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Corporate self-commitments to mitigate the global plastic crisis: Recycling rather than reduction and reuse

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ABSTRACT

An increasing number of companies are voluntarily committing to help complete the transition from a linear to a circular economy, thereby curbing the global environmental pollution caused by plastics. The various endeavours are codified both by signing global commitments, like the *New Plastics Economy Global Commitment*, and by incorporating individual plastic strategies in sustainability reports. However, a critical analysis of whether these voluntary commitments can mitigate the plastic crisis and shape the transformation towards a circular economy is lacking. This paper qualitatively analyzes the self-commitments of ten international consumer goods manufacturers and reconstructs their understanding of the circular economy concept itself as well as the related key concepts: reduction, reuse, and recycling (3Rs). It can be demonstrated that a uniform definition of the 3Rs is missing and that the concepts of reduction and reuse are mostly associated with recycling. As this prevents the rigorous implementation of a circular economy from the outset, commitments must be strictly evaluated based on unambiguous definitions and this is currently not being done.

1. Introduction

Plastic has many advantages: products are, for example, durable, hygienic, light weight and cost effective (Rhein and Schmid, 2020). However, the flood of single-use plastic items, especially packaging, and their, typically, uncontrolled disposal have reached a level that threatens all ecosystems worldwide (Geyer et al., 2017). Thus, the fight against the global environmental pollution caused by plastic waste is one of the greatest challenges of our time (Beaumont et al., 2019; Derraik 2002). The pollution of the world's oceans, in particular, has attracted a great deal of attention in recent years and has triggered a multitude of measures to mitigate the environmental destruction caused by plastics (Ogunola et al., 2018; Vince and Hardesty, 2017; Xanthos and Walker, 2017).

The transformation of economic systems and processes from a *linear* towards a *circular economy* is considered to be a long-term solution to the environmental problems caused by plastic packaging waste, a solution which goes hand-in-hand with both economic and ecologic sustainability (European Commission, 2018; Kirchherr et al., 2018). Such a transformation, however, requires a coherent approach by all actors and, particularly, a high degree of cooperation on the part of companies. The *New Plastics Global Commitment*, initiated by the Ellen MacArthur Foundation, supported by the United Nations' Environmental Program and launched in 2018, is focused on this goal. It provides businesses, governments and other organizations with the opportunity to voluntarily commit to a "common vision and targets to address plastic waste and pollution at its source" (Ellen MacArthur Foundation, 2020, n. p.; see also Ellen MacArthur Foundation et al., 2016). The New Plastics Global Commitment provides a set of targets that should be met on the way towards a circular economy of plastic, in which plastic "never becomes waste" (NPEGC, 2019). Companies, governments and NGOs, among others, can be a part of this voluntary self-commitment to support the circular rather than linear economic processes. The Global Commitment now unites more than 450 actors (NPEGC, 2020a). Those who belong to the manufacturing industry account for approximately 20% of plastic packaging produced globally. The signatories commit themselves to implementing measures *by 2025* for the sustainable use of plastic and, especially, to *eliminate* unnecessary plastic items, to ensure *reusability*, *recyclability* and/or *compostability* of plastic through *innovations*, and to *circulate* all plastic items so that these

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do not end up as waste (NPEGC, 2019).

Besides signing global and cross-company joint commitments like the New Plastics Global Commitment, companies also make individual commitments and concretize their endeavours towards a more sustainable use of plastic within their sustainability reports and press releases (Stewart and Niero, 2018). These corporate statements can convey the impression that companies are working strictly on a transformation from a linear to a circular economy. A closer look at the commonly used, elaborate marketing terminology, however, reveals that these statements are neither fully in-line with a strict interpretation of the circular economy concept, nor do they use the related terminology in an unambiguous and precise manner.

Due to the growing importance of voluntary commitments to mitigate the plastic crisis (Schmaltz et al., 2020), it is necessary to analyze and assess these commitments' effectiveness for achieving a circular economy. Therefore, this paper analyzes the individual, plastic-related commitments of the ten biggest consumer goods manufacturers, whose packages are most frequently found in worldwide waste counts on coasts and beaches (breakfreefromplastic, 2018; Ryan et al., 2019; Schnurr et al., 2018). In doing so, the following research questions are addressed:

- What do companies associate with the concept of a *circular economy*?
- How do companies interpret the three core requirements of a circular economy – *reduction, reuse* and *recycling*?
- Do the corporate targets (really) support the transformation towards a circular economy in its strict sense?

The paper demonstrates that the ambiguous use of terminology and imprecise consideration of the standards of the waste hierarchy lead to a strong focus on recycling and, thus, hinder the implementation of a circular economy. The paper is structured as follows: Section 2 briefly introduces the circular economy concept and discusses both the (missing) definitions of related terms and concepts and the current state of research. The verbal database as well as the applied qualitative method are introduced in Section 3. Results are presented in Section 4 and critically discussed in the light of the endeavour to implement an environmentally friendly circular economy in Section 5.

2. The circular economy concept and relevant related research

In order to evaluate corporate voluntary commitments regarding their effectiveness in mitigating the plastics crisis and, in particular, establishing a circular economy, it is important to introduce the specific understanding of circular economy and the related concepts that we then use to assess the companies' statements. According to the Ellen MacArthur foundation, a circular economy can be thought of as "an industrial economy that is restorative or regenerative by intention and design" (2013: 14) Instead of carrying products and materials from "cradle to grave" – true to the motto: *take, make, dispose* – the circular economy strives for loops that are as closed as possible and carry *things* from "cradle to cradle" (Braungart et al., 2007; Gregson et al., 2015). However, whether these targeted loops are primarily thought of as loops of product flows or loops of material flows, varies in the relevant literature (Bocken et al., 2016; Kirchherr et al., 2018; Korhonen et al., 2018; Zink and Geyer, 2017). This is particularly interesting as the relation between the endeavour of *keeping products in a cycle* and of *keeping materials in a cycle* can be clarified with the help of the waste hierarchy (Fig. 1), which is commonly accepted as an important cornerstone of a circular economy (Kalmykova et al., 2018; Pires and Martinho, 2019).

The waste hierarchy as laid down in the European Commission's Directive 2008/98/EC on waste (Waste Framework Directive), represents the European idea of how waste is to be classified and managed (European Parliament and the Council, 2008; European Commission, 2019). It is based on the 4Rs-framework and ranks waste prevention and reduction measures according to their importance in protecting the environment: *Reduction*, *Reuse*, *Recycling* and *Recovery* (Sihvonen and Ritola, 2015).

Referring to the waste hierarchy, the a-priori reduction, i.e., the *prevention* of waste has top priority. Consequently, it is of utmost importance that products and/or packaging are designed in such a way that they do not easily become waste and/or that they consume as few resources as possible (Hultman and Corvellec, 2012). According to the European Union's Waste Framework Directive, the second highest priority is given to the idea of *(preparation for) reuse*, which refers to the repeated use of products for there original purpose (Morseletto, 2020). The repeated use of materials is addressed by the term *recycling*. Recycling can be further categorized according to the purpose for which the reclaimed *material* is used: either the same purpose or a different one (European Parliament and the Council, 2008). However, the differentiation between *reuse* and *recycling* is not always as clear as that implied by the European Waste Directive. In particular, the process of *recycling* and the subsequent use of recycling materials for the same purpose as before, is referred to as *reuse* as well (Zink and Geyer, 2017). Such a interpretation of the term *reuse* appears problematic as it weakens the strict requirements of the waste hierarchy and makes recycling look as if it were a second-level measure on the way towards a circular economy.

Consideration of the waste hierarchy can be completed by examining *recovery*, which means the incineration of waste to generate energy, and *disposal* (e.g., landfills): these should occupy the lowest two ranks in the waste hierarchy, whereby the latter option is to be used as little as possible (Hultman and Corvellec, 2012). The waste hierarchy must be implemented by the member states of the European Union in their national legislation (European Commission, 2019).

In summary, and addressing the question of whether products or materials are to be kept in a cycle, it becomes clear that circular economic processes must be differentiated into *two levels of loops*. On the upper level, it must be ensured that products themselves are kept in a cycle of reuse. Only when reuse is no longer possible should products be recycled. Therefore, on the *practical* level, the implementation of the circular economy requires business visions that go far beyond recycling and specifically question single-use systems and mass packaging (European Commission, 2018).

Research regarding *companies*' understanding of the circular economy concept and related terms is scarce. It is known that companies associate the circular economy primarily with waste management in general (Ghisellini et al., 2016), product design or design for recycling (De los Rios and Charnely, 2017) and the need to develop new business models (Bocken et al., 2016; Heyes et al., 2018; Lüdeke-Freund et al., 2019). There is even less research investigating what exactly companies associate with these strategies and how these associations relate to the conceptual confusion outlined above. Stewart and Niero (2018), for example, discovered that companies follow the 3Rs, *reduce, reuse* and *recycling* to achieve a circular economy. However, the applied quantitative research approach does not enable statements to be made about what exactly the companies associate with these terms and how they are related, and whether they follow the strict definition of reduction, reuse, and recycling as introduced by the European Union, or a more ambiguous one. In order to realize a common and efficient development of a circular economy, however, this understanding is

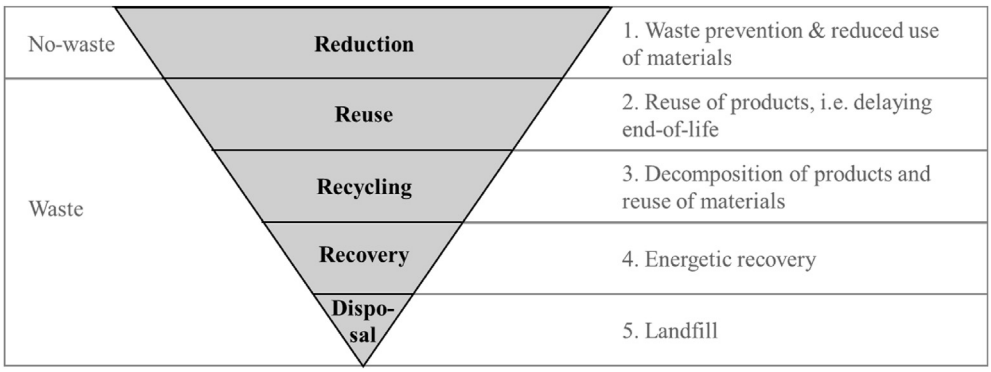

Fig. 1. The waste hierarchy. Illustration referring to European Commission (2019) and Kirchherr et al. (2017).

of particular importance as loopholes introduced by varying interpretations of terms and fuzzy definitions allow companies to operate at a lower, less environmentally friendly standard of the waste hierarchy, while appearing absolutely "green".

3. Data and method

This paper's qualitative analyses are based on a dataset from the publicly accessible strategies concerning plastic use by the ten companies, whose plastic packaging was found most frequently in the world's oceans and on coasts during various counts (breakfreefromplastic, 2018). These companies belong to the group of large consumer goods manufacturers whose products can be purchased globally and who have the highest annual production of plastic worldwide (NPEGC, 2019). These companies are, therefore, under particularly strong public pressure (in terms of plastics) and are expected to bear responsibility (towards the environment) because of their high level of plastic production (Dilkes-Hoffman et al., 2019; Ma et al., 2020). The latest sustainability reports as well as current press releases (September 2019–September 2020) for each of the ten companies are considered in this analysis.

All sustainability reports were downloaded in February 2020. These reports are particularly suitable for the intended analyses as they not only contain the central commitments and targets regarding plastic packaging but are also comparable among companies due to similar reporting standards (Hielscher and Will, 2014; Stewart and Niero, 2018). The respective publication dates range from 2016 to 2019; 9 out of 10 companies are signatories of the New Plastic Economy Global Commitment. The examination of sustainability reports has several advantages: it helps to ensure comparability between companies, as most of them have the same reporting standards (Kolk, 2004) and all reports contain chapters on the sustainable use of plastic packaging, circular economy and waste management. These chapters constitute the initial database that was enriched by press releases addressing the subject of packaging and published between September 2019 and September 2020. The inclusion of the pertinent press releases was intended to grant the companies an "additional voice" and ensure that current developments, not yet reflected in the sustainability reports, are appropriately considered.

Table 1 provides an overview of the composition of the dataset.

The qualitative analyses were conducted applying the explorative GABEK® method (Software: WinRelan®), which provides for an inductive procedure (Zelger, 2000; Zelger and Oberprantacher, 2002). WinRelan® is based on a system of index cards, which are designed to contain one *unit of sense* each. A *unit of sense* is defined as an inherently comprehensible semantic text unit that contains at least 3 and at most 9 relevant lexical terms (keywords). In relation to well-structured publications such as sustainability reports and press releases, such an inherently meaningful text unit is often equivalent to one or a few sentences (Zelger, 2004). The procedure of the analysis starts by coding within each text unit all keywords that reflect the meaning of the text unit (Zelger, 2000; Zelger and Oberprantacher, 2002). The keywords of each index card are to be coded by hand under consideration of the rigorous coding standards of the GABEK® method (Buber and Kraler, 2000; Zelger, 2004). Based on the coding procedure, WinRelan® makes it possible to extract associative relationships between keywords throughout the whole verbal dataset, which can be illustrated via network graphs, among others (Ahlert and Sträter, 2020; Raich et al., 2014; Rhein and Schmid, 2020). Associative linkages between keywords are represented via connecting lines. Whenever two (or more) keywords are mentioned together in one and the same unit of sense (i.e., within one and the same line of thought), they are connected within the network graphs. With the help of WinRelan®, it is possible to identify those associative linkages between keywords that repeatedly occur. Thus, it is possible to demonstrate how the analyzed companies understand and implement circular economy concepts. GABEK®/WinRelan® enables the combining and compressing of information, knowledge and attitudes of many individual statements while maintaining the ability to return to the level of individual statements at any time. This ensures transparency and traceability of results.

4. Results

All the companies considered in our analysis make publicly accessible statements in which they report on their *self-commitments* that are intended to guide them on the way towards a *circular economy*. Danone, for example, note that they have formalized a whole "series of global commitments in favor of a circular economy of packaging" (Danone, 2018, p.7). Fig. 2 illustrates the most central components of these statements using a network graph. If keywords are repeatedly mentioned together in one and the same text unit, they are connected by a line. The network graph (Fig. 2) reports such connections if the respective terms appear in at least 13 different text units.

It is evident that the individual plastic strategies, as published in the context of company-specific sustainability reports, systematically adopt the formulations of the New Plastics Economy Global Commitment (Fig. 2, left-hand side): companies want "100% of plastic packaging to be reusable, recyclable or compostable by 2025" (NPEGC, 2019, p. 26). PepsiCo, for example, strives for all their "packaging to be recyclable, compostable or biodegradable by 2025" (PepsiCo, 2018, p.6). The same holds for Danone, who wants to "having all of our packaging recyclable, reusable or compostable

Table 1
Composition of the dataset.

Company	Main products	Signatory of the NPEGC	Sustainability Report	Additionally considered press releases
Coca-Cola	bottled tea, bottled water, juice, soft drinks	yes	Coca-Cola, 2018	2019a, b, c; 2020a, b
Colgate-Palmolive	health care, household care, personal care, pet care, oral care	yes	Colgate-Palmolive, 2017	2020, 2019
Danone	baby foods, bottled tea, bottled water, dairy products,	yes	Danone, 2018	2020a, b
Mars	confectionery, food (instant food and sauces), ice cream, pet care	yes	Mars, 2019a	2020, 2019b
Mondeléz	confectionery, drink mixes, food (e.g., snacks, baked goods), gum	yes	Mondelēz, 2017	2020a, b, c
Nestlé	baby foods, bottled water, cereals, confectionery, coffee, dairy, drink mixes, frozen food, ice cream, pet care, soft drinks	yes	Nestlé, 2019a	2020a, b, c, d; 2019b
PepsiCo	bottled tea, bottled water, juice, protein drinks, snacks, soft drinks	yes	PepsiCo, 2018	2020a, b; 2019a, b
Procter & Gamble	baby care, fabric care, family care, feminine care, grooming, health care, home care, oral care, skin care	no	Procter & Gamble, 2017	2020; 2019
Tetra Pak	carton packaging for food and beverage, single-use packaging,	yes	Tetra Pak, 2019	2020a, b
Unilever	beauty and personal care, bottled tea, home care, ice cream, (instant) food, oral care	yes	Unilever, 2017	2020; 2019a, b

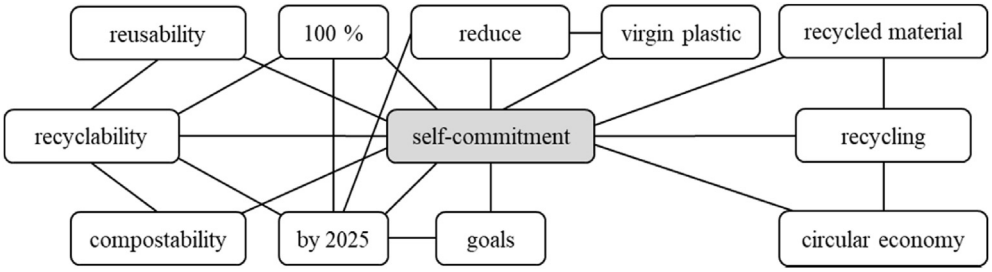

Fig. 2. Self-commitments (authors' illustration).[11]

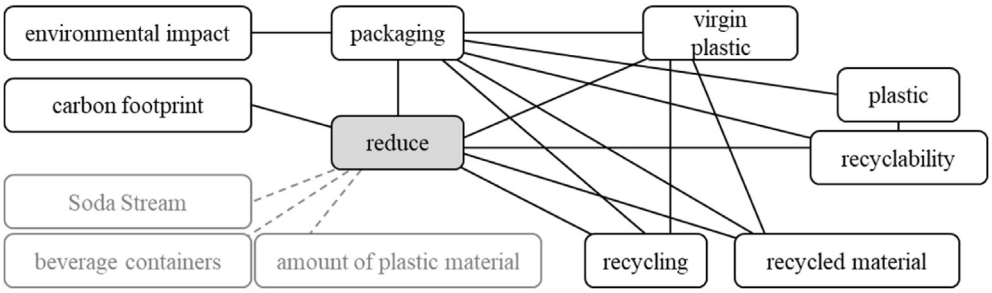

Fig. 3. Associations of companies with reducing (authors' illustration).[21]

by 2025" (Danone, 2018, p. 17) or Mars, who "plans for 100% of […] plastic packaging to be reusable, recyclable or compostable." (Mars, 2019a, n. p.).

The commitment of the analyzed companies to the (transition towards a) circular economy can be found on the right-hand side of Fig. 2. The results indicate that, in the context of the analyzed statements, the idea of a circular economy is most often associated with recycling and recycled materials. This is particularly interesting in the context of the waste hierarchy, as measures of reduction and reuse should be prioritized for a circular economy. Given the restrictive requirement of a thirteenfold provability of co-occurring associations, the target dimension of *reduction* (Fig. 2, middle) is primarily connected with virgin plastic. The companies' associations with the key concept of reduction will be analyzed in more detail in the following section as further information is needed in order to clarify what exactly these companies want to reduce.

Following the waste hierarchy, we will now take a closer look at what companies associate with reducing, reusing and recycling.

Fig. 3 illustrates those key aspects that are recurrently addressed in contextual relation to the term *reduce*. At first glance (and with the given reduction to keywords only), Fig. 3 might create the impression that companies aim to *reduce packaging* (Fig. 3, middle) and, through the reduction of packaging, to reduce their *environmental impact* (Fig. 3, left-hand side). This would be somewhat in line with the waste hierarchy.[3] However, appearances are deceptive: the right-hand side of Fig. 3 shows that there is also a strong relation with plastic, virgin plastic, recycling, recyclability and recycled material that must be considered. Analyzing these relationships in more detail, it becomes clear that companies do not want to reduce the amount of packaging per se, but the percentage of plastic and, in particular, virgin plastic. Thus, besides the negligible number of companies that are reporting on their endeavours to reduce volume and weight of packaging, what is captured by the effort to reduce the *amount of plastic material*, the formulated efforts to *reduce* address the amounts of specific materials *contained*

[3] Frequently, the reduction of the carbon footprint is also associated with *reduce*, which is not always related to packaging itself and often refers to production processes in general.

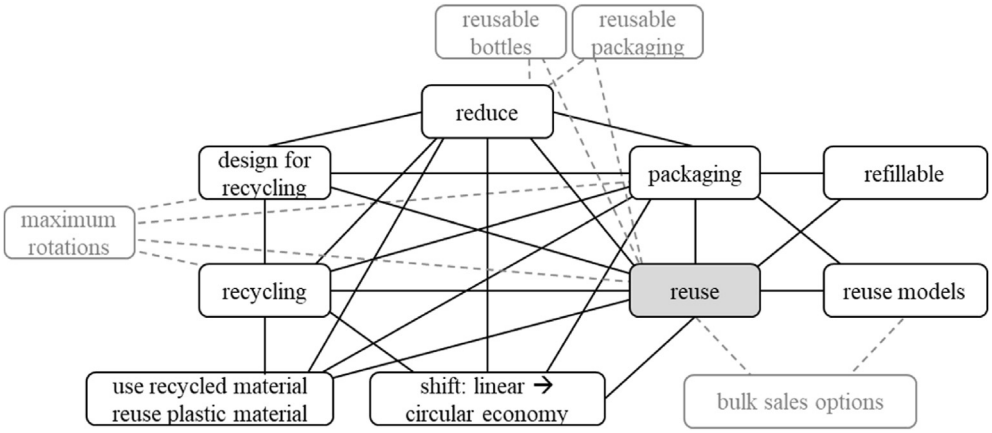

Fig. 4. Associations of companies with reuse (author's representation).[41]

in (plastic) packaging – not plastic packaging itself.

Underlining this relationship, PepsiCo, for example, states that they

> " (…) aim to use more recycled content in our packaging, displacing virgin plastic and helping us toward our target to reduce 35% of virgin plastic content across our beverage brands by 2025" (PepsiCo, 2018, p. 20).

Colgate-Palmolive argues in a similar direction stating that they

> "(…) are committed to reducing our use of plastic in our packaging, using more recycled plastic, and increasing the recyclability of our plastic packaging" (Colgate-Palmolive, 2017, p.3).

In summary, our analysis suggests that, although companies take *reduction* seriously, their understanding of reduction is not compatible with that of the waste hierarchy, as we will discuss in more detail (Section 5).

In addition, our analysis also indicates that *reuse* in the strict sence is not an important consideration for companies when they discuss reduction of plastics and environmental damage, although, again, reuse should be more important than recycling according to the waste hierarchy. A possible explanation for the lack of reuse in the context of reduction can be found by considering the respective associations illustrated in Fig. 4.

The right side of Fig. 4 represents the few associations that address *reuse* as defined in the waste hierarchy: the companies' statements reveal that there are different projects on different levels of development that try to implement refill and reuse models on the product level. Pepsi, for example, is moving in this direction and wants to go "beyond the bottle" (PepsiCo, 2019b) with its Sodastream, a device for making beverages at home. Mars also explicitly refers to reuse models of packaging as follows:

> *"We also will reduce our packaging use by shifting to reuse models, where possible. (…) This includes bulk sales options like M&M Colorworks in grocery stores"* (Mars, 2019a, n.p.).

However, there are very few statements that are directly related to the reuse of the packaging itself.

Usually, the term *reuse* is mentioned in addition to the other prominent concepts of *recycling* and *reduction* (3 R's, Fig. 4, left-hand side). By analyzing these statements, which include the term *reuse*, it turns out that companies associate reuse primarily with the level of materials rather than with the level of packaging per se. Keeping in mind that the endeavour to *reduce* is mainly associated with the reduction of virgin plastic in use (Fig. 3), the left-hand side of Fig. 4 represents a quite consistent message: *Reuse* refers to the reuse of plastic material, i.e., the use of recycled material, and, thus, actually refers to recycling. The use of recycled material helps to *reduce* the amount of virgin plastic in use, and design for recycling will ensure that all these interrelationships work.

In the following example, Coca-Cola reports on a project in Sweden. In the first sentence of the statement, it seems that they are talking about the reuse of packaging. However, they then explain that the material and not the bottle itself is going to be reused:

> *"Coca-Cola Sweden wants to lead the development of a circular economy where all packages are collected so that they can* ***be used again****. We are taking a big step as we become the first market in the world to move to 100 percent recycled plastic for the full PET portfolio (…)"* (Coca-Cola, 2019a).

Unilever, for example, explicitly refers to their reuse of the *plastic*:

> *"A more circular approach is nedded, where we not only use less packaging, but design the packaging we do use so it can be* ***reused****, recycled or composted"* (Unilever, 2017, p. 260).

The same holds for PepsiCo, who formulate their statement in a similar way:

> *"Creating a world where plastics need never become waste requires a shift from a linear to a circular economy approach. This means recycling and* ***reusing packaging material*** *rather than treating it as waste"* (PepsiCo, 2018, p.20).

[2] Connecting lines between black-framed keyword are reported only if the respective keywords co-occur in ten different text units at the minimum. The grey-framed ones, which are connected to *reduce* with dashed, grey lines, co-occur at least in five different text units.

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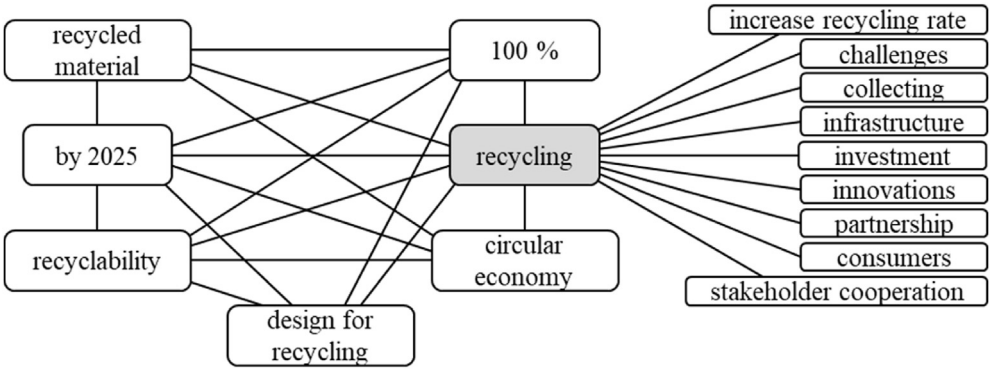

Fig. 5. Associations of companies with recycling (author's representation).[51]

It turns out that *reuse* is, indeed, considered a measure for the transformation process from a linear to the circular economy – but this associative relation is somewhat misleading as *reuse* is primarily associated with *recycling*.

In addition, and more often than not, companies formulate statements related to *reuse* in such a way that keeps their options open – simply by using the little word *or*. Unilever, for example, states that they want to make it *"[…] technically possible for all […] plastic packaging to be reused* ***or*** *recycled"* (Unilever, 2017, p. 246). Danone says: *"[…] our packaging should be designed to accomplish a maximum number of trips or rotations in a system for reuse;* ***and/or*** *with materials that can be successfully collected, sorted and recycled in practice and at scale."* (Danone, 2018, p.5). The confectionery manufacturer Mars promises: *"To advance towards this vision, by 2025 we plan to reduce our virgin plastic use by 25% and for 100% of our plastic packaging to be reusable, recyclable* ***or*** *compostable."* (Mars, 2019a, n. p.). Whereas the ideas of reduction and reuse are somewhat misinterpreted within the context of the companies' sustainability reports, this is not the case with recycling (Fig. 5).

Recycling itself appears again and again in all networks and, thus, seems to be *the* most important strategy of companies on their way towards a circular economy regarding packaging. In particular, the use of recycled materials and the attainment of complete recyclability through *design for recycling* can be identified as central elements, as, for example, Pepsi points out: *"To further our progress, we are integrating design for recyclability into our product development process."* (PepsiCo, 2018, p.20). Colgate has also developed the world's first recyclable toothpaste tube and wants to establish this recycling standard for tubes worldwide, which is why the company has announced that it will share its technology with competitors (Colgate-Palmolive, 2019). Overall, it is apparent that the companies want to achieve 100% recyclability of their packaging by 2025. At the same time, they associate recycling with major challenges, as shown on the right side of Fig. 5. The lack of collection infrastructure is one of the biggest challenges to achieve recycling related targets and, in particular, to increase recycling rates. Pointing to this, Coca-Cola stresses that *"Bottle and can recycling rates differ dramatically [between countries], as does the infrastructure in place and even the quality of recycling data that could help us improve"* (Coca-Cola, 2018, p.22). Cooperation with stakeholders, such as service providers and recyclers, and partnerships with research institutes as well as public-private initiatives should help to meet this challenge, for example, through the development of innovative technologies. In this context, it is repeatedly emphasized that a change from the linear economy to the circular economy can be realized, if and only if a high degree of cooperation between different actors can be achieved. Mondeléz, for example, states that there is a need to work *"in coalitions to* support *improved infrastructure and greater harmonization of packaging formats, so that more waste is collected and can be recycled."* (Mondeléz, 2017, p. 26). Companies like Nestlé want to increase investments to support the expansion of recycling and waste infrastructure (Nestlé, 2020c). A further barrier to achieving recycling related targets is attributed to consumer behavior and lack of *consumer awareness*. Tetra Pak asks for *"collaboration at every stage of a product's lifecycle – from sourcing and product design, to* ***consumer awareness****, collection and sorting, to recycling and market"* (Tetra Pak, 2019, p. 8). Mars emphasizes that *"Even when a package is designed to be recyclable, reusable or compostable, it won't be without the right* ***consumer behaviors****, collection, sorting systems and infrastructure."* (Mars, 2019a, n. p.). Mondeléz states the following regarding its brand *Philadelphia*: *"With every purchase and recycling of Philadelphia products across Europe,* ***consumers will play an important role*** *in keeping plastic waste out of the environment and meaningfully contribute to a more sustainable future for people and planet."* (Mondelēz, 2020a).

5. Discussion

The analysis of public corporate statements enables a detailed examination of companies' understanding of the concept of circular economy and related terms. This, in turn, makes it possible to examine the well-considered and thoughtful formulations (Sweeney and Coughlan, 2008) of these sustainability reports and press releases. Initially, in the following, the results of the analysis of the companies' understanding of the 3Rs – *reduction*, *reuse* and *recycling* – will be critically discussed. Secondly, the impact of these interpretations on the general effort to implement a circular economy are examined. Finally, this discussion attempts to raise awareness of some general problems that result from vaguely-formulated targets and an inconsistent understanding of terms and concepts in the context of self-commitments.

Our results point to the fact that the considered companies interpret the terms *reduction*, *reuse* and *recycling* in a significantly different manner from that given by the strict definitions in the waste hierarchy.

Reduction, the waste hierarchy's top priority measure, is interpreted by companies primarily within the context of materials. The

[4] Connecting lines between black framed keywords are reported only if the respective keywords co-occur in two different text units at the minimum. Connecting lines of grey framed ones are reported if the respective terms co-occur at least once. The fact that connecting lines in this figure are reported even though the respective key terms co-occur at least twice, results from the lack of explicit consideration of the concepts of reuse within the database in general.

amount of virgin plastic used to produce plastic packaging is to be reduced and is to be substituted by recycled material (Fig. 3). A second, weaker focus is placed on the reduction of packaging weight and volume through optimization (of design). The endeavour to reduce the amount of virgin plastic and optimize packaging with regard to volume and weight has made an important contribution to reducing the amount of virgin plastic in use and, without question, is an important step towards a more sustainable way to deal with plastic packaging (Schmid and Rhein, 2018).[6] However, the requirement of *reduction* as defined in the waste hierarchy refers to a (further) reduction of packaging and, thus, to the promotion of unpackaged alternatives and/or reusable packaging. This takes us to the second R, *reuse*.

Following the strict definition as provided by the waste hierarchy, *reuse* refers to the reuse of packaging itself and not to the reuse of the material of which the packaging is made. Several companies, for example, Pepsi with its Sodastream (PepsiCo, 2020a) or Unilever, who are working on a refillable deodorant stick (Unilever, 2019a), describe projects that are in line with this strict interpretation of reuse. However, these projects are the exception rather than the rule and some are still in the (very) early stage of development. Most of the associations with *reuse* (Fig. 4) refer to the reuse of material and, thus, are more in line with *recycling* than with *reuse*.[7]

Regarding *recycling*, the companies considered – as assessed by their sustainability reports and press statement – are ambitious and describe many ideas about how the consumption of virgin plastic could be reduced. In particular, the companies seem to take the problem of non-recyclable packaging and plastic waste seriously. At the same time, companies emphasize numerous barriers that need to be overcome, especially in the area of recycling. A lack of infrastructure and a lack of consumer willingness to take action are considered some of the biggest challenges and partnerships with stakeholders, especially waste management companies or government collaborations, should bring solutions. These findings are in line with the result of other studies (Gong et al., 2020; Ma et al., 2020). In summary, it turns out that the companies' focus is on ensuring *recyclability* through design – whether recyclable packaging will be actually recycled in 2025 remains to be seen.

All these efforts mentioned by the companies are valuable. However, the strong and somewhat narrow focus on recycling must be critically discussed, as the substitution of virgin plastic by recycled plastic does not lead to a reduction of plastic packaging and packaging waste and is, therefore, insufficient to mitigate the plastic crisis (Geyer et al., 2017; Herberz et al., 2020; Miller, 2020). This is, among other aspects, why the European Plastics Pact, a voluntary commitment to mitigate the pollution of single-use plastic in Europe, introduced in 2020, underlines the fact that whereas "improving recycling is crucial, we cannot recycle our way out of the plastics issues we currently face" (European Plastics Pact, 2020, p.8).

The implementation of a circular economy presupposes that the top-priority measures of *reduction* and *reuse* are taken seriously. The companies' statements, however, reveal that:

- *reduction* is primarily associated with the reduction of the use of virgin plastic in favor of recycled plastic – which implies a focus on recycling;
- and that *reuse* is associated with the reuse of material – in other words, recycling.

The results, thus, demonstrate that although the analyzed statements are intended to tell the world about the companies' efforts to implement a circular economy, the evidence suggests that companies are apparently working on implementing a *recycling economy*. This insight has a degree of brisance, both in itself and considering the fact that almost all companies are signatories of the NPEGC – which takes us to the last part of the discussion.

The NPEGC aims to unite actors behind a common vision of a sustainable use of plastic and explicitly states that all "signatories have signed up to a clear set of 2025 targets underpinned by shared definitions" (NPEGC, 2020a). However, NPEGC's strict definitions of *reduction* and *reuse* are in line with that of the waste hierarchy (NPEGC, 2020b)[8] – whereas the companies' definitions are not.

In addition, there is a certain weakness in the formulations of the NPEGC's targets that can be also found in most of the analyzed companies' statements: by 2025, the companies want to ensure that their products are 100% reusable *or* recyclable *or* compostable and so on. Thus, even if there would be a common understanding of reuse and recycling, the unremarkable word *or* allows focusing on recycling only.[9] This vagueness suggests that companies might make self-commitments only for political-strategic reasons and might not intend to pursue serious interest in their implementation (Glachant, 2007; Lyon and Maxwell, 1999; Malhotra et al., 2019). A more precise formulation of objectives in combination with truly common definitions would enable a proper assessment of the commitments. This is particularly important because, political-strategic corporate self-regulation can prevent political intervention and at the same time lead to inadequate environmental protection measures (Dauvergne, 2018; Dauvergne and Lister, 2012).

6. Conclusion

In summary, our analysis suggests that, in addition to the well-known challenges of implementing a circular economy, such as technological limitations and a lack of waste infrastructure or the difference between consumer awareness and consumer behavior (Gong et al., 2020; Ma et al., 2020; Rhein and Schmid, 2020), a uniform understanding of the three R's, *reduction*, *reuse* and *recycling* is missing, which is also apparent in situations where common definitions are explicitly assumed. This absence of definitional precision in combination with certain weaknesses in the formulation of targets – both in the NPEGC and the analyzed corporate reports and statements – lead to a situation in which companies talk about a *circular economy* while implementing a *recycling economy*. Current research indicates that an immediate and substantially more radical change in the present method of production

[5] Connecting lines between black framed keywords are reported if and only if the respective keywords co-occur in eight different text units at the minimum.

[6] Reduction is also associated with the reduction of greenhouse gas emission caused by (production and use of) packaging. Taking such additional negative externalities into account is certainly worth honouring. However, the discussion of this issue in more detail would go beyond this paper's focus.

[7] It is beyond dispute that tradeoffs remain between the ecological advantage of multi-use packaging systems and problems that are related to both cost effectiveness and barriers of implementation. Multi-use packaging systems initially need more plastic, infrastructure and transport routes but are, nevertheless, often considered more sustainable than disposable packaging (Hamade et al., 2020; Herberz et al., 2020). This is ultimately reflected in the waste hierarchy.

[8] The NPEGC defines reuse as an "operation by which packaging is refilled or used for the same purpose for which it was conceived (…)" and points to the fact that, thereby, reuse "… has the potential to significantly reduce the need for single-use packaging" (NPEGC, 2020b pp. 8–9). Our results indicate that the definitions of the companies do not correspond to this *shared* definition.

[9] Most of the packaging used by Coco-Cola worldwide, for example, are colorless single-use plastic bottles made of polyethylene (PET) (Coca-Cola, 2018). These bottles have been nearly 100% recyclable since their invention and market introduced in the 1970s (Elmore, 2012).

and consumption of plastic, including a consistent avoidance of single-use packaging, is needed (Lau et al., 2020). Consequently, it must be ensured that, politically permitted self-regulation by companies through self-commitments is implemented in such a way that the respective commitments contain ambitious objectives that still need to be achieved. In the case of plastic packaging, our analysis shows that stricter targets for reduction and reuse in the strict sense of the waste hierarchy need to be formulated. In addition, the commitments must be strictly evaluated based on unequivocal definitions.

It would be of great interest, in terms of future research, to discuss this paper's findings with corporate experts to gain a deeper understanding of the *reasons* behind their strategy choices. In addition, we would like to emphasize the importance of analyzing cross-company commitments such as the Global Commitment, the European Plastics Pact, the UK Plastics Pact, the U.S. Plastics Pact, etc., applying qualitative methods to understand how they established their targets and the influence of these targets on companies. Furthermore, the interdependencies between both self-commitments and environmental (plastic) policies as well as self-commitments and consumer awareness are to be analyzed in more depth.

CRediT authorship contribution statement

Sebastian Rhein: Conceptualization, Project administration, Methodology, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Katharina Friederike Sträter:** Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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