being developed in the EU Emissions Trading Scheme (EU ETS) can also incentivize investment in novel recycling processes and how a tie-in with $CO_2$ reduction targets can be achieved. Also, real laboratories can help define the conditions for a functioning market environment for recycling raw materials. Instruments for research funding and especially for the necessary pilot and demonstration plants should address CAPEX and OPEX cost factors.

## Putting chemical recycling into practice

**Example: Innovative recycling process gives mattresses a second life**

Covestro is developing an innovative process to recycle polyurethane foams that had up to now not been recyclable. The goal here is the energy-efficient recovery of both production raw materials as feedstock for the manufacture of new mattresses and polyurethane products.

**Proposal: It should be examined how the recycling of plastics and chemical recycling can be tied in with the climate protection targets of the EU and other regions and incentive systems for new technologies e.g. under EU ETS.**

## Using $CO_2$ as a raw material

**Example: From waste to added value thanks to $CO_2$ technology**

With its $CO_2$ technology, Covestro, following nature's example, is enabling carbon dioxide to be reused as a substitute for petrochemical raw materials in polyol production. By using $CO_2$ to manufacture durable products (such as mattresses or insulation materials), an important contribution can be made to negative emissions and the circular economy.

**Proposal: In order to help $CO_2$ technologies achieve a breakthrough, the crediting of $CO_2$ savings by CCUs in the European Emissions Trading Scheme in particular would be a decisive contribution.**

## Open innovation as a driver of technical development

**Example: Joint development of "smart pyrolysis"**

In collaboration with Fraunhofer IMWS and TU Bergakademie in Freiberg, Covestro is researching an innovative pyrolysis technology that recovers complex plastic building blocks from rigid polyurethane foams already at temperatures between 300 – 500°C. Rigid polyurethane foams are used, for example, for the inner workings of wind rotor blades and contribute to the success of the energy transition. Compared with conventional production, smart pyrolysis is expected to save upstream process steps and thus achieve substantial $CO_2$ reductions. External academic and research partners are crucial in the development of this technology.

**Proposal: To bring innovative technologies to market maturity even faster, CAPEX and OPEX cost factors should be subsidizable for pilot and demonstration plants.**

## Use of renewable energy in production

**Example: Targeted purchase of renewable energy for production**

A key lever in making circular value creation climate-neutral is the consistent switch to renewable energy in electricity and heat supply. Covestro is driving this forward, among other things, through the targeted conclusion of power purchasing agreements. Large quantities of renewable electricity and green hydrogen are needed on the further path to greenhouse gas neutrality. For this, the expansion of infrastructure (grids, pipelines, terminals) is essential. These renewables will be subject to global trade, as previous energy sources have been.

**Proposal: In order to stimulate the necessary trade and transport of green energy carriers intra-EU and globally, cost components that impede this cross-border trade should be reduced.**

Further information available at:
Innovative recycling for less plastic waste

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