Verband der
Chemischen Industrie e.V.
Wir gestalten Zukunft.

VCI-PED-POSITION ON CHEMICAL RECYCLING

Chemical recycling as a building block of a circular economy

1. Introduction

Chemical recycling is currently attracting a great deal of interest from politicians, administrators, scientists and industry, as it has the potential to make a decisive contribution to achieving the goal of greenhouse gas neutrality as a building block of a circular economy. This is because chemical recycling is a promising solution to recycle a wide range of plastic-containing waste that so far cannot be recycled. The technology shows promising results in terms of sustainability, especially when the alternative for the waste stream would otherwise be incineration [1,2]. In this way, chemical recycling technologies, in combination with classic mechanical processes, make a decisive contribution to achieving the climate and circular economy goals of the EU Green Deal and the EU Circular Economy Action Plan. The German government is aiming towards strengthening the circular economy and therefore takes up chemical recycling in the coalition agreement.

This position paper identifies the framework conditions under which chemical recycling can play an important role in a comprehensive circular economy, the steps that need to be taken by all stakeholders and how the industry can thus contribute to achieving climate and circular economy goals.

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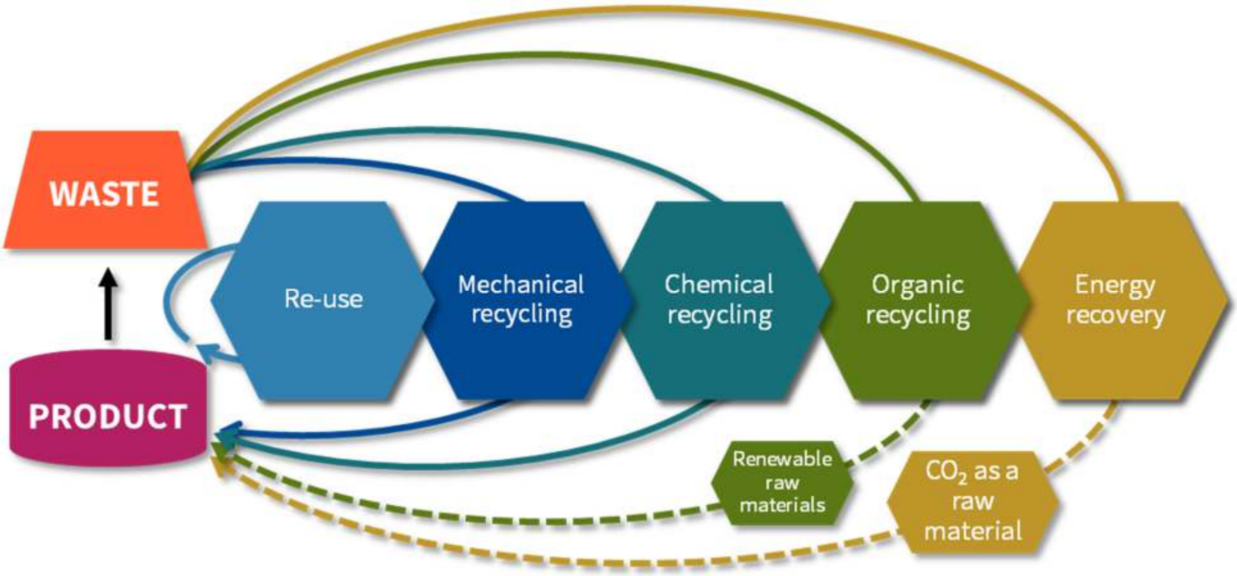
[1] https://plasticenergy.com/wp-content/uploads/2020/10/Plastic-Energy-LCA-Executive-Summary.pdf

[2] Hofmann, A.; Franke, M.; Betsch, F.; Rieger, T.; Seiler, E.; Mäurer, A.: Recycling technologies for plastics - position paper, Fraunhofer Cluster of Excellence Circular Plastics Economy CCPE (Ed.), Oberhausen / Sulzbach-Rosenberg, September 2021

2. What is chemical recycling and what does it contribute to the circular economy?



Simplified scheme for cycles in chemistry (own representation)

Alongside the reuse of products, the classic mechanical recycling of waste is currently the most common way to close material and thus carbon cycles. In this process, plastic waste is mechanically processed into regranulate, which is used for new products.

Waste that is contaminated, mixed or cannot be recycled according to the current standard of processing technologies, or cannot even be sorted in a meaningful way in the first place, is nowadays sent for energy recovery, for example in a waste-to-energy plant. According to the available statistics, the share of energy recovery of end consumer waste containing plastics in Germany was slightly over 50 per cent in 2019[3].

In order to further reduce the proportion of plastic waste that is energetically recovered and thereby further close loops, the chemical industry and plastics producers in Germany are working intensively on innovative technologies in parallel to the further development of sorting and mechanical recycling processes in order to recycle such waste streams as well.

The technologies behind the collective term "chemical recycling" include processes such as solvolysis, pyrolysis and gasification. These processes can produce as-new building blocks for a circular economy from a wide variety of material and waste streams, including mixed ones. These building blocks are then used in the value chain to produce new basic chemicals, other chemical products and also plastic materials, i.e. recyclates. By increasingly closing the loop, more and more fossil resources, such as crude oil, can be saved.

Due to the virgin quality of these recyclates, their use is unrestricted. For example, in sensitive applications such as food packaging, in the pharmaceutical and medical sector or even

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[3] Stoffstrombild Kunststoffe in Deutschland 2019

technically demanding applications such as in the automotive or electronics sector. In the case of mechanical recycling, such high recyclate qualities are only possible in areas with well-sorted material flows, such as bottle deposit systems (PET bottles), PVC window recycling or the recycling of industrial packaging. Detailed information on the legal classification of chemical recycling can be found in Appendix A to this position paper.[4].

3. Why is chemical recycling important?

In addition to essential mechanical recycling, chemical recycling technologies are necessary, especially for mixed waste streams, so that a circular economy can be increasingly implemented. They are thus a key element in achieving greenhouse gas neutrality by 2050. To achieve this important goal, a significant increase in the use of recyclable and sustainable raw materials is necessary. In addition, the EU recycling targets call for, 55% recycling of plastic packaging by 2030, the EU-wide processing of 10 million tonnes of recycled plastics into new products by 2025, and 100% reusability or recyclability of all plastic packaging and beverage bottles with at least 30% recycled content in the EU market by 2030. Various initiatives under the Circular Economy Action Plan will also specifically address recyclate use and recycling targets in further industries, e.g. in the context of the revision of the End-of-Life Vehicles Directive and Construction Products Regulation.

Why chemical recycling in particular is a required complementary element lies - from a technological point of view - in the way chemical recycling can transform waste back into its original building blocks. This makes a large part of energy recovery gradually unnecessary. Since plastics can be recycled at the end of their life that have not previously been suitable for mechanical recycling processes (including medical products, coloured plastics, textiles, car parts, multi-layer films). In addition, depending on the process, upstream process steps in production that are necessary to create the plastic building blocks on a conventional and fossil basis can also be saved. For well-sorted and only slightly contaminated waste streams, mechanical recycling processes are the processes of choice from an ecological and economic point of view, according to the current status. As the degree of waste purity decreases, chemical recycling processes are becoming increasingly effective for the treatment of waste. This synergy of existing mechanical recycling with new chemical recycling technologies can optimise the circular economy as a whole, broaden the raw material base through the availability of a wide variety of recyclates and ultimately make a decisive contribution to achieving climate targets.

A study[5], that evaluates different recycling paths of light packaging waste in Germany from a techno-economic perspective shows the highest potential savings and higher carbon efficiency when using a combined and technology-open recycling approach of both mechanical and chemical processes compared to the baseline scenario with the current state of the art. Using the combination of mechanical and chemical recycling can lead to an overall increase in recycling potential. Thus, according to the researchers, an additional one to two million tonnes

[4] Appendix A: Legal classification of chemical recycling

[5] Volk et al (2021) Techno-economic assessment and comparison of different plastic recycling pathways

of this waste per year could be kept in the cycle instead of being recovered for energy. This would be sufficient to achieve both the European and the German targets for recycling residual waste containing plastics and to further decouple resource consumption from value creation. Without additional chemical recycling, it currently appears impossible to achieve the recycling targets.

4. What is the state of development and what is the industry already doing?

In recent years, investments and projects for chemical recycling have rapidly gained momentum worldwide. As a result, many chemical recycling technologies are currently under large-scale development worldwide[6]. Each technology has its own specific application, ecological footprint and different contribution to the recyclability of e.g. plastics and other materials. In Germany, the industry is investing heavily in research on these technologies[7]. Current projects in cooperation with federal ministries show how great the potential is[8,9].

Research[10] on pyrolytic processes, for example, shows that essentially all the mixed plastic waste from real-life applications that was studied can be recycled. The average carbon recovery was 50-80%, depending on the waste type. The energy required for melting, pyrolysis and evaporation is comparatively low and was about five per cent of the energy content of the plastic-containing waste. Despite these positive findings, there is a need for further research, especially in process design to optimise the further use of the recyclates in order to operate the techniques on an industrial scale in the future[11].

The German chemical industry and plastics producers, together with partners from the value chain, are already developing products such as food packaging, mattresses and fittings for cars from chemically recycled materials. However, the examples mentioned currently reflect the fact that chemical recycling in Germany could only be realised in individual cases with selected input materials until recently. In Germany there is a deficit in the large-scale implementation of chemical recycling projects. It is important for Germany not to lose touch with the corresponding developments in Europe, but also internationally. Consequently, with the announced recognition of chemical recycling in the Packaging Law, the German government has now sent an important signal to raise chemical recycling processes to industrial scale. From a technical point of view, Germany has good preconditions for this, especially due to well-functioning waste management systems and the existing disposal infrastructure. Complementing mechanical recycling with chemical processes creates additional new business

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6 Discover Cefic's members concrete examples on chemical recycling

7 https://plasticseurope.org/de/2021/05/26/milliardeninvestitionen-in-das-chemische-recycling-2/

8 KUBA - Nachhaltige Kunststoffwertschöpfungskette

9 Ressourceneffiziente Kreislaufwirtschaft – Kunststoffrecyclingtechnologien (KuRT) – FONA

10 Chemical Recycling of Mixed Plastic Wastes by Pyrolysis – Pilot Scale Investigations - Zeller - - Chemie Ingenieur Technik - Wiley Online Library

11 BKV Dechema PlasticsEurope VCI: Forschungspolitische Empfehlungen zum chemischen Recycling

fields in the recycling sector, also for specialised small and medium-sized enterprises (SMEs). Chemical companies are already cooperating successfully with SMEs in the field of innovative recycling. Research and development ambitions should therefore take all actors into account to enable an efficient circular economy.

In order to answer many urgent questions about the transformation of the industry towards greenhouse gas neutrality and the circular economy in the future, the VCI and VDI, together with the BMU[12], have developed the Stakeholderplattform „Chemistry4Climate“.

5. How can chemical recycling become a building block of the circular economy?

Way "More" recycling through improved mechanical and new chemical recycling processes is the industry's central promise to a circular economy. With the addition of the chemical recycling component to the circular economy, the total amount of recycled materials can be increased more and more.

In order to demonstrate the economic viability and the ideal legal framework for technology-open recycling, industry together with science will show that large-scale chemical recycling processes work under economic conditions and in enforcement practice. One way to realise such projects is under the umbrella of a demonstration project with “regulatory sandbox” character (operation of pilot or demonstration plants with all actors in the value chain using exemptions or adaptions on the regulatory framework to evaluate this framework with regard to the implementation of research into innovations in the market). The knowledge gained in this process creates the evaluation basis for further improvement and implementation of the processes. On this evidence base, the necessary legal framework should then be optimised - through regulatory learning. The same applies to regulatory enforcement and industrial implementation of the legal framework.

Ultimately, the goal of the combined use of mechanical and chemical recycling processes is to enable the best use of waste streams, ecologically as well as technically and economically. From the perspective of the chemical and plastics industry, this will lead to improved security of supply and reliable product cycles in the future.

In order to answer the numerous unanswered questions concerning chemical recycling, it is necessary to carry out dedicated balancing and evaluations using established methodologies, such as energy balancing, mass balancing (especially according to ISO22095), greenhouse gas balancing, economic efficiency analysis in the sense of competitiveness, and, if necessary, life cycle assessments (especially according to DIN EN ISO 14040ff. or 14044).

[12] Bundesumweltministerium unterstützt Chemische Industrie auf dem Weg zur Treibhausgasneutralität | Pressemitteilung | BMU

6. Framework conditions for the success of chemical recycling

In order to adapt the existing framework in an appropriate way, the current open regulatory questions must be considered in a technology-open manner and answered in the sense of a sustainable and viable circular economy. In order not to lose the international connection for this promising technology, an investment-friendly climate for the circular economy must be created - especially in Germany. This requires the bundling of activities of politics and federal ministries for better coordination with the industry in order to avoid hurdles resulting from mutual demands. The optimised joint solutions must be coordinated between politics, administration, science and the industrial value chain in order to achieve the best possible effect and the fastest possible progress for a large-scale, functioning, technology-open overall circular economy in order to also take German climate policy into account.

In this context, research funding measures such as KuRT by the BMBF (see Chapter 4) are specifically welcomed[13]. In the process of research and development, support is needed for the establishment of demonstration plants and regulatory sandbox projects. Through the principle of technological openness (i.e. that every technology should – politically – be considered to contribute to technological or political driven challenges) , the improvement of existing processes (e.g. sorting and processing), embedding in infrastructures and markets, accelerated approval procedures as well as modern digitalisation and the addition of new chemical recycling processes, recycling rates can be effectively increased and thus make an important contribution to the specified recycling targets in Germany.

Transformation technologies such as chemical recycling are not yet economical in their introductory phase and require market introduction. Therefore, corresponding investments should be flanked by carbon contracts for difference (CCfD) to create planning security. CCfDs are envisaged as a central instrument to support the transformation in industry in the German government's emergency climate protection programme. Corresponding contracts for difference should include investment and operating costs.

Therefore, corresponding investments should be flanked by carbon contracts for difference (CCfD) to create a reliable basis for planning. CCfDs are envisaged as a central instrument for supporting the transformation in industry in the German government's immediate climate protection programme. Corresponding contracts for difference should include investment and operating costs. [14]

A central prerequisite is the recognition of chemical recycling processes as recycling in the legislative and regulatory definition of waste, in order to contribute to the fulfilment of all relevant recycling and recyclate use quotas. This must be done independently of the waste stream. Because waste must always be fed to the optimal disposal route in accordance with the waste hierarchy. This means that priority must be given to the recycling route that is better from

[13] Bekanntmachung - BMBF

[14] The VCI has taken a position on carbon contracts for difference: https://www.vci.de/themen/energie-klima/klimaschutz/carbon-contracts-for-difference.jsp

an ecological point of view. Chemical recycling can then become an important part of the industry's climate protection strategy and gradually lead to more recycling and less energy recovery.

The announcement in the coalition agreement of the new federal government to include chemical recycling as a recycling option in the German Packaging Act is a first important step in the right direction. It now has to be about giving chemical recycling the required importance in the legislation in order to make the circular economy feasible with all available technologies. This cannot be delayed for too long, because only with these additional processes our ambitious recycling targets can be achieved. Further measures, such as the inclusion of waste incineration in the EU ETS, can create incentives for chemical recycling and the circular economy, provided that the technical alternatives, such as chemical recycling processes or CCUs, are actually available and usable on a large scale in sufficient capacities and at economically viable conditions. Further framework conditions for the above are summarised in a VCI position paper[15].

Another basic requirement is the use of suitable, recognised methods, especially with regard to the mass balance approach with a so-called credit model for chemical recycling based on a recognised standard of harmonised norms such as the international standard ISO 22095 "Chain of custody - General models and terminology". A detailed standard on mass balancing is currently being developed in ISO/TC 308 "Chain of Custody".

Furthermore, an enabling policy framework is needed that looks beyond the traditional boundaries of regions and member states and provides an open investment environment and a competitive economic model. This also requires, for example, a revision of the rules on intra-European waste shipments, so that waste can be traded as an economic good in the internal market but not improperly discarded in third countries. Another fundamental prerequisite is to urgently bring forward the end of landfilling of plastic-containing waste, ideally in the 2020s and not only in 2035 according to the EU Landfill Directive, with exceptions even in 2040, so that plastic-containing waste can be recycled at all.

[15] https://www.vci.de/ergaenzende-downloads/20210623-fin-vci-position-co2-bepreisung-von-abfallverbrennungsemissionen.pdf (for the framework conditions for exceptions, see p. 4).

7. Key messages

- The circular economy is an essential contribution to achieving the goal of greenhouse gas neutrality.
- The industry's goal is to increase the amount of waste recycled in Germany and Europe
- Chemical recycling is an important addition to existing recycling processes
- By complementing mechanical recycling with chemical recycling processes, national and European recycling targets can be achieved
- Chemical recycling allows plastic waste to be recycled that could not be recycled previously
- Chemical recycling processes are suitable for a wide range of waste types
- Chemical recycling processes can remove interfering substances from the carbon cycle
- Recyclates from chemical recycling offer the same quality as products made from fossil raw materials and can be used in a wide range of applications (e.g. in medicine and food packaging).
- The quality of chemical recycling processes can be further optimised by expanding the sorting of waste
- Legal framework conditions must be created for the crediting of chemical recycling processes to the legal recycling quotas in order to create incentives for further investments.
- The industry is working on solutions to issues of certification, standardisation, mass balancing and life cycle assessment of chemical recycling processes
- Support is needed in research, development and commercial testing, especially in the establishment of demonstration plants and regulatory sandbox projects
- Investments in chemical recycling facilities should be incentivised by means of Climate Change Differential Contracts (CCfD) that address both operating and investment costs.

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German Chemical Industry Association:

EU Transparency Register number: 15423437054-40.
The VCI is registered in the "public list on the registration of associations and their representatives" of the German Bundestag.

The German Chemical Industry Association (VCI) represents the interests of about 1,900 companies from the chemical-pharmaceutical and chemical-related industries vis-à-vis politics, authorities, other sectors of the economy, science and the media. In 2021, the member companies of the VCI had a turnover of around 220 billion euros and employed more than 530,000 people.

PlasticsEurope Germany

Register number Lobby Register for the representation of interests vis-à-vis the German Bundestag and the Federal Government: R000410

PlasticsEurope Germany represents the interests of plastics producing companies, is closely linked to the German Chemical Industry Association as a trade association and is part of the pan-European association Plastics Europe with offices in several major economic centres in Europe.