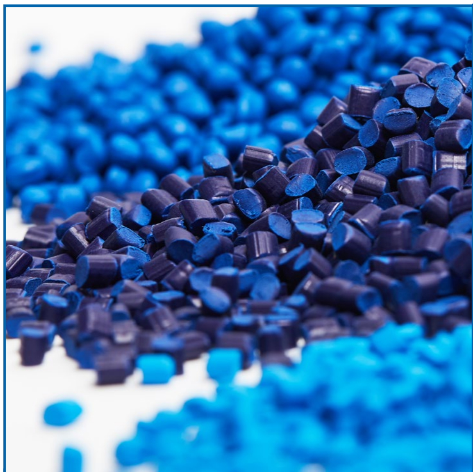
ZVEI:
Die Elektroindustrie

Guideline

Plastic recyclates in the electrical industry

Synergies and conflicting goals of sustainable implementation in practice



German Electrical and Electronic Manufacturers' Association

ZVEI: Die Elektroindustrie

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Synergies and conflicting goals of sustainable implementation in practice

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September 2021

Foreword

Dear members of the ZVEI,

the use of recycled plastics is assessed as one of the core elements for a functioning circular economy, effective climate protection and the achievement of the (especially ecological) Sustainable Development Goals (SDGs) of the United Nations[1]. This paper discusses current challenges arising from an increased use of plastic recyclates[2] and examines the environmental, economic and social sustainability of their use in electrical products. We also show what companies should look for when addressing the issue of plastic recyclates in practice.

The SDGs were selected for this sustainability assessment because they are a global framework that summarises the most important challenges of sustainable development and enjoys strong global support from governments and organisations of all kinds. In the context of the SDGs, goal 12 "Sustainable Consumption and Production" seems particularly relevant for the developments towards an increased use of plastic recyclates. With a growing world population and a parallel rise in living standards due to the increasing number of people moving up into the so-called middle class, there is an increasing material footprint per person on a global scale. Sub-goal 12.6 calls on governments to encourage companies to operate sustainably[3]. In a global survey, companies themselves give goal 12 the highest priority for implementation after goal 13 (climate protection). Urgent measures for the efficient use of resources and substantial reduction of waste are closely linked to this corporate opinion[4].

The present results of the sustainability assessment cannot be a conclusive evaluation for practice, because the electrical industry is very heterogeneously positioned and the sustainability of recycled plastics in electrical products depends on many different parameters. Nevertheless, this publication provides initial assistance to facilitate entry into a complex subject area that is already of great importance to companies today. Four best-practice examples, which we have integrated at various points in this paper, show how companies in the electrical industry have experienced the topic of plastic recyclates to date. All examples have one thing in common: partnerships are indispensable to realise sustainable solutions in practice.

We wish you an exciting read!

Dr. Bastian Bach,
Chairman of the ZVEI Task Force SDGs & Sustainability

Leo Stein,
Senior Manager Sustainability and Environment (ZVEI)

[1] A new Circular Economy Action Plan For a cleaner and more competitive Europe: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN, retrieved 16 April 2021.

[2] The terms "recyclate" and "recycling process" are used in this paper regardless of the origin (post-consumer vs. post-industrial / pre-consumer) of the material or a specific process. If specific recyclates or processes are mentioned, they are explicitly referred to in the text. For further background, please refer to Chapter 2 (Terminology).

[3] https://sdgs.un.org/goals, retrieved 16 April 2021

[4] https://www.globalsurvey-sdgs.com/, retrieved 16 April 2021

Content

Summary

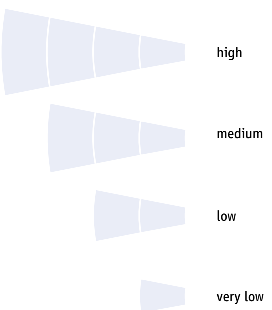
The use of plastic recyclates in the electrical industry can contribute to the achievement of various SDGs. For goals 7 (especially in the context of energy-efficient technologies), 8 (value creation, jobs), 9 (innovation, research), 12 (resource efficiency) and 17 (partnerships), a high leverage effect is possible through various measures. However, potential conflicts of objectives must also be taken into account, such as the partly unknown environmental / climate balance of recyclates currently available on the market. Therefore, a holistic assessment is always recommended.

In areas with comparatively low challenges (e.g. packaging or non-visible parts), companies should already be able to use recyclates today. The electrical industry can also support the sustainable use of recycled plastics through the targeted selection of primary plastics that can be processed into suitable recyclates at the end of their service life. However, increased use of recycled plastics is not yet holistically sustainable in many cases today and only contributes to the achievement of partial goals.

In order to clarify open questions and to overcome conflicting goals, especially around the improvement of availability and usability, a trialogue must be established between the manufacturers of plastics, the electrical industry as a user of plastics and the recycling industry. This paper is an impulse for such a trialogue. The ZVEI will work to ensure that events are held between the various stakeholders.

For more background on plastics and SDGs, please refer to the two ZVEI publications below (Electrical Industry Perspective) and the bibliography at the end of this paper (Electrical Industry and Beyond):

- Guide for sustainable development in the electrical industry (in German)
- Discussion paper "Plastics in the Electrical Industry"



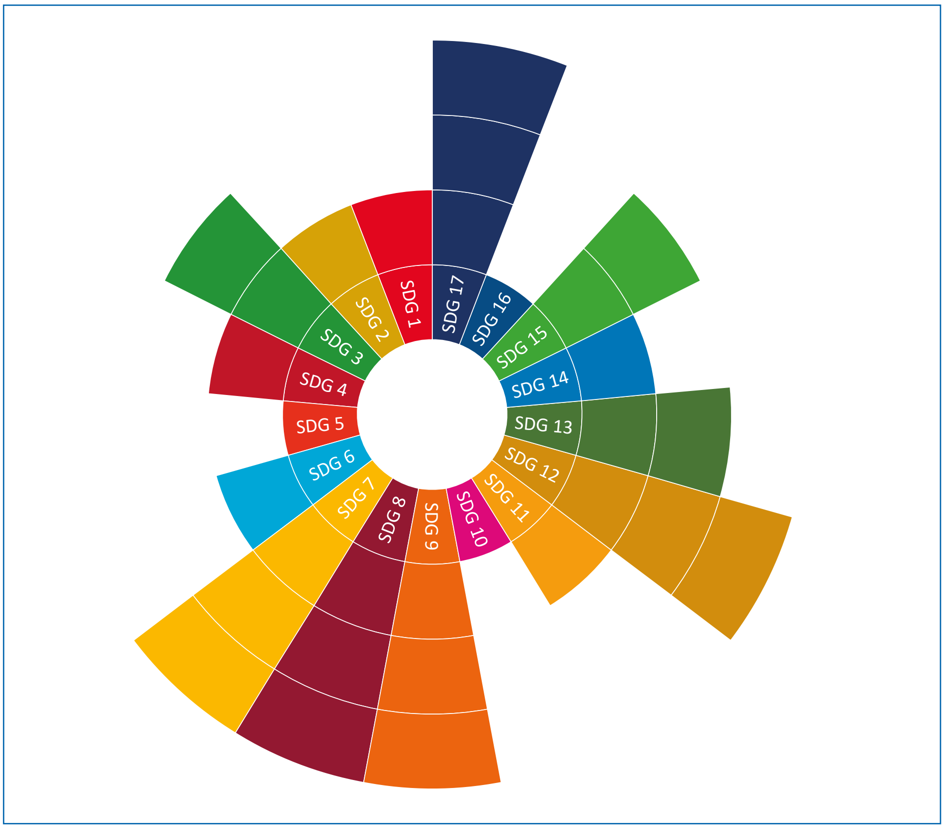


Figure 1: Overview of the potential leverage of the electrical industry in relation to the SDGs in the context of plastic recyclates

1 Background

1.1 Plastic recyclates in the political and social debate

Politics

With the publication of its "New Circular Economy Action Plan" in March 2020, the European Commission has placed a focus on maximising the share of recycled materials as one component of the European Green Deal. Among other things, new, binding requirements for the recycled content in products are to be developed in the area of plastics[5].

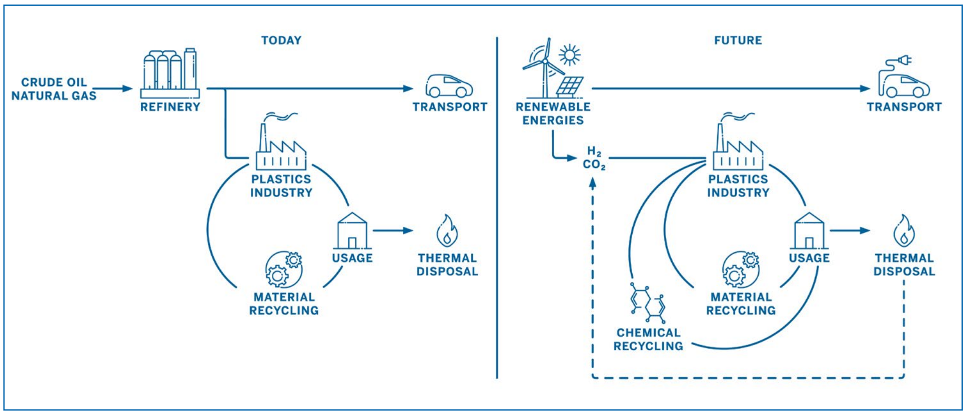


Figure 2: Illustrative representation of the carbon cycles in the plastics system - In view of the very limited global potential of sustainably provided biomass, there are two main strategy options: Increased recycling and, in the long term, the industrial synthesis of hydrocarbons (Source: IN4climate.NRW).

Based on the first Circular Economy Action Plan (December 2015), a European Strategy for Plastics in the Circular Economy[6] has already been adopted in 2018, addressing the untapped economic benefits of a more "circular" economy and the environmental impacts. Among other things, the strategy takes full account of recycling needs (alongside reuse and repair) and makes a concrete contribution to achieving the SDGs and meeting the Paris Climate Agreement. Annex III of the Plastics Strategy includes a call for stakeholders to commit to processing ten million tonnes of recycled plastics into new products for the EU market by 2025. To achieve these goals, the EU Commission has founded the Circular Plastics Alliance (CPA) (see infobox). Due to the long lifespan of electrical appliances, the CPA assumes that current changes in the design of electrical appliances will not yet have an impact on the political target in 2025[7].

Circular Plastics Alliance (CPA):

The stakeholder group, which was founded in September 2019 on the basis of a declaration, currently consists of over 250 organisations from industry, education and public institutions[8]. One working group is dedicated to Waste of Electrical and Electronic Equipment (WEEE) and represents the electrical and electronics industry. The work of the CPA produced its first deliverables in 2020. Relevant contents are discussed at various points in the remainder of this paper[9].

[5] https://ec.europa.eu/commission/presscorner/detail/de/ip_20_420, retrieved 16 April 2021
[6] https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:52018DC0028&from=EN, retrieved 26 February 2021
[7] https://ec.europa.eu/docsroom/documents/43688/attachments/1/translations/en/renditions/native, retrieved 17 March 2021
[8] https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance_en, retrieved 26 February 2021
[9] https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance/commitments-and-deliverables_en, retrieved 03 March 2021

In addition, the plans for the implementation of the EU taxonomy show that it also very specifically addresses plastics production[10]. Under environmental goal 4, there are concrete demands, for example, for waste reduction and avoidance, for the reduction of the use of primary raw materials and the increased use of high-quality secondary raw materials.

Society

In public, plastics are mainly perceived as a problem of littering, i.e. the careless throwing away into the environment and oceans, although these plastics do not originate mainly from European latitudes.

Plastic products fragmented into small particles by multiple processes ("microplastics"[11]) are also a cause of concern for a growing proportion of society due to their occurrence in water and soil, not least because of the currently unknown consequences[12].

Addressing these circumstances and concerns, the EU has most recently regulated, among others, certain single-use plastic products with Directive (EU) 2019/904 on reducing the impact on the environment[13].

[10] https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=uriserv:OJ.L_.2020.198.01.0013.01.DEU, retrieved 22 February 2021
[11] Microplastic is any solid plastic particle insoluble in water less than 5000 µm in length
[12] https://www.boell.de/sites/default/files/2020-11/Plastikatlas%202019%205.Auflage%20web.pdf?dimension1=ds_plastikatlas, retrieved 03 March 2021
[13] https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32019L0904, retrieved 16 April 2021

Best practice examples from the electrical industry

SLV GmbH

Brief description of the product example

When developing the SAMRINA outdoor luminaires, SLV GmbH had a clear goal: to replace as many primary raw materials as possible with secondary raw materials. For this reason, the ground spike luminaires are proportionately made of the plastic Schuladur® GF30 from LyondellBasell, which contains 35 percent recycled raw materials. In the total mass of the luminaires, the proportion of recycled material is 17 percent. At the same time, SAMRINA offers the quality and durability you are used to from SLV. Thus, it is a flexibly alignable ground spike luminaire, which makes in gardens, in front of homes, hotels and restaurants an equally sustainable, as stylish figure.

Dr.-Ing. Pinar Erol, Head of Group Sustainability SLV Lighting Group

„Developing and manufacturing sustainable products is a balancing act: In addition to using secondary raw materials – conserving resources, we make no compromises when it comes to quality, design and durability. With SAMRINA we have succeeded."

Challenges and solutions

The usual quality and safety standards must also be guaranteed with secondary raw materials. At the same time, customers want to benefit from a long service life and appealing aesthetics. From this point of view, it has become clear that the 100 percent use of recycled secondary raw materials is technically extremely demanding and not very effective. Thus, only a partial application is currently being considered, which can be further increased with technological progress.

Sustainability Assessment

In line with the SLV Lighting Group strategy of increasing its own sustainability along the entire value chain and thinking consistently in terms of life cycles, replacing primary raw materials with secondary raw materials has a double effect: On the one hand, waste and residual materials can be fed into a functional circular economy and plastic waste accumulating in the environment can be reduced. On the other hand, the consumption of new raw materials is reduced, as these can be supplemented by secondary raw materials while maintaining the same product quality.

The central finding was:

For sustainable business models, the use of secondary raw materials becomes unavoidable. To realize this requirement and to avoid bottlenecks, availabilities must be continuously checked. This requires consistent life cycle thinking and life cycle assessments in order to make more sustainable decisions through quantitative comparisons.

2 Overview of plastic recyclates

2.1 General

Facts and figures

In 2018, 390 million tonnes of plastic were processed worldwide. Of this, 360 million tonnes was newly produced plastic (primary plastic). Processed recyclates were used in only 30 million tonnes of the total quantity produced. This corresponds to a share of 7.6 percent. However, a total of 50 million tonnes or 20 percent of the 250 million tonnes of plastic waste produced in the same period was recycled. The difference results from average process losses of 40 percent[14].

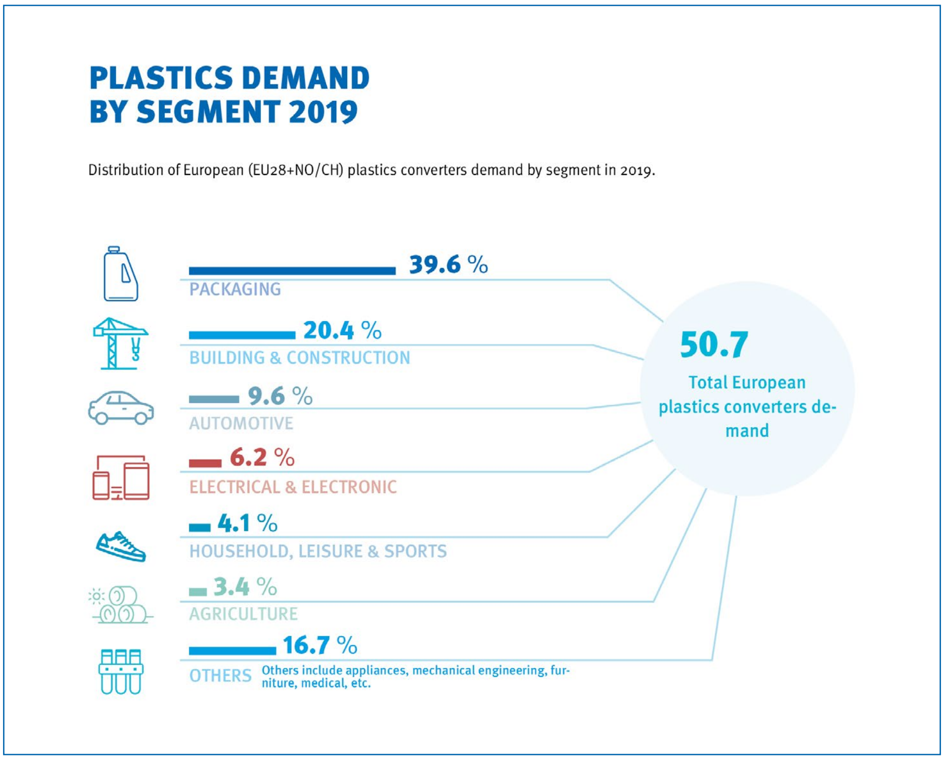


Figure 3: Plastics demand by segment 2019. Distribution of European (EU28+NO/CH) plastics converters demand by segment in 2019 © Plastics – the Facts 2020

In Europe, about 62 million tonnes of plastic were produced in 2019, and demand from plastics converters was about 51 million tonnes. The electrical industry represents about 6.2 percent of this demand (Figure 3). A wide range of polymer types are used in electrical equipment (Figure 4).

[14] Conversio Market & Strategy GmbH: Global Plastics Flow 2018 https://www.bkv-gmbh.de/studien/studie-global-plastics-flow-2018-conversio.html, on 12 February 2021

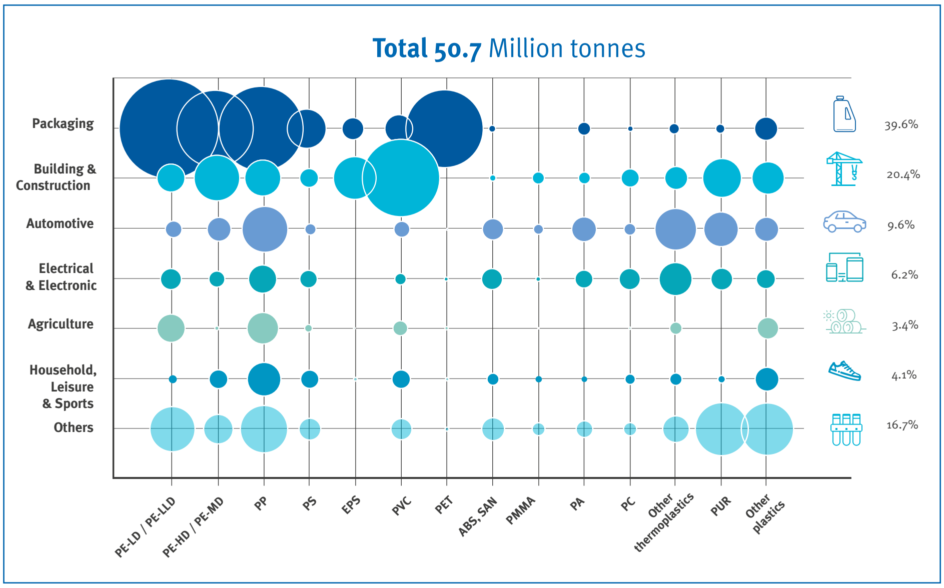


Figure 4: Demand for plastics by segment and polymer type in 2019. Total: 50.7 Mt, data for EU28+NO/CH. The electrical industry uses various different thermoplastics, but also thermosets (PUR, Other plastics). For explanation of abbreviations see source. © PlasticsEurope Market Research Group (PEMRG) and Conversio Market & Strategy GmbH

For the EU, the CPA estimates in a first results report that the amount of demonstrably recycled plastic from used household electrical appliances is around 560,000 t (2016) out of a total amount of used electrical appliances of approx. 9 Mt.[15] The proportion of plastic in household electrical appliances is currently slightly increasing and, depending on the source and category, is between 15 and 28 percent[16].

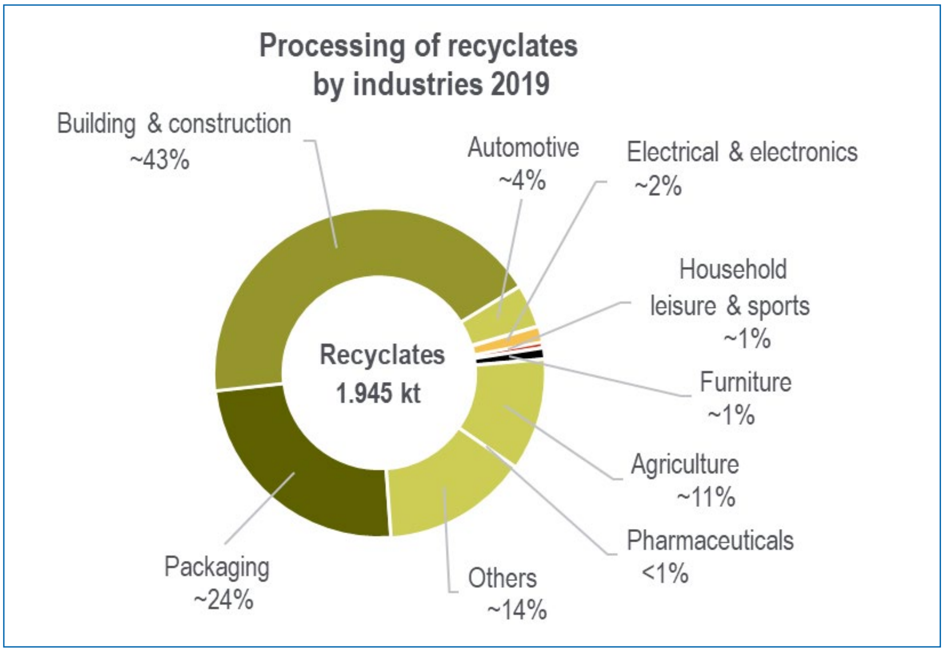


Figure 5: Processing of recyclates by sector in Germany 2019.
© Abridged version of the Conversio study "Material flow diagram plastics in Germany 2019"

[15] https://ec.europa.eu/docsroom/documents/43694/attachments/1/translations/en/renditions/native, retrieved 16 April 2021
[16] CPA: 22% in 2016, Conversion Market & Strategy: 26% in 2019, UBA: 28% for small appliances, 15% for large appliances.

The difference between the amount of plastic recyclates used and the total amount of plastics put on the market in electrical appliances is due, on the one hand, to the fact that electrical appliances are long-lived and, on the other hand, to the fact that only a part of the old appliances is found in the official collection and recycling systems. The entire quantity of WEEE collected through official channels is treated properly and is thus available for recycling. A recent study shows that, in relation to the total amount of WEEE put on the market, 55 percent of WEEE is collected and officially reported[17]:

- At least 20 percent of WEEE is in other streams (mixed with metal scrap, WEEE in bins, WEEE exported for reuse, illegal WEEE exports).
- The study estimates the whereabouts of 25 percent as unknown (13 percent of the WEEE is not recorded. Approx. 12 percent is either also not recorded or there are uncertainties in the calculation method).

There are no data available to analyse the quality of treatment of WEEE collected by other, different actors. This naturally makes it difficult to draw conclusions about the materials contained in WEEE.

2.2 Terminology and procedures

Relevant definitions

Various EU regulations define relevant terms such as waste or recycling (cf. infobox) and contain, among other things, harmonised end-of-waste criteria for some materials, but not for plastics. The end-of-waste criteria for plastics in Europe are described in particular in EU waste and chemicals legislation. In order for recyclates to be used by customers in various fields of application, they must above all meet quality and safety requirements that apply to products under the relevant chemicals and product legislation (cf. Chapters 2.3, 2.4). As an example, reference is made to the German Environment Agency's guideline "REACH and the recycling of plastics".

Definitions of waste and recycling[18, 19]

The Waste Framework Directive of the European Union defines "waste" in Art. 3(1) as any substance or object which the holder discards, intends to discard or is required to discard. Based on this, "recycling" according to Article 3(25) of the German Waste Management Act (KrWG) means any recovery process in which waste is reprocessed into products, materials or substances, whether for the original or another purpose. This includes the reprocessing of organic material, but not energy recovery and reprocessing into materials to be used as fuels or for backfilling measures.

The term recyclate has not yet been defined in any law at EU level, but it is included in the current amendment to the KrWG (cf. infobox above). Initially, it says nothing about the origin (post-consumer vs. post-industrial / pre-consumer), the recycling process that may have been carried out, the composition or the resulting recycling effort. When using the term recyclate, reference should be made to the ongoing discussion among various interest groups as to whether recycled plastics obtained from post-industrial waste are equivalent recyclates compared to those from post-consumer waste. Regardless of (predominantly missing and / or immature) legal or normative definitions for recyclates, the environmental relevance of the origin of secondary raw materials for recyclate production, such as post-industrial versus post-consumer, is currently being discussed. For example,

17 https://unitar.org/sites/default/files/media/file/In-depth-review_WEEE%20Collection-Targets-and-Rates_UNITAR_2020_Final.pdf, retrieved 23 March 2021
18 https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32008L0098&from=DE, retrieved 23 March 2021
19 https://www.gesetze-im-internet.de/krwg/KrWG.pdf, retrieved 23 March 2021

Deutsche Umwelthilfe considers post-industrial recycling to be pragmatism in production rather than environmental protection[20]. Irrespective of this discussion, it should be noted that every material recovery, regardless of the recycling process, makes its contribution to environmental protection and to a circular economy. Even if the contributions of the various recycling options are to be evaluated differently in comparison with each other, possibly ecologically or with regard to sustainability aspects (What does this mean for business practice? Cf. chapter 4.2f.).

Additional quality standards and detailed technical information, as they exist for primary plastics, are the content of the work of standardisation committees such as the DIN Plastics Standards Committee (FNK). For example, the DIN SPEC 91446 project is developing reliable and verifiable standards for the (internet-based) trade in and processing of plastic waste and recyclates[21] through an open consortium.

Furthermore, one of the expected results of the CPA's work is a document that discusses the terminology and definitions in the context of plastic recyclates and presents possible solutions. The documents prepared within the framework of the CPA can be found on the website of the EU Commission after their publication.

Definitions

Recyclate[22]: The German Waste Management Act defines recyclates as "secondary raw materials that have been obtained through the recovery of waste or are produced during the disposal of waste and are suitable for the manufacture of products"[23]. The definition includes both post-consumer and post-industrial waste, but not by-products (see definition below).

Plastic recyclates are obtained from post-consumer or post-industrial waste. Processing into recyclate takes place in the form of regrind, regranulates or regenerates. The recyclate produced is used again as a secondary raw material in the manufacture of plastic products.

Post-consumer waste is all end-user waste that accumulates after use from both commercial and household end-user areas. In addition to residual household waste, the collection of light packaging (LVP; "yellow bag") and the collection of old electrical appliances, this also includes waste that is generated during installation, assembly or relocation, etc. (e.g. pipes, cables, flooring, tarpaulins, etc.). The waste often has a certain degree of contamination and/or mixing, insofar as it is not collected by type.

Post-industrial waste / pre-consumer waste are plastics that are produced during the manufacture or processing of plastics and leave the plant or the process for reprocessing (e.g. sprues, faulty batches). As a rule, the materials are sorted by type and the ingredients are largely known to the user.

By-products: Materials that can be reused in the same process, at the same place and for the same application are considered by-products under the conditions of § 4 KrWG. This is the recycling of material that does not need to be significantly reprocessed/modified to be used again for the same purpose and does not leave the factory premises for the open market. This material does not fall under the term recyclate.

[20] https://initiative-frosch.de/richtiges-recycling-falsches-recycling/, retrieved 23 March 2021
[21] https://www.din.de/de/forschung-und-innovation/din-spec/alle-geschaeftsplaene/wdc-beuth:din21:328328400, retrieved 24 March 2021
[22] Modified according to https://www.bkv-gmbh.de/studien.html, retrieved 02 March 2021
[23] https://www.gesetze-im-internet.de/krwg/KrWG.pdf, retrieved 23 March 2021

Recycling processes and their sustainability

Basically, there are various recycling processes that focus on material recovery (mechanical, physical, chemical) that generate raw materials or materials.

Today, mechanical and chemical recycling processes in particular are discussed as particularly suitable or proven (cf. infoboxes). Both processes described (mechanical and chemical) offer advantages and disadvantages that depend, among other things, on the composition and degree of contamination of the input materials.

Recycling process[24] [25]

Mechanical recycling summarises various recycling processes. It represents a combination of different, mechanical pre-treatment steps, which play a decisive role in the process, and a subsequent preparation and processing in the extruder. Thermoplastics can usually be recycled using mechanical-physical processes because their properties (melting when heated, solidification when cooled) are reversible, unlike thermosets (experience a chemical change when heated)[26]. The quality of the recycled product depends on the highest possible grade purity and low degree of contamination of the input. The plant technology, which runs at comparatively low cost, is well established and is constantly being optimised.

Chemical recycling refers to various processes for depolymerising plastics, most of which are still in pilot scale or research for upscaling. The resulting products are usually chemical base materials that can be used in subsequent steps for the further production of plastics. The quality of these plastics is equal to those made from primary raw materials. In chemical recycling, the recycled carbon cannot be physically traced back directly. The processor who buys material from chemical recycling usually receives a certificate at the end from the manufacturer about the recycled content for his purchased material, which does not necessarily contain the recycled carbon itself[27]. Proof is usually provided by means of a mass balance approach.

[24] https://www.bvse.de/dateien2020/2-PDF/01-Nachrichten/01-bvse/2020/November/Statusbericht_der_deutschen_Kreislaufwirtschaft_2020.pdf, retrieved 24 February 2021
[25] https://www.plasticseurope.org/de/resources/publications/3377-stoffstrombild-kunststoffe-deutschland-2019-kurzfassung, retrieved 02 February 2021
[26] https://www.plasticseurope.org/de/resources/publications/3377-stoffstrombild-kunststoffe-deutschland-2019-kurzfassung, retrieved 02 February 2021
[27] https://widersense.org/content/uploads/2020/12/polyproblem-report-2-wertsachen.pdf?x74604, retrieved 02.02.2021

The advantages and disadvantages of chemical recycling in particular are increasingly discussed in the literature. Based on the literature sources considered, it is clear that both processes have enormous potential for contributions to sustainable development. Especially in the area of ecological advantages, the processes offer different possibilities. Due to a multitude of factors, no process per se can be described as more sustainable or ecologically advantageous. In practice, partnerships of companies are increasingly forming along the product life cycle of plastics, with a particular focus on the environmental and climate footprint. As an example, some assessments from various sources are listed below.

A current **BASF** project shows that, under certain conditions, a plastic produced via chemical recycling has a similar carbon footprint to mechanically produced ones[28].

The **K-Zeitung** refers to early life cycle assessments that show that chemical recycling processes can save almost as much greenhouse gas emissions as mechanical recycling[29]. However, the life cycle assessments are still based on scaling assumptions, as there is no realised large-scale plant yet.

In a discussion paper, the state initiative **IN4climate.NRW** concludes that the expansion of chemical plastics recycling offers many opportunities for climate protection[30]. Due to the high energy demand, however, the climate contribution can only be realised in conjunction with the expansion and availability of renewable energies. Whether ecological benefits can be achieved through chemical recycling processes must therefore be investigated on a case-by-case basis and in the context of the respective system conditions (energy supply, alternative options, development trends, etc.) over the relevant course of time (dynamic).

The chemical company **SABIC** produces technical PBT (polybutylene terephthalate) materials from PET bottles, which can also be used for components in the electrical industry, e.g. for plugs or housings and components in the field of consumer electronics. According to SABIC, the results of an independent life cycle assessment show that the recyclate reduces the impact on global warming by 29 percent and lowers the cumulative energy demand by 43 percent compared to virgin PBT[31].

In the absence of currently available research data, the **German Environment Agency** assumes that mechanical recycling is in principle ecologically and economically more advantageous than chemical recycling, since less complex recycling processes are used (e.g. less use of additives and energy)[32].

The **BMU** points out the ambivalence of plastic as a material between its great technical and ecological advantages and the problem of plastics entering the environment in an uncontrolled manner[33]. A major obstacle to higher recycling rates is the heterogeneity of many types of waste, the processing of which involves a high level of procedural effort and energy input. On the question of whether chemical recycling processes offer an alternative here, the BMU points out, among other things, that there is still no legal definition of the term. For plastic waste that is difficult to recycle, for example due to high pollutant content, chemical recycling processes could be an alternative - both in ecological and economic terms (see also Chapter 2.4 on "legacy substances").

[28] https://www.basf.com/global/de/who-we-are/sustainability/we-drive-sustainable-solutions/circular-economy/mass-balance-approach/chemcycling/lca-for-chemcycling.html, retrieved 24. February 2021

[29] https://www.k-zeitung.de/chemisches-recycling-marktanalyse-und-trends/, retrieved 16 April 2021

[30] IN4climate.NRW (ed.) 2020: Chemical Plastics Recycling - Potentials and Development Perspectives. A contribution to the defossilisation of the chemical and plastics processing industry in NRW. A discussion paper by the Circular Economy Working Group. Gelsenkirchen. Link, retrieved 16 April 2021

[31] https://www.sabic.com/en/news/26517-over-100-million-pet-bottles-are-upcycled-into-sabics-lnp-elcrin-iq-products, retrieved 17 March 2021

[32] https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2020-07-17_hgp_chemisches-recycling_online.pdf, retrieved 24 February 2021

[33] Rubbish and Waste 5/2020, https://muellundabfall.de/ce/chemisches-recycling-von-kunststoffabfaellen-eine-alternative-zur-werkstofflichen-verwertung/_sid/YCYR-249887-67at/detail.html, retrieved 23 March 2021.

2.3 Requirements for plastics in the electrical engineering and electronics industry

The heterogeneous product portfolio of the electrical engineering and electronics industry includes a wide range of plastic applications. The quantity, type and service life of technical plastics differ very significantly depending on the electrical product. While in the packaging sector the general environmental awareness of companies is in the foreground (e.g. reduced use or, if necessary, substitution of primary raw materials for the production of packaging), plastics in electrical engineering products fulfil many different requirements (cf. Infobox).

i

Requirements for plastics in the electrical industry (selection)

Product safety: electrical insulation, fire behaviour, arc fault protection, colouring (e.g. emergency stop switch), dielectric strength.

Mechanics: High freedom of design and thus fulfilment of even complex functional requirements (e.g. production of the smallest electronic components) while at the same time using little material.

Material / Technical: Low density, food grade, UV resistance, tracking resistance, temperature resistance, long term reliability, technical reproducibility, increased resistance to fracture and elongation, lower corrosion as well as chemical resistance compared to metals, flame resistance, poor heat conductor and electrical non-conductor.

Optics / aesthetics: colouring, colour stability, acoustics, odour neutrality, haptics.

2.4 Challenges in the use of plastic recyclates in the electrical and electronics industry

Use of plastic recyclates in general

The political efforts described at the beginning of this chapter represent a major challenge for the economic actors involved and require extensive reorganisation including optimised networking and communication[34]. In principle, plastic recyclates must be available on the market in sufficient and certifiable quality and quantity in order to be able to meet the requirements of the many different product applications of the electrical industry over the service life. A practical example is the certification requirements for electrical products of the American Underwriters Laboratories (UL test mark), which only permit the use of recyclate from post-consumer or post-industrial waste with extensive post-testing.

In addition, the legal requirements regarding additives in plastics (e.g. REACh, RoHS, Food Contact) and electrical safety (e.g. fire protection, voltage protection) as well as normative product requirements pose enormous challenges for the use of recycled materials. Improved standards and norms with comprehensive information on mechanical, thermal, rheological and other application-specific parameters, such as electrical properties, are necessary for increased use of recyclates.

[34] Scaling recycled plastics across industries, Jos Vlugter, 03.2017: https://www.ellenmacarthurfoundation.org/assets/downloads/ce100/Scaling-Recycled-Plastics-across-Industries.pdf, retrieved 16 April 2021

The use of recyclates from end-of-life appliances in new products must be carefully examined against the background of the input materials that may be contained in the end-of-life appliances, as the secondary material may no longer comply with the current material and regularly changing legal requirements ("legacy substances"). Figure 6 describes these and other challenges for the use of post-consumer recyclates in electrical appliances that originate from mechanical recycling. When using recyclates from chemical recycling, these challenges do not apply for the most part, as they are materials with identical properties compared to primary plastics (cf. chapter 2.2.).

Economical	Technical	Organizational
Compared to “virgin materials”, supply chains are quite complex and opaque A large number of (smaller) providers on the market with strongly fluctuating material qualities Building a second source is not always feasible High quality recyclates are priced at the same price as “virgin materials” or even more expensive Suppliers (granulates / components) must be coordinated	Material qualities can be lower than primary goods • Compensation by mixing with new goods • Use of fillers and batches • New design • Fallback solutions with primary goods are inevitable Limitations in the choice of colors • Many parts in the visible area are ruled out Batch-related fluctuations • Color • Mechanics • Processing properties	Recyclate does not have a good image (especially PCR) The use of recyclate increases the number of variants High and continuous testing effort • Initial qualification / supplier evaluation • Material qualification (basic examination) • Component testing • Endurance test • Batch testing Pilot tests with running series difficult • Tool availability / cleaning effort • Personnel capacities / dates Conversion often only makes sense with a series change → advance notice Solutions for customer communication are needed

Abbildung 6: Modified after Schnarr, M. (2020): Einsatzbereiche von Post-Consumer-Recycled (PCR)-Kunststoffen: Current situation, current barriers and potentials from the perspective of an appliance manufacturer. Fachdialog "Rezyklateinsatzquote für energieverbrauchsrelevante Produkte unter der Ökodesign-Richtlinie?", 20.10.2020, Dessau / Berlin / Hamburg.

The Circular Plastics Alliance working group on the electrical and electronics industry (CPA WG EEE) notes that the quality of recycled plastics from household WEEE is often low and they are therefore mainly downcycled, i.e. reduced in quality and / or functionality (for example by using them for applications such as outdoor furniture or planters)[35]. In this process, recyclates are reduced in value in relation to the original material. One of the main reasons for this is the high heterogeneity of WEEE flows. This includes the diversity of materials such as metals, ceramics, composites and also plastics, etc. In addition, especially appliances with a high metal content are lost via unofficial channels and thus also their (plastic) recycling potential. The majority of plastics from WEEE collected through official channels are already recycled in appropriately equipped facilities.

[35] https://ec.europa.eu/docsroom/documents/43694/attachments/6/translations/en/renditions/native

Use of plastic recyclates in operation

In addition to the general prerequisites and challenges for the use of recyclates, there are also other issues that need to be considered in operational practice. These include, among other things, appropriate control of waste management.

On the one hand, storage capacities and containers are needed for the partly diverse plastic fractions in order to enable sorting by type. Creating the intralogistical possibilities in the company is an important prerequisite, and employee training and control of waste sorting is a necessary consequence. The handling of shortages also needs to be regulated.

Secondly, the material logistics and planning processes should be designed in such a way that the material is in the right place at the right time so that it can be prepared and further processed.

Best practice examples from the electrical industry

Schneider Electric

Brief description of the product example

The System M and System Design range of switches and socket outlets from Merten has been awarded the international, manufacturer-independent and neutral "Cradle to Cradle™" certification in silver. This makes Schneider Electric the first company in the electrical industry to hold a certificate in this category, which honors the reversal from linear economic activity to a circular economy. At Schneider Electric, designers and developers have been working for a long time to develop products that contribute to sustainable development and have now been able to prove extensively that recycled plastics find their way back into high-quality products.

Dirk Kohler, Vice President Home & Distribution

„The certification criteria are demanding. They apply not only to our in-house production, but also to upstream and downstream manufacturing and distribution processes. We continue to work on improvement and strive for gold and platinum in all areas."

Learn more about the Cradle to Cradle certification in this video.

Challenges and solutions

The supply chains for the individual components imply a particular challenge:

- Incoming materials must be extensively inventoried, quality-assured and optimized with regard to the chemicals they contain in constant dialog with suppliers.
- Equally demanding is ensuring minimum social standards, especially when it goes beyond direct suppliers, which requires a close relationship and continuous communication with suppliers.

Sustainability Assessment

- The certificate confirms the recyclability of the plastics and all other materials after the end of the respective usage cycles.
- In addition to mandatory compliance with environmental standards such as REACh or RoHS, the use of CO_2 and renewable energy management as well as the responsible use of water resources were also successfully tested.
- An integral, independent audit category was also the assurance of social justice for all people involved in the value chain.

The central finding was:

In the category 'Renewable Energies & CO_2 Management', the Gold Standard has already been achieved. The task now is to continuously raise the standard in the other categories as well.

3 Methods

The present assessment is based on the 17 United Nations (UN) Sustainable Development Goals (SDGs) and aims to consider all three sustainability perspectives at least at a general level.

To this end, the members of the ZVEI SDGs & Sustainability Task Force first conducted an SDG analysis in relation to the topic of plastics recyclates. The result is 17 fact sheets (one per SDG) with a list of synergies, conflicting goals, possibilities for evaluation / measurability as well as best practice examples and literature references. With the help of the synergies and trade-offs, a connection is made between the individual SDGs and possible activities of the electrical industry in practice. The possibilities of assessment / measurability, best practice examples and literature references have been taken into account at various points in this publication as an aid for companies in practice.

Furthermore, an assessment of the potential "leverage effect" (influence that the companies of the electrical industry have on the SDG and its achievement) is made. The leverage effect is based on the number and value of synergies and conflicting goals and is divided into five levels: very high, high, neutral, low and very low. The fact sheets are available to ZVEI member companies for download at https://connects.zvei.org/themen/Umwelt/sustainable/Seiten/Start.aspx.

The contents of the fact sheets are summarised in this paper as described below. For reasons of clarity and relevance, only the SDGs with neutral and high leverage are considered (a very high leverage has not been shown for any SDG). The analysis of the SDGs with (very) low leverage can be found in the individual fact sheets.

1. Graphical representation based on a sustainability radar[36]: Overview of the leverage effect of the electrical industry on different SDGs
2. Graphical representation based on a SWOT analysis[37] (Figure 7): Illustration of possible activities in practice and their leverage effect as well as potential synergies and trade-offs

	low ········ leverage ········ high	
Synergies	• Prioritise for for optimisation • Checking whether leverage can be increased	• Use synergies • Enlarge lever
Conflicting goals	• Not get worse	• Checking whether conflicts of objectives can be resolved/reduced • Shape alternatives sustainably

Figure 7: Evaluation scheme based on a SWOT analysis, as a way of illustrating possible activities of companies in the electrical industry in practice and their leverage effect vis-à-vis synergies and conflicting goals.

[36] Liedtke, C.; Kühlert, M.; Huber, K.; Baedeker, C. (2020): Transition Design Guide - Design for Sustainability. Designing for today and tomorrow. A guide for design and development in companies, cities and neighbourhoods, research and teaching. Wuppertal Special No. 55, 2nd corr. edition, Wuppertal Institute for Climate, Environment, Energy. Wuppertal. Available online: https://wup-perinst.org/design-guide, ISBN 978-3-946356-19-6, accessed 16 April 2021.
[37] SWOT analysis: Acronym for Strengths, Weaknesses, Opportunities and Threats - a strategic planning tool.

Best practice examples from the electrical industry

Alfred Kärcher SE & Co. KG

Brief description of the product example

The blast pipe production for Kärcher high-pressure cleaners has been switched to a particularly high-quality recycled polyamide. It is a recyclate manufactured in Europe from fabric remnants from airbag production and used parts. The polyamide used is reinforced with 30% glass fibers to withstand the exceptionally high pressure when using a Kärcher high-pressure cleaner. In addition, the material must be resistant to environmental influences and cleaning agents, for example. Kärcher is using this recycled polyamide in series production for the end-user market.

Elena Spöri, Sustainability expert

„Using recycled materials is essential for Kärcher to contribute to a functioning circular economy. In order to use recycled plastic successfully, it is particularly important to find the right recyclate for the corresponding requirements. Here, aspects such as stable processability, quality requirements or compliance with legal requirements often make the differeance."

Challenges and solutions

The challenges in using recyclates are, on the one hand, consistent material quality and, on the other, security of supply. With the polyamide recyclate, Kärcher has succeeded for the first time in using a recycled material that has no loss in its property profile compared to the original material. In addition, it is industrial waste in large quantities, which makes it possible to use it in series production.

Sustainability Assessment

With this project, Kärcher is coming a decisive step closer to its sustainability goal of noticeably increasing the use of recycled plastics. Nevertheless, we have not yet reached the end of this development. We want to continue to push the use of recyclates in Kärcher products at full speed in order to contribute to the achievement of a successful circular economy. This will significantly reduce CO_2 emissions, water consumption and the use of non-renewable raw materials, for example. Further information. https://www.kaercher.com/de/inside-kaercher/nachhaltigkeit.html

The central finding was:

The use of recycled plastics involves a lot of effort, as consistent quality, security of supply and a suitable price must be ensured. Nevertheless, one thing is certain: the use of recycled materials is an elementary building block for a sustainable future!

4 Results

4.1 Analysis of synergies and conflicting goals for the electrical industry

Chapter 2 looked at different processes for the production of plastic recyclates and found that they can be very different in their sustainability performance and thus their contribution to the SDGs. Table 1 shows the main synergies, trade-offs and inferred leverage for the most relevant goals identified in the analysis of the ZVEI SDGs & Sustainability Task Force. The results serve as general orientation and are to be understood as ideas. Depending on the company, application and process used, other or further results may emerge.

SDG	Leverage effect	Synergies	Conflicting goals
7 AFFORDABLE AND CLEAN ENERGY	High	• Reuse of production scrap • Provision of energy-efficient technologies for sorting and reprocessing • Energy saving, if applicable	• Higher energy consumption depending on process and application
8 DECENT WORK AND ECONOMIC GROWTH	High	• Building regional recycling capacities and promoting the regional economy • Promotion of R&D, training • Marketing of innovative processes (techniques) and products • Strengthening competitiveness	• Usually additional financial expenditure when using recycled materials • Limited security of supply of the required qualities
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	High	• Promotion of technological developments and innovations • Promoting employment and GDP • Enter into partnerships with KS manufacturers and recyclers • Collaboration on standards	• PCR plastics: often additional tests required • Usually additional financial expenditure when using recycled materials
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	High	• Lower (primary) raw material demand • Use of primary plastics that are easier to recycle and reuse than those currently used • Creating new, circular business models	• Higher energy consumption depending on process and application • Depending on the recycling process: Compliance with material policy requirements (REACH, RoHS, FCMs) • Further rebound effects possible, including on product availability and resource consumption
17 PARTNERSHIPS FOR THE GOALS	High	• Form partnerships • Dialogue: Sharing knowledge, facing challenges together • Collaboration on standards • Participation Circular Plastics Alliance	• Joint positioning, especially with other players in the value chain, challenging
3 GOOD HEALTH AND WELL-BEING	Neutral	• Reduction of waste and reduced production of primary plastics and associated health impacts • Influence on supply chain to reduce health impacts	• Low quality of recyclate can lead to hazards for users in the field of electrical insulation, for example. • Possibly worse emission balance of the recyclate
13 CLIMATE ACTION	Neutral	• Reduction of waste and reduced production of primary plastics and associated health impacts • Influence on supply chain to reduce health impacts	• Climate footprint for electrical products not always known
15 LIFE ON LAND	Neutral	• Conservation of natural resources through lower primary raw material requirements • Reduced discharge of waste into the environment	• Increased use of primary paper and cardboard as packaging material

Table 1: Overview of the most relevant SDGs for the electrical industry in the context of plastic recyclates (own illustration)

The results show that the electrical and electronic industry can contribute to the achievement of various SDGs through the use of plastic recyclates. A very high leverage effect is not seen for any SDG, as the electrical and electronic industry itself does not represent the entire process chain "production, processing and recycling of plastics" and the achievement of goals is always dependent on other actors. For goals 7, 8, 9, 12 and 17, a "high leverage effect" is possible through various measures. In addition, a "neutral leverage effect" is seen for goals 3, 13 and 15. Positive developments for climate protection in the context of plastic recyclates primarily follow from a functioning circular economy or resource efficiency and can only be considered in isolation from this to a limited extent. Therefore, only a neutral leverage effect is seen for SDG 13, even if the electrical and electronic industry has extensive technology contributions ready for a climate-neutral future.

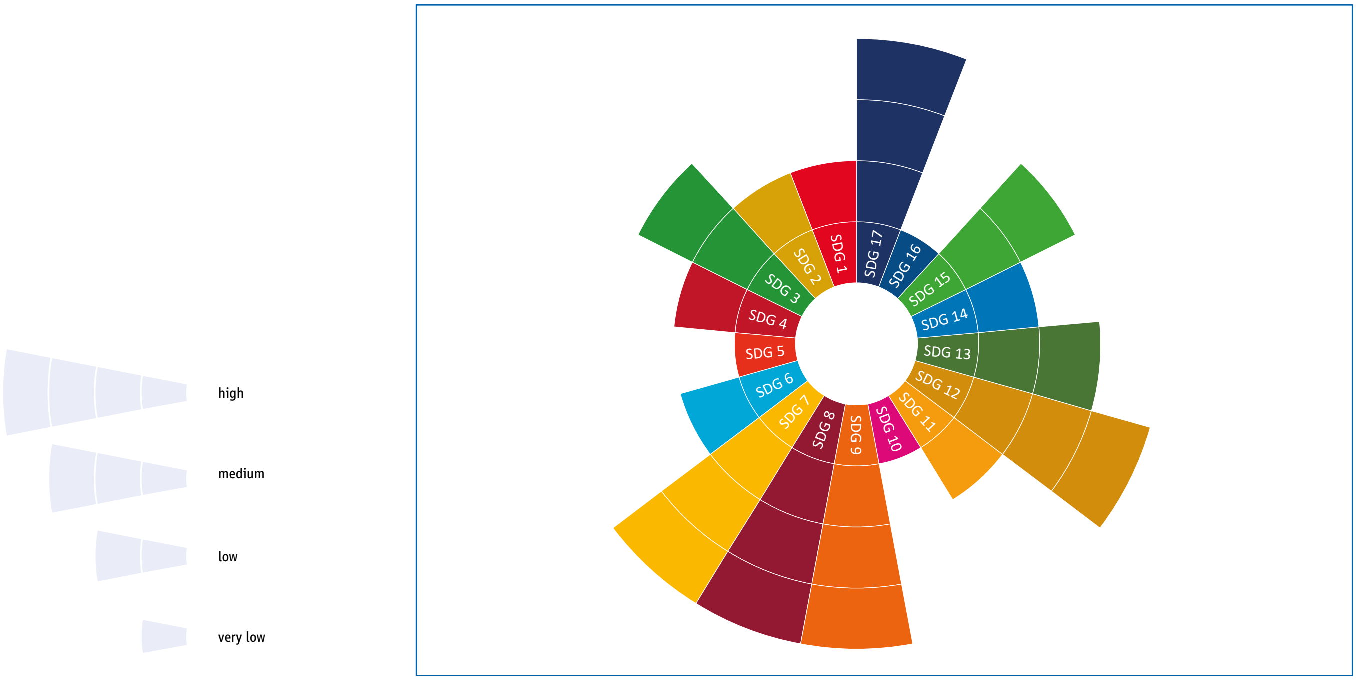


Figure 8: Overview of the potential leverage effect of the electrical industry with regard to the SDGs in the context of plastic recyclates (Sources: Own representation; ZVEI Guide to Sustainable Development)

The sustainability radar in Figure 8 provides an overview of the potential leverage of the electrical and electronic industry in relation to all 17 SDGs in the context of plastic recyclates. In comparison to the prioritisation of the SDGs for the electrical industry as a whole (cf. Figure 8, from the „Wegweiser für nachhaltige Entwicklung in der Elektroindustrie“) it can be seen that for four of the six SDGs with high potential for positive impacts, there is also a high leverage effect in the context of plastics recyclates.

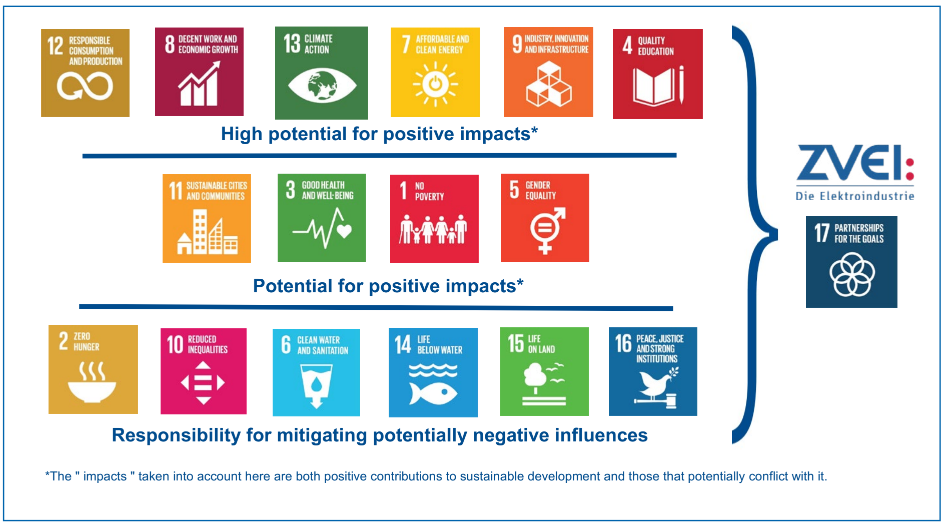


Figure 9: Prioritisation of the SDGs for the electrical industry as a wholet (Sources: Own representation; ZVEI Guide to Sustainable Development)

Figure 10 compares selected synergies and trade-offs with their potential leverage. The illustration is intended to serve as a suggestion for companies as to which conclusions can be drawn in practice from an analysis of synergies and trade-offs on the one hand and the actual leverage effect for contributions to sustainable development on the other (cf. also Figure 8 in Chapter 3).

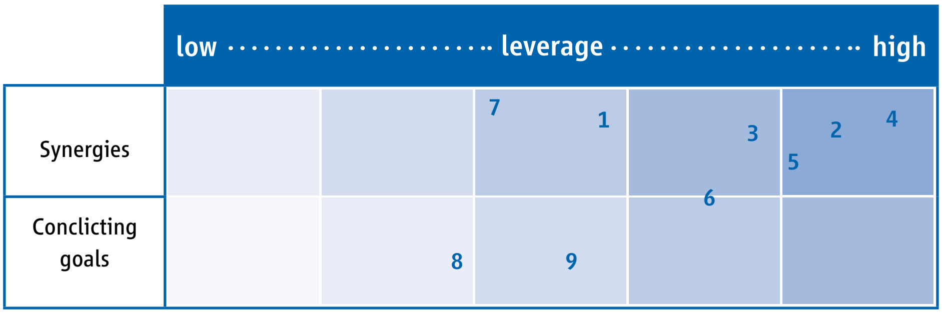


Figure 10: Evaluation of plastic recyclates from the perspective of the electrical industry: comparison of selected synergies and trade-offs and their potential leverage.

1 Reuse of production scrap
2 Provision of energy-efficient technologies for sorting and reprocessing
3 Promotion of technological developments and innovations
4 Form partnerships with plastics manufacturers and recyclers
5 Cooperation on relevant standards / norms
6 Improve climate / environmental balance
7 Reduction of plastic use and use of primary plastics that are easier to recycle than those currently used
8 Potential additional financial expenditure when using recycled materials
9 Dangers for users (in case of non-compliance with the requirements for electrical insulation etc. – cf. chapter 2.3)

4.2 Assistance: Approaches to the topic of plastic recyclates for companies

First approaches

The electrical industry can support the sustainable use of recycled plastics through the targeted selection of primary plastics that can be processed into suitable recyclates at the end of their service life. In areas with predominantly comparatively low challenges (e.g. (transport) packaging, non-visible components – see also infobox), companies should (be able to) already use recyclates today. In order to act credibly, a transparent approach is recommended that takes into account possible rebound / boomerang effects as well as conflicting goals at an early stage and avoids the potential accusation of greenwashing (see infobox page 24).

Where do other companies start?

In terms of the use of plastic recyclates, most companies start with:

- The simplest components (parts that do not require any special technical properties)
- Non-visible parts (avoiding aesthetic problems with recycled plastics - e.g. base of a dishwasher)

Avoid Greenwashing!

In order to avoid potential accusations of consumer deception[38] or greenwashing as far as possible, companies should be transparent about the type of recyclates they use (cf. chapter 2.2 term "recyclate"). The same applies to the use of assessment parameters and statements on better environmental, climate or sustainability performance, especially in comparison to other products. A transparent presentation of which impact categories perform better (or worse) compared to primary materials makes their statements more robust.

An info box below lists the questions that companies might ask themselves in an initial analysis when they want to assess whether the use of plastic recyclates is sustainable for their company or a particular product. This is intended as a first start. Depending on how the answers turn out, a more detailed consideration is worthwhile.

Checklist "Questions that companies could ask themselves during an initial analysis if they want to use plastic recyclates sustainably"

- Can rejects / waste be used in production?
- Can plastics from the company's own products be processed into recyclate?
- Is the recyclate technically and qualitatively suitable to replace the primary material?
- If relevant: Is the recyclate approved for use?
- Can the recyclate be processed in the same way with the existing machines and processes?
- What quantity of the recyclate is required for the company's own production and at what delivery times and quantities?
- Is the type and quantity of the required recyclate available on the market in the long term?
- How much primary material does this replace and what is the sustainability balance?

Due to the complexity of the issue, companies should aim for an iterative approach if they want to use more recyclates[39]. Decisive for the learning curve towards the practical suitability of recyclates are in particular their material properties, as these change the requirements for the design and processing of the products. Accordingly, it is advisable for representatives of the electrical industry and its individual product categories to participate in the initial steps towards standardising recyclate qualities and properties.

Partnerships with plastics manufacturers, other plastics processors and companies in the recycling industry are recommended to clarify open questions and overcome conflicting goals. The best practice examples presented in this paper also show that sustainable solutions can usually only be achieved through collaboration.

[38] https://initiative-frosch.de/richtiges-recycling-falsches-recycling/, retrieved 23 March 2021
[39] https://www.umweltbundesamt.de/publikationen/einsatz-von-post-consumer-recycling-kunststoffen-in, retrieved 02 March 2021

4.3 Support: Possibilities for the sustainability assessment of plastic recyclates

Assessment parameters enable comparability and thus transparency and credibility. In addition, they provide a structured approach in which both direct and indirect impacts of primary and secondary plastics can be considered over the entire life cycle. The following comments address a comparative assessment of primary and secondary plastics. Of course, a more general approach is also possible within the framework of a sustainability assessment of plastics in relation to one's own entrepreneurial activities. Examples of such a general assessment can be found in an info box below.

General assessment of the issue of plastics in relation to corporate action:
A recent WWF report[40] summarises possible indicator categories for a company's "plastic impact", including:

- Total plastic footprint (% of revenue from products containing plastics)
- Problematic plastic[41] in portfolio (% of revenue from products containing problematic plastics)
- Recyclable or compostable plastic in portfolio (% volume of packaging material that is recyclable)
- Commitment to phasing out of problematic plastic (Target on elimination of single-use plastics)
- Reporting on milestones and progress (Performance on interim milestones)
- Roles and responsibilities (% of total full time employees assigned to the work on developing substitutes for problematic plastics)
- Measurement reporting and communication (# of metrics disclosed)

When assessing the sustainability of recycled materials, a holistic approach of ecological, economic and social aspects should be applied. A generally valid statement, especially on ecological sustainability, is often complex or only partially possible due to a multitude of factors and partly missing data. However, since the ecological parameters have the greatest leverage effect in most cases, their assessment should not be neglected under any circumstances.

When considering the topic of recyclates from the customer's point of view, softer factors such as customer satisfaction / customer acceptance can also play a major role in addition to quantitative parameters. Due to the current social discussion (e.g. "Fridays for Future") but also legal requirements (e.g. "ban on single-use plastics"), customer awareness of the responsible use of plastics has increased enormously. So far, the focus has mainly been on packaging. Here there are already numerous examples of implementation (e.g. food packaging, drugstore articles). When it comes to the use of recyclates in electrical appliances, customers in many areas are still concerned about quality, aesthetics, ingredients and doubts about the longevity of the recyclates. In order to gain initial experience as a company in dealing with recyclates, approaches could initially be pursued with plastic components that are not visible in the normal use of a product, have to meet lower technical requirements or are subject to less stress (e.g. no UV resistance necessary).

The use of recyclates can be very complex in business practice, for example in the use of PCR in electrical appliances. In this case, close cooperation between all actors from the compounder, manufacturer and recycler is necessary in order to sort the material flow of PCR as purely as possible and thus to be able to use it as a high-quality secondary material in electrical appliances (partnerships).

[40] https://wwfint.awsassets.panda.org/downloads/wwf_plastics_impact_esg_report_2020_v11_0303.pdf, retrieved 25 March 2021
[41] In the WWF report, "problematic plastic" refers to plastics that are intended for single use and are easily released into nature due to careless consumer behaviour; that cannot be mechanically recycled due to their polymer type, blend or design; or that are not intended for reuse and recycling and are not naturally compostable.

Valuation parameters

The table below lists assessment parameters as a first approximation for the assessment or measurability of the sustainability of plastics. Currently, there is no validated life cycle assessment for a comparison of individual types of plastic recyclates and primary plastics. A recent WWF report[42] also states that the assessment of plastic impacts is currently still limited. So far, there are only individual providers of corresponding ESG data. This currently results in a lack of comparability of different ratings / assessments. For a comparison, therefore, one's own comprehensible reference system must be created, whereby existing standards can be of assistance. All life cycle assessments can only be carried out by means of a comparison of the respective defined "functional unit" (reference values), using the same assessment method. In addition, a cradle-to-cradle approach is recommended, i.e. consideration of the complete life cycle.

There are some soft parameters (cf. infobox) that naturally also contribute to sustainable development in the sense of the SDGs. However, these parameters are usually difficult to quantify and are therefore not listed in the table. Depending on the context, however, these parameters can be helpful for companies, for example when talking about the contributions to the circular economy in relation to plastics in the context of the sustainability report.

In our analysis, we have primarily made references to the globally recognised Global Reporting Initiative (GRI). Specific references between plastics / recyclates and SDG indicators[43] can be found for the indicators 12.2.1 Raw material footprint, 12.2.2 Material use, 12.5.1 Recycling rate, 13.2.2 Greenhouse gas emissions and 14.3.1 Ocean acidity. To link GRI indicators to the SDGs, more information can be found here:

- https://www.globalreporting.org/about-gri/news-center/2020-05-11-how-to-link-the-gri-standards-with-the-sdgs/
- https://standards.sinzer.org/gri/sector#

Soft parameters in the context of plastics recycling

- Customer satisfaction
- Customer acceptance
- Number of standards on which a company collaborates
- Share of turnover of products / components used in the plastics recycling industry
- Partnerships, technology transfer projects (e.g. local companies with which collaboration takes place, joint ventures, platforms on which collaboration takes place, collaboration with universities, projects with research institutions)
- Lack of information on substances, additives, foreign substances or contaminants contained

[42] https://www.wwf.de/2021/maerz/wie-bewertet-man-den-plastik-fussabdruck-von-unternehmen, retrieved 16 April 2021
[43] https://sdg-indikatoren.de/, retrieved 16 April 2021

Valuation parameters	Unit	Further notes	Possible indicators
Relevant parameters for production (input-output mass balance)			
Amount of raw materials, additives, chemical substances that are used	[t / t plastics]		GRI 301-1: Materials used by weight or volume
Water consumption	[m³ / t plastics]		GRI 303: Water and wastewater
Energy consumption	kWh / t plastics]		GRI 302: Energy
Amount of waste that cannot be recycled	[t / t plastics]		GRI 306: Waste water and waste
Waste water volume	[m³ / t plastics]		GRI 306: Waste water and waste
Relevant parameters for product life cycle			
GHG/CO_2 eq. emissions per quantity of plastics used	[t CO_2 eq. / t plastics]	Scope must be defined, if possible Scope 1, 2 and 3 Differentiation between different types of plastic, if applicable More background: GHG Protocol: https://ghgprotocol.org/	GRI 305: Emissions GRI 305-1: Direct GHG emissions (Scope 1) GRI 305-2: Indirect energy-related GHG emissions (Scope 2) GRI 305-3: Other indirect GHG emissions (Scope 3)
Share of recycled plastics in a product / in the total plastic share of the product • Share of post-consumer recyclates • Share of post-industrial recyclates	[%] [% share of total recyclate use]	Depending on the desired result, pay attention to the reference value Differentiation between different types of plastic, if applicable	GRI 301-2: Recycled input materials used
Other relevant parameters			
Investment in R&D for recyclates	[% share of company turnover] [% share of all R&D investments]		
Acquisition / production costs for plastics	[€]		

Table 2: Overview of assessment parameters as a first approximation for the assessment or measurability of the sustainability of plastics. For the first section "Relevant parameters for manufacturing (input-output mass balance)", ISO 14041 (Environmental management - Life cycle assessment - Goal and scope definition and inventory analysis) gives a good overview.

Best practice examples from the electrical industry

Schneider Electric

Brief description of the product example

As part of an industry collaboration with BASF at the end of 2018, Schneider Electric produced an Acti 9 iK60 circuit breaker in a proof of concept for chemical recycling. The prototype is made of chemically recycled Ultramid®, which contains a flame retardant. In the ChemCycling project, pilot quantities of a pyrolysis oil obtained from plastic waste were used as a raw material in production for the first time. The process can be used to process plastic waste that currently cannot be recycled to a high quality and in accordance with current specifications due to incorporated chemicals, such as mixed or contaminated plastics.

Xavier Houot, Senior Vice President Sustainable Supply Chain and Safety

„We hope that this test with BASF will open up new opportunities for innovation in the circular economy for our products in energy management and distribution."

Learn more about the proof of concept in this video.

Challenges and solutions

When using secondary raw materials such as recycled plastics, the demanding quality and safety standards as well as the strict norms and guidelines of the industry must be met.

The expertise of manufacturers such as BASF is crucial in presenting the overall advantages of the process in terms of sustainability and keeping the costs attractive by further developing the processes for use on a large industrial scale.

Sustainability Assessment

- The collaboration shows that companies can successfully develop circular solutions in the field of plastic recyclates.
- ChemCycling, in which the proportion of recycled plastic is mathematically allocated to the end product via the mass balance approach, can help companies contribute to sustainable development.

The central finding was:

If a manufacturer is committed to carbon neutrality and circular business models using materials that contribute to sustainable development, industry partnerships with manufacturers and recyclers of materials are essential for success in implementation.

5 Discussion of the results

The results of the analysis of the SDGs & Sustainability Task Force were discussed with experts from other ZVEI working groups and external experts before this paper was published. The conclusions have been incorporated into the present texts. The core statements of the interviews with Dr. Ingo Sartorius (PlasticsEurope Deutschland e.V., Managing Director Consumer and Environmental Affairs) and Dr. Klaus Wittstock (BASF SE, Head of Industry Affairs).

PlasticsEurope Deutschland e. V., Dr. Ingo Sartorius
Managing Director Consumer and Environmental Affairs

In principle, it is important for the circular economy that, after product use, end-of-life appliances are collected and treated in an orderly manner. In this context, the diverse and different collection systems must be considered and taken into account in today's established ways of treatment and recycling. Specific take-back systems, such as industry solutions, can help to generate sorted and clean waste streams that are suitable for recycling. Nevertheless, there is still a great need for development in order to establish solutions for the circular economy for the numerous mixed fractions.

A sound sustainability assessment is helpful in principle. Nevertheless, it is necessary to consider practical experience, because a recycled material must fulfil the technical and material requirements in the respective application. Additional requirements, especially with regard to product safety, must always come first.

Greenwashing should be prevented as a matter of principle. Guidelines and established standards such as the international ISO 14020ff. series of standards for environmental product declarations are suitable methods for product assessment and communication with regard to ecology and sustainability aspects.

ZVEI can only be recommended to participate in relevant standardisation committees at an early stage. After all, standards are a suitable means of developing harmonised procedures and methods.

Dialogue with all relevant actors, not only in the industrial value chain, but also together with administration and science are of high importance. Thus, enforcement is an essential supporter of the principle of practical implementation of private sector organisation of product stewardship. And research and development are essential to identify and develop innovative recycling processes for the circular economy as quickly as possible.

Technology neutrality is an important basic prerequisite for a successful plastics recycling economy. The strengths of the different processes must be utilised. The diversity of the processes should also include the diversity of the different waste streams collected. Cooperation and joint projects are important initiators on the way to an effective circular economy through recycling.

BASF SE, Dr. Klaus Wittstock
Head of Industry Affairs

Policymakers should not per se draw conclusions from experiences in the field of packaging to other applications.

Quality and safety must always take precedence over a circular economy. In a high-tech country like Germany, we should not compromise here. Safety is an important component of the social sustainability pillar.

The decisive impact categories in the ecological assessment are energy/CO_2 as well as resources and, depending on the application, water consumption.

Where possible, closed product cycles should be created. This can also meet the increasing legal requirements for more product responsibility in the context of a circular economy.

An open dialogue with all relevant stakeholders is enormously important.

6 Outlook

Chapter 4 dealt with various measures that companies can take to contribute to an increased, sustainable use of plastic recyclates. It has also already been discussed that standards for the respective product-specific requirements are needed to ensure the quality and safe use of recyclates. On the currently hotly debated topic of recyclate use quotas, the UBA states in a recent study that "the special features of the individual product groups must be taken into account in each case through product group-specific recyclate use quotas. A horizontal requirement in the form of a recyclate input quota across product groups, on the other hand, does not seem appropriate[44]"

Further open points are described below, which should be addressed by different stakeholders in the future. However, this paper is also seen as a starting point for a deeper dialogue with relevant stakeholders in the future, when more practical experience is available. Because according to SDG 17, sustainable development can only be achieved with partnerships and the electrical industry wants to actively contribute to this. Be it through joint ventures and concrete projects in practice or also the creation of knowledge and awareness in politics and society when it comes to the complexity and challenges in the context of plastic recyclates.

Legal environment: There is no one solution that can ensure the sustainable use of more plastic recyclates. However, an important part of the solution is a legal environment that gives companies a secure framework for action. This includes relevant and practical definitions of, among others, the different recycling processes in waste and product legislation. In addition, national governments and the European Commission need to actively monitor and enforce proper disposal of WEEE so that this waste stream is available for reuse. Otherwise, valuable raw materials will be lost. Regarding recycling processes, we advocate a technology-neutral approach, as the sustainability of the processes, as described in detail in this paper, depends on various factors and the application. A general requirement to use fewer plastics in electrical products is not expedient due to the requirements for electrical and electronic equipment described in chapter 2.3. Instead, it is only possible to promote the increased and sustainable use of recycled materials in a suitable form.

Standardisation: In the CPA WG EEE, three polymer applications were defined that are used in as many products as possible (basis: derivation of accumulated quantities in the WEEE stream) and that have a possibly high potential for recyclate use in order to realise a maximally effective design for recycling. These products are used as examples to analyse which standards are necessary and what share the applications have of the total plastic waste volume in the electrical industry[45].

Promotion of innovation, research and development: In its R&D agenda, the CPA states that there is a need for better ways of separating plastics in the recycling of WEEE, as is already the case today for metals[46]. At present, there are still too few facilities that meet the technical and economic requirements. For example, in order to enable more recycled plastics in the food contact sector, better detection and separation technologies must be developed to remove contaminants from the waste stream. Innovative, technologically open recycling processes are the essential, sustainable way to produce new plastics based on secondary raw materials - in addition to established mechanical-physical processes - which meet the same criteria and requirements as virgin materials with regard to their properties. Nevertheless, there is still a need for further research in this area. In this context, the necessary flexibility for a practical circular economy should be made possible with regard to the legal framework conditions.

[44] https://www.umweltbundesamt.de/publikationen/einsatz-von-post-consumer-recycling-kunststoffen-in, retrieved 16 April 2021
[45] https://ec.europa.eu/docsroom/documents/43688/attachments/1/translations/en/renditions/native, retrieved 17 March 2021
[46] https://ec.europa.eu/docsroom/documents/43693/attachments/1/translations/en/renditions/native, retrieved 17 March 2021

7 Further reading

Below you will find selected further literature and other references on the topic of "Sustainability and Plastics". The list aims to provide the greatest possible reference to relevant sources of information, but by its nature can never be exhaustive.

Plastics / plastic recyclates in general

- **German Environment Agency (short expert report, partial report): Use of post-consumer recycled plastics in energy-related appliances (in German).** The short expert report addresses the question of how the use of post-consumer recycled plastics in energy-related appliances can be strengthened. In particular, the technical and regulatory feasibility of a recyclate use quota is examined. Based on an analysis of the status of the use of recycled plastics in appliances as well as the currently available detection systems, policy recommendations were developed on how the use of recycled plastics can be increased and these were discussed in an expert meeting with relevant stakeholders. https://www.umweltbundesamt.de/publikationen/einsatz-von-post-consumer-recycling-kunststoffen-in
- **IN4climate.NRW (ed.) 2020: Chemical Plastics Recycling - Potentials and Development Perspectives.** A contribution to the defossilisation of the chemical and plastics processing industry in NRW. A discussion paper by the Circular Economy Working Group. Gelsenkirchen. https://www.in4climate.nrw/fileadmin/Downloads/Ergebnisse/IN4climate.NRW/AG-Papiere/2020/in4climatenrw-chemisches-kunststoffrecycling-web-de.pdf
- **Federal Ministry of Education and Research (BMBF): Guideline for funding research and development projects on the topic of "Resource-efficient recycling management - plastics recycling technologies (KuRT)".** With this funding measure, the BMBF aims to further promote the development of a resource-efficient circular economy in Germany and expand the high-quality recycling of plastics. https://www.bmbf.de/foerderungen/bekanntmachung-3080.html
- **VDI project 4095 "Assessment of plastics in the circular economy".** Among other things, the guideline is intended to describe the current situation in the field of "plastics recycling". https://www.vdi.de/richtlinien/details/vdi-4095-bewertung-von-kunststoffen-in-der-kreislaufwirtschaft
- **ZVEI (discussion paper): Plastics in the Electrical Industry.** The paper presents the most important discussion points on plastics in the circular economy from the perspective of manufacturers of electrical engineering and electronic products. https://www.zvei.org/en/press-media/publications/plastics-in-the-electrical-industry-discussion-paper
- **PlasticsEurope Deutschland e. V. (website).** The association of plastics producers in Germany provides extensive information on plastics on its website. In addition to basic information on plastics, it also provides market data, publications and events. https://www.plasticseurope.org/de

Plastics and SDGs / Sustainability

- **WWF(Report): Integration of plastics impact evaluation into ESG assessments.** Detailed guidance on integrating plastics into environmental, social and governance performance assessments of companies. The report outlines how relevant performance indicators can be developed and integrated into existing analytical frameworks. Consideration is given to where companies are in the plastics value chain, what measures are being taken to reduce plastics and what readiness there is for change. https://wwfint.awsassets.panda.org/downloads/wwf_plastics_impact_esg_report_2020_v13.pdf
- **KUNSTSTOFF.swiss (website).** The Association of the Swiss Plastics Industry presents on its website the contribution of plastics to the SDGs for the individual goals and makes practical references. https://kunststoff.swiss/Nachhaltigkeit/Kunststoffe-f%C3%BCr-eine-nachhaltige-Zukunft
- **ZVEI: Guide to sustainable development in the electrical industry (in German).** The guide developed in the ZVEI SDGs & Sustainability Task Force serves as an aid for approaching the topic of sustainability / SDGs. The guide shows ways of structuring both existing measures and future action, making them more transparent and using them in a more targeted way for companies. https://www.zvei.org/themen/gesellschaft-umwelt/wegweiser-fuer-nachhaltige-entwicklung-in-der-elektroindustrie-ist-erschienen

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