POLY
PRO
BLEM
REPORT

TREASURE HUNT

Faults and Flaws of the Recycling Market
...AND A GLIMPSE INTO A POSSIBLE FUTURE.

WIDER SENSE

RÖCHLING STIFTUNG

Publisher

Röchling Stiftung GmbH
Richard-Wagner-Straße 9
D-68165 Mannheim
+49 621 4402 232
info@roechling-stiftung.de
www.roechling-stiftung.de

Wider Sense GmbH
Monbijouplatz 2
D-10178 Berlin
+49 30 24088 240
info@widersense.org
www.widersense.org

www.polyproblem.org

Editors

Uwe Amrhein (Röchling Foundation),
Marius Ehrlinspiel, Anne Marie Jacob (Wider Sense),
Christian Schiller (cirplus)

Assistent editor: Sarah Güth (Röchling Foundation)

Authors

Christian Schiller, Uwe Amrhein, Marius Ehrlinspiel,
Anne Marie Jacob, Prof. Hans-Josef Endres, Dr Henning Wilts

Layout

ds.DTP – Detlef Scholz

Images

Adobe Stock, Detlef Scholz, Leibniz University Hannover, Wuppertal Institute,
Procter & Gamble, Werner & Mertz, WIP e.V., Der Grüne Punkt, cirplus

1. Edition, December 2020

cirplus | the global marketplace for circular plastics

This edition of the Polyproblem reports was published in cooperation with cirplus.
The Hamburg-based start-up cirplus has been active in developing the global marketplace for circular plastics since December 2018. The software company links the value chains of plastics and recycling. By utilising its digital technology, the company reduces the cost for the industrial use of recycled plastics. In April 2020 the start-up was awarded the Efficient Solution label by the Betrand Piccard's Solar Impulse Foundation.
www.cirplus.com

TREASURE HUNT
FAULTS AND FLAWS OF THE RECYCLING MARKET

Used plastic is no longer considered a waste product. It is the preferred raw material for the production of plastic goods. This applies to both packaging and technical applications. Recycled plastics are available in all necessary qualities and in sufficient quantities. They are traded at competitive prices in a transparent market.

Let us suppose that these statements were true. That would be a major step towards solving the massive environmental problems caused by plastic waste. Plastics, especially those in packaging for consumer goods, would have a different value. There would no longer be any reason to throw it away carelessly. It would go from being waste to being a sought-after material in a circular economy.

However, the reality is different: The market for recycled plastic is broken. Suppliers of recycled materials complain about competitive handicaps and a far too small sales market. At the same time, industry and processors are missing the quantities and qualities they would need for a more sustainable business model.

How can this be? Why do supply and demand manifestly do not match? And why is this happening at a time when politicians and citizens are calling for solutions with increasing urgency?

This POLYPROBLEM report wants to explore these questions. We take a closer look at a market that many of its players have labelled as „dysfunctional“. In conversations with experts, we present the positions of the various players in the market and their academic observers and followers.

The result is a discussion paper that does not claim to be a scientific study, but is intended to highlight areas of tension and possible solutions along the entire plastics value chain.

A functioning recycling system with a fair and transparent market for recyclable materials is one of the most important building blocks for solving the environmental problems caused by plastic waste. This is beyond dispute. The same cannot be said for the question of how to get there.

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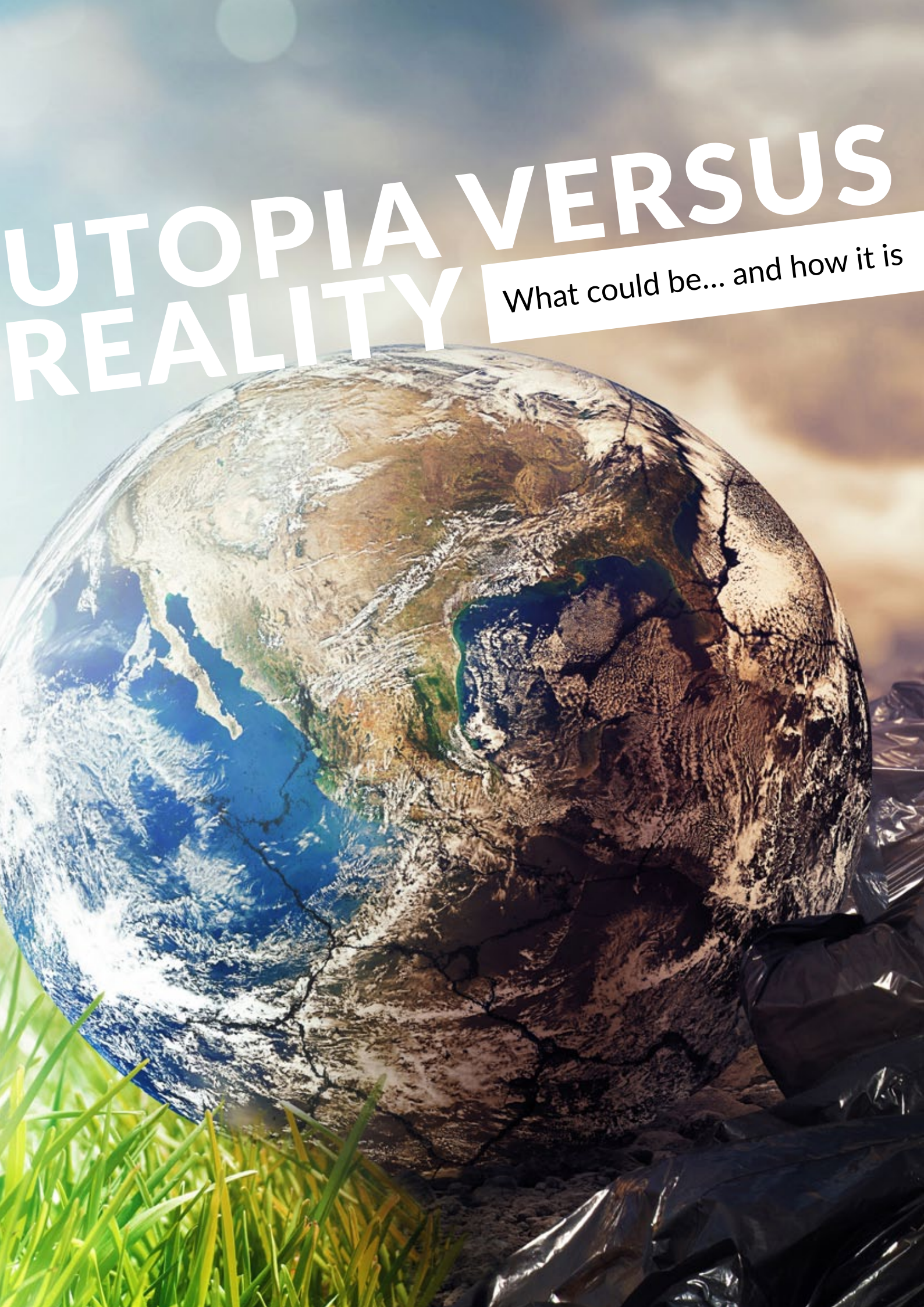


What could be

WHAT COMES AFTER THE PLASTICS PANDEMIC

A hopeful vision of a circular future

It is January 2050. All over the world, ceremonies are being held to commemorate the 30th anniversary of the outbreak of the corona pandemic. People are remembering the victims and the devastating economic and social consequences of the pandemic. But there is also a sense of joy about what has been achieved since then.

Not only has humanity survived. We are rapidly applying what we have learned to the management of other crises. Economies and societies are being restructured and even meeting climate targets seems realistic again. This progress can be clearly seen in the use of plastics.

FROM BIG OIL TO ALL ORGANIC

Plastics production in 2050 relies much more heavily on sustainable raw materials than was assumed 30 years ago. Bioplastics are to plastics production what renewables are for energy generation: an industry standard. About half of the newly produced raw materials for plastic goods come from by-products of ecologically sustainable agriculture, such as maize starch or sugar.

Green genetic engineering helps to shape the molecular structure of agricultural by-products in such a way that the production of plastics from organic raw material is significantly cheaper than the production of new plastics from crude oil had been in 2020. Less raw material becomes more plastic. And as early as the production stage, molecular markers are introduced into the plastics. These markers later allow clear tracking of the use and recovery cycle.

However, the production of such organic-based virgin material has already been declining since 2035 and now accounts for only about 20 per cent of the total amount of plastics used. This is the result of the extensive use of high-quality recycled materials from mechanical, bio-enzymatic, physical and chemical processes. These materials are recovered in highly developed reprocessing and recycling centres all over the world.

When producing new and improved plastics for a specific application, “design for reuse” or “design for recycling” is already one of the most important optimisation categories for plastics engineers. This is because the production of non-recyclable plastics is associated with extremely high transaction costs.

MANUFACTURERS: ALWAYS KEEPING AN EYE ON THEIR ECO²BALANCE

This positive development is due in large part to the brand manufacturers and OEMs who are continuously improving the **eco²balance** of their products. This internationally established concept incorporates both senses of “eco”: economic and ecological.

Companies use this management model not primarily because of strict political regulation. This was only necessary in the early years of the great transformation in the 2020s to 2030s. More importantly, a positive **eco²balance** gives them market advantages. The reconciliation of the economic and ecological camps that were previously at odds with each other has been a complete success.

End consumers not only appreciate this but can also verify the facts if they are in doubt. The CheckYourProducer smartphone app provides insights into the entire production, supply and recycling chain of products at the tap of a button.

This process of innovation has fully taken the plastics processors by storm. New machine parks make the

simultaneous processing of recycled plastics and bioplastics into new products incredibly easy: In addition to improved, familiar production methods, new processes have also been scaled up industrially: 3D printing, the digital twin etc.

END CONSUMER? NO: TEMPORARY USER OF PRODUCTS

This technological leap has also completely changed the behaviour of commercial and private end consumers, who, by the way, are no longer called "end consumers" in 2050, but only "product users". For example, the product users of 2050 select products and packaging types in retail stores. A 3D printer allows the production of the appropriate reusable or disposable packaging on site.

A noticeable difference is the absence of bottle-deposit machines. This can be explained by taking a look at the recycling industry. The recycling companies are the producers of raw materials. The markers introduced into the material during production have given the sorting of materials a massive boost. As a result, both the quality and the quantity of recycled plastics that can be used again have increased immensely. In 2050, only a fraction of all used plastic products is being incinerated.

The deposit system has been replaced by so-called plastics credits. Every time a product user in 2050 disposes of a certain product, he or she will be credited with plastics credits, which are traded like a freely available currency. Consumers no longer pay for recycling but receive money for providing the industry with a valuable raw material.

RECYCLERS: THE PRODUCERS OF RAW MATERIALS OF THE 21ST CENTURY

This kind of digitised waste infrastructure at the "point of trash" has led to waste generation, disposal and recycling taking on the role of the former oil giants. As a result, waste exports to other countries have also undergone a drastic transformation. Waste no longer always takes the cheapest route – as it used to until 2020 – but the route of optimal recycling in terms of the **eco²balance**.

Comparable to the flow of oil around the world at the beginning of the 21st century, the raw material waste is now directed to the recycling plant that provides the highest yield for a specific plastic.

The global South no longer serves as the world's dumping ground. The technological leap in recycling technology in the 2030s and 2040s, combined with an almost complete phase-out of oil production, transformed such landfills into raw material deposits. That made waste as good as gold within three decades.

FROM THE WASTE HIERARCHY TO THE RECOVERY CYCLE: PRODUCE, REUSE, RECYCLE… REPEAT

Once it no longer makes sense to reuse a product, the recycling industry steps up to the plate. Sophisticated **mechanical recycling** has been established as a measure for standard plastics and engineering plastics due to its lower energy requirements and comparatively low installation cost. Ten to twelve recycling sequences are not uncommon. In this form, plastic is incidentally superior to paper, metal and glass in its **eco²balance**.

Bioenzymatic recycling has cut the Gordian knot of 'non-recyclable composite products'. With little energy input, micro-organisms and enzymes can be 'trained' to be able to break down even the most difficult multilayer materials into their individual polymer components so that these can then be used as it they were newly produced.

Finally, depending on the application, **physical** or **chemical recycling** comes into play. These processes, which are more energy-intensive, play an important role especially in the area of individual technical and high-performance plastics. These different processes are not in competition in 2050, but complement each other in a sensible way.

By contrast, after being all the rage for a short time, biodegradable and compostable plastics are no longer of interest in 2050. The reason for this was that they encouraged consumers to discard plastics improperly into the natural environment and that they compromised the plastics too much during the use phase. In short: They were a transitional idea, born out of the necessity caused by the sheer uncontrollable amount of plastic that was still ending up in the environment in 2020.

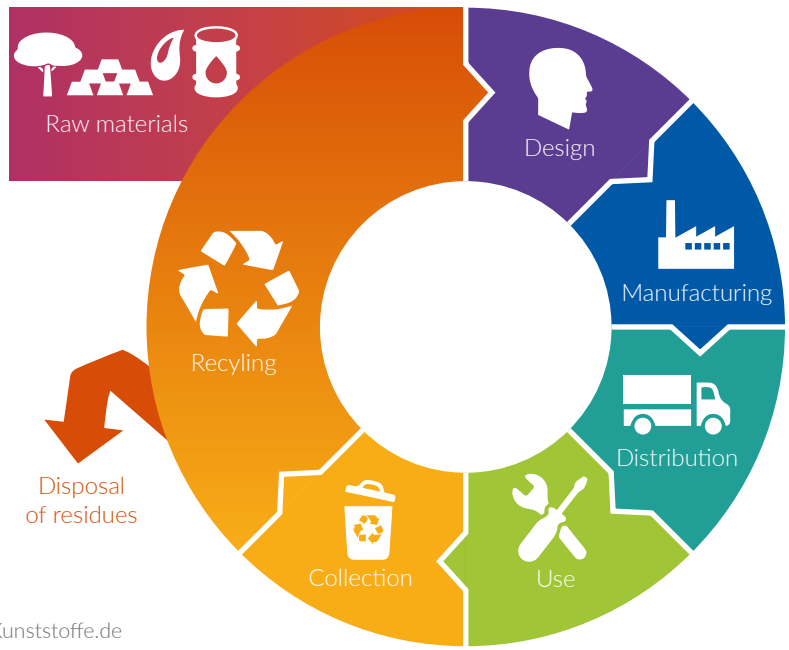
WASTE. WHAT WASTE?

As the 2050 celebrations of the anniversary of the coronavirus pandemic are reaching their zenith, millions exuberantly celebrate in streets and squares around the world. They do not leave behind the heaps of waste that used to be a common side-effect of such events in the past. And why would they? Who among the revellers would want to miss out on the plastics credits that are automatically added to their accounts as soon as a used product is thrown in one of the scanner-equipped recycling bins.

Waste... Well, that no longer exists.

FROM THE LINEAR PRESENT...

... TO A CIRCULAR FUTURE



Source: WIP-Kunststoffe.de

How it is

15 MILLION TONNES OF MARKET FAILURE

A sobering look at the linear present

The year is 2020 and the corona pandemic has the planet in its grip. Meanwhile, it may not come as a surprise that the plastic pandemic is also still a key factor in the lives of the majority of Germans. According to a representative survey conducted by the SINUS Institute1 on behalf of YouGov at the beginning of June 2020, three out of four Germans viewed the state of the world's oceans as just as important as it was before the pandemic, making the deposition of plastics into the world's oceans the all-dominant concern. 77 per cent cited this as the most critical problem to be solved.

The awareness of the problem is not matched by adequate progress when it comes to recycling. More than 90 per cent of the nearly 400 million tonnes[2] of plastic products produced annually are made from petroleum-based virgin material. Why is humankind unable to recycle more plastic? Paper, metal and glass are being recycled, after all.

First of all, there is a paradox that needs to be explained. The plastics recycling industry is complaining about how difficult it is to market their output. At the same time, an increasing demand for recycled materials from major manufacturers and plastics processors is not being met. How does this figure? Why do supply and demand not match?

To understand this market failure, it is important to know that we are not dealing with one dysfunctional market for recycled plastics, but with at least two:

1. The market for so-called 'downcycling' materials, suitable for robust applications such as the production of flowerpots, park benches or artificial turf: Here, we are seeing an over-supply. Suppliers can no longer sell their output because the Covid-19 pandemic has pushed the already low price for crude oil and thus the cost of producing virgin plastics below that of down-cycled materials (see pages 22-25).

2. The market for so-called upcycled or closed-loop materials for high-end applications such as cosmetics packaging, automotive parts, consumer goods or the construction sector: Here, demand is predominant. Driven by the requests from consumers and stricter regulation, distributors are increasingly committing to increase the share of recycled materials in their products. The only problem is that they cannot find the necessary qualities and quantities to permanently convert their production (see pages 28-29).

Both markets for recycled plastics do not function properly. But why is that the case? The plastic pandemic can essentially be boiled down to three causes: high price, low quality, no transparency. And market participants cannot agree on whether any interventions in the market should be taken – and if so, which ones.

1 Yougov.com (2020)

2 PlasticsEurope (2020)

PROBLEM NUMBER ONE: THE PRICE

Every year, 15 million tonnes of waste end up in the world's oceans[3] – from a commodity that generated billions in revenues during production. This shows that at the end of its first use cycle, plastic is obviously not valuable enough to be reused.

Few consumers could conceive of the idea that brand-new plastic should be so much more inexpensive than used material. After all, a second-hand car also costs much less than a new one – why is it any different for plastics? But it is. Fresh material is between 20 and 30 per cent less expensive to buy than the recycled material of comparable quality. Why should this be?

Broadly speaking, the industrial-scale production of virgin materials has about a 40-year head start on plastics recycling. The supply chains and processing methods of the petroleum and petrochemical industries are optimised for extreme efficiency, whereas plastics recycling, especially of consumer waste, only became part of the plastics industry with the introduction of the Dual System just over 30 years ago. And that only applied to a limited number of plastics. About half of the waste from the Dual System ends up being incinerated. In other words, this an 'indirect' form of burning crude oil. And this in a time when there is such a heated debate on phasing out coal-based energy generation and climate change.

The process steps of collecting, sorting and reprocessing of waste are less streamlined, and the market and technology have attracted little private investment and research funding due to a lack of demand for recycled plastics. Thus, the few trailblazer projects for producing high-quality recycled plastics are significantly more expensive than the industrial-scale processes in the petrochemical industry. Not to mention that it also buys its raw material at extremely reduced prices. On the other hand, hardly anyone has any use for the downcycling-quality materials that are available in large volumes.

PROBLEM NUMBER TWO: QUANTITIES & QUALITY

So, while there has been little serious demand from the major plastics-consuming industries such as the packaging, automotive, construction and consumer goods sectors, this is changing at a breath-taking speed. The number of companies that have voluntarily signed up to the Ellen MacArthur Foundation's Global Commitment to use recycled materials and improve the recyclability of their own products has grown by a factor of 200 in the last three years alone.[4]

But while board members express the will to improve the circularity of their plastic products, their chief buyers are surprised to find that even if one is willing to pay 20 to 30 per cent more for recycled materials, in most cases the markets are fiercely competitive (for instance the PET sector) or the quantities and quality to meet the demand of even a medium-sized established company simply is not available.

In the EU, 50,000 plastics processors are set against as little as 1,000 plastics recyclers, mostly small and medium-sized companies with 10,000 to 20,000 tonnes of annual capacity. There is no clearer way of illustrating the recycling gap of the linear plastics economy: A lack of volume and technological progress.

The large petrochemical groups BASF, Dow Chemical, Borealis and the like have also recognised this gap and are investing in chemical and mechanical recycling processes (see pages 35-39). They are not afraid jeopardise their own business model, which in essence consists of the production and sale of virgin material. They are keen not to miss the boat when it comes to reorganising the value chain. BASF launched the new business unit ChemCycle in early 2019. The Borealis AG bought into two mechanical recyclers, EcoPlast and mtm Plastics.

These examples show that the petrochemical industry obviously does not want to hand over a substantial part of its business to the large recycling and waste management companies such as VEOLIA, Suez and Remondis,

3 The High Level Panel for Sustainable Ocean Economy (2020)

4 Ellen MacArthur Foundation (2020)

GOLD IN – GOLD OUT

WHY PET IS DIFFERENT

Different rules apply to one group of recycled plastics: Polyethylene terephthalate, or PET for short, is the material drinks bottles are made of. And it is still a sought-after commodity after use. PET recycling is therefore seen by many in the industry as a model for the future of the sector.

In the case of PET, the problem of poor quality in the recycled material has been solved. How was this achieved? The market for recycled PET benefits from a very pure waste stream, namely from the collection of deposit bottles. The 25-cent deposit on plastic beverage bottles ensures that these bottles are not disposed of via the household recycling but by the supermarket. The deposit machines placed there only collect PET bottles. This means that there are virtually no impurities in the collected material. The bottles can be recycled directly and are always suitable for use in products that come into contact with food.

'gold in – gold out' as opposed to 'waste in – waste out' as it is practised today as part the collection of regular household recycling.

Because of this high quality, the packaging, consumer goods and also the textile industries are fighting over the available quantities. Who would not want to have the label "100% recycled material" on their products?

This shows that the demand side, i.e. the processing industries, can be willing to accept high prices. In March 2020, the price difference between rPET (about 1,450 euros per tonne) and the virgin material (about 800 euros per tonne) was 650 euros. Nevertheless, there was no shortage of buyers for the recycled PET.

However, even PET was not immune to the effects of the coronavirus and cheap oil. In May, the price of virgin material had fallen by almost 200 euros per tonne and companies that had previously been eager to buy even the expensive recycled PET switched into economic safety mode in view of the corona crisis and reverted back to the much more inexpensive virgin material[5].

What this segment of the market does show in any case is that with well-sorted input streams and high-quality recycling technology, markets for recycled plastics can work. Does this imply the need to introduce a deposit system for all plastics – or at least a few more types of plastic? That is an idea worth contemplating.

5 Source: ICIS (2020)

to name but a few. Meanwhile, there is not even any clear indication whether these players would even be able to serve the market for high-quality applications of recycled plastics, as this requires massive investments in research and development as well as a profound knowledge of polymer chemistry.

Perhaps it will be completely new players that will enter the recycling scene. Maybe a vertically integrated plastics processor like ALPLA – a classic packaging company that is establishing its own recycling capacities around the world. Or a large retailer such as the Schwarz Group, which already has access to vast amounts of plastic waste – the 'new gold' of the Circular Plastics Economy[6] – from its own operations. The struggle for dominance over the recycling market has begun.

The stakes are high. And the dynamics in the market demonstrate that in order for the minimum recycling quota of 25 per cent and more to come into effect, distribution and production methods will have to change radically and swiftly.

PROBLEM NUMBER THREE: THE LACK OF TRANSPARENCY AND DIGITALISATION

Finally, an efficient recycling of plastics requires greater transparency and digitalisation. The waste and recycling industry is a world onto itself, with very few and large top dogs, some medium-sized players and many intermediaries. They all roughly deal with three types of plastic waste streams: production waste, consumer waste and commercial waste.

Each of these waste streams – depending on the type of plastic involved – are not only different in terms of their value. The waste streams are subject to different national and international legal frameworks. In Germany, for example, these include the Closed Substance Cycle Waste Management Act (Kreislaufwirtschaftsgesetz), the Packaging Act (Verpackungsgesetz), the Commercial Waste Ordinance (Gewerbeabfallverordnung) to name just a few. Between EU member states, the regulations again differ significantly (see pages 44-47).

Furthermore, a network of intermediaries has become part of the path from the production to the recycling of waste. Last but not least, such a non-transparent system also gives rise to illegal activities, as the international police agency Interpol pointed out in August 2020.[7]

Although the rules of the game are more transparent in the plastics processing industry compared to the waste management sector, the wide variety of plastics products and types of plastic gives it a highly fragmented structure.

On top of the lack of transparency and fragmentation, both the plastics and the recycling industry show a very low degree of digitalisation. It is not uncommon for business deals to be initiated and concluded during a visit to a trade fair, with a phone call or by e-mails or fax.

Digital technology can help reduce the transaction costs of recycled plastics at every stage of the value chain – from deal origination, logistics, certification, tracking the material across the globe, to payment processing and

6 CHEManager (2020)

7 INTERPOL (2020)

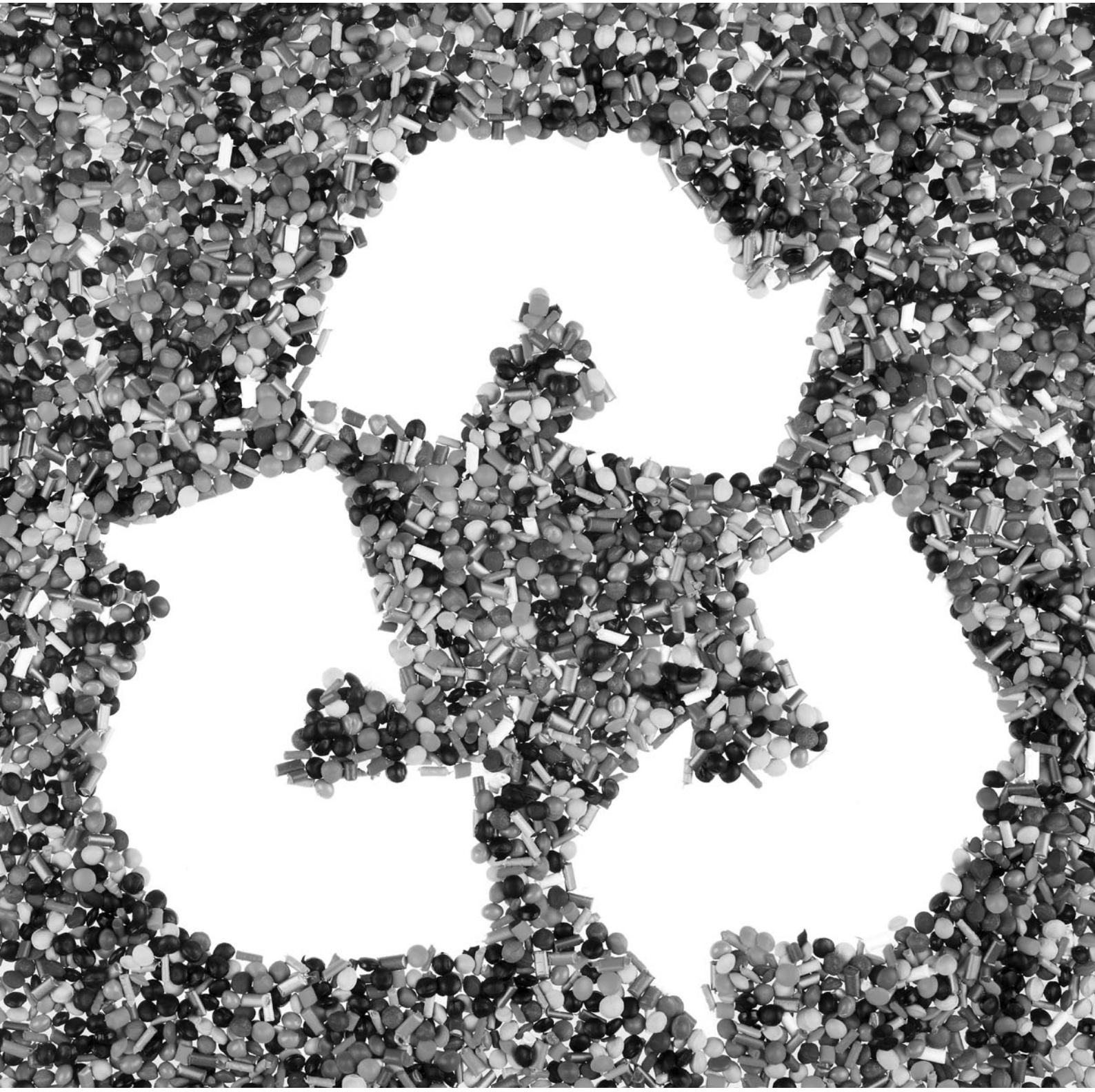
insuring the deal. The big question, especially in relation to waste management, is: Will the industry embrace digitally enabled transparency and efficiencies, or will it try to keep the waste markets in the semi-dark?

The fact is that there is a great deal of resistance to change, and not only from the plastics producing industry. The waste and recycling industry will also have to reposition itself if the vision of fully circular plastics is to become a reality one day. Who will be tapping these future 'gold mines' is a question that remains to be answered. This also provides an interesting development-policy perspective: Whereas today the countries of the Global South are still treated as the world's dumping grounds, tomorrow they could supply the world with the urgently needed circular hydrocarbons. After all, what today lies dormant as poorly recyclable plastic waste in illegal landfills in Southeast Asia, Africa and Latin America may in the future become a repository for the raw materials for producing plastics.

Sounds utopian? Perhaps. But the signs of change are unmistakable. Now, in 2020, in view of the increasingly catastrophic effects of the plastic pandemic on humans and animals alike, there is a real chance that the plastics industry will make a sustainable shift.

Christian Schiller is the founder of cirplus, a digital marketplace for recycled plastics. The company wants to make the trade in circular plastics along the entire value chain simpler and more transparent.

For this POLYPROBLEM report, he contributed to the concept and wrote the utopia of a circular future and the description of the linear present. Together with Uwe Amrhein, he also formulated the recommendations for action at the end of this report.



MATERIAL AND STREAMS

Money, markets and the system

OF MASS AND MERCHANDISE

How the demand for recycled plastics is developing globally

In the coming years, the global consumption and production of plastics will increase strongly. What share of this demand will recycled plastics have? At present, the production and consumption of virgin material still very clearly exceeds the use of recycled materials in plastic products. To shed light on the various reasons, the Polyproblem editorial team spoke with Peter Börkey, Environment Director of the OECD.

NEW VS. RECYCLED: THE RELATION IS 90 TO 10

In 2018, 390 million tonnes of plastic were processed worldwide. Of this, 360 million tonnes, or more than 90 per cent, was newly produced plastic, so-called virgin material. Processed recycled plastics used were only 30 million tonnes. This corresponds to a share of 7.6 per cent of the total quantity produced.

However, a total of 50 million tonnes or 20 per cent of the 250 million tonnes of plastic waste generated in the same period was recycled. The difference results from average process losses of 40 per cent.[8]

"Due to the lack of waste management structures in the Global South, efforts to collect and also recycle high-quality material have so far been very limited. However, it must be noted that due to the very low wage levels in many countries, the informal sector is very active in waste collection, sorting and recycling. Unfortunately, it is difficult to collect data on this: There is no registration of informal waste recyclers. It could therefore be that some emerging countries actually have high recycling rates, they are just not officially recorded."

(Peter Börkey, Environment Director of the OECD)

The absolute and relative share of plastic waste that is fed into the recycling process varies greatly between different parts of the world (see Table 1). Not surprisingly, it is apparent that – taken relative to population size – the amount of plastic waste generated is particularly large in the countries of the Global North. In the countries of the Global South, where waste management systems often are not or only insufficiently developed, people consume far less plastic. On the other hand, a higher proportion of it ends up in illegal landfills or in the environment.

POLITICS AND CIVIL SOCIETY ARE EXERTING PRESSURE – MOSTLY IN EUROPE

"Most regulatory measures for the market of recycled plastics are initiated within the context of the European Union or by its member states."

(Peter Börkey, Environment Director of the OECD)

Already in 2018, the European Commission adopted a directive on recycling quotas for packaging waste. According to this directive, member states must recycle at least 65 per cent of their packaging waste by 2025. By 2030, the mandatory quota increases to 70 per cent.[9] The following year, another directive was introduced requiring member states to recycle 25 per cent of beverage bottles (PET) by 2025 and 30 per cent by 2030.[10]

8 Conversio Market & Strategy GmbH (2020a)

9 Directive (EU) 2018/852 (2018)

10 Directive (EU) 2019/904 (2019)

Table 1: Plastic waste and recycling in 2018 by world region in million tonnes

Region	Plastic waste	Collected (informal and formal sector)	Recycling	Leakage & improper disposal
Europe	45	41 (91 %)	12 (27 %)	4 (9 %)
North America	38	37 (98 %)	4 (11 %)	1,5 (4 %)
Latin America	27	15 (45 %)	4 (15 %)	12 (44 %)
Asia Pacific	114	72 (63 %)	27 (24 %)	42 (37 %)
Africa	26	10 (38 %)	3 (12 %)	16 (62 %)
Total	**250**	**175 (70 %)**	**50 (25 %)**	**75,5 (30 %)**

Source: Conversio Market & Strategy GmbH (2020a)

SIDE NOTE: THE SITUATION IN GERMANY[11]

In 2019, around 14 million tonnes of plastic were processed in Germany. Of this, 12.3 million tonnes were virgin material and 1.95 million tonnes were recycled plastics (13.4 per cent). The plastic waste collected in the same period was around six million tonnes; about half of this (3.1 million tonnes) was packaging with a short life cycle. Overall, more than 99 per cent of plastic waste was processed, about 47 per cent of this was recycled (mainly mechanically) and almost 53 per cent was incinerated.

Recycled plastics are now used in almost all market segments. The largest quantities of them processed in 2019 were in the construction (43 per cent), packaging (24 per cent) and agriculture (11 per cent) sectors. In terms of plastic processed in each sector, the share of recycled plastics is particularly high in agriculture (36.5 per cent), construction (23.3 per cent) and packaging (10.9 per cent).

Overall, the use of recycled plastics in Germany increased by around ten per cent between 2017 and 2019. This increase is almost exclusively due to an increase in post-industrial waste. In the same period, the processing of virgin materials has decreased by around three per cent.

11 Conversio Market & Strategy GmbH (2020b)

In addition, the EU Commission, together with the Circular Plastics Alliance[12] it initiated, has set itself the goal of using ten million tonnes of recycled material in plastic products or packaging by 2025.[13]

With the new Packaging Act (VerpackG) of 2019, the recycling quotas in Germany for plastic packaging were raised from the previous 36 per cent to 58.5 per cent and to 63 per cent by 2022.[14] However, the Packaging Act does not provide quotas for the use of recycled material in plastic products.

As recently as the middle of 2020, the upper house of the German Parliament again rejected such deployment quotas. The reason given: The free movement of goods in the EU should not be impaired and there is an insufficient supply of recycled plastics to meet the necessary quality requirements in the first place[15]. In France, the Waste Control and Circulation Act of this year goes even further: A recycling quota of 100 per cent is planned by 2025 and by 2040 single-use plastic packaging is to be banned entirely.[16]

The Plastic Pacts initiated by the Ellen MacArthur Foundation also play an important role in promoting the use of recycled materials. They pursue the goal of bringing together local companies, governments and NGOs to work towards a functioning circular economy for plastics. Besides France, five other European countries (the UK, Denmark, Portugal, the Netherlands and Poland) have already introduced national Plastic Pacts. They are joined by the US, Chile and South Africa. Depending on the country, the signatories of the Plastic Pacts commit to a recycling rate of between 33 and 70 per cent and a recycled content in packaging of 30 per cent by 2025.[17] Canada, which has not yet introduced a Plastic Pact, is also aiming for a minimum target of 50 per cent recycled content in plastic products and packaging by 2030. [18]

PRIVATE SECTOR REACTS WITH SELF-COMMITMENTS

The devastating environmental impact of the global flood of plastic can be seen everywhere. Against this background, social pressure on the consumer goods industry has increased enormously in recent years. Increasingly, companies are therefore responding with voluntary commitments. A large number of these companies are also signatories to the New Plastics Economy Global Commitment and – with a few exceptions – are aiming for a 25 per cent share of recycled plastics in packaging by 2025. This is also the target set by the Ellen MacArthur Foundation, initiator of the New Plastics Economy.

However, studies show that many of the signatory companies are still far from achieving the targets they have set themselves: The percentage of recycled materials used is still mostly in single digits.[19] These companies' voluntary commitments also has to be assessed particularly critically in light of their geographical focus. For the most part, they only apply to the European market. In the Global South, where companies are increasingly seeing growing markets, such voluntary commitments usually do not apply.

12 The Circular Plastics Alliance is an initiative under the European Strategy for Plastics based on voluntary commitments from companies with the aim of promoting the market for recycled plastics in Europe. More details: https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance_en

13 European Commission (2019)

14 Packaging Act (2019)

15 newsroom.plastics-packaging.com (2020)

16 Anti-Waste and Economy Act - Circular (2020)

17 Plastics Pact (2020)

18 Canadian Government (2020)

19 Changing Markets Foundation (2020)

SUPPLY AND DEMAND OF RECYCLED MATERIALS ARE NOT DEVELOPING HARMONIOUSLY

In view of the regulatory measures and voluntary commitments to increase recycling and the use of recycled materials in plastic products, it can be assumed that the supply of plastics processed for recycling will continue to increase. This raises the question as to whether the market for secondary plastics will be able to cope with this growth at all.

"It is evident that in the global North, especially in the European Union, a lot is being done to boost the demand for recycled materials. But in emerging economies in particular, more work is being done to introduce instruments such as Extended Producer Responsibility (EPR) in the packaging sector. All this will lead to a further increase in the supply of recycled plastics."

(Peter Börkey, Environment Director of the OECD)

Currently, the market for post-consumer recycled materials, i.e. plastics that are recycled after use, is expected to grow globally from 15.5 billion US dollars in 2020 to 18.7 billion in 2025.[20] This corresponds to an annual growth rate of 5.7 per cent. Due to a growing population, increasing gross domestic products and rising incomes, the Asia-Pacific region in particular is forecast to become the leader of the market in recycled plastics in terms of both value and volume by 2025.[21] Assuming that mechanical and chemical recycling continue to increase, forecasts indicate that, in terms of volume, one-third of the demand could be met by the use of recycled plastics as early as 2030 – and as much as around 60 per cent by 2050. [22]

In view of the stricter legal requirements of the EU, the recycling quota for Europe should almost double. However, to realise this, the production capacity of the recycling industry in the EU would have to more than double from the current five to eleven million tonnes per year.[23]

Consumer pressure could also increase, leading to increased demand for recycled plastics. A global survey shows that every second consumer would already be willing to buy goods made from that material.[24] According to the Gesamtverband Kunststoffverarbeitende Industrie e.V. (GKV – General Association of the Plastics Processing Industries), it is assumed that the public debate on plastics in the environment will result in an increased demand of 51 per cent.[25]

"In the last 30 years, people have really only been concerned with expanding the market for recycled plastics. But no one has been concerned with how strong the demand is."

(Peter Börkey, Environment Director of the OECD)

It seems all the more astonishing that currently the industry's demand for recycled plastics to manufacture new plastic products is actually developing rather hesitantly. Compared to the 11 million tonnes of recycled plastics that would have to be processed in the European market by 2025 if the quotas were to be met, the recycling industry has so far been assured purchases of no more than 6.4 million tonnes.[26] While demand has more than doubled across Europe – from 2.8 million tonnes in 2015 compared to today, numerous factors continue to hamper the growth of the market for recycled plastics. First and foremost, these are the price and the quality.

20 ResearchAndMarkets.com (2020)
21 Ibid.
22 Hundertmark, T., Mayer, M., McNally, C. et al. (2018)
23 EnvironmentalEconomy.com (2020)
24 Neue Verpackung (2020)
25 Plastics.com (2020)
26 Small Business Association (2019)

INTERVIEW

Michael Wiener is Managing Director of DSD - Duales System Holding GmbH & Co. KG, better known in Germany as 'der Grüne Punkt' (the Green Dot). POLYPROBLEM spoke to him about the difficult state of affairs in the recycling industry – and possible solutions.

Michael Wiener is keen to show what works. The floor coverings and parts of the office furnishings in the new corporate headquarters of the Duales System Deutschland Holding GmbH, not far from Cologne Airport, are made from recycled plastics collected from household waste. The message is clear: Recycled plastics are a high-performance raw material.

The 'Green Dot' is ubiquitous in Germany. The seal stands for the collection and recycling of used retail packaging throughout Germany that was introduced in 1990. We spoke with company CEO Michael Wiener about why recycled plastics still have a hard time competing in the market against virgin materials.

Mr Wiener, it seems paradoxical: the political sphere and society call for more recycling. Laws and regulations to that end are being enacted. At the same time, the recycling industry is performing poorly. What is the reason?

It is true: Not only in Germany, but everywhere in Europe, plastic recycling capacities are currently being reduced rather than increased. One reason for this is the persistently low price of crude oil.

Recycled plastics continue for the most part to be used in very solid and simple products, such as paint buckets. And it is precisely in these simple applications where price matters more to the industry than sustainability. If the price of oil goes down, buyers expect the price of the recycled plastics to go down as well. But the fact that our production costs have nothing whatsoever to do with the oil price does not matter to them at first. Their goal is to optimise costs.

And that is different for more demanding plastic applications?

Yes. When brands and retailers decide to use recycled plastics in more sophisticated plastic products, such as packaging for detergents, cleaning products and cleaning agents, they usually also promote them to their customers as particularly sustainable. This is why these companies continue to use the recycled material even when the purchase price for virgin material drops. Because the value proposition to the customer in this case is not the cheapest price, but sustainability. This shows that the recycling industry has to continue working on increasing the quality of its products to enable higher-value applications.

“Sustainability requires fair pricing”

Michael Wiener: virgin and recycled materials have yet to compete on a level playing field.

For PET, binding use quotas for recycled material are already in place. Similar quotas for other plastics are expected to be introduced. And within the framework of the Circular Plastics Alliance, almost all major market players have committed to using ten million tonnes of recycled materials by 2025. Are the recyclers even capable of delivering these quantities?

In Europe, about 60 million tonnes of plastics are processed annually. This corresponds to a recycling capacity of around eight million tonnes. These figures show that the recycling industry would certainly have capacity problems in the event of a sudden and massive increase in demand.

However, this is really a problem that I would like to have. It is true that everyone is predicting a strong increase in demand for recycled plastic across the board. However, after the voluntary commitment as part of the Circular Plastics Alliance, I have yet to notice an increase in demand. Actually, this trend should have started long ago if the target of ten million tonnes is to be reached in four years.

What could be the reason that, despite increased consumer awareness, policy measures and voluntary commitments by industry, demand for recycled plastics is not already rising noticeably?

First of all, the simple and already mentioned reason that recycled material for higher-value applications are more expensive than virgin material. This price difference to the detriment of recycling is due both to the low oil price and the lack of scaling in our recycling industry.

It remains impossible to untie this Gordian knot: the lower the production quantities in recycling, the higher the price compared to the virgin material produced at mass industrial volumes. And the higher the price of the recycled material, the lower the demand. This is a vicious cycle that puts secondary raw materials at a disadvantage on the market compared to virgin materials.

What could break this cycle?

We would need long-term purchase guarantees from the industry, for example in combination with supply contracts over three or four years. These would enable us to invest in additional production capacities. And that in turn would make the recycled material cheaper relative to the amount.

So, this is the old chicken-and-egg problem?

That is how it is often presented. The industry says to the recyclers: We would buy more from you if you could deliver more in the corresponding quality. And the recyclers reply: We could supply you with more if you gave us planning security.

This way of seeing it is not wrong – but it is too simplistic. In fact, high-quality recycled plastics are also at a real

disadvantage, which the market urgently needs to compensate for.

And what disadvantage is that?

In the production of plastics from virgin materials, the true cost has always been externalised in the past decades. The chemical industry enjoyed fantastic growth rates in the production of basic plastic products. But only because the question of recyclability was completely ignored during production.

In other words, the success of plastic in its production is at the expense of those who have to deal with the waste products in the end. And dealing with the waste products brings with it organisational and technical complexities, making it more expensive than producing from virgin materials.

In short, there is no level playing field, i.e. no competition between virgin and recycled material under the same initial conditions.

What could create fair market conditions for recycled plastics?

An important lever would be to value the reduction in CO_2 emissions from recycled plastics. Research by the German Öko-Institut at our company have shown that even very complicated recycled plastics for demanding applications bring around 50 per cent CO_2 savings compared to virgin materials.

But this substantial environmental advantage of the secondary raw material does not give us an edge in the market. That makes no sense to me. If the responsible consumption of greenhouse gases is such a scarce commodity, then this scarce commodity should also have a price in the market.

You are demanding a CO_2 levy on newly produced plastic?

Look at it the other way round: Companies that produce and use climate-friendly secondary raw materials should receive a CO_2 credit. That would not be a subsidy, but a reward for sustainable action and a fair compensation for the previously described unfair market conditions that we currently have.

What is your position on the 800-euro tax per processed tonne of non-recycled plastic that was decided at EU level? Does this tax not go in a similar direction?

Unfortunately, the money is not earmarked for the expansion of the recycling infrastructure and thus the promotion of a circular economy, but it flows into the general tax coffers of the finance ministers. The way we see it, taxing virgin plastic is not a bad idea. However, in its current form, it is also not a real breakthrough.

Would additional quotas be more effective?

First and foremost, we need different quotas. Everybody is looking at quotas in terms of sorting. If there were a maximum quota for the use of virgin materials, that would be a real game changer. Products would have to be designed in such a way that they contain a high proportion of recycled materials. For PET this already exists: In 2025, all plastic bottles need to contain 25 per cent of recycled plastic. In 2030, this will rise to 30 per cent.

This principle should quickly be transferred to other plastics and areas of application. Packaging for detergents, cleaning agents and cleaning products could immediately be made from at least 30 per cent recycled materials. And that would only be the start.

35 to 40 per cent of the approximately 60 million tonnes of plastics processed annually in Europe are used to produce packaging. This means that packaging is by far the largest area of application. This area above all is where the industry is called for to move from being part of the problem to being part of the solution. Companies that voluntarily go down this path and put recyclable products on the market do, by the way, have quite the edge on the competition.

But compared to the overall market, these are still small amounts, are they not?

That is exactly the problem: The very fact that packaging made from recycled material is marketed as this

wonderful speciality. Such products have to become the new normal across the entire industry. This would increase the demand for recycled plastics, which in turn would enable investment in production capacities and improved technologies. It would set the currently malfunctioning market in motion.

And regulatory action by policy-makers is only one building block on that road. The question of who can pull the lever here is not decided by the respective market share. What we need is honest commitment by the market participants and authentic communication. This begins with the question of where the material actually comes from.

Sounds good, but in fact one player in the market is waiting for the other to make a move: the plastics manufacturers need the specifications from their customers, the established manufacturers. They, in turn, are waiting for the political decision-makers to say something... and so on.

Producer responsibility, which applies in large parts of the EU, clearly defines who is responsible for packaging, even after use: The person or entity that puts it into circulation. If the industry wants to continue this successful model, it has to work on the recyclability of its products and their packaging. Those who believe they can continue to sit this problem out will eventually find themselves facing regulations from Brussels. And these are rarely business-friendly. Just keeping your head down is no longer an option.

What does this mean for concrete, practical action?

Packaging and other plastic products must be consistently designed in such a way that they can be predominantly made from recycled plastic. But they also have to be designed so that they themselves are easy to recycle.

Here, in the design for recycling, is where I see positive developments: Less complexity, fewer materials, better printing inks, adhesives that are easier to remove and more transparent rather than solidly coloured packaging. All of these will ensure that the quantity of the plastic waste collected for recycling will be much better in terms of the quality in just a few years. This is also urgently necessary, because according to our analysis, about one third of the recycling waste we collect from private households, is currently not recyclable at all.

Once this changes, the amount of high-quality recycled plastics that we can offer to industry and its manufacturers at a competitive price will also increase. Which brings us back to the market mechanisms.

Let us talk about the reliable quality of recycled plastics. Plastics processors complain that they cannot find sufficient information about the properties and characteristics of the material because there are no standards. Is that not also an obstacle for a functioning market?

Yes, this will have to be solved. In fact, there are no standards for recycled plastics. But buyers need orientation and security. One example: We have long confirmed that recycled HDPE is very well suitable for bottles for detergents and cleaning agents. However, there are companies that still opt for virgin material because they fear issues involving product liability when using recycled materials. We have to be able to allay the doubts of these hesitant companies by introducing binding and recognised standards for our products. We are currently working on this as part of a cross-sectoral working group together with the DIN Institute.

The entire market needs to become much more transparent.

What do you predict: Will we see a functioning market for secondary raw materials in the foreseeable future?

We have to work on this together, because otherwise we will not get a circular economy up and running. It is important to understand that the market for secondary raw materials cannot be developed solely through supply and demand. That is why we need both: smart guidance from political decision-makers and, on the other hand, the realisation in the consumer goods industry that sustainability is more than optional, but a prerequisite for survival in the market.

Plastics suppliers between sustainability and customer pressure

SQUARING THE CIRCLE

What are the difficulties in using recycled materials, especially for SMEs

Many plastics processing companies are in a bit of a tight spot. On the one hand, they face increasing demand from their customers for the use of recycled material. On the other hand, they have to meet these customers' unchanged high demands when it comes to the technical properties of their products. "This is like squaring the circle and often almost impossible to achieve," says Berit Bartram. She works as the coordinator of the non-profit Knowledge and Innovation Network for Polymer Technology (WIP - Wissens- und Innovationsnetzwerks Polymertechnik), where companies and academic institutions along the entire value chain of the plastics industry have joined forces.

Especially small and medium-sized enterprises (SMEs) could find themselves in this "sandwich", as Berit Bartram puts it. SMEs are typical among plastics processors that, while being active as suppliers, do not offer their products to end consumers themselves. She experiences the dilemma almost daily in conversations WIP member companies.

Many users of plastic products, and that includes parts of the automotive industry, have so far hardly adapted their requirement catalogues for the products they supply to the changed conditions of more sustainable production that is demanded everywhere.

The sometimes extreme requirements in terms of, for example, shape, dimensional stability or smell properties stay the same, while the proportion of recycled materials in the products should increase. However, recycled plastics do not behave as predictably as the original material during processing. The plastics processing company as a supplier must therefore create an unchanged product using a different material input.

According to Berit Bartram, this challenge is exacerbated by the often insufficient documentation of the technical properties of recycled materials. With newly produced plastic granulates, also known as the virgin material, the chemical industry provides comprehensive safety data sheets. The material properties for dimensioning, processing and application are well-known and communicated. For recycled materials, however, such information is usually not available as reliably and completely. This deficit can often only be avoided by the recyclers at great expense - if only because the properties of recycled plastics change with the input flow at the recycling plants, whereas virgin material always consists only of more or less the same basic materials. „Our medium-sized companies in particular do not usually have the means to check the incoming material themselves in this respect," says Berit Bartram.

The result of this dilemma: When in doubt, the plastics processor does not go for the recycled plastics but rather for the virgin material - simply to be on the safe side.

"We need to have a debate now on the extent to which the applying industry can increase its tolerances when buying intermediate products, without noticeable losses in quality for the end consumer", Berit Bartram demands in her role as representative of a cross-sector network.

The prerequisite for this is that the product designers for the applying industry talk more intensively to the plastics processors about a balance between product properties and sustainability than they used to. They should also be prepared to make compromises. "For example, if the board of a car manufacturer decides that from now on 30 per cent of its vehicle parts should be made of recyclable material, then in future it will no longer be enough to simply pass this requirement on to the suppliers," says the WIP coordinator.

Speaking of price: That is apparently the next problem for suppliers of plastic products. As intermediate product manufacturers who themselves have no contact to the end consumer, plastics processors are usually unable to compensate for the more expensive use of recycled materials by demanding higher prices. This is because they lack the opportunity to position their products with the consumers as particularly sustainable and thus higher priced. “Margins are already approaching zero,” Berit Bartram reports.

Incidentally, she also does not believe that minimum recycled material quotas introduced by law will help the industry out of the dilemma described here: “General quotas are not an effective means because they hardly take into account the product-specific conditions.”

Nevertheless, she does have a sensible regulatory measure in mind. “It would be helpful to support the recycling companies to avoid the high costs that are caused by complex testing and documentation of the material properties. This would at least partially offset the cost disadvantage of recycled plastics compared to virgin materials and at the same time make it easier for our processing companies to use recycled plastics. The data obtained could then also be useful for product designers as part of simulation processes.” However, such a proposal is currently not on the political agenda.

The most important step remains a stronger cross-industry cooperation in the development of sustainable solutions using plastics. The members of the Knowledge and Innovation Network for Polymer Technology also see this as a task for them. “We have to find a new, common language,” Berit Bartram believes. “Everyone keeps talking about the value chain. What we really need are circles of value creation.”

Berit Bartram coordinates the non-profit Knowledge and Innovation Network for Polymer Technology (WIP). Research institutions and companies from various sectors of the plastics industry have joined forces in the association.

From the demand side's point of view

"THE AVAILABLE QUANTITY OF SUFFICIENTLY HIGH QUALITY IS A BIGGER PROBLEM THAN THE PRICE"

When it comes to recycling, Procter & Gamble focuses on innovation instead of regulation

The global giant has ambitious plans: The consumer goods company Procter & Gamble (P&G) has around 600,000 tonnes of plastic processed into packaging every year. Half of this, i.e. 300,000 tonnes, is to be made from post-consumer recycled plastics (PCR) or saved no later than 2030. Currently, the P&G Group, with brands such as Pampers, Braun, Fairy, Head & Shoulders, Ariel or Lenor, uses around 52,000 tonnes of recycled material (PCR).

"We have ambitious goals. Therefore, we welcome and appreciate the contributions of all actors along the value chain. After all, our common goal is to efficiently manage plastics in the circle on a large scale. And this can only be achieved by working together and in partnership," explains Gabriele Hässig, Managing Director Communications and Sustainability at P&G. To her, this includes the sorters and recyclers as well as the compounders and processors. The fact is that the demand for high-quality materials will continue to grow in the future. Because of this, it is worth investing in innovation and in processes that improve recycling all the way to the finished packaging made from recycled material.

Gabriele Hässig is aware of the existing tension: On the one hand, recyclers who complain about not enough sales opportunities and, on the other hand, the consumer goods industry, which fears that it will not receive enough suitable post-consumer recycled plastics to meet its voluntary commitments.

"Innovation is the key to resolving this tension," the manager is convinced, and then goes into detail: "Currently, about half of the plastic waste collected in the household recycling is incinerated. If the collected plastic waste were to be made more sortable through new technical processes and thus the quantity of recyclable waste was to be significantly increased, this would bring about positive economies of scale for the recycling companies. They could produce more inexpensively, which would at least partially offset the cost disadvantage of recycled plastics compared to virgin materials.

According to Gabriele Hässig, her sector, the consumer goods industry, should not only demand the necessary innovations, but also actively participate in their development. As an example, she mentions the "HolyGrail 2.0" project initiated by P&G, which, together with many partners, aims to incorporate invisible codes into packaging materials, which could then be read in sorting facilities.

Why go through all of this trouble? "We are currently not getting the quantities of high-quality recycled materials that we need," Gabriele Hässig says. Particularly in the personal hygiene and beauty sectors, which are important for her group, but also in household cleaners, it is difficult to procure packaging solutions made from recycled material. "That has to change. Because safety is a top priority, especially for products that directly come in contact with the human body. And here, for most recycled plastics, we still do not have clear definitions for a variety of material properties or health-related boundary values, that buyers can

use and that at the same time give us legal certainty," Hässig explains and calls for more transparency through improved standards. The consumer goods industry is already actively involved in this area and cooperates in working groups such as Cospatox. But there still is a lot of work to be done.

The example of PureCycle also shows that Procter & Gamble not only demands innovation, but actively promotes it in order to increase the available amounts of high-quality as well as also competitively priced recycled plastics. PureCycle is a process developed by P&G to produce high-purity recycled polypropylene.

Improved material flows, more transparency on product properties, new processes: From the point of view of one of the largest international distributors of packaged consumer goods, these are the three essential factors on the way to a functioning market for recycled and recyclable plastics.

Gabriele Hässig does not share the usual scepticism that newly manufactured plastics will always remain more attractive for large corporations like Procter & Gamble than post-consumer recycled materials as a result of the low oil price. "Of course, using recycled materials is initially a financial challenge for our industry, but P&G has committed to halving its use of virgin plastics. This is not up for debate," she affirms and goes on: "The plastic tax for non-recycled plastic has been decided at the EU level. The CO_2 tax is also coming and will make virgin material even more expensive. These two steering instruments together will have an effect," Gabriele Hässig is certain. In addition, consumer demand for sustainably designed products is increasing.

"We need technical processes that reliably enable large quantities of recycled plastics in all required qualities. That worries us more than price arguments," Hässig sums up her position.

It should not come as a surprise that Gabriele Hässig is not in favour of politically imposed quotas for the use of recycled materials. "Let us not underestimate market forces," she says. "If we really want the system to be transformed in a sustainable way, it has to be done on the terms of the market. The solutions found have to be able to sustain themselves over time." Regulatory measures can set certain guidelines, but they cannot replace the market in the long run.

In other words, there is nothing that governments can do to increase the use of recycled plastics? "Yes, they can," says Gabriele Hässig. "The state buys a lot and builds a lot, especially when it comes to infrastructure projects. Setting a good example as a buyer would certainly provide an important push for further progress.

Gabriele Hässig is Managing Director for Communications and Sustainability at Procter & Gamble. She is in charge of these issues in Germany, Austria and Switzerland.

INTERVIEW

Reinhard Schneider is Managing Partner at Werner & Mertz, a medium-sized manufacturer of cleaning and care products.

He has been presented with a string of packaging and design awards, speaks at international summits and business conferences, and not infrequently gets into trouble in his own industry. Reinhard Schneider is the CEO and equity holder at Werner & Mertz, the company behind the Frosch, Erdal and Emsal brands. He believes that using fully recycled plastics in packaging is primarily an entrepreneurial choice. We met up with the ambitious CEO at the company headquarters in Mainz.

Mr Schneider, with your Frosch brand you are considered a pioneer and a rebel when it comes to packaging. What are you currently working on?

As far as our bottles are concerned, we are at 100 per cent recycled material. Now we are working on our sachets. They came later because we had to solve a major problem. Sachets that are able to stand upright used to be made from laminates, consisting of a composite of a number of types of plastic fused together. They were almost impossible to recycle, if only because the plastics used have different melting points. Now we have a completely recyclable mono-sachet.

That was the last gap we still had to fill. With regard to other common types of plastic for packaging, such as PET, HDPE and PP, we had already gone there a few years ago – for instance with the world's first recycled HDPE bottle made entirely of recycled waste plastic that is certified for cosmetics.

What is more important to you, the recyclability of your packaging or the use of recycled materials for making it?

These are two sides of the same coin. One makes little sense without the other. Unfortunately, many players in the market forget this.

How did your company come to devote itself so wholeheartedly and early to the topic of the recyclability of packaging? Was there a particular instance that inspired you?

This decision was certainly based on economic considerations. At some point we came to the conclusion that we, as a medium-sized company, would be able to hold

“Trust is more important than the bottom line.”

Packaging entirely made from recycled materials: How does that work?

our own particularly well in the market if we did not make it all about the retail price, but offered our customers particularly trustworthy products. Large corporations concentrate on economies of scale and then try to go as cheap as possible. When medium-sized companies try to imitate this growth model, it usually goes wrong. Simply because you need a certain size to succeed in this kind of growth.

We have other strengths. As a medium-sized company, we do not rely on optimising our operations according to the numbers from stock market analysts. If we had to explain the steps we have been taking for a more sustainable business for the last 20 years to stock market analysts, we would have been dismissed as the management. After all, in the first four or five quarters, our ventures cost more than they earn.

We can afford to think more long-term. The reward is that we have been considered ‘Most Trusted Brand’ for many years.

But sustainability is no longer a unique selling point...

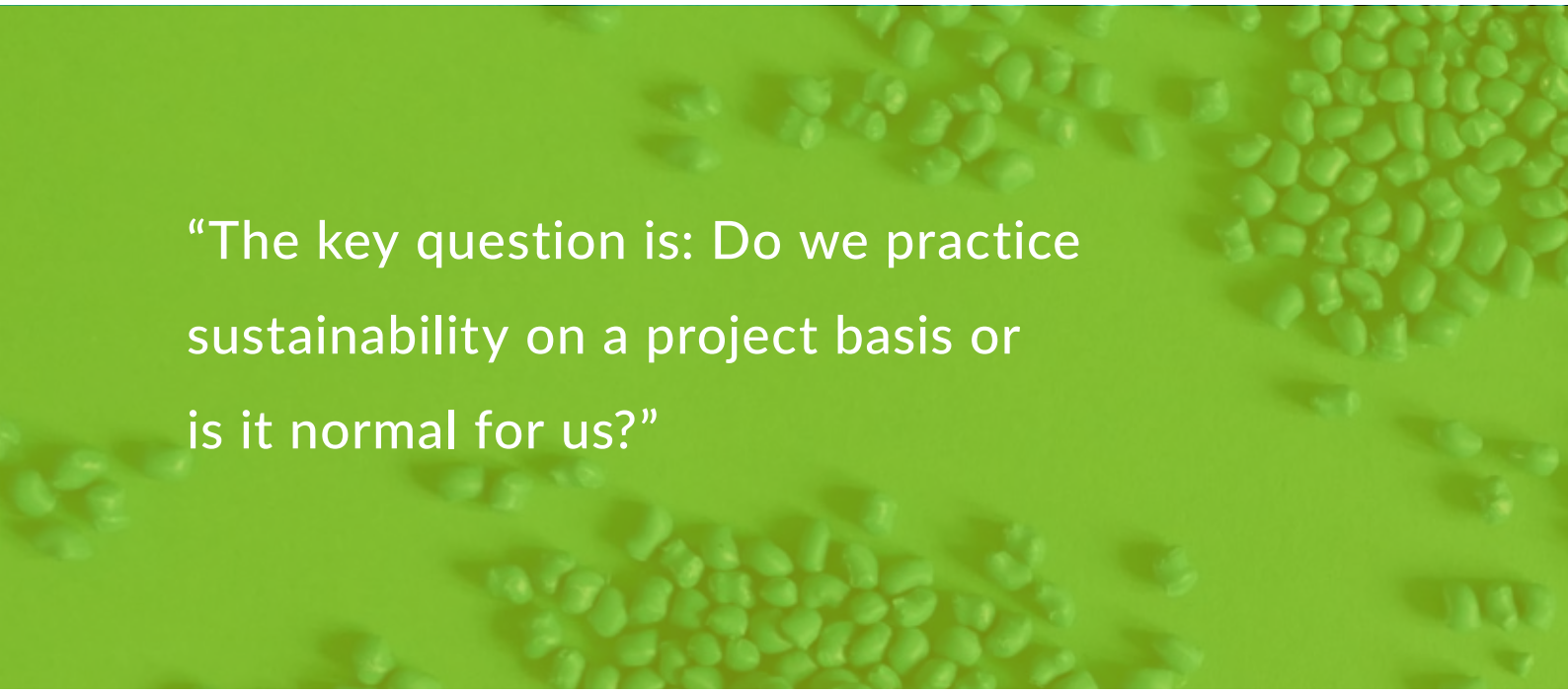
It is true that ‘purpose’ is very fashionable in business. But the question is how believably you can be that you actually are sustainable. These days, consumers are much more able to do their own research on whether promises made by companies are actually kept. The half-life of empty marketing slogans is getting shorter.

If what you say is true that only a medium-sized company can really operate sustainably because it is largely independent of shareholder value, this would be bad news for the circular economy.

I am not saying that the big players can never achieve sustainability in practice. But it takes them much longer. First, losing face in society has to become a worse fate than not listening to stock market analysts. As long as this is not the case, much of what is called sustainability will in fact be nothing but marketing.

Which particular aspects of this do you dislike?

I dislike the fact that it triggers emotional reflexes without creating a real solution to the problem. I call this symbolic romanticism. If I buy a few kilos of so-called ocean plastic from an NGO for a lot of money and produce a limited edition of a few thousand bottles, each containing 20 per cent of this material – what have I achieved? At best, I have made a few consumers feel good. This is a modern form of selling indulgences: It has nothing in common with a genuinely circular economy.



“The key question is: Do we practice sustainability on a project basis or is it normal for us?”

Are you not being a bit too polemical?

No. Because how else can you explain the fact that we are 160 times smaller than our largest competitor, but at the same time we are by far the world record holder in circulating plastic packaging made of 100 per cent recycled materials. This can only be explained by the fact that our words and our actions are the same.

The key question is: Do we practice sustainability on a project basis or is it normal for us?

How do you actually make this work? Recycled plastics of the quality you need are much more expensive than virgin materials. Afterall, it also has to add up economically.

Before the coronavirus pandemic, the recycled materials we use were about 20 per cent more expensive to buy than virgin materials. Currently, the price difference is about 100 per cent. From a business standpoint, we compensate for the resulting significant financial disadvantage from material procurement exclusively by increasing our market share. That means we accept a lower margin, while growing more strongly than our competitors.

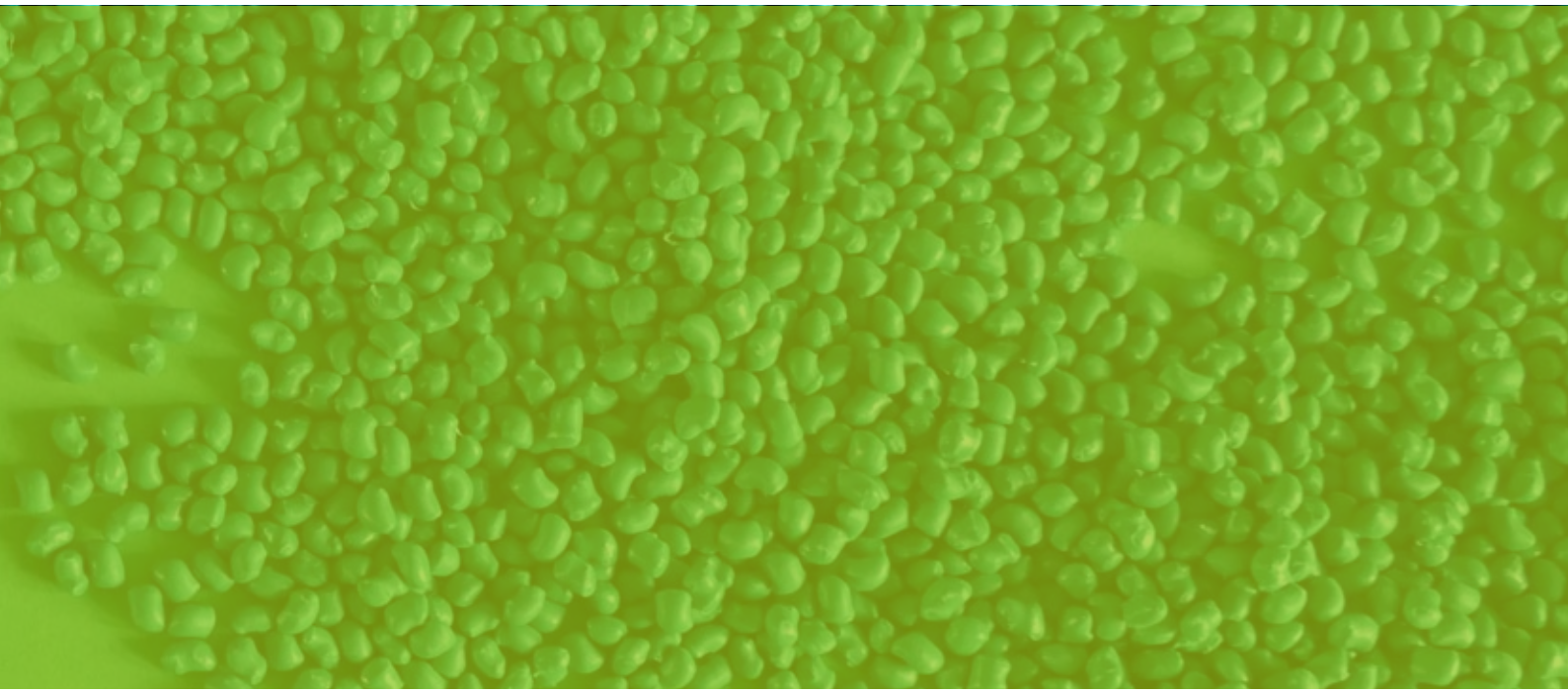
Did you deliberately decide to forego turnover profitability?

Yes, we did. Our return on sales per bottle sold is below that of the competition. But it is still sufficient to finance our investments and thus our growth. In the past two years we have made the largest investments in the history of the company into expanding our production capacities. We have an A rating with the banks, even though we procure materials more expensively. It works if you want it to. But this strategy is a marathon, not a sprint.

Nevertheless, you cannot be happy with the fact that recycling is much more expensive than a linear economic business model.

It is incomprehensible that there is no bonus-malus system in favour of companies that keep recyclable materials in curculation. The German Packaging Act even stipulates that those who put non-recyclable packaging into circulation should pay a higher licence fee to the Duales Systems than those who use packaging that is easy to recycle. In practice, however, this regulation is hardly ever applied because the ten different competing dual systems have to fear losing customers if they actually charge more for non-recyclable packaging.

As long as the policy sphere does not intervene, this results in a failing market. I cannot understand that governments, for example, massively subsidise the introduction of green forms of propulsion in the automotive sector, but at the same time hardly do anything about the issue of plastic packaging.



A tax of 800 euros per tonne of newly produced plastics has already been decided at EU level ...

Yes, but whether and to what extent this tax is implemented is at the discretion of the member states. And now the lobbyists of the business associations are already knocking on doors, saying the plastics tax will harm employment and prosperity. What nonsense.

I calculated by how much the implementation of the plastics tax would raise the production cost of a standard plastic bottle. It is 1.6 cents. Actually, that is still far too little to have an influencing effect, because it shrinks into insignificance compared to the price difference between recycled plastics and virgin materials.

What do you propose?

The plastics tax should actually be levied on the users of virgin material, but these tax revenues would not flow into the general state budget, but be earmarked for a special fund. This fund could then be used to support those who use recycled materials in order to compensate for their temporarily higher unit costs. For the users of recycled plastics, this would be a fair compensation for their cost disadvantages when it comes to procurement. And for those who still use virgin materials, it would be an incentive to start using recycled materials.

In addition to the higher price, many companies also complain about insufficient availability of recycled plastics as well as insufficiently reliable quality.

That is a protective claim. We simply went out and got the cosmetics approval for a bottle made of 100 per cent recycled HDPE. Close cooperation with the manufacturers according to the principle of open innovation is helpful for this. In many cases, the development of such tested and approved packaging is only profitable for a manufacturer if we do not take out an exclusive patent on it, but allow them to make the solution available to other companies after a short period of exclusivity.

And as far as the available quantity is concerned: Consider that more recyclable plastic is currently being incinerated in Germany than ever before. In other words, enough secondary raw material would be available. Of course, this does not apply to every plastic in the same, arbitrary quantity. Now, I can either hide behind the fact that my recycler is unable to supply exactly what I want. Or I can adapt and develop packaging for which the right secondary raw materials are available. Personally, I am in favour of the latter option.

MATERIAL AND DATA

Technologies and standards

Processes at a glance

RECYCLING AND CIRCULAR ECONOMY ARE NOT ALWAYS THE SAME

Professor Hans-Josef Endres advocates a smart combination of technologies

Until now, the roles were clearly divided: The chemical industry supplied the plastics industry with virgin materials for the production of plastic components. The recycling companies sorted, cleaned and shredded used plastic articles in mechanical processes and supplied the plastics processors on the market with the recycled plastics obtained in this way. Everybody kept to their own turf.

With the introduction of chemical recycling processes, which are strictly speaking not new but are now increasingly being used, companies in the chemical industry are entering a market that is new to them. They are adding another source of raw materials in addition to crude oil, namely used plastics.

In the process, the chemical industry is also claiming the term 'recycled materials' previously used in mechanical recycling. This terminology is now also used to refer to the new plastic products that are produced on the basis of chemical recycling processes. This changes the market structure. Chemical companies are entering into direct competition with the traditional recycling industry, which – unsurprisingly – is causing considerable tension there.

There are many different recycling processes with different input streams, objectives and results. Some of these are new processes, while others are established and rediscovered technologies. Often, 'recycling' is used as a blanket term, although the respective input streams and resulting end products are completely different.

In the **recycling** of plastics for **energy purposes**, the focus is on energy recovery as the end product. Relevant parameters of the input stream are, in particular, the calorific value and undesirable components in terms of combustion, such as ash content or substances that can result in toxic or corrosive combustion products.

In addition, there is also so-called **biological or organic recycling**. This includes biological degradation processes that produce biomass, carbon dioxide, water or methane as end products. In a broader sense, **enzymatic recycling** also belongs to the biological processes. This process focuses on the targeted degradation by enzymes of a component, such as cotton to recover polyester fibres from a polyester/cotton mixed fabric.

In **chemical recycling**, substances for re-polymerisation represent the end result. In the case of **mechanical recycling**, the focus is on the original plastic itself as the end product.

In addition, there are other procedures that result from a combination of various chemical and physical processes, which are to be summarised as **physical recycling processes** in order to differentiate them from **chemical recycling**. These include in particular so-called **solvent-based recycling**, in which certain polymers are selectively dissolved by specifically acting solvents and then recovered from the solvents in several steps. The polymer itself is merely dissolved while its structure remains intact.

Energy or biological recycling are processes are not aimed at establishing a material cycle, because after incineration or biological degradation, the material cannot be recovered. Referring to such processes as recycling is therefore misleading.

In contrast, chemical, mechanical and physical recycling processes are **material recycling processes** that can be further subdivided into **raw material and feedstock recycling**. Raw material recycling, i.e. chemical recycling, represents the recovery of feedstock substances for re-polymerisation, and should therefore be distinguished from mechanical recycling.

In terms of input streams, a distinction is essentially made between the **recycling of post-consumer and pre-consumer (post-industrial) waste**. Post-consumer waste includes waste after it has been used by households as well as public, commercial and industrial facilities. Pre-consumer waste is essentially materials before their use phase, i.e. waste from the manufacturing processes of a material or product.

In principle, the various recycling processes can be applied to both pre-consumer and post-consumer waste, but certain processes differ in how well or poorly suited they are for certain input streams. Biological recycling, for example, naturally requires that the material is biodegradable or can be metabolised. Meanwhile, the efficiency of solvent-based processes depends on the basic solubility of the polymer in question, its quantity proportions and the effectiveness of the solvent as well as the separability of solvent and polymer. Energy recovery is preferred especially in cases where the waste is highly contaminated or where there is a lack of waste treatment and sorting infrastructure.

MECHANICAL RECYCLING

Mechanical recycling is a combination of various steps of mechanical pre-treatment, followed by processing and granulation in an extruder. The quality of the product depends on the highest possible degree of purity and a low degree of contamination of the input. The pre-treatment steps of sorting, separation, washing and cleaning play a key role here.

If further material components are added during the extrusion process, the pellets are referred to as 'recompound' or 'regenerate', while in the case of pure melting without further additives, the pellets are called 'regranulate'. If the process is a simple shredding without melting or remelting in an extruder, the term 'regrind' is used. The three end products of mechanical recycling - recompound, regranulate and regrind - are subsumed under the term 'recycled plastics'.

The individual recycling steps and in particular the various pre-treatment processes as well as the purification of the melt and the addition of further material components are intended to prevent downcycling. In general, the term downcycling is used for a reduced quality of the recycled plastics, without, however, a clear definition what that means. For instance, even a change in colour, the withdrawal of certification for contact with food after recycling or altered processing properties constitute downcycling.

The processing technology for mechanical recycling involves technically well-understood processes. In recent decades, the pre-treatment steps in particular have been further optimised in terms of output quantity and quality, and recycling extruders with throughput rates of up to several 1,000 kilograms per hour have been developed for the subsequent steps.

A significant advantage of mechanical recycling over the other recycling processes are the low costs and robust technologies. From an environmental point of view, mechanical recycling is significantly more advantageous compared to the production of virgin materials from crude oil. That is because a new, immediately usable, material is created with little use of energy and other inputs such as water, chemicals or additives. How to correctly weigh the possibly reduced performance of the material as part of a life cycle assessment of mechanical recycling is a current field of scientific research.

Table 2: Overview of important plastics recycling processes

Designation	Procedure/process	Result
Enzymatic recycling	Specific degradation of polymer substances	E.g., polyester recovered from mixed fabrics by enzymatic degradation of cotton or PUR.
Biological/organic recycling	Biological polymer degradation	CO_2, H_2O, methane, biomass
Energy recovery	Incineration with energy utilisation/ recovery	Energy, (CO_2, H_2O, ash)
Solvent-based recycling	Specific dissolution and recovery of individual polymer types (from the waste stream)	Polymers of one polymer type
Mechanical recycling	Mechanical shredding	Regrind (composition identical to input stream)
	Pre-treatment of the input stream with subsequent extrusion/ granulation	Granulate, referred to as regranulate
	Pre-treatment of the input stream with subsequent extrusion/ granulation with addition of further material components	Granulate, referred to as recompound/regenerate
Chemical recycling	Pyrolysis	Pyrolysis oil, gas and solid carbon
	Gasification	high-calorific gases
	Liquified natural gas hydrogenation	Saturated liquid hydrocarbons
	Methanolysis	PET: Dimethyl terephthalate
	Solvolysis (glycolysis, hydrolysis, alcoholysis)	PET glycolysates Bis(hydroxyethyl) terephthalate, various acids, esters etc.
	Ammonolysis	Amines

CHEMICAL RECYCLING

In chemical recycling, there are a number of sub-processes that can be classified as either thermolysis or chemical depolymerisation. Thermolysis involves decomposition reactions as a result of heating processes, while in the second group it is mainly chemically induced reactions that lead to depolymerisation.

All processes not only require a higher energy input to generate the high temperatures and pressures involved,

but also the use of liquefied natural gas, hydrogen or other chemical substances to reverse the polymerisation. The resulting depolymerisation products are then polymerised again together with petro-based components and thereby processed into synthetic materials. For this purpose, for example, the pyrolysis oil is directly cracked together with petrochemical products. The steps that follow are identical to the those in conventional plastics production.

In these processes, the recycled carbon cannot be physically tracked directly. The processor who buys the materials from chemical recycling eventually receives a declaration of conformity from the manufacturer about the recycled content for the purchased product, but this does not mean that the recycled carbon itself is necessarily included in the purchased product.

The various chemical recycling processes are at different stages of technical maturity, most still being in the development and scaling-up phase. At an industrial scale, chemical depolymerisation processes are usually technically complex. Moreover, because the subsequent polymerisation of the obtained depolymerisation products is integrated into established processes and facilities for plastics production, the plant technology set up centrally at the respective chemical sites is also used for this purpose.

The material quality ultimately achieved by means of chemical feedstock recycling corresponds to the quality of virgin materials. Potential organic impurities in the input stream are separated out during the various chemical processes. In this way, chemical recycling ultimately produces microbiologically and food-legal products.

Another advantage of chemical recycling is a lower requirement for purity with regard to the mix of plastics in the input stream.

With the complex process and plant technology, the cost of the recycled feedstock compared to virgin materials produced from crude oil determines the economic viability of the chemical recycling process. Due to the high energy and resource requirements, chemical recycling involves a considerable ecological impact.

Professor Hans-Josef Endres is head of the Institute for Plastics and Recycling Technology at the Leibniz University Hanover. For this POLY-PROBLEM report he has laid out a comparison of different recycling technologies.

NO EITHER-OR

The comparison of mechanical and chemical recycling shows advantages and disadvantages on both sides. The chemical processes should be used in particular where the recycled materials have to meet tough hygienic or legal requirements or where mechanical recycling is not possible. Both processes complement each other and, in the author's opinion, have the potential to make a substantial contribution to the expansion of a sustainable plastics recycling economy.

Table 3: Advantages and disadvantages of chemical versus mechanical recycling

Feature	Mechanical recycling	Chemical recycling
Input stream requirement	– (high)	+ (low)
Technical output quality	0	+
Food-legal certification of the output	0 (requires specific process certification -> challenge test)	+
Possibility of multiple recycling cycles	0 (downcycling effects)	+
Cost	+ (low)	– (high)
Technical requirements on infrastructure/processes	+ (low)	– (high)
Possibility of decentralised facilities/processes	+ (possible)	– (difficult/not economical)
Stage of maturity	+ (high)	0 (not fully matured))
Ecological impact	+	0

+ = positive, 0 = different or medium, - = negative

INTERVIEW

Standardisation expert Madina Shamsuyeva is a research associate at the Institute for Plastics and Recycling Technology at the Leibniz University Hanover. The POLYPROBLEM editorial team interviewed her about the importance of improved quality standards.

Ms Shamsuyeva, let us start with a question that would seem obvious at first glance: Is there even a clear definition of what recycled plastics are?

The term recycled plastics has been used in various application-specific DIN and EN standards since 1999. Depending on the area of application, it is used either to describe materials from used plastic products that have been cleaned and shredded (DIN EN 1566) or to describe recyclable plastic materials produced by the recycling of plastic waste (DIN EN ISO 472).

At first glance, this seems simple. But not every cleaned and shredded material is suitable for reprocessing as a secondary raw material. Moreover, the term recycled plastics says nothing about the origin of the material. For the composition and the recycling effort, however, it makes a large difference whether we are talking about waste after use (post-consumer) or material left over from industrial production or waste before use (post-production or pre-consumer). Moreover, according to the current definitions, a plastic product that only contains a proportion of recycled materials is also referred to as such. There actually is no clear definition regarding the minimum proportion of recycled materials.

At the same time, a variety of recycling processes are currently available. In view of the dynamic advance of the circular economy, this number will increase. The best-known processes so far are mechanical recycling and chemical recycling. Mechanical recycling produces a thermoplastic material that can be directly reprocessed. The current definition fits this process. Chemical recycling, on the other hand, produces monomers or other chemicals in gas, liquid or solid form. Although the products of the two processes are different, they are both referred to as recycled plastics. It is therefore obvious that the definition of the term needs to be updated and better delineated.

“No data, no market”

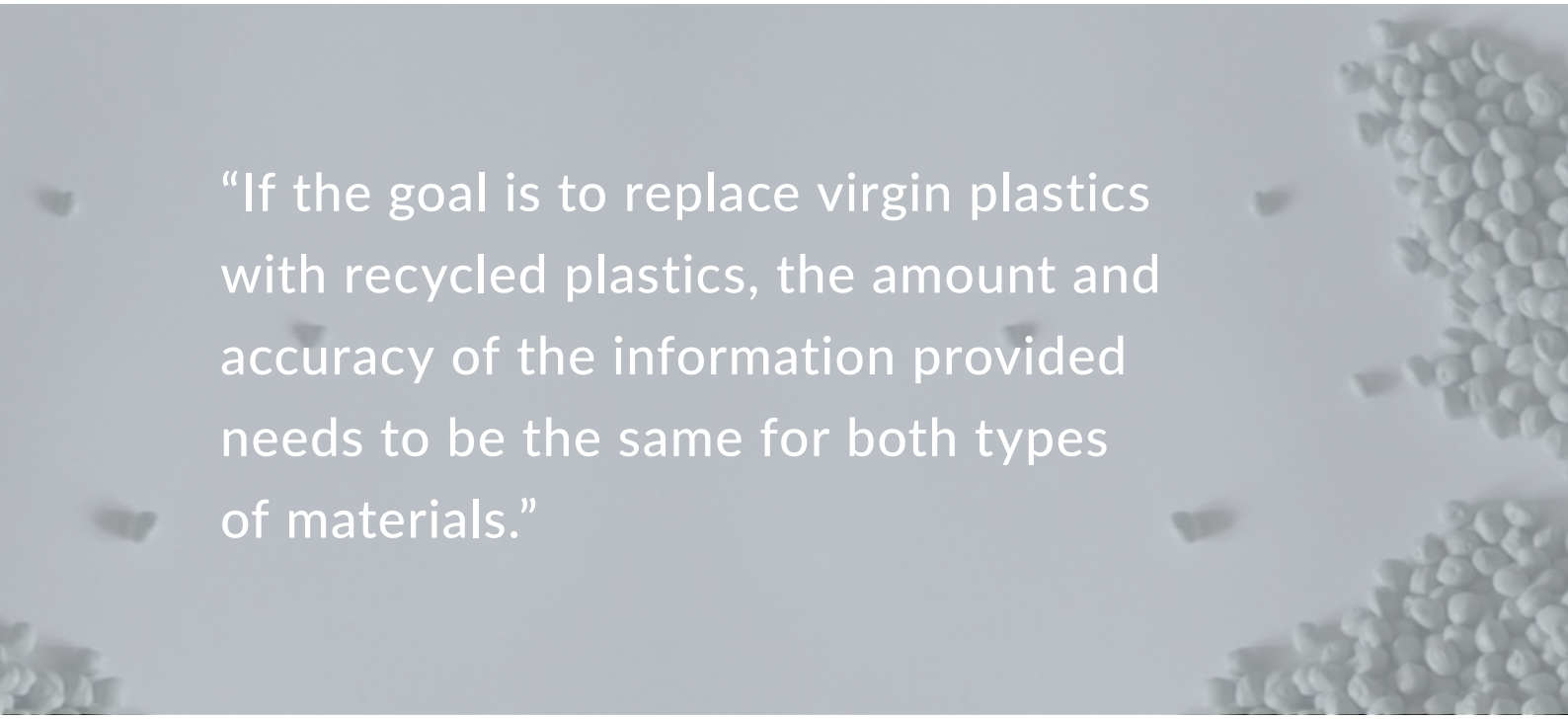
How a lack of standards stands in the way of the spread of recycled plastics

The demand for recyclable materials will increase dramatically in the coming years, partly due to government regulations and partly due to changing consumer demand. What role do quality and other standards play in this development?

Quality standards define technical information concerning a given product that the recycler needs to provide to the buyers. Standards therefore help to ensure consistent, reproducible quality. This is the most important factor for the processing of recycled plastics. Binding quality standards could therefore help to simplify and promote the domestic and global commercialisation of recycled plastics. In other words: no data, no market. Finally, quality standards promote customer acceptance. This is particularly the case in areas where end customers have direct physical contact with products made from recycled plastics, such as cosmetics or textiles.

Manufacturers of plastic products repeatedly emphasise that they would like to use more recycled plastics if only there were reliable and binding quality standards for the material. They want more certainty that they can actually meet their own customers’ requirements with recycled materials. Is this a valid objection?

The introduction of reliable quality standards would certainly promote the establishment of a value chain for recycled plastics. However, their absence is not the only reason for the sometimes still hesitant uptake in recycling. One example: The standard for the characterisation of polystyrene (DIN EN 15342:2007) has been in place since 2008. The recycling process for this material now generates high-quality output material. However, the recycling of polystyrene is comparatively more expensive than polyethylene or polypropylene. Therefore, it has so far only been recycled in very small quantities. This clearly shows that if the production and use of recycled materials is not profitable, (quality) standards will not make a difference.



Why is the information provided by the recycling companies in technical data sheets not sufficient to assess the quality of the recycled plastics that they offer?

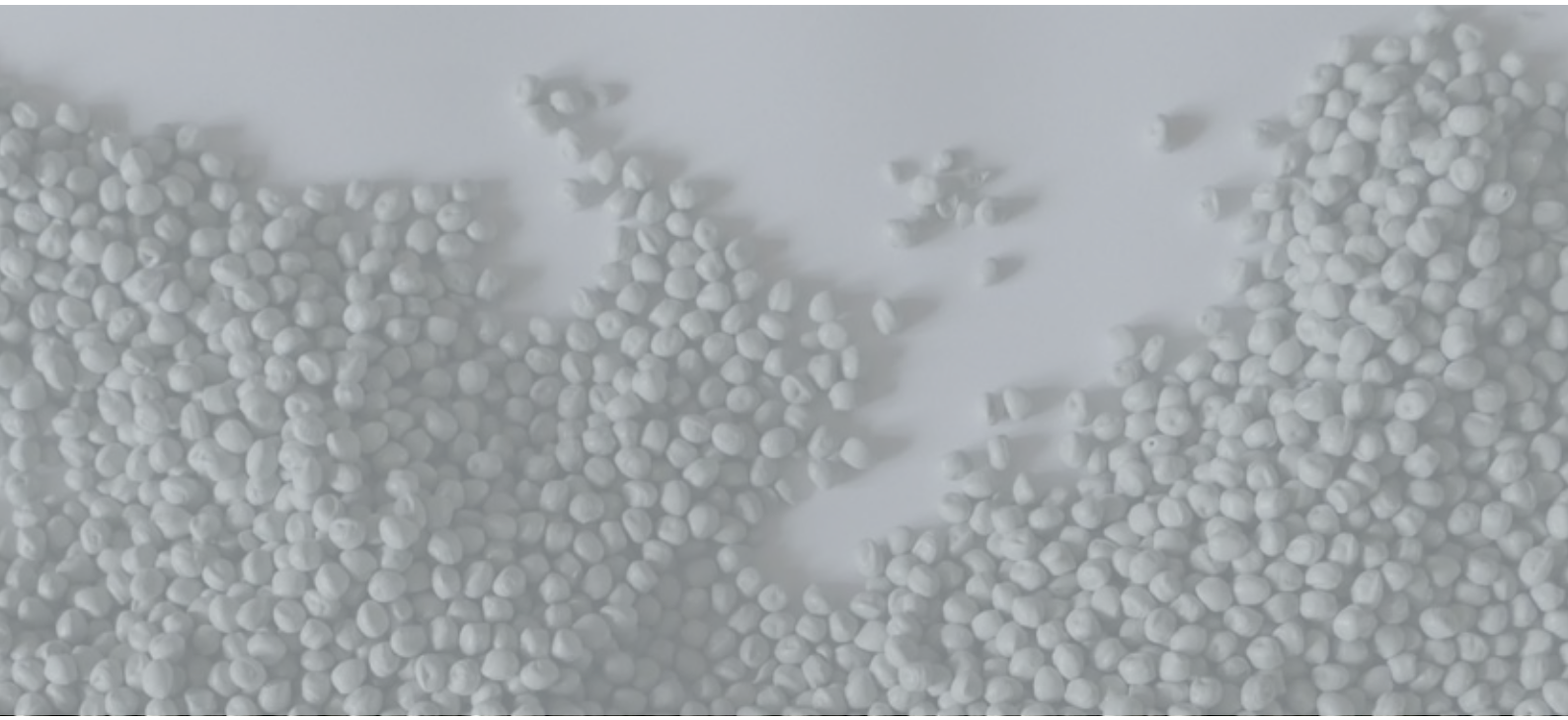
Compared to the technical data sheets for virgin materials, the data provided in the data sheets for recycled materials is significantly less plentiful and accurate. Depending on the polymer type and the recycler, the technical data sheets for recycled plastics sometimes only give four properties: Density, Melt Flow Index, melting point and residual moisture. A technical data sheet for a virgin plastic, by contrast, usually contains detailed information on the mechanical, thermal, rheological as well as other application-specific characteristic values, such as electrical properties.

If the goal is to replace virgin plastics with recycled plastics, the amount and accuracy of the information provided needs to be the same for both types of materials.

There are already a number of DIN and ISO standards. Which issues do these standards mainly deal with and what do you think is missing the most?

The existing recycling standards, most of which were developed in the early 2000s, represent the very first steps of the plastics industry towards a circular economy. One can divide these into four groups: Characterisation of certain polymers (PET, PE, PP, PS etc.), terminology and labelling, recycling of certain plastic products (PVC windows, PET bottles, etc.) as well as sampling and testing.

The first two groups are the most important, as they are used by different actors in the value chain and are currently independent of the past or future application of the recycled material. The structure of the polymer-specific standards specifies required and optional data for the characterisation of the given materials.



From a scientific point of view, some of the required data needs to be supplemented by appropriate measurement methods. For example, the colour and shape of the material for recycling is a required data point that has to be established more precisely than just by visual inspection. These standards are currently being reviewed and adapted. For example, a draft version of the revised version of the standard for PE is already available. Compared to the previous version, this new one specifies that data on the presence of PP and foreign polymers has to be provided. This is an important step forward. The remaining standards also need to be reviewed and updated.[27]

Do you currently see promising approaches to achieving more convincing quality standards? If so, which ones? And who is working on them?

A number of groups are currently working on the development of new and the revision of existing standards. For example, the German Institute for Standardisation related to DIN SPEC 91446 and the DIN Standards Committee on Recycling of Plastics in the Circular Economy. In addition to the German Institute for Standardisation, various associations also develop recommendations or guidelines for the handling and classification of recycled plastics. Since this area is developing very dynamically, there will probably be a number of different documents on this topic in the near future.

Appropriate standards seem to be an essential prerequisite to get the market for recycled plastics and thus the circular economy going. Who do you think should be the driving force here: the recyclers, the manufacturers, the users or the political sphere?

From a certain point, this will have to, of course, be teamwork. However: Only manufacturers can set the technical information and quality requirements for the recycled plastics that need to be provided to enable them to be processed and used effectively and sustainably in specific applications.

THE WASTE CHAOS IS GROWING, AND SO IS THE REGULATORY CHAOS

A personal view by Henning Wilts

Both the European Commission and the German government have set ambitious targets with regard to the market for recycled plastics: According to the EU Strategy for Plastics in the Circular Economy, the European market volume for recycled plastics is to grow four-fold by 2030, and the German Federal Ministry for the Environment also announces in its Five-Point Plan for Less Plastic and More Recycling that it wants to significantly increase the demand for recycled plastics. The ambitious plans are set against a sobering reality: a patchwork of diverse regulations that send very different signals along the entire value chain. There is no clear line in the EU on what the future of plastics in a circular economy should look like.

In order to get product suppliers and manufacturers to make plastics more recyclable, EU member states are increasingly relying on economic incentives. Simply put, those who make recyclability part of their designs, for example for packaging, should be required to pay lower licence fees to the Dual Systems. Regulations like this are already in place in France and Italy. In Germany, Paragraph 21 of the Packaging Act requires similar measures from all dual systems.

However, the multitude of different regulations for each country is very difficult to get a handle on for the producers of packaging who, after all, tend to be globally active companies. It is often cheaper for them to simply pay higher licence fees. In Germany alone, there are different assessment systems by which one and the same packaging material can be assessed differently with regard to its recyclability.

The chaos continues when it comes to the specifications for collection and recycling. Different countries have different separation systems based on different recycling rates. Where deposit systems are in place, they are not compatible across countries and therefore create incentives for all sorts of deposit fraud.

The debate on the chemical recycling of plastic waste in Europe has reached a maximum level confusion. Some countries, such as Germany, have so far taken a relatively clear position that such processes should not count towards recycling quotas for packaging. In neighbouring countries such as the Netherlands, the debate is quite different - with corresponding consequences for the assessment of what is ‘recyclable’ packaging in either country.

But even within Germany, key requirements such as the Commercial Waste Ordinance on the separate collection of plastic waste, among other things, are implemented and monitored extremely differently. This has the expected effect on the collection quality, which varies greatly from one federal state to the next.

The list of contradictory and inconsistent regulations could be continued almost indefinitely, for example when it comes to the permitted use of recycled plastics in different types of packaging, to criteria for labels for environmentally friendly packaging aimed at consumers, to the requirements for the transport of pre-sorted plastic waste, which is regulated very differently between the EU member states, but also between the German federal states. For example, what may be transported from the sorter to the recycler subject to manageable environmental requirements in one country is classified as hazardous waste in the next and may therefore only be transported with special vehicles.

Many of these different regulations reflect the diversity of waste management infrastructures, cultural characteristics or historically developed legal philosophies. The conditions for the circular economy in the Netherlands are different from those in Bulgaria, as are those in the Ruhr region compared to the Uckermark in Germany, for example. Of course, it must be possible to take this into account when designing regulations that can be adapted.

If one considers the permitted use of recycled plastics in sensitive areas of application, it is understandable that some countries without the necessary technical infrastructure for monitoring such regulations are often rather cautious and, because of that level of caution, can be restrictive. They are well aware of the risks that could arise for the consumer if upper limits for contaminants, for example, were exceeded.

Conversely, however, more attention must be paid to how massively the national and municipal regulations described above hinder the emergence of a European market for recycled plastics. There is an abundance of studies that point to the massive cost advantages of a real circular economy in plastics. But such advantages are not realised in practice, partly because the market for virgin materials is so much more uniform, standardised and thus more efficiently organised than the market for recycled plastics.

The potential savings of producing plastics from household waste instead of crude oil are swallowed by the chaotic bureaucracy of these requirements. An economist would call this ‘transaction costs’. Even companies that want to operate sustainably end up sticking to the use of primary plastics optimised for decades. Once they have had to deal with the detailed regulations of the European member states, or even further afield in the global market as to where and when which recycled plastics may be used, they tend to lose heart.

A lack of clarity and small scale of production then also result in a lack of trust among the companies, which in turn creates further obstacles in terms of psychology and business management. In addition, there is the crucial factor of economies of scale: Generally speaking, the larger the plant, the larger the market, the lower the average costs. The very small-scale market for recycled plastics – because its regulations are very compartmentalised – competes with some of the largest companies in the world that have perfected the production of primary plastics– and have only been able to survive for this reason.

From the perspective of the circular economy, there is an urgent need for political consideration: Where do the advantages of small-scale and differentiated regulation outweigh the disadvantages, where would a strengthened circular economy bring greater ecological, but also socio-economic advantages? On the other hand, could more flexible forms of regulation be found that reconcile the interests of both sides?

Often enough, it would only be easily feasible harmonisations that could, for example, promote a green public procurement policy. Is there really a need for national colour specifications for products such as garbage containers, which would then make it more difficult for foreign manufacturers to produce the recycled plastics to make them? A state of affairs that means that too many of these are still made from virgin plastics?

In all of this, it is often overlooked that we are running out of time to be having this discussion: There still is time for Europe to become a pioneer for the circular economy of plastics and to implement it according to its own ideas. However, it is becoming apparent that China, for example, is investing heavily in this sector. China has long since taken on a global pioneering role when it comes to publications in scientific journals or patent applications. So it is foreseeable that in the near future such considerations will no longer be driven by Brussels or Berlin, but by Beijing.

It is therefore urgently required to turn the above-mentioned ambitious goals into reality and to create the appropriate framework conditions for the necessary transformation process.

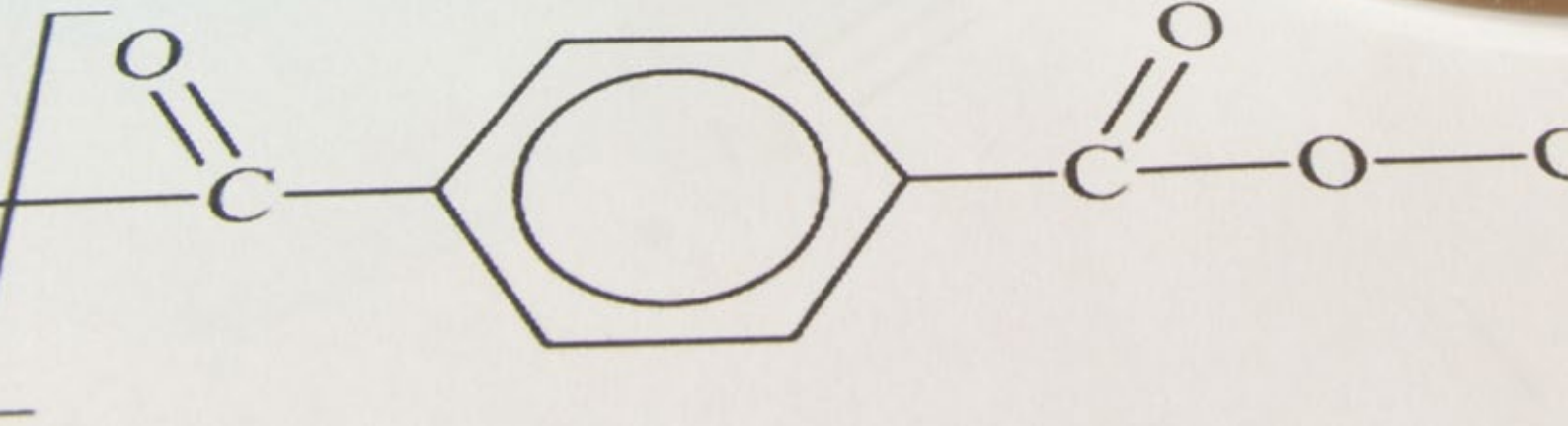
The current chaos may benefit those who are still profiting from the linear economy in the short term. In the medium term, the question is whether the income generated from the circular economy is to be generated in Europe or elsewhere. Just like the question of whether we still want to have a say in setting environmental standards for the market for recycled plastics or whether we will be beholden to other regions of the world, as in the market for crude oil.

Time is pressing!

The author, Henning Wilts, is in charge of circular economy at the Wuppertal Institute.

CHANGE IS POSSIBLE

A conclusion



WE NEED A SMART MIX OF ACTIONS

Used plastics are no longer waste. It is the preferred raw material for the production of plastic items. This is true for both packaging and technical applications. Recycled plastics are available in sufficient quantities in the required quality and are being traded at competitive prices in a transparent market.

This situation, here still formulated as a vision, must be realised quickly. Surveys such as the highly regarded study Breaking the Plastic Wave[28] conducted by the PEW Charitable Trusts and Systemiq show that a transformation of the recycling system is a central building block for avoiding a massive increase in the dramatic environmental damage that is already happening. In the face of rapidly increasing plastic production volumes, this is urgently needed.

The good news is that it is feasible. However, a bundle of different measures is necessary to reach this goal, rather than the one magic bullet. And precisely that is the challenge.

Measures being considered by legislators should ideally meet all five of the following guiding criteria:

1. They favour the most economical use of virgin materials.

2. They make the use of recycled plastics more economically viable than virgin materials. The price of virgin materials should include the cost of the environmental impact of their production, namely pollution and CO2 emissions.

3. They establish an incentive system that continuously increases the share of recyclable plastics in production and use.

4. They follow the hierarchy of the circular economy. This means that the incentive effect is strictly based on the life cycle analysis for each type of plastic and application, with the aim of keeping the hydrocarbons that are part of the polymer in the cycle for as long as possible and as energy-efficiently as possible.

5. They prevent a situation where the increase in the price of virgin materials diverts users into alternative materials (paper, glass, metal) with a possibly worse overall ecological footprint compared to that of cleanly recycled plastics.

The following interventions can contribute to meeting these criteria:

TAXES AND DUTIES

— The tax of 800 euros per tonne of virgin materials used, which has already been decided at the EU level, should soon be implemented by the member states. The resulting revenue should, in contrast to what has been envisaged so far, not come into the general state budget, but be earmarked to promote research and development as well as an improved recycling infrastructure.

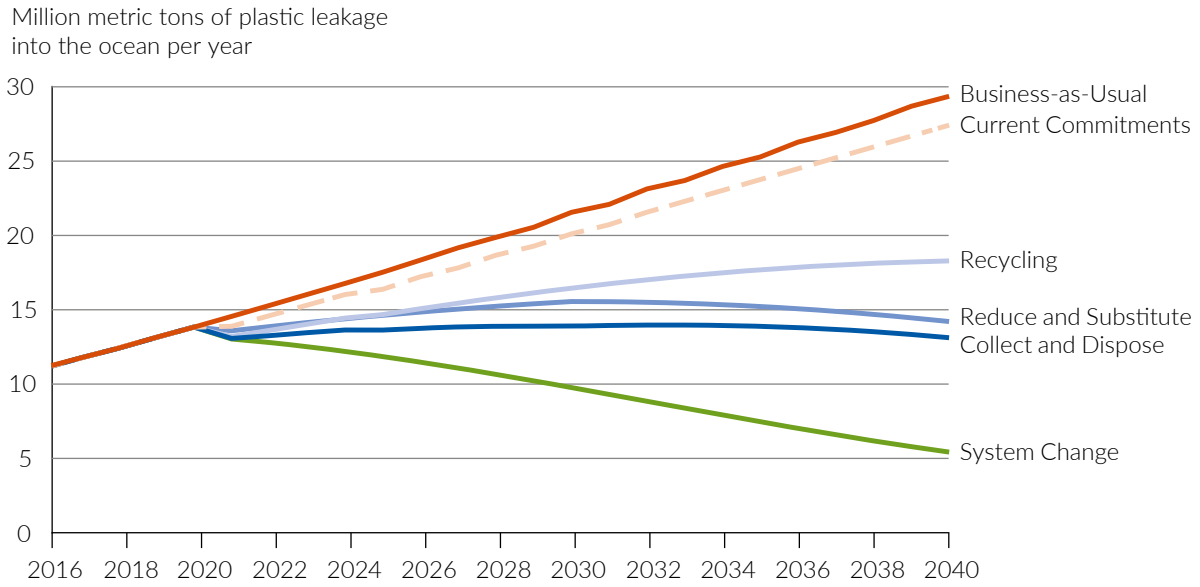
— The exemption of virgin materials from the energy tax should be eliminated.

— A trade in plastics recycling certificates - analogous to CO2 certificate trading - would result in the incentivising of recycling: Those who recycle plastics would generate ‘plastic recycling certificates’, which the manufacturers of new products would have to purchase in order to be allowed to produce a proportional amount of new plastics. This creates a market mechanism for linking recycling to the production of virgin materials.

— The regulation already laid down in the German Packaging Act (Paragraph 21) to reward the distributors of plastic packaging for good recyclability (Paragraph 21, Section 1 (1)) or the use of recycled plastics (Paragraph 21, Section 1 (2)) needs to be reinforced. The desired incentive effect can only

28 PEW Charitable Trusts, Systemiq (2020)

Development of plastic pollution of the oceans based on different assumptions



According to a model in the study Breaking the Plastic Wave by Systemiq and The Pew Chartiable Trusts, a fundamental transformation of the system towards a circular economy could reduce annual amount of plastic pollution of the oceans by about 80 per cent compared to continuing the current linear business model. The data-driven model also shows that focusing on single pathways, reduce and replace, for example, would not result in the annual amount of plastics emitted into the oceans falling below 2016 levels.

Source: PEW Charitable Trusts, Systemiq (2020)

occur if the bonus-malus regulation of Paragraph 21 is aimed at the price of virgin materials.

— The deposit system already commonly used for beverage bottles should be extended to other types of plastic products. This could - as already successfully practised for PET - also provide for largely 'pure' input streams and thus raise the quality of the recycling products for other types of plastic as well.

— Use quotas for recycled materials

— As a yardstick for the success of the circular economy, a 'quota for the reuse of recycled materials' should replace the recycling rate that is common today. In the area of consumer waste, the latter today only describes the amount of plastics that are fed into a sorting process, but not the amount actually recycled and reused. Therefore, the recycling rate suggests a much higher effectiveness than is actually the case. A quota for the reuse of recycled materials, on the other hand, would provide a clearer view of the state of the circular economy.

— Minimum use quotas for recycled materials should not be formulated in general terms, but specifically for the different types of plastic and their applications. The conditions under which plastics are produced and uses vary greatly. Only with more specific quotas can the plastics processing industry contribute to the achievement of the set research and development targets - especially when it not only comes to packaging but also to technical applications of plastics.

QUALITY STANDARDS AND TRANSPARENCY

— Providing comprehensive documentation of properties, behaviour and performance characteristics is considerably more difficult and costly for recycled materials than for virgin materials. The plastics processing industry needs reliable information. Insufficient standards are a significant barrier to greater use of recycled materials. Therefore, the setting of standards must be promoted more forcefully. Mechanical recyclers should be partially compensated for the associated costs - counter-financed, for example, by revenues from a future plastics tax.

RESEARCH AND INVESTMENT

— The recycling industry must expand its production capacities and invest in improved processes in order to be able to meet an increasing demand resulting from the measures described here. However, it is precisely here that the lack of the necessary funds - due to the current market disadvantages of their products - is felt most keenly. This chicken-and-egg-problem needs to be solved. Tax incentives for research and development expenditures, loans at favourable conditions and an intensified call for funding programmes, among a number of other measures, could help here.

PUBLIC PROCUREMENT

— The public sector is a major client and purchaser. Recyclable products and those with a high proportion of recycled materials should be treated preferentially in public procurement, even if this involves short-term cost increases due to the higher price of recycled materials. Such criteria should be included in all publicly awarded contracts and tenders. This would act as a signal and multiplying factor for the private sector.

COMMUNICATION AND TRANSPARENCY

— At present, consumers are almost only provided with information about the proportion of recycled materials in a product or packaging, if a supplier explicitly advertises a sustainably designed product as such. In the future, consumers should be informed about the recyclability of each product and packaging that they buy in an easily understandable and conspicuous manner. This information should include both the proportion of recycled materials and the recyclability after use. Furthermore, it should be explicitly stated whether the recycled plastics contained in the product actually comes from household recycling (which is still more difficult to recycle) or from the waste streams of commercial and production waste that are comparatively easier to recycle.

— When countries, industrial companies and associations enter into long-term voluntary commitments to improve the circular economy, progress towards the promised goals should be easier to measure than now and be presented to the public with all due transparency. A cross-sectoral reporting standard can help here, as is already common practice for measuring the impact of social innovations, for example.

RESTRICTIONS ON EXPORT AND LANDFILL

— The export of difficult-to-recyclable plastic waste should be banned. In addition, there should be restrictions on landfilling, as close as possible to a full ban on landfilling. The latter is already a reality in Germany, but not in other EU member states.

A HOLISTIC MISSION

The key insight that the authors of this POLYPROBLEM report took away from their research is: None of the interventions laid out here will work on their own. Not one measure will be sufficient to set up a circular market for plastics.

It is crucial to complement and support the market-based principle of supply and demand by wisely combined measures. It will take a comprehensive package of mutually reinforcing activities.

POLY
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POLYPROBLEM: Knowledge. Transparency. Cooperation

POLYPROBLEM is a joint initiative of the non-profit Röchling Foundation and the consultancy Wider Sense. In 2019, the two organisations published a study under the same title that came to the sobering conclusion that despite the lively public interest in the increasing pollution caused by plastic waste, a global agenda remains out of reach. In addition, there are only a few resources that provide continuous, comprehensive and academically sound information on this topic.

As a collaborative effort between the private sector, foundations, NGOs, academia and the political sphere, POLYPROBLEM is intended to close this gap and help to support the best innovations for an environment free of plastic waste.

Together with experts involved in both research and practical applications, POLYPROBLEM is published twice per year and covers the latest developments and most pressing questions around the topic of Plastics and the Environment. The aim is to make indistinct fields of action clearer, more transparent and help to define a new direction, but also to inform on surprising or previously unexplored aspects.

www.polyproblem.org

RÖCHLING STIFTUNG

The Röchling Foundation focuses on the issue of plastics and the environment. It supports both research projects and civil society initiatives that contribute to the responsible use of plastics in line with a sustainable circular economy. The Röchling Foundation sees its role as more than a mere funding partner, but is primarily engaged in establishing new, cross-sector cooperation and networks.

Under this thematic agenda, the Foundation also initiates its own activities that contribute to a comprehensive understanding of and integrated solutions to the global challenge around plastics and the environment.

The Röchling Foundation was established in 1990 by the Röchling family. The family also owns the Röchling Group, one of the leading international suppliers of high-performance plastics for the automotive sector, industrial applications and medical technology.

www.roechling-stiftung.de
info@roechling-stiftung.de

WIDER SENSE

WIDER SENSE supports companies and foundations in effectively shaping social change. This happens through advice specifically tailored to the needs of the clients, from research to strategy to implementation. Since May 2015, WIDER SENSE has also been a certified B Corporation. Over the past years, WIDER SENSE has generated expertise in CSR, philanthropy and social investment as well as establishing a global network of strategic partners. With its international reach and multidisciplinary team, WIDER SENSE has worked with more than 100 clients on projects in over 30 countries, which have directly impacted social change funds in excess of 100 million euros.

https://widersense.org
info@widersense.org

LINKS TO THE ORGANIZATIONS MENTIONED

Organisation	Acronym	Link
BASF SE	BASF	https://www.basf.com/global/de/who-we-are/sustainability/we-drive-sustainable-solutions/circular-economy.html
Borealis AG		https://www.borealisgroup.com
Changing Markets Foundation		https://changingmarkets.org
Circular Plastics Alliance		https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance_en
cirplus GmbH		https://www.cirplus.com
Conversio Market & Strategy GmbH		https://www.conversio-gmbh.com/de
Der Grüne Punkt – Duales System Deutschland GmbH	DSD	https://www.gruener-punkt.de
German Institute for Standardisation	DIN	https://www.din.de
Ecoplast Kunststoffrecycling Ges.m.b.H	EcoPlast	https://www.ecoplast.com
Ellen MacArthur Foundation		https://www.ellenmacarthurfoundation.org
European Commission		https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32019D0665&from=EN
European Plastics Converters		https://www.plasticsconverters.eu
General Association of the Plastics Processing Industries	GKV	https://www.gkv.de
Independent Commodity Intelligence Services	ICIS	https://www.icis.com
Institute for Plastics and Recycling Technology at the Leibniz University Hanover	IKK	https://www.ikk.uni-hannover.de
International Organization for Standardization	ISO	https://www.iso.org
INTERPOL		https://www.interpol.int
mtm plastics GmbH		https://mtm-plastics.eu
New Plastics Economy		https://www.newplasticseconomy.org
Global Environment Facility	GEF	https://www.thegef.org/
Organisation for Economic		
Cooperation and Development	OECD	https://www.oecd.org/environment/waste/policy-highlights-extended-producer-responsibility-and-the-impact-of-online-sales.pdf
Öko Institut e.V.		https://www.oeko.de/forschung-beratung/themen/rohstoffe-und-recycling
PEW Charitable Trusts	PEW	https://www.pewtrusts.org
Procter & Gamble	P&G	https://de.pg.com/
Sinus Institut		https://www.sinus-institut.de
Systemiq		https://www.systemiq.earth/
Knowledge and Innovation Network for Polymer Technology	WIP	https://wip-kunststoffe.de
Wuppertal Institute		https://wupperinst.org

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The following people were interviewed for this report:

DSD – Duales System Holding GmbH & Co. KG: Michael Wiener, CEO

Institute for Plastics and Recycling Technology at the Leibniz University Hanover:
Madina Shamsuyeva, Research Associate

Institute for Plastics and Recycling Technology at the Leibniz University Hanover:
Hans-Josef Endres, Professor

OECD: Peter Börkey, Principal Administrator, OECD Environment Directorate

Proctor & Gamble Service GmbH: Gabriele Hässig, Managing Director Communikations and Sustainability

Werner & Mertz GmbH: Reinhard Schneider, CEO and Equity Holder

WIP – Kunststoffe e.V., Knowledge and Innovation Network for Polymer Technology: Berit Bartram, Koordinatorin

Wuppertal Institute gGmbH: Henning Wilts, Director Circular Economy