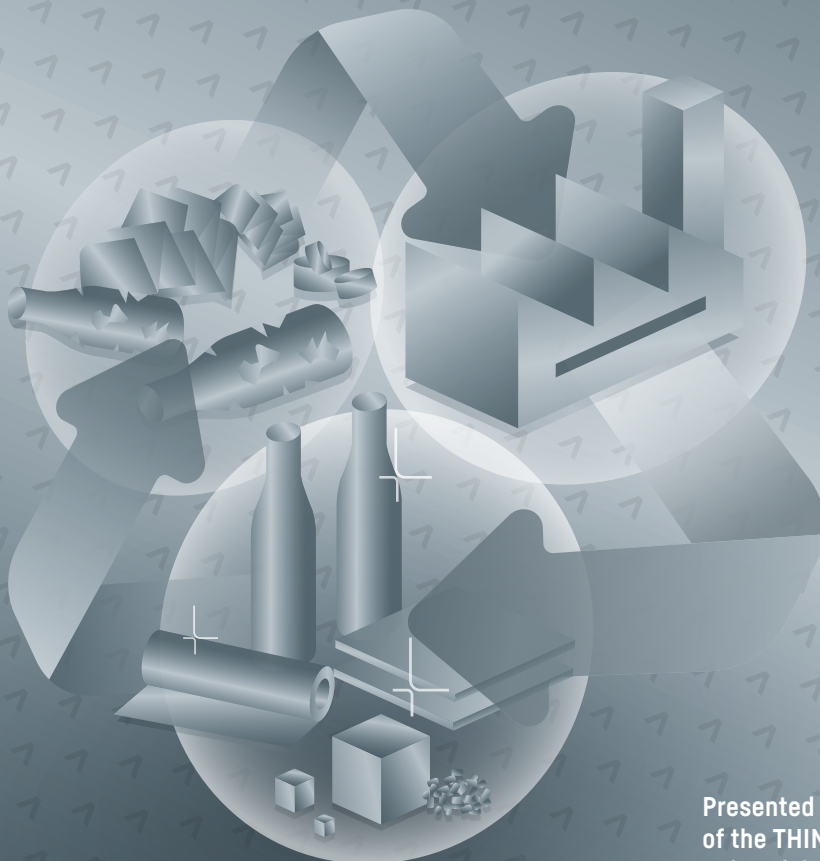


CORPORATE FORUM CHEMICAL RECYCLING [CFCR]

Political fields of action for the raw material turnaround and transformation into a circular economy by means of chemical recycling in Germany



Presented by the CEO
of the THINK TANK for
Industrial Resource
Strategies




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Introduction and background

Given the dangers that have arisen and continue to be engendered by climate change, society, business, and politics are faced with huge challenges in their efforts to shape and bring about the raw material turnaround. Substituting fossil carbon sources is pivotal if global climate goals are still to be met by 2050.

Chemical recycling will contribute to this endeavour and offers the possibility of material recovery for plastic waste hitherto destined for energy recovery. Chemical recycling processes are a necessary addition to mechanical and physical recycling processes.

Implementing projects focusing on industrial-scale chemical recycling is progressing at a slow pace in Germany. There are many reasons for this, including:

- absence of regulations defining End-of-waste criteria
- unresolved issues relating to mass balance
- no equal treatment or technology neutrality for level 3 of the waste hierarchy according to the German Circular Economy Act (Kreislaufwirtschaftsgesetz – KrWG), hereinafter referred to as the Circular Economy Act and the Waste Framework Directive (Abfallrahmenrichtlinie – AbfRRL), hereinafter referred to as the Waste Framework Directive, in the German Packaging Act (Verpackungsgesetz – VerpackG), hereinafter referred to as the Packaging Act.
- absence of the classification of recycling rates, especially in the Packaging Act
- lack of incentive systems to encourage sorting of plastics from commercial and domestic waste.
- insufficient data recording for tracking plastic waste and its material recovery

Chemical or advanced recycling is the technology that can create products from plastic waste in the same quality as that of new products. For market players in Germany to be able to tap into the circular economy and make their contribution to the raw material turnaround, obstacles must be removed and attractive conditions created to encourage necessary investment.

Corporate Forum Chemical Recycling (CFCR)

The Corporate Forum Chemical Recycling (CFCR) was founded by stakeholders across the circular value chain because they consider chemical recycling to be a future-focused technology for producing additional secondary raw materials from waste on an industrial scale.

The Forum's mission is to demonstrate that chemical recycling and its diversity of technologies can and will contribute significantly to a comprehensive circular economy for plastic waste in Germany.

The CFCR has drafted a benchmark paper, which considers current European and German parameters and puts forward proposals for specific fields of action.

Current situation

In view of the predicted trebling of plastic consumption by 2060 (OECD basic scenario 1), the general target of reducing the use of plastic cannot be achieved. It is therefore all the more important to exploit all technical potential to promote a circular economy for plastics. Chemical recycling plays a significant role in this development, because it produces plastic products that achieve the quality of new goods - a quality hitherto reserved for fossil-based plastics.

In Germany and Europe, current approaches to the reuse of plastics and to their mechanical and other physical recycling are neither adequate nor appropriate in terms of supplying an alternative solution. Valuable waste continues to be destined for energy recovery (more than 50% of plastic waste [Conversio survey 2021]) and is lost to the circular economy. The same applies to other organic waste, which literally continues to go up in smoke. This is also true of 32% of old tyres.¹

¹ Wirtschaftsverband der deutschen Kautschukindustrie e.V. (Wdk) [German Rubber Manufacturers' Association]

Germany, as an industrial hub, faces the challenge of

- meeting substitution or recycling rates also for food packaging in the wake of the planned revision of the Waste Framework Directive and the on-going revision of the Packaging and Packaging Waste Regulation. Technologies available today in the area of mechanical recycling are not approved for this sector by the EFSA.
- tackling not only the energy, but also the raw material transition, and showing the same commitment to promoting the necessary new technologies and to creating attractive framework conditions for processes. Chemical recycling provides a huge potential in this area.

The current inadequate supervision and execution of the Commercial Waste Ordinance hamper investment in additional sorting and treatment processes for producing specific waste streams, which would be available for mechanical, further physical, and also for chemical recycling.

Summary

The current situation is characterised by significant obstacles to the use of recyclates in food packaging, low incentives for sorting plastics from commercial waste and uncertain underlying conditions for investing in recycling processes (mechanical, physical, and chemical) and the processing of plastic waste.

Specific political and legislative fields of action suggested by CFCR

Already in November 2021 Germany's current government enshrined in its coalition agreement that chemical recycling was to become an optional recycling method in the Packaging Act. Additional supporting amendments to the legislation and executive provisions are required.

The proposed fields of action are intended to form the basis for a constructive discussion between the stakeholders and provide the framework for the short-term legal implementation of a chemical recycling living lab. The Forum proposes the following fields of action:

1. Waste hierarchical level

Chemical recycling encompasses chemical processes such as pyrolysis, hydrothermal plastic recycling, solvolysis, and gasification, which correspond to waste hierarchical level 3 pursuant to the Circular Economy Act and the Waste Framework Directive (Directive 2008/98/EC), unless said processes produce combustibles or fuels. They are therefore placed on the same waste hierarchy level of waste legislation as mechanical recycling.

2. End-of-waste status

Products of chemical recycling receiving a REACH registration thus legally also attain product status.

3. Use of specific and flexible mass balance methods

Mass balance is a chain-of-custody principle (set forth in ISO 22095). It permits a data driven tracking of the characteristics of sustainable input materials in large-scale recycling installations mixed with conventional (mostly fossil) input materials ensuring their appropriate attribution to products. The fuel-use-exempt mass balance approach should be recognised as a necessary regulatory framework for chemical recycling and applied on condition that it is subject to recognised external certification. This model enables recycled secondary raw materials to be attributed to products taking into account energy and process-related losses. The attributed quantities of recycled secondary raw materials should be factored into the recyclate use rate. (see also section 5)

4. Amendment of Article 16 [2] of the German Packaging Act

Article 16 [2] of the German Packaging Act should be amended so that beyond the first 63% of the material recovery rate for plastics, a higher recycling rate may be achieved by systems by means of chemical recycling processes (Packaging Act rate and definition).

5. Product-specific recyclate use rates

Binding recyclate use rates in packaging and other applications may increase the use of recycled plastics, providing that the framework conditions are right. Recyclate use rates are not an end in themselves, but serve the actual recycling of waste and raw material substitution, thus the transformation from fossil to circular raw materials. In order to achieve ambitious goals in raw material substitution (in the manufacture of plastic), along with recyclates from mechanical recycling, these rates must also include secondary raw materials from chemical recycling (such as pyrolysis oil). A recyclate use rate must therefore factor in the quantities from the attribution of secondary raw materials as part of mass-balanced chemical recycling. Irrespective of this, product claims aimed at end consumers should distinguish between “recyclates” (physically verifiable circular content) and “attributed recycled content” arising from mass-balanced chemical recycling (see also section 3). Investment in the collection, sorting, and recycling infrastructure is also required. In addition, access to waste must be ensured.

6. Investment and steering effect

At the same time, funding and subsidies that are not compatible with the waste hierarchy or which are solely aimed at energy recovery, should be abolished. This applies primarily to the building of incineration plants without the appropriate sorting and separation of waste that could be recovered as a source of raw material for new products, or facilities which by means of other processes only separate and/or store carbons and do not recycle them.

In order to ensure chemical recycling of a maximum of material streams which are currently incinerated, investment in mechanical-biological waste processing facilities should be encouraged in order to achieve efficient steering towards the sorting of commercial urban waste, certain construction and demolition waste, and municipal waste subject to verifiable disposal.

7. Sorting of domestic-type urban waste

Along with the separation of commercial urban waste and certain construction and demolition waste, the treatment and processing (mechanical-biological treatment) of urban waste (domestic and bulky rubbish) must be rolled out. Before any energy recovery or disposal, waste should be treated and/or sorted, providing that the waste cannot be sent directly for reutilisation. This means that direct energy recovery from waste that has been collected or handled should be excluded. (Draw analogy to the Packaging Act and the Commercial Waste Ordinance, in which by prescribing recycling rates, a rate should be reached based on a suitable recycling method.)

8. Consistent implementation of the Circular Economy Act and the Commercial Waste Ordinance

Besides effectively implementing supervision of execution based on existing provisions, the Commercial Waste Ordinance must be amended to include incineration plant supervision. In the future, supervision of the separation of commercial urban waste and certain construction and demolition waste must be extended to the treatment and processing of urban waste (domestic rubbish) and certain construction and demolition waste.

Specific sorting and recycling rates for plastics arising from mixed commercial waste (50% by 2030 and 70% by 2040), a material recycling rate for plastics separated in this way (60% by 2030 and 75% by 2040)² and a gradual prohibition of the incineration of tyres (amendment to Section 14 Circular Economy Act, Article 4 Commercial Waste Ordinance in conjunction with Article 6 (1) and Article 5 (5) Commercial Waste Ordinance) must be introduced.

² Amendment to Section 14 Circular Economy Act, Article 4 Commercial Waste Ordinance in conjunction with Article 6 (1) and Article 5 (5) Commercial Waste Ordinance

9. Establishment of a single independent body and creation of legal requirements to collect data for all waste and recycling methods, as well as for certificates

A single independent body should be established, which is capable of

- registering, documenting, and assessing all waste from its origination to certified secondary raw material or incineration and disposal (comparable to the central body in the Packaging Act).
- introducing and supervising certification processes for all recycling methods, which must be performed regularly by recycling firms, including export regulations; setting auditors strict thresholds for determining the recycling rates to be achieved.

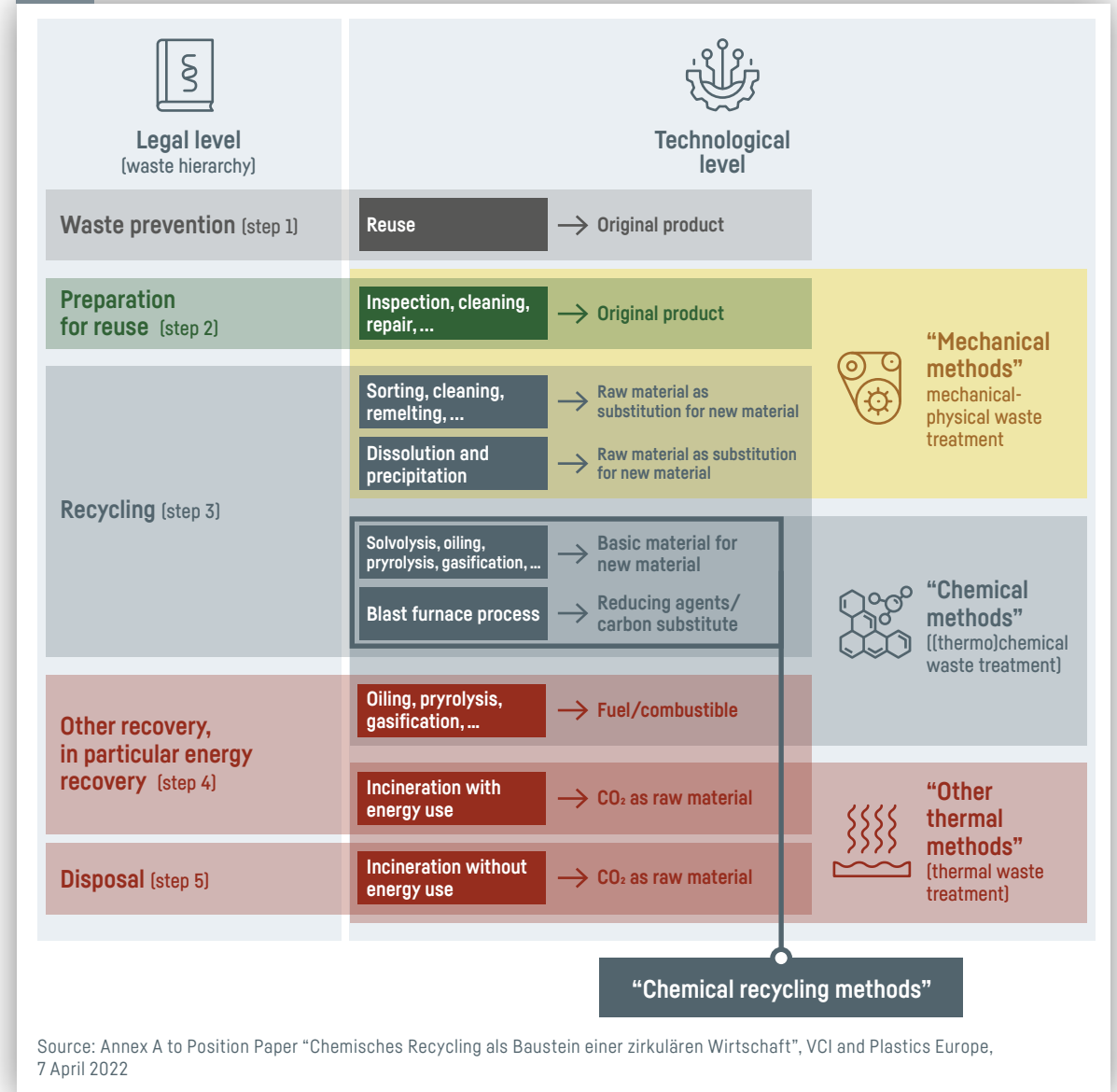
APPENDIX

Legal and technological classification of chemical recycling

“In case of chemical processes, the recycling definition is complied with when the resulting products can be used for new materials (material substitution). They are then deemed chemical recycling methods. If the resulting products are used as fuel, the processes are not deemed chemical recycling methods”³ (Fig. 1). The CFCR shares the legal and technological view of chemical recycling, as proposed by VCI and Plastics Europe.

³ Source: Annex A to Position Paper “Chemisches Recycling als Baustein einer zirkulären Wirtschaft”, VCI and Plastics Europe, 7 April 2022

Figure 1



Glossary

Chemical recycling

Chemical or feedstock recycling of plastics describes process chains in which polymers are wholly or partially converted back into their basic chemicals and then used as material to create new polymers or other substances and – apart from by-products or residual substances – are not used for energy recovery. [On-going Departmental Research Plan project draft, version: September 2022]

It is beyond dispute that chemical recycling should be classed as recovery within the meaning of Section 3, [23] Circular Economy Act, because its principal outcome is that waste is put to a useful purpose within the plant or in the wider economy, either by substituting other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function. This may commonly be assumed to be the case for products created by means of chemical recycling [e.g. synthesis gases, oil, monomers]. [UBA / July 2020 / Para. 3.2 Page 12 Column 2 Subpara. 2 Sentence 2]

Circular Economy Act

Law promoting the circular economy and ensuring the environmentally friendly management of waste [Kreislaufwirtschaftsgesetz KrWG]

Commercial Waste Ordinance

German ordinance on the management of commercial urban waste and certain construction and demolition waste 1 [Gewerbeabfallverordnung – GewAbfV]

EU Waste Framework Directive

European Union Directive | Directive 2008/98/EC

Directive 2008/98/EC on waste and repealing certain Directives [Waste Framework Directive]

German Packaging Act

German law governing the placing on the market, return and high quality recovery of packaging [Verpackungsgesetz – VerpackG]

Material recovery

Circular Economy Act Section 3 [23a]

Material recovery within the meaning of Section 3 [23a] Circular Economy Act shall be any recovery operation with the exception of recovery of energy and processing into materials intended to be used as fuel or as another means of energy generation. In particular, material recovery shall include preparation for re-use, recycling and backfilling.

EU Waste Framework Directive: Article 3, 15a

Material recovery means any recovery operation, other than energy recovery and the reprocessing into materials that are to be used as fuel or other means to generate energy. It includes, inter alia, preparing for re-use, recycling and backfilling.

Material recovery

Only applicable according to the German Packaging Act: recovery by methods substituting new material of a similar nature or the material shall remain available for further material use [Packaging Act, 5 July 2017, Article 3 [19]

Article 16 [2] Packaging Act

A minimum of 90 mass percent of plastics must be destined for recovery. This must be ensured by at least 65 percent and as per 1 January 2022, by 70 percent through material recovery.

Mechanical recycling

Mechanical recycling is where plastic waste is processed into secondary raw materials or products in which the chemical compounds are not broken down.

Physical and mechanical waste treatment

Methods, which do not convert polymers, but sort, clean, and preserve the structure of the polymers by means of physical and mechanical processes

Plastic

DIRECTIVE (EU) 2019/904 OF THE EUROPEAN PARLIAMENT AND COUNCIL of 5 June 2019 on the reduction of the impact of certain plastic products on the environment, Article 3 [1]:

A material consisting of a polymer as defined in point 5 of Article 3 of Regulation (EC) No 1907/2006, to which additives or other substances may have been added, and which can function as a main structural component of final products, with the exception of natural polymers that have not been chemically modified.]

Recovery

Recovery within the meaning of the Circular Economy Act shall be any process the principal outcome of which is waste that is put to a useful purpose within the plant or in the wider economy, either by substituting other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function. Providing that the packaging waste accounted for by plastic material from dual system collection is appropriately recycled, the input quantities can contribute to complying with the recycling rates for plastics within the meaning of Article 16 [2] 2 Packaging Act. The same applies to other waste streams for which recycling rates apply.

Recyclate

Circular Economy Act, Section 3 [7b]
Secondary raw materials that have been generated by means of the recovery of waste or are generated in the disposal of waste and are suitable for the production of products

Recycling

Circular Economy Act Section 3 [23]
Recycling within the meaning of the Circular Economy Act [23a] shall be any recovery process with the exception of recovery of energy and processing into materials intended to be used as fuel or another means of energy generation; it includes the treatment of organic materials, with the exception of energy recovery and processing into materials intended to be used as fuel or for backfilling.

EU Waste Framework Directive Article 3 , 17
“Recycling” means any recovery operation by which waste materials are reprocessed into products, materials or substances, whether for the original or other purposes.

It includes the reprocessing of organic materials but does not include energy recovery and the reprocessing into materials that are to be used as fuel or for backfilling.

Secondary raw materials

Secondary raw materials are I) Recyclates, II) Waste for general material recovery, III) By-products, or IV) Extracted CO₂.

Note 1 to the term: The term secondary raw material must not be understood as a value judgement/second-ratedness of the raw material.

[Glossary, Module A “Basic Terms for Raw Materials” of the BDI Initiative Circular Economy]

Thermo(chemical) waste treatment

Chemical methods that use heat to break down polymers into parts and thus fully or partially disassociate the structure

Legal framework

Circular Economy Act Section 3 [23a] and [25]

Subsection 23a: Material recovery within the meaning of the present Act shall be any recovery process with the exception of recovery of energy and processing into materials intended to be used as fuel or as another means of energy generation. Material recovery shall particularly include preparation for re-use, recycling, and backfilling.

Subsection 25: Recycling within the meaning of the present Act shall be any recovery process by which waste is processed into products, materials or substances, whether for the original or other purposes; it shall include the processing of organic material, but shall not include recovery of energy and processing into materials that are to be used as fuel or for backfilling.

Circular Economy Act Section 3 [28]

Technical state-of-the-art within the meaning of the present Act shall be the level of development of advanced processes, installations or modes of operation that gives a reliable indication of the practical suitability of a measure for limiting emissions into the air, water and soil, for ensuring installation safety, for ensuring that waste management is environmentally compatible, or for preventing or reducing environmental impacts in other respects, in the interest of achieving a generally high level of overall environmental protection. In determining the technical state-of-the-art, the criteria listed in Annex 3 must be taken into special account.

Packaging Act: material recycling

The Packaging Act does not define a meaning for recycling, but refers to Section 3 [25] Circular Economy Act. In the Packaging Act Article 16 regarding recovery requirements, in **para. 2** the term “material recycling” is used additionally especially for licensed plastics (for packaging subject to system participation). Under this paragraph, as per 01.01.2022 licensed plastics must be recycled by 90%, of which 70% must be recycled using a material recovery method.

- Example: A company licenses 1,000 t of plastic packaging
- 90 % = 900 t must be subjected to a recycling process
- Of this, 70% must be verifiably subjected to material recovery (70% of 90% = 63 % of the licensed quantities = 630 t)
- The remaining 37 % = 370 t may be verifiably recycled
- This means that currently it would be possible to chemically recycle approximately 333,000 t of the some 900,000 t of licensed plastics in the dual system

Packaging Act: recycling

In Article 16 (4), systems are required to recycle at least 50% of the registered mixed waste. The term “recycling” is based on Section 23 Circular Economy Act, according to which every recovery method excepting energy recovery is permissible.

Packaging Act: **System auditor** – registered expert: Article 17 (2), Article 20 (4) and Article 20 (2) 1 Packaging Act

System auditors are auditors appointed for the systems in accordance with Article 20 (4) and who audit and confirm the interim and annual volumes in accordance with Article 20 (2) 1. According to Article 17 (2), only experts registered with a central body are entitled to audit mass flow.

Commercial Waste Ordinance Recycling and separate collection

The Commercial Waste Ordinance bases the term recycling on the definitions of the Circular Economy Act. Compared to the Packaging Act, separate collection is defined less strictly. It is based on economically efficient separation in conjunction with the volumes and organisational possibilities – see Sections 3 and 4.

Commercial Waste Ordinance Authorisation for verifying compliance with regulations

See Article 4 (5) 1 to 4: Accreditation with the national accreditation body or the Environmental Audit Act. Officially appointed in accordance with Section 36 of the Industrial Code.

EU Waste Framework Directive 2008/98/EC, revised in conjunction with 2018/851

As a Directive of the European Community, Directive 2008/98/EC of 19 November 2008 relating to waste sets forth requirements for political action by Member States in their transitioning to a circular economy and, in particular to their waste legislation.

New aspects are extended manufacturer responsibility, the incentive system to use the waste hierarchy, the end-waste status for some products, recovery regulations: addressees are the Member States directly, who are called upon to introduce the appropriate legislative procedure.

The definition of “material recovery” according to Article 3 (15a) of the EU Waste Framework Directive has been added:

the term **material recovery** now means any recovery operation, other than energy recovery and the reprocessing into materials that are to be used as fuels or other means to generate energy. It includes, inter alia, preparing for re-use, recycling and backfilling.

EU Directive on Packaging and Packaging Waste EU 94/62/EC, revised with EU 2018/852 and the planned new revision for 2023

- The EU Packaging Directive is aimed at EU countries contributing to increasing the percentage of reusable packaging (through deposit systems, financial incentives, etc.). In addition, the 2021 EU Packaging Ordinance sets forth specific requirements for packaging: they are to be reused in an environmentally friendly manner without compromising food hygiene or consumer safety. Plastics containing heavy metals and chemical substances shall therefore be replaced by packaging made of natural materials. Furthermore, with the help of measures, countries are to ensure that the relevant recycling targets for the different types of packaging are reached (e.g. EU Recycling Codes or Recycling Code for Italy). Only if the requirements are complied with, may the packaging be brought into circulation and into the economic cycle.
- **EU Packaging Directive 2023:** wider harmonisation of packaging legislation
- High recovery requirements coupled with a drastic additional use of new packaging
- The proposal for a new directive was published on 30.11.2022. It aims to continuously reduce the use of plastic over the next 20 years, based on 2018 figures, and to achieve higher recycling rates, especially in the use of recycled plastic in packaging, as well as the introduction of collection systems in all EU Member States for drinks in disposable plastic and metal bottles.

EU Regulation 2022/1616 on recycled plastic materials for foods

Commission Regulation (EU) 2022/1616 of 15 September 2022 on materials and items made of recycled plastic intended to come into contact with foods and repealing Regulation (EC) No 282/2008

- Regulation (EU) 2022/1616 complements Regulation (EU) No 10/2011, which sets forth requirements for the composition that ensures safe use of materials intended to come into contact with food, including the materials and migration thresholds approved for their production. In order to ensure the same safety level for materials and items made of recycled plastic, they should have the same composition as manufactured plastics in accordance with Regulation (EU) No 10/2011 and comply with the limits and specifications such as migration thresholds specified in the aforementioned Regulation.
- Regulation (EU) 2022/1616 does not apply to the use of waste for producing materials that are named in the European Union's list of approved materials in accordance with Article 5 Regulation (EU) No 10/2011, nor to the production of materials subject to Article 6 [1] and [2], as well as [3] a of the aforementioned Regulation, providing that they are intended for subsequent use in accordance with the aforementioned Regulation.

Circular Economy Act Annex 3 Criteria for determination of the technological state-of-the-art (exemplary)

- Use of low-waste technology
- Promotion of the recovery and re-use of the substances
- Progress in technology and in scientific findings
- The nature, impacts and quantity of the respective emissions
- Consumption of raw materials and the type of raw materials used in the individual processes (including water), as well as energy efficiency

German law governing the placing on the market, return and high quality recovery of packaging (Verpackungsgesetz – VerpackG)

Aims:

- Requirement of product responsibility pursuant to Section 23 Circular Economy Act to avoid and reduce environmental impact with the duty to avoid waste generation, reuse, and recycle
- Generation of additional valuable materials for high-quality recycling
- The Packaging Act is also intended to comply with Directive 94/62/EC on packaging and packaging waste
- Implementation of mandatory system participation (Article 7) with a pricing system to promote good recyclability

German ordinance on the management of commercial urban waste and certain construction and demolition waste 1 (Gewerbeabfallverordnung – GewAbfV)

The Commercial Waste Ordinance is based on Sections 8, 65 and 10 of the Circular Economy Act. It regulates the collection, treatment by means of upstream facilities, recovery, disposal and keeping records and proofs of disposal for commercial urban waste and certain construction and demolition waste.

It determines the separation of waste materials, however in consideration of economic efficiency, and the requirement of input into an upstream facility aimed at achieving a specified recycling rate.

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- b)** UBA: Klimaverträgliche Abfallwirtschaft: 11 February 2021 and Ökobilanzstudie (UBA 2010: 18 Mio. t CO₂ Einsparung 2006 zu 2005 durch thermische Verwertung vs. Deponierung), <https://www.umweltbundesamt.de/daten/ressourcen-abfall/klimavertraegliche-abfallwirtschaft#abfallbehandlung-schutzt-heute-das-klima>
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- f)** German Circular Economy Act – Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen (Kreislaufwirtschaftsgesetz – KrWG), Referentenentwurf eines Gesetzes zur Umsetzung der AbfRRL – Lesefassung (Stand: 05.08.2019), https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Glaeserne_Gesetze/19_Lp/krwg_novelle/Entwurf/krwg_novelle lese bf.pdf
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- h)** TÜV SÜD: ICCS+ and ReCert2
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- j)** Ass. Jur. Sakina Wagner LL.M.Eur IHK Karlsruhe: <https://www.ihk.de/karlsruhe/fachthemen/umwelt/abfall/aktuelle-informationen/die-neue-eu-abfallrahmenrichtlinie-4160290>
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- o)** <https://www.bundesverband-reifenhandel.de/themen/altreifen/entsorgung/>
- p)** See Annex A of the German Position Paper “Chemisches Recycling als Baustein einer zirkulären Wirtschaft”: Rechtliche Einordnung des chemischen Recyclings (mechanische Verfahren und chemische Verfahren, die geeignet sind der Stufe 3 „Recycling“ der Abfallhierarchie gerecht zu werden) by Plastics Europe and VCI, April 2022
- q)** “Recycling rates (material recovery rates) map the collection rate of potentially recyclable material and not the rate of recycled material (output of recovery analyses) or material that is returned to the economic system. Previously used recycling rates are nevertheless of high interest, since they map the quality of the collection and recycling infrastructure.” (Resources Commission at the German Environment Agency (KRU), Substitutionsquote: Ein realistischer Erfolgsmaßstab für die Kreislaufwirtschaft, July 2019)
- r)** “No indicators are currently implemented for circularity metrics regarding the use of secondary material as a substitute for primary material, which would make it possible to map the existence and effectiveness of a circular economy.”(ebenda)
- s)** Included are the indicators regarding secondary raw materials (Eurostat 2018a, 2018b, 2018c): see also t)
- t)** Contribution of recycled material to cover demand for raw materials (Circular Material Use rate, CMU): “ratio of recycled waste material over the overall material demand (operationalised by domestic material consumption plus the amount of recovered waste)” (Eurostat 2018a)
- u)** End-of-life recycling input rates, EOL-RIR: “this indicator measures recycling’s contribution to materials demand per type of material for a selected subset of materials” (Eurostat 2018b)
- v)** Trade with recyclable raw materials (Eurostat 2018c)
- w)** Evaluation of the collection and recovery of selected waste streams for the continued development of the circular economy

Imprint

Title

Corporate Forum Chemical Recycling [CFCR]

Political fields of action for the raw material turnaround and transformation into a circular economy by means of chemical recycling in Germany

Published by

THINK TANK for Industrial Resource Strategies
at Karlsruhe Institute of Technology (KIT)
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Version

Published 7/2023

Graphic design, illustrations, typesetting

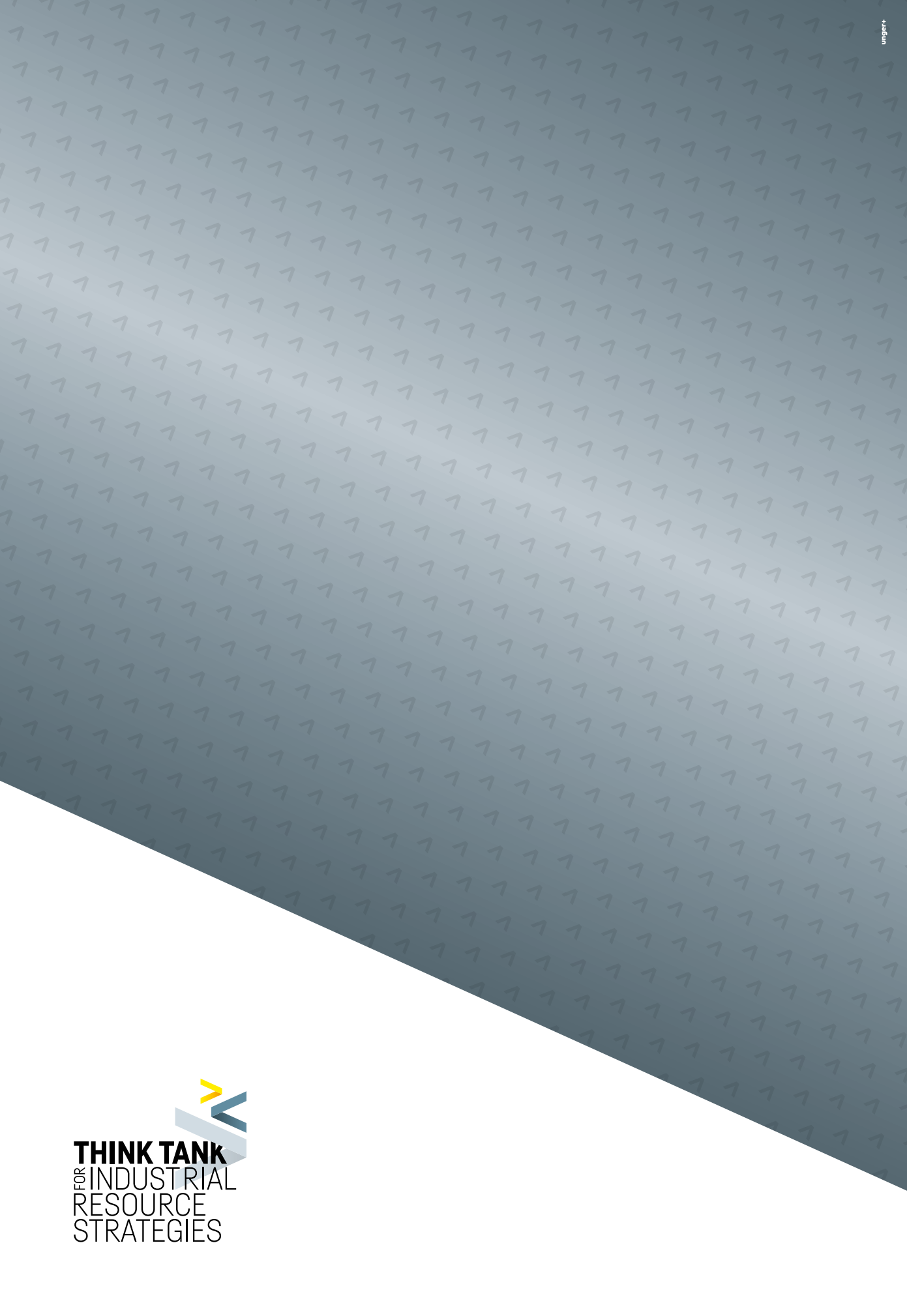
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The Industrial Resource Strategies THINK TANK is supported by funding from the Ministry of the Environment, Climate Protection and the Energy Sector, Baden-Württemberg.



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