The German chemical industry's circular economy strategy

Content

Circular economy as an opportunity

Sustainability is the "leitmotiv" for action in the German chemical industry. The 17 sustainable development goals (SDGs) of the United Nations are the cornerstones of this guiding principle. Climate protection ranks among their central aspects. In order to make a major contribution, the German chemical industry is actively working on solutions to become greenhouse gas neutral by 2050.

This is why the chemical industry was early to commit to the circular economy concept which focuses on all efforts for resource conservation – with a view to reducing greenhouse gas emissions. This is achieved by improving resource efficiency at all stages of the value chain, increasing the lifespan of products, and using renewable energies. Another decisive step on the way to a circular economy is to run substances and materials in cycles. The latter means; in particular, a strict closing of the carbon cycle.

Vision: On the way to the future

In the chemical industry, the responsibility for a sustainable future does not stop at the factory gates. Quite the contrary, the industry assumes responsibility for the supply chain and the further use of its products, including the phase after their useful life. Concretely, it is important for chemical businesses that their suppliers comply with sustainability standards.

In their own production, chemical companies are changing to efficient and climate-friendly processes. They develop materials and solutions that help conserve resources during the use phase, extend this phase and enable reuse or recycling/ recovery after that.

The chemical industry is a key sector in this setting. Its innovative strength is needed to create new substance cycles within a circular economy. Furthermore, the chemical

industry changes not only its own value and production chains: it also supports other sectors in closing their cycles. Chemical companies are facing up to this challenge.

Irrespective of all successes in the past years, the industry is not yet at the goal post. The raw material base remains largely fossil, production processes are not greenhouse gas neutral, and recycling rates are low. Moreover, plastics cause environmental damage due to improper disposal instead of being managed in cycles.

For these reasons, companies and the industry as a whole have identified ambitious objectives:

- For the carbon used in our industry, we want a full cycle by 2050.
- Together with European plastics producers, the industry has committed to increase the reuse and recycling rate of plastic packaging to 60 percent by 2030, as a first step.
- New concepts are to be developed for plastics production. Depending on the application, this can also mean a farewell to single-use packaging and multi-layer composite materials – or the use of more suitable additives.
- The industry wants to become greenhouse gas neutral by 2050 at the latest. With this in mind, not only the classic mechanical recycling of plastics will increase in the future. There will also be new technologies for the production of chemicals based on chemically recycled plastics, biomass and carbon dioxide.

The outlined objectives cannot be reached overnight. First of all, research and development must be driven forward and new products and processes need be brought to market maturity. For the industry, this requires a sustained high level of investment in innovative products, new technologies and service-oriented business models. This is the only approach for us to hold our own in international competition in the long term.

The chemical industry cannot succeed on its own. Change calls for a better cooperation with customer industries and a consistent orientation to the wishes and needs of consumers. Above all, this includes a stronger integration with other sectors.

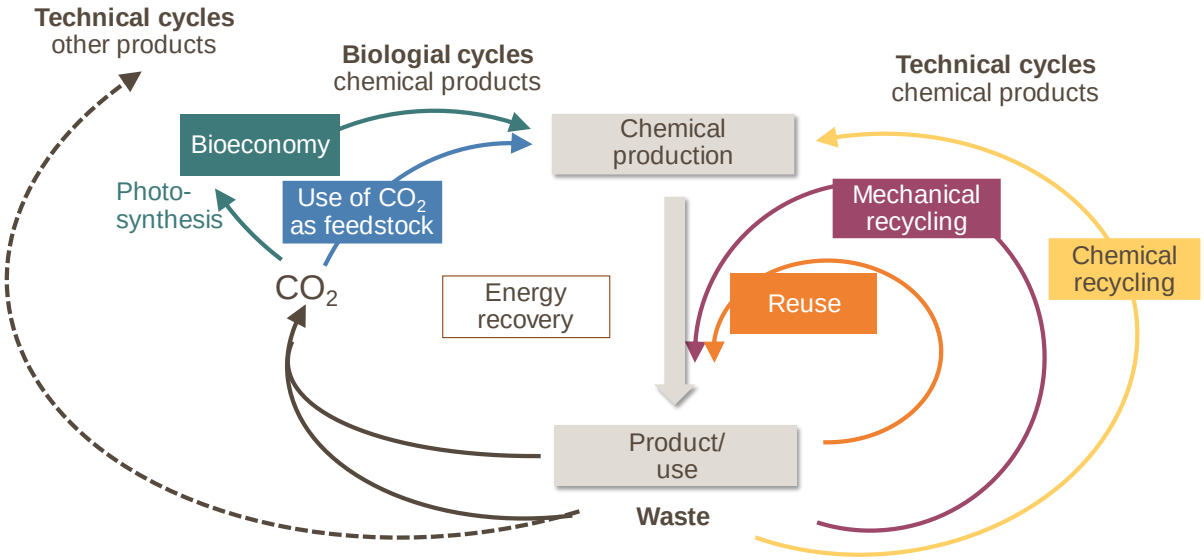
Competences: Where do we stand?

The chemical industry is an elementary part of the solution on the way to a circular economy. It is closely networked with other sectors of the upstream and downstream value chain where its products and production methods enable the circular management of substances and materials. Beside existing cycles in chemical production, products from the chemical industry have long been contributing to resource conservation and circularity in other fields.

Cycles in the chemical industry

There are many options to make cycles a reality in the chemical industry. Manifold processes and strategies at different levels offer the opportunity to close cycles in various ways. The following distinctions need to be made:

- Classic mechanical recycling
  - Waste is treated in mechanical / physical processes (sorting, washing, density separation, melting, filtering etc) for reuse as a material in other areas. As soon as a collection of clean and pure-grade waste is no longer possible, there is an increase in technical effort, the demand for resources and the cost of mechanical recycling methods.
- Chemical recycling
  - Applying chemical processes (pyrolysis, gasification or solvolysis), waste is broken down in its chemical components which are then used to manufacture new products. The focus is on waste that is soiled or cannot be sorted, so that adequate mechanical recycling is not feasible. Next, such components can be reused in the manufacture of new-quality plastics. This makes chemical recycling a necessary supplement of mechanical recycling.
- Use of biomass as a raw material
  - As plants bind carbon from atmospheric CO2, there are various plant-based products for use in the chemical industry (e.g. oils, sugar, cellulose, resins etc). Thus, atmospheric CO2, can be run in cycles, reducing the additional release of CO2 into the atmosphere.
- Use of CO2 as a direct carbon source
  - In the medium term, CO2 can be obtained from point sources (e.g. cement factories). In the long run, however, there should be considerations of obtaining CO2 from ambient air (direct air capturing) – where catalysed processes with hydrogen as a cofactor and energy input can convert CO2 into basic chemicals, e.g. methanol or polyols. The required hydrogen can be produced CO2-free by electrolysis using renewable energies or by methane pyrolysis. With the help of certain microorganisms (e.g. clostridia), gas fermentation can convert CO2-containing gas streams in chemicals such as ethanol, acetone, butanol, acetic acid and other alcohols as well as organic acids. Here, hydrogen is used too.



Already now, there are examples of cycles in all of these fields. The consistent promotion and further development of technologies and processes can bring about a complete cycle management in the end.

Resource conservation through chemical products

The cycle management of chemical products enables effective resource conservation and a minimisation of environmental impacts. However, especially for complex chemical products it remains necessary to weigh the requirements to the product on the one hand and recyclability on the other. This means that it is always necessary to take into account sustainability when running waste streams in cycles.

Products from the chemical industry help reduce waste volumes by significantly extending the lifespan of other products. Paints and coatings reduce corrosion and decay and improve the durability of everyday consumer goods. Construction chemicals prolong the lifetime of the entire infrastructure. Adhesives enable lightweight construction, integrate high-performance materials in products without these materials losing their high-performance properties, and ensure that the most suitable materials are invariably used even in complex goods (vehicles, mobile phones, household appliances etc). Without suitable plastic packaging, countless foodstuffs could not be preserved; that would cause enormous food losses.

The complexity of the fields of application shows that mechanical recyclability and the requirements to products cannot always be reconciled with each other. In such cases, too, the chemical industry has the answers. For example, composite materials (e.g. thermal insulation composite systems in buildings) contribute to enormous energy savings and thus to resource conservation and sustainability. In order to fulfil the aspect of cycle management, the VCI cooperates with manufacturers (example: the KUBA project – sustainable plastic value chain – RWTH Aachen) and looks into ways of utilising

wastes from the mentioned composite materials. This means that it should be possible in the future to have both efficiency and waste recovery without conflicting goals.

Strategy: Where do we want to go?

To reach the industry's ambitious objectives of a circular management style, the industry has to make enormous efforts which will partly result in a restructuring of chemical value chains.

For this purpose, we, the chemical industry, wish to highlight in our strategy what routes could be followed to drive forward a circular economy and make it a reality. We want the following:

- Continuously increase the mechanical recyclability of products while considering the aspects of sustainability by
  - developing innovative additives and products
- Run material streams, which are not yet suitable for mechanical recycling, in cycles by
  - promoting chemical recycling processes
- Encourage the use of renewable and alternative raw materials by
  - supporting research and development for innovative chemical products
- Improve the efficiency of resources and materials by
  - using chemical products efficiently at all stages of the value chain
- Reduce the generation of waste while improving efficient waste recovery by
  - further developing mechanical and chemical recycling methods
  - modern and efficient energy recovery from waste
  - direct CO_2 use
  - direct reuse of products (e.g. leasing models)
- Think of climate protection in a holistic approach by
  - considering all partial aspects of climate protection
    - circular economy
    - resource efficiency
    - reducing greenhouse gas emissions

Circular economy and climate protection

Climate protection is an overarching goal in the development of a comprehensive circular economy.

A study published by the VCI in 2019 *("Roadmap Chemistry 2050 – Working towards a greenhouse gas neutral chemical industry in Germany")* shows what way the German chemical industry could take towards greenhouse gas neutrality. The roadmap demonstrates that a largely greenhouse gas neutral chemical production in Germany by 2050 is thinkable in technical terms. This is made possible primarily by new forms of circular management through mechanical and chemical recycling and the use of biomass, CO_2 (carbon cycles) and CO_2-free hydrogen production. It will depend on several factors to what extent the chemical industry can put this technical potential into practice. Most importantly, these include competitiveness in every phase of development and favourably priced renewable energy in large volumes, combined with legal framework conditions that are open to a wide range of different technologies and innovation-friendly – so that carbon can be fully run in cycles in the future and complete greenhouse gas neutrality is achieved.

Framework conditions – What are the challenges?

Realising the vision of a circular economy is a major challenge for all stakeholders from business, research, politics and society. Therefore, this endeavour should be characterised by an open dialogue and strong cooperation. The chemical industry can and will do its part – but the industry needs adequate framework conditions to master the change. Politicians see the urgency of shifting to a circular economy and take up this matter in several initiatives at national and European level. In 2015, the EU adopted a *"Circular Economy Package"* which has been almost fully implemented by now. Within the *"Green Deal"*, the EU Commission builds on this in a new *"Circular Economy Action Plan"*.

The following points are important for the chemical industry's contribution to developing a circular economy:

- Circular economy can only succeed with an open mind to a wide range of different technologies,
  - accepting all recycling/recovery methods side by side
- Recycling methods (mechanical and chemical) should be seen as complementing each other, in order to
  - enable the best possible recovery of material streams at the end of the life cycle, including the aspect of a circular economy
  - do justice to the diversity of waste streams and direct each material stream into the most efficient form of recycling/recovery. Finally, this means that both energy recovery and landfilling must be maintained as options

- Innovation should be supported in a consistent and long-term approach so that
  - promising technologies can be brought to market maturity
- It is essential to ensure the availability of large volumes of renewable energy at competitive prices for a greenhouse gas neutral circular economy,
  - allowing us to meet our climate targets
- Prevent the relocation of productions,
  - in order not to lose jobs and know-how
- There must be no blanket discrimination against substances due to their hazard classification so that
  - framework conditions can be shaped in such a way that the safety of products and their performance remain guaranteed
- See product design holistically by always taking into account the aspects of performance and safety,
  - to get a genuine design for sustainability instead of a one-dimensional design for recycling
- Chemicals/product legislation and waste legislation must not be mixed,
  - to prevent that recyclability becomes an end in itself and to safeguard important product properties (e.g. consumer protection, quality, durability, benefit for society and environment, energy efficiency) as well as climate protection and marketability of products

The challenges

For the future, all actors are facing major challenges that can only be tackled together to promote climate protection and sustainability as best as possible.

- Global competitiveness must be maintained,
  - to prevent location disadvantages for Europe
- The restructuring of the energy sector should be pursued fast by all stakeholders so that
  - the enormous volumes of renewable energy required by industry can be provided
- Also, in the future, the industry must be able to recruit skilled and expert staff, in order to
  - drive forward innovation and development
- Expectations regarding the pace of innovation should be realistic along the value chain and in society,
  - to allow a long-term development of the industry
  - for not breaking the link between society and industry