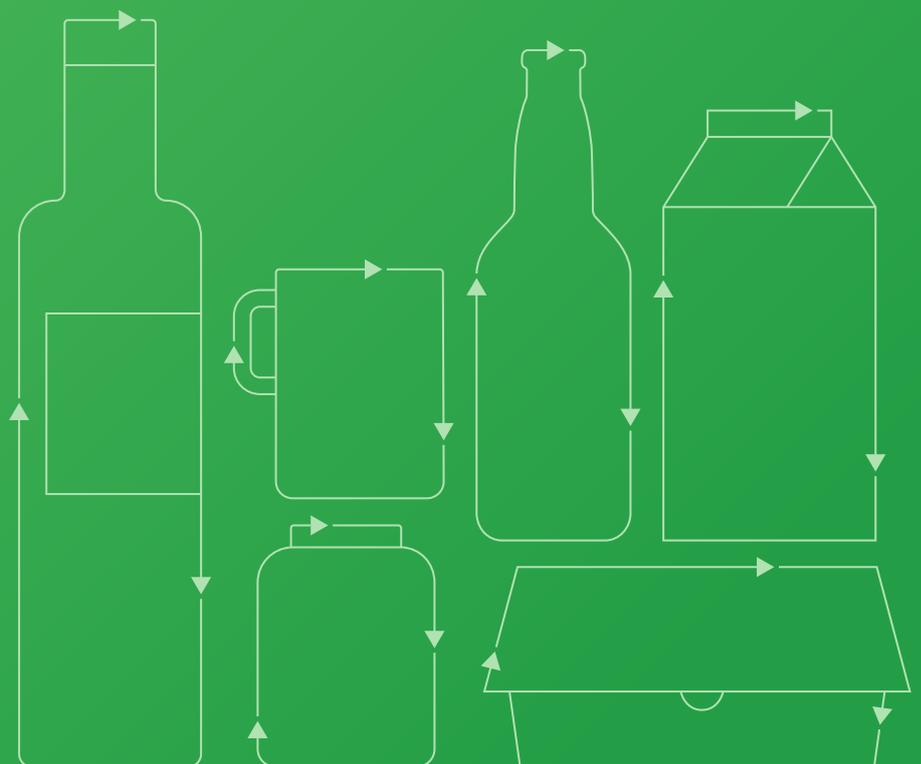




TOWARDS CIRCULAR TARGETS

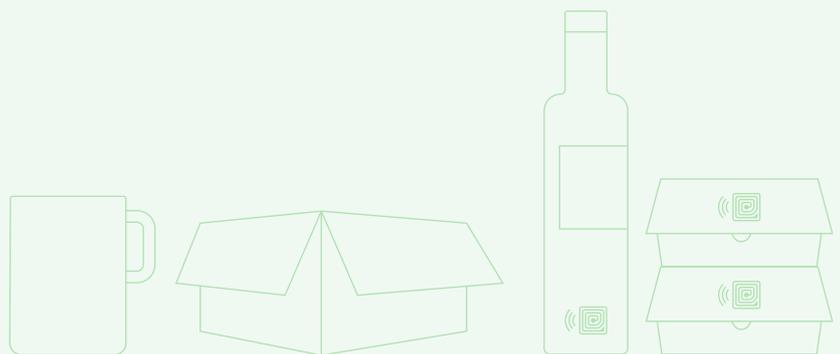
Framework with criteria and calculation rules to set circular targets for prevention (using less products), reuse & recycling, exemplified with glass packaging



TOWARDS CIRCULAR TARGETS

Framework with criteria and calculation rules to set circular targets for prevention (using less products), reuse & recycling, exemplified with glass packaging

The Hague (the Netherlands), September 2022



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TABLE OF CONTENT

Preface — 4

Summary — 6

This report — 9

1. Circular economy policy is about resource reduction — 10
2. Circular actions aim at reducing waste (not resources) — 11
3. Reducing waste does not necessarily reduce resources — 11
4. Resource reduction calls for circular targets — 13
5. Prevention as a term needs unambiguous redefinition — 15
6. Setting circular targets demands criteria — 17
7. Calculation rules yield smart circular targets — 19
8. Prevention & reuse can substantially reduce resources — 20
9. Resource reduction by recycling is limited — 21
10. Criteria met by calculation rules & circular targets — 23
11. Solid circular targets strengthen Europe's policy — 24

References — 26

Literature other than letters or legal texts — 26

Letters — 27

Legal texts — 27

Appendix 1: Dutch glass packaging example — 28

Appendix 2: Calculation rules — 30

Prevention — 30

Reuse — 30

Recycling — 31

PREFACE

Europe's circular economy policy aims at reducing Europe's resource use. That is clearly stated in the European Commission's (EC's) [new action plan](#) for the circular economy. However, the EC wants to set waste reduction targets that at most indirectly steer on resource reduction. This report presents a framework for setting circular targets that directly steer on resource reduction.

The framework consists of twelve criteria and a set of calculation rules that allow setting circular targets for a product group. The circular targets set requirements for prevention (using less products), reuse (using products multiple times (longer)), more recycling (more product waste entering the recycling process; existing recycling targets) and better recycling (more recycled materials from the recycling process being reprocessed as recycled content in the same products they originate from; recycled content targets). Targets for more recycling are basically covered by the already existing recycling targets. The set of circular targets for prevention, reuse, and more and better recycling together enable to achieve a desired resource reduction for the product group at stake. The framework has been exemplified with glass packaging as a product group.

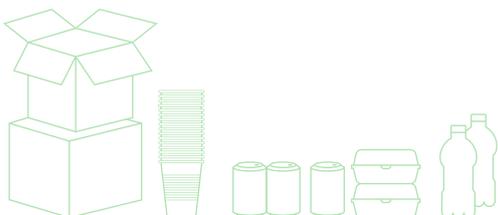
Circular targets are needed to make European circular economy policy consistently steer on reducing resource use rather than on reducing waste. Reducing waste does not lead to reducing resources as long as our [production](#) and [consumption](#) are still increasing (typically the case), or when recycling leads to low grade secondary materials unable to replace the virgin or primary materials they originate from ([typically the case](#)). In both cases, waste may be reduced, but extraction of new resources is still needed for producing new primary materials used in manufacturing new products to provide in our needs. Indeed, after the financial crisis and before the corona pandemic, [Europe's resource use](#) has been growing, albeit slightly.

We hope this report will stimulate the EC to indeed include circular targets for prevention (using less products), reuse, and more and better recycling in its revised Packaging and Packaging Waste Directive (PPWD) and Waste Framework Directive (WFD) (like several European countries advocate in their [letter](#) to the EC). Furthermore, we hope the EC will reconsider some of its terminology, like to consistently use prevention in the meaning of using less products, and to put the focus on reuse as such instead of on *preparing for reuse* (the latter leaving unclear how much is actually reused). In that way the waste hierarchy



stops to be a waste hierarchy but becomes a **waste & resource hierarchy**. That is, a hierarchy relevant for both waste reduction (waste policy) and resource reduction (circular economy policy).

This report is based on a report written in Dutch. The summary of the Dutch report has been translated and adjusted to the European policy context. Both the English and Dutch versions are written under auspice of 'Het Groene Brein' (The Green Minds). 'Het Groene Brein' is a group of leading Dutch academics that joined their brain power in support of the circular economy. With this report, 'Het Groene Brein' wants to facilitate the EC to include separate circular targets for prevention (using less products), reuse, and more and better recycling in its current revision of the Packaging and Packaging Waste Directive (PPWD) and Waste Framework Directive (WFD).



SUMMARY

Europe's circular economy policy is about resource management. The introduction to the new circular economy plan is clear about that. On closer reading of the new circular action plan, however, reducing waste seems to be seen as the way to reduce resource use (EC, 2020). As a correction to this simplified approach, this document presents a solid framework for setting circular targets for product groups that steer directly on resource reduction (instead of indirectly via waste reduction). Such circular targets for prevention (using less products), reuse, more recycling (recycling targets) and better recycling (recycled content targets) per product group thus directly help reducing Europe's resource use. They are also essential for reducing environmental impact (like climate change) from extracting resources and processing them into materials and products, as well as from treating disposed products.

While reducing waste as such is a good thing, it does not necessarily go hand in hand with reducing resource use (and related environmental impact). When recycling as a waste-reducing measure is involved, for example, there remains a need for primary materials to be produced from resources as extracted from nature if recycled materials cannot replace the virgin or primary materials they originate from on a one-to-one basis. This applies to many materials in the current situation (Allwood, 2014). Similarly, primary materials produced from natural resources remain to be needed when production (Eurostat, 2021e) and consumption (Eurostat 2021f) grow faster than waste is reduced. Reducing resource use thus needs targets directly steering on resource reduction rather than indirectly via targets for waste reduction that are supposed to achieve this but in practice nevertheless may not lead to *resource* reduction.

Europe's waste policy sees reuse and recycling as two main strategies to achieve waste reduction, and uses waste reduction and prevention as synonyms (EC, 2018). However, the waste hierarchy does also place prevention as a strategy for waste reduction above reuse and recycling (EC, 2008). That obviously is illogical. It is also unpractical. If prevention means waste reduction, it cannot mean resource reduction at the same time.

This document proposes that waste policy and circular economy policy consistently and solely use prevention in the meaning of using less products, and consistently and solely speak about resource reduction and waste reduction. This leads to:



WASTE POLICY AIMS AT WASTE REDUCTION , TO BE ACHIEVED BY:	CIRCULAR ECONOMY POLICY AIMS AT RESOURCE REDUCTION , TO BE ACHIEVED BY:
PREVENTION: Using less products	
REUSE: Using products multiple times (longer)	
RECYCLING: – More recycling: More product waste entering the recycling process (higher recycling rate) – Better recycling: More secondary materials leaving the recycling process and being reapplied in similar products (higher recycled content rate)	

Understanding prevention as using less products is in line with the joint [letter](#) of five European countries to the European Commission (EC). In their letter, the five countries ask the EC to set ambitious prevention targets for reduction of packaging placed on the market at the EU-level. In addition, they request mandatory reuse targets and recycled content targets.

This document presents a solid framework for setting such circular targets for product groups that steer directly on resource reduction (instead of indirectly via waste reduction). The framework consists of twelve criteria with which the circular targets should comply, and calculation rules to set such circular targets for prevention (using less products), reuse, more recycling (recycling target) and better recycling (recycled content target) per product group.

Prevention targets take the form of a maximum allowed quantity in tonnes of **new** products placed on the market in a target year. The targets for reuse, more recycling (recycling targets) and better recycling (recycled content targets) take the form of a minimum required percentage in the quantity of **new** products placed on the market in a target year. This makes the formats for the circular targets for reuse and recycled content similar to the one for the recycling targets. They are all expressed as a minimum required percentage of the quantity of new products placed on the market in a target year. This makes these reuse and recycled content targets consistent with the already existing recycling targets that will continue to serve as such. Setting a maximum for the quantity in tonnes of new products placed on the market, the prevention target, stimulates using fewer products in numbers (e.g., by stopping overpackaging or sharing cars) and to make products less heavy (i.e., more material-efficient). In addition, it stimulates replacing disposable by reusable products (i.e., to increase the percentage of reusable products to above the minimum percentage required by reuse targets), as well as to increase the number of returns for reusables. Note that new products placed on the market exclude reusable products already been used before.

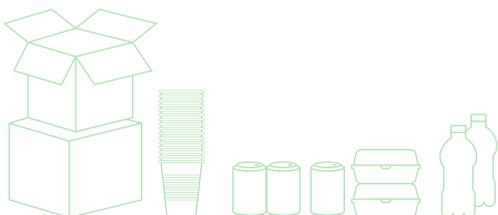


The calculation rules allow establishing multiple combinations of circular targets leading to a same desired reduction in resource use for a certain product group. This provides the European Commission with space to accommodate the interests of different stakeholders in setting circular targets. To illustrate their use in setting circular targets, the calculation rules have been applied to the use of glass packaging in the Netherlands.

Prevention by using less **disposable** glass packaging reduces resource use far more than prevention by using less **reusable** glass packaging which on average are reused twenty times. The relatively high number of returns for reusable glass packaging makes replacing disposable by reusable packaging, thus reuse, almost as effective as prevention by using less disposable packaging. Such a high number of returns as for glass packaging is typically not possible for packaging made from other materials (like for reusable plastic packaging), and reusables are also less obvious for some packaging made from other materials (like beer cans).

More and better recycling together, where all glass packaging waste enters the recycling process and ends as recycled content in new glass packaging, can theoretically achieve a 100% reduction of resource use. Based on literature, however, in practice just around 60% reduction of resource use is at most feasible. After all, it is unavoidable that glass packaging waste will partly escape separate collection, and there are also limits to the maximum achievable quantity of recycled glass suitable for being reprocessed into new glass packaging.

The calculation rules comply with almost all, and the circular targets based on them comply with all criteria. Thereby, the proposed framework, consisting of twelve criteria and calculation rules, provides a solid base for setting separate circular targets to strengthen Europe's circular economy policy.



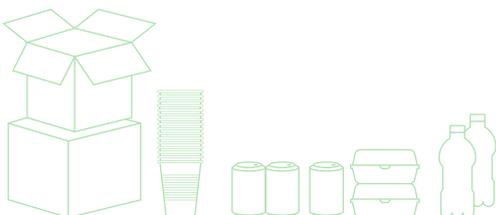
THIS REPORT

This report wants to support the further development of Europe's circular economy policy as resource management. It hopes to do so by providing a solid framework for setting circular targets for product groups that steer directly on resource reduction (instead of indirectly via waste reduction). The framework for setting circular targets consist of twelve criteria with which circular targets should comply, and calculation rules to set such circular targets for product groups.

The European Commission (EC) clearly positions circular economy as resource management in her new action plan for the circular economy (EC, 2020), but apparently assumes that waste reduction targets indirectly also steer on resource reduction. This is the subject of Sections 1 & 2. Section 3 explains why circular targets need to focus on reducing resources directly, while section 4 outlines how such circular targets would look like. Circular targets cover, amongst others, targets for using less products (prevention). Section 5 elaborates on how prevention is currently understood in EC-language and how it should be understood (i.e., as using less products). The following sections introduce the framework and how it can be used.

Section 6 provides twelve criteria with which calculation rules for circular targets should comply. Section 7 introduces those calculation rules for setting smart circular targets. The calculation rules are exemplified in this report with glass packaging for the Dutch market in 2014. Section 8 & 9 show how they can be used to calculate resource use and set circular targets for prevention (using less products) and reuse (section 8) and for more recycling (recycling targets) & better recycling (recycled content targets (section 9).

Section 10 reflects on whether the calculation rules and circular targets based on them meet the criteria. Section 11, as the last one, draws some main conclusions.



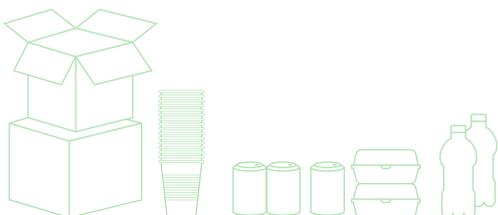
1. CIRCULAR ECONOMY POLICY IS ABOUT RESOURCE REDUCTION

According to Frans Timmermans, EC's vice-president, "COVID-19 has underlined the urgency of stopping the destruction of our natural environment and exposed the fragility of the current economic model" and "Circular economy is the model of the future, for Europe and the world. It brings balance back in our relationship with nature and reduces our vulnerability to disruptions in global, complex supply chains" ([Gibson, 2020](#)).

The above quotes of Frans Timmermans are taken from a talk in 2020 where he presented the EC's new action plan for the circular economy ([Gibson, 2020](#)). Since then, unexpected new disruptions of our global supply chains have come to light. Europe is still grappling with shortages in supplies of resources, materials and products due to the Suez Canal blockage in Spring 2021 ([ShipWorks, 2022](#)), while Russia's invasion of Ukraine exposed Europe's dependency on imports of fossil fuels and other resources, and caused a food crisis worldwide ([Consilium, 2022](#)).

Frans Timmermans' above quotes align with a change in tone from the EC's first to its new action plan for the circular economy. The first action plan, released in 2015, mainly approaches circular economy policy from the perspective of waste management ([EC, 2015](#)). The introduction to the new action rather frames circular economy policy as resource management ([EC, 2020](#)):

"As half of total greenhouse gas emissions and more than 90% of biodiversity loss and water stress come from resource extraction and processing [...] Scaling up the circular economy from front-runners to the mainstream economic players will make a decisive contribution to achieving climate neutrality by 2050 and decoupling economic growth from resource use, while ensuring the long-term competitiveness of the EU and leaving no one behind. To fulfil this ambition, the EU needs to accelerate the transition towards a regenerative growth model that gives back to the planet more than it takes, advance towards keeping its resource consumption within planetary boundaries, and therefore strive to reduce its consumption footprint and double its circular material use rate in the coming decade."



2. CIRCULAR ACTIONS AIM AT REDUCING WASTE (NOT RESOURCES)

Where the first action plan contains zero key actions (explicitly) related to resource management, in line with above citation, the new action plan indeed includes two promising key actions about resources (EC, 2020):

- “Proposing a Global Circular Economy Alliance and initiating discussions on an international agreement on the management of natural resources”
- “Updating the Circular Economy Monitoring Framework to reflect new policy priorities and develop further indicators on resource use, including consumption and material footprints”

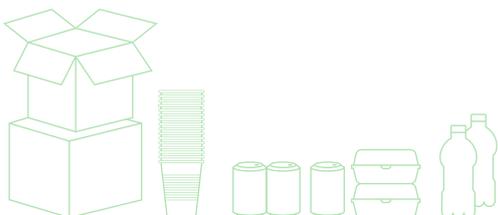
Both key actions imply an upcoming shift in Europe’s circular economy policy towards more resource-related key actions. Nevertheless, as in the first action plan, about a quarter of the key actions in the present new action plan is explicitly waste-related. These waste-related key actions, amongst others, announce waste reduction targets for specific waste streams (product groups). Furthermore, on closer reading of the new action plan, reducing waste seems to be seen as the key to reducing resource use (EC, 2020).

Similar to the new action plan (EC, 2020), Directive 2018/852/EC (EC, 2018) also refers to reducing waste as the means to reducing resource use. Point 4 in the introduction to this directive (EC, 2018), that amends Directive 94/62/EC on packaging and packaging waste (EC, 1994), says “Waste prevention is the most efficient way to improve resource efficiency and to reduce the environmental impact of waste”. This indeed confirms that the EC sees waste reduction as the way to reduce resource use.

Reducing waste is more often seen as an obvious way to reducing resources, but the rationale behind it is usually not explained.

3. REDUCING WASTE DOES NOT NECESSARILY REDUCE RESOURCES

Excluding major mineral waste (e.g. demolition waste), total waste generation in Europe actually didn’t go down but went up by 4.3% from 2004 to 2018 (Eurostat, 2021a). In the same period, municipal waste generation increased by 2.8% (Eurostat, 2021b). Europe’s use of resources (raw material consumption), on the other hand, shrank by 12.3% (Eurostat, 2021c; Eurostat, 2022a).



The period from 2004 to 2018 includes the financial crises from 2007/2008 to 2011 and excludes the covid pandemic that struck in full force in 2020. It should be noted that the 12.3% shrinkage in resource use is entirely attributable to the financial crisis. During the financial crises, waste generation continued growing, but resource use significantly fell before slightly rising again ([Eurostat, 2021a](#); [Eurostat, 2021b](#); [Eurostat, 2021c](#)).

Despite the influence of the financial crisis, thus overall, Europe's generation of waste increased and its use of resources decreased between 2004 and 2018. [Eurostat \(2022b\)](#) indeed reports a 33.8% surge of resource productivity (gross domestic product versus domestic material consumption). In other words, resource use decoupled from economic growth in this period. This raises the question of how waste generation and resource use are connected.

Again in the period from 2004 to 2018, waste treatment in Europe shifted from disposal (4,1% decline) to recovery (36.5% rise). This aligns with a rise of recovery in total waste treatment from 45.9% in 2004 to 54.6% in 2018. The 54.6% recovery in 2018 breaks down to 37.9% recycling, 10.7% backfilling, and 6.0% incineration with energy recovery ([Eurostat, 2021a](#); [Eurostat 2022c](#)).

Recycling yields recycled or secondary materials that may replace primary materials for manufacturing new products. It can thereby avoid natural resources being extracted for producing new or primary materials. According to [Eurostat \(2021d\)](#), the share of secondary materials in total material consumption indeed grew by 3.4% from 8.3% in 2004 to 11.7% in 2018, corresponding to 741 million tonnes in 2018 (similar data for 2004 are not available).

Above numbers, summarized in below table, suggest that recycling is at least partly responsible for the decoupling of resource use and economic growth in Europe. However, although Europe's recycling of waste into secondary materials grew faster than waste generation, the growth of secondary materials from recycling has not prevented a (slight) increase of resource use after the financial crisis and before the covid pandemic. Reducing waste generation, or rather increasing waste recycling, thus does not necessarily result in reducing resource use as the European Commission apparently assumes.

Currently, recycling typically leads to secondary materials of lower quality than the virgin or primary material they originate from ('downcycling') ([Allwood, 2014](#)). If recycled materials cannot replace the primary material they originate from on a one-to-one basis, there remains a need for resources to produce primary materials. Similarly, a need for primary materials and thus resources remains



if production and consumption grow faster than recycling yields secondary materials. Europe's production (Eurostat, 2021e) and consumption (Eurostat 2021f) indeed were growing between the financial crisis and covid pandemic.

Table 1: Generation of waste (Eurostat, 2021a; Eurostat, 2021b), treatment of waste (Eurostat, 2021a; Eurostat 2022c), use of resources (Eurostat, 2021c; Eurostat, 2022a) and resource productivity (Eurostat, 2022b) in 2004 and 2018

	2004	2018	CHANGE
WASTE GENERATION			
– Total waste (excluding major mineral waste)	780 million tonnes	813 million tonnes	4.3%
– Municipal waste	216 million tonnes	222 million tonnes	2.8%
WASTE TREATMENT IN EUROPE (EXCLUDING EXPORT)			
– Recovery (recycling, backfilling, incineration with heat recovery)	870 million tonnes	1184 million tonnes	36.5%
– Recycling		757 million tonnes	
– Disposal (landfilling, incineration without heat recover)	1027 million tonnes	984 million tonnes	-4,1%
RESOURCE USE (RAW MATERIAL CONSUMPTION)			
– Total resource use	7427 million tonnes	6510 million tonnes	-12.3%
– Biomass, metal ores (gross ores), fossil energy materials/carriers	3976 million tonnes	3488 million tonnes	-12.3%
SECONDARY MATERIALS USE			
– Secondary materials in total materials use	8.3%	11.7%	+3.4%
RESOURCE PRODUCTIVITY (DOMESTIC MATERIAL CONSUMPTION PER GROSS DOMESTIC PRODUCT)	99.8 index-2000	133.6 index-2000	33.8%

4. RESOURCE REDUCTION CALLS FOR CIRCULAR TARGETS

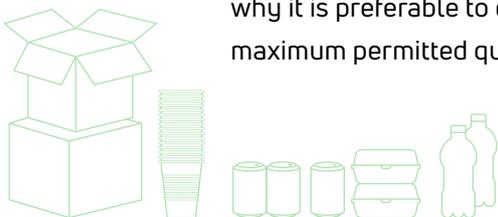
Waste reduction targets may limit waste generation, and thereby are instrumental in waste policy, but they do thus not necessarily limit resource use as the new action plan for the circular economy apparently assumes (EC, 2020). That is the key message of the previous section. Reducing resource use therefore needs targets focusing on **resource** reduction rather than targets for **waste** reduction that are supposed to achieve this but in practice nevertheless may not lead to resource reduction. Resource reduction or circular targets are also essential for reducing the environmental impact (like climate change) from extracting these resources and processing them into materials and products, as well as from treating disposed products.



The main strategies for reducing resource use involve using less products (prevention), using products multiple times (longer) (reuse), more product waste entering the recycling process (more recycling), and more recycled materials from the recycling process being reprocessed as recycled content in the same products they originate from (better recycling). Circular targets for prevention (using less products), reuse, and more and better recycling together should achieve a desired resource reduction for the product group at stake.

Targets for more recycling are already available in the existing recycling targets that set minimum requirements for the percentage of product waste that in a certain target year should enter the recycling process after collection, sorting and cleaning. The quantity of product waste may be deemed equal to the quantity of **new** products placed on the market according to Directive (EU) 2018/852 (EU, 2018). Targets for better recycling may entail minimum requirements for the percentage of recycled materials in **new** products placed on the market in a certain target year (recycled content targets). Such recycled content targets provide a measure of the quality that recycled or secondary materials coming out of the recycling process need to have for replacing primary materials they originate from. Similar to the targets for more recycling (recycling targets) and better recycling (recycled content targets), targets for reuse may entail minimum requirements for the percentage of reusable products in the quantity of new products placed on the market in a certain target year (note that new reusable products have not been used before).

Targets for more recycling (existing recycling targets, better recycling (recycled content targets), and for reuse can thus be expressed in a **minimum** requirement for their **percentage** in the quantity of new products placed on the market in a certain target year. Such format is not possible for prevention targets for using less products. Prevention targets for using less products call for a **maximum** permitted **absolute** quantity in tonnes of **new** products placed on the market. Alternatively, the prevention target could also relate to new and old products (i.e., including reusables already used before). Both stimulate using fewer products in numbers (e.g., by stopping overpackaging or sharing cars) and making products less heavy through product design (i.e., more material-efficient). However, setting a maximum for the quantity in tonnes of **new** products placed on the market, the proposed prevention targets, additionally stimulates replacing disposable by reusable products (i.e., to increase the percentage of reusable products to above the minimum percentage required by the reuse targets), as well as to increase the number of returns for reusables. That is why it is preferable to express prevention targets for using less products as a maximum permitted quantity in tonnes of **new** products placed on the market.



Prevention targets putting requirements for the maximum permitted quantity of new products placed on the market are in line with the request of five European countries in their [Letter](#) to Vice-President Frans Timmermans and commissioner Virginijus Sinkevičius of the European Commission. The five countries write to the European Commission “Unnecessary (over)packaging should be prevented and we ask to set an ambitious target for reduction of packaging placed on the market on the EU-level”. They also call for mandatory reuse targets and recycled content targets.

5. PREVENTION AS A TERM NEEDS UNAMBIGUOUS REDEFINITION

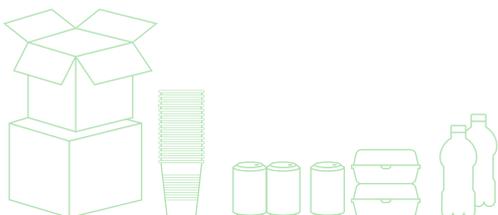
It probably feels intuitively right to most people to use prevention in the meaning of using less products. Nevertheless, the use of prevention in this meaning contradicts the definition of prevention in the directive 2008/98/EC, usually referred to as the waste framework directive. The waste framework directive literally writes ([EC, 2008](#)):

“ ‘prevention’ means measures taken before a substance, material or product has become waste, that reduce:

- a) the quantity of waste, including through the re-use of products or the extension of the life span of products;
- b) the adverse impacts of the generated waste on the environment and human health; or
- c) the content of harmful substances in materials and products”

The waste framework directive thus understands prevention in the meaning of reducing waste (and its impact). Indeed, the waste framework directive uses prevention 46 times, of which 33 times as ‘waste prevention’, 3 times as ‘prevention of waste’, and 7 times in the meaning of waste prevention. The waste framework also contains 75 times product, including as in products and production, but never in the context of using less products.

Prevention is thus clearly understood as reducing waste in the waste framework directive. At the same time, this directive sees prevention as one of the strategies to achieve waste prevention. The waste framework directive literally writes about the waste hierarchy ([EC, 2008](#)):



“The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy:

- a) prevention;
- b) preparing for re-use;
- c) recycling;
- d) other recovery, e.g. energy recovery; and
- e) disposal.”

The waste framework directive does not explain what it means by prevention as the upper strategy in above hierarchy (i.e., the one behind the (a)). Possibly prevention here simply means reducing waste as well. In that case, the waste framework directive thus basically says that waste prevention is to be achieved by waste prevention, preparing for reuse etc. That is obviously illogical.

Directive 2018/852/EC, which amends the packaging and packaging waste directive, may shed some light in the darkness. Point 11 in the introduction to this directive says “..., by prioritising prevention including reuse, and recycling, in line with the waste hierarchy” (EC, 2018). This suggests that (waste) prevention is not a strategy in itself in the waste hierarchy, but its overall aim, and that reuse and recycling represent strategies to achieve waste prevention (i.e. to reduce waste).

While directive 2018/852/EC solves the illogic in the waste hierarchy in the waste framework directive, it potentially introduces new problems. After all, if prevention means reducing waste, it cannot at the same time mean reducing resources and neither mean using less products (the latter now is not included as a strategy in the waste hierarchy). It would be better to omit using prevention in the meaning of reducing waste, but to simply start using reducing waste (or reducing resources) when this is what is meant to be conveyed, and to consistently start using prevention in the meaning of using less products. The hierarchy of prevention (using less products), reuse and (more and better) recycling then applies to waste policy as well as to circular economy policy (see table 2). In other words, the waste hierarchy is then remodelled into a waste & resource hierarchy.

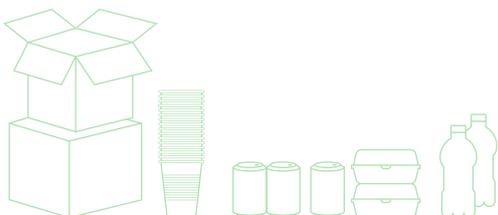


Table 2: Proposed waste & resource hierarchy to replace the waste hierarchy as now included in the waste framework directive (EC, 2008)

WASTE POLICY AIMS AT WASTE REDUCTION , TO BE ACHIEVED BY:	CIRCULAR ECONOMY POLICY AIMS AT RESOURCE REDUCTION , TO BE ACHIEVED BY:
PREVENTION: Using less products	
REUSE: Using products multiple times (longer)	
RECYCLING: – More recycling: More product waste entering the recycling process (higher recycling rate) – Better recycling: More secondary materials leaving the recycling process and being reapplied in similar products (higher recycled content rate)	

6. SETTING CIRCULAR TARGETS DEMANDS CRITERIA

It follows from the above text that circular economy policy needs circular targets for product groups that focus on resource reduction, and that these circular targets should cover the main strategies for reducing resource. So circular targets are needed for prevention (using less products), reuse, and more and better recycling of the materials in products that have become waste. There are a couple of additional criteria with which circular targets should comply, and that serve as a basis for the development of the calculation rules to set these circular targets.

Table 3 summarizes the twelve criteria for circular targets. These twelve criteria are based on existing policy documents and reports. Each criterion is briefly explained in the table. The last two columns are elucidated in the second last section (i.e., Section 10).

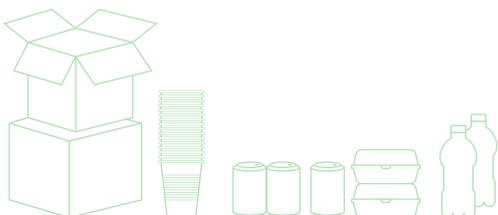


Table 3: Criteria with which circular targets should comply, as well as the calculation rules to set these circular targets, and whether these criteria are met

	CRITERIA	CALCULATION RULES (*)	CIRCULAR TARGETS (*)
1	They relate to specific product groups (≠ material groups, because downcycling of materials from one to another product group should be avoided)		
2	They can encompass several product groups (such that resource reduction can also be quantified and followed at an aggregate level)		
3	They enable enforcement at the producer level if national policies require so	Targets in % not applicable to new producers (*)	
4	They focus on resource reduction (≠ waste reduction; less waste ≠ less resources if recycling leads to downcycling, or when production and consumption grow)		
5	They are (indirectly) based on a reference year (because a reference year is needed to quantify resource reduction in tonnes)		Yes (although not expressed with a target year)
6	They cover the whole product chain (so that a decrease of resource use in the one life stage is not counteracted by an increase in another life stage)	Yes, but not yet demonstrated (*)	Yes, but not yet demonstrated (*)
7	They can address material substitution, prevention, reuse and recycling (and more detailed circular strategies as refuse, rethink etc.)		
8	They allow a breakdown to prevention, reuse and recycling (and to more detailed circular strategies as refuse, rethink etc.)		
9	They are consistent with the already existing recycling targets, namely relating to new products placed on the market	Comparable, but slightly different (*)	
10	They account for quality loss of secondary materials (since resources remain needed if secondary materials cannot replace primary materials)		
11	Compensation between separate circular targets for a product group is not allowed (this would be a policy choice that creates unclarity and may lead to fraud)		
12	They are clear, simple and understandable (as is needed for law enforcement and fraud fighting)	Yes, but can be simpler (*)	

* Green means complying, and orange means not (yet) fully complying with the criterion at stake; see last section 10 for an explanation of the columns at the right hand



7. CALCULATION RULES YIELD SMART CIRCULAR TARGETS

The criteria in table 3 have been used to develop calculation rules for quantifying how much prevention (using less products), reuse, and more and better recycling contribute to resource reduction in a target year relative to a reference year for a certain product group. This is instrumental for setting quantitative circular targets that reduce Europe's resource use for that product group (see following sections for more details on how this can be done).

The calculation rules allow establishing multiple combinations of circular targets leading to a same desired reduction in resource use for a certain product group. This provides the European Commission with space to accommodate the interests of different stakeholders in setting circular targets.

To illustrate their use in setting circular targets, the calculation rules have been applied to the use of glass packaging in the Netherlands (see following sections and appendix 1 for more details). Circular targets for glass packaging in a certain target year would look as follows:

- **Prevention target:** The maximum permitted quantity in tonnes for *new* glass packaging placed on the market
- **Reuse target:** The minimum required percentage of reusable glass packaging in the quantity of *new* glass packaging placed on the market
- **Recycling targets (existing recycling targets):** The minimum required percentage in the quantity of glass packaging waste entering the recycling process after collection, sorting and cleaning (which equals the quantity of *new* glass packaging placed on the market)
- **Recycled content targets:** The minimum required percentage of recycled glass in the quantity of *new* glass packaging placed on the market

The format for the already existing recycling targets, as described in Decision (EU) 2019/665 (EU, 2019), will continue to serve as recycling targets here. As already mentioned in section 4, Directive (EU) 2018/852 (EU, 2018) deems glass packaging waste equal to the quantity of new glass packaging placed on the market. That makes the formats for circular targets for reuse and recycled content similar to the format for the already existing recycling targets. They are all expressed as a minimum required percentage of the quantity of new glass packaging placed on the market in a target year. The prevention target also relates to new glass packaging placed on the market. New glass packaging includes new disposable as well as new reusable packaging (and excludes reusable packaging already used before). New reusable packaging has not yet been used before.



The prevention target is thus to be expressed as the maximum permitted quantity in tonnes of **new** glass packaging placed on the market in a target year. As explained in section 4, this is preferable above the alternative to relate the prevention target to new and old products (i.e., including reusables already used before). Both stimulate using less packaging by using fewer glass packaging in numbers, and by making glass packaging less heavy through product design. However, setting a maximum for the quantity in tonnes of **new** products placed on the market, the proposed prevention target, also stimulates replacing disposable by reusable products (i.e., to increase the percentage of reusable products to above the minimum percentage required by reuse targets), as well as to increase the number of returns for reusables.

Obviously, producers can also switch from glass packaging to packaging made from other materials. In that case, they still should meet the circular targets for packaging made from those other materials. The space for material substitution is thus limited. European policy can motivate producers to explore the possibilities of material substitution by making circular targets for packaging made from one material stricter than the circular targets for packaging made from other materials.

8 PREVENTION & REUSE CAN SUBSTANTIALLY REDUCE RESOURCES

Figure 1 shows for the Dutch glass example how much prevention (using less packaging) and reuse can contribute to reducing resource use in a target year relative to 2014 as the reference year. Using less packaging (prevention) is possible by using fewer glass packaging in numbers as well as by making glass packaging less heavy through product design. Using less **disposable** glass packaging reduces resource use far more than using less **reusable** glass packaging which on average is reused twenty times. The relatively high number of returns for reusable glass packaging makes replacing disposable by reusable packaging (reuse) almost as effective as using less **disposable** packaging (prevention).

Such a high number of returns as for reusable glass packaging is typically not possible for reusable packaging made from other materials (as for reusable **plastic** packaging), and reusables are also less obvious for some packaging made from other materials (such as beer cans). The effectiveness of replacing disposable by reusable glass packaging (reuse), contributing almost as much to resource reduction as using less disposable glass packaging (prevention), is thus not likely for packaging made from other materials.



As a matter of logic, prevention and reuse combined can never contribute more to resource reduction than the quantity of resource use for glass packaging in the reference year. Apart from that, resource reduction by prevention and by reuse are mutually independent. However, prevention and reuse do influence resource reduction by more and better recycling. That is, because prevention and reuse determine the quantity of glass packaging waste available for recycling.

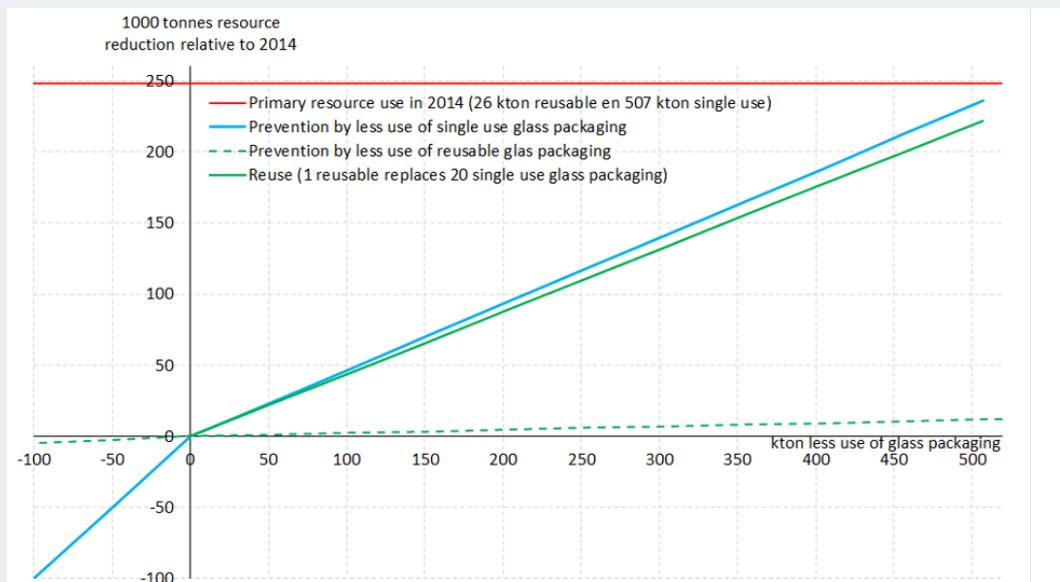


Figure 1: Resource reduction (primary glass reduction) by using less disposable and reusable glass packaging (prevention), and by reuse of glass packaging relative to 2014

9. RESOURCE REDUCTION BY RECYCLING IS LIMITED

How much (less) packaging is used (prevention) and how much (more) reusable packaging is used (to replace disposable packaging) (reuse) in the target year relative to a reference year determines the quantity of packaging waste available for recycling. The quantity of glass packaging waste determines the quantity of glass packaging waste entering the recycling process and therewith also the quantity of recycled or secondary glass leaving the recycling process and ending as recycled content in new glass packaging. The quantity of packaging waste does not influence the **percentage** of it entering the recycling process nor the **percentage** of it ending as recycled content in new glass packaging. Those percentages are properties of the recycling process.

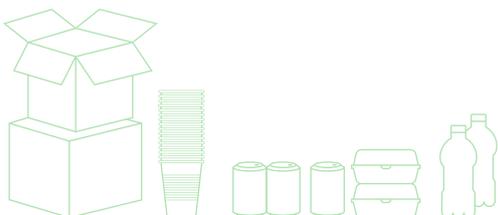


Figure 2 shows the contributions of more and better recycling to reducing resource use in a target year relative to 2014 as the reference year. These contributions are calculated for the same quantity of new glass packaging placed on the market in the target as in the reference year (i.e., no prevention and reuse are assumed). More recycling by improved separate collection, sorting and cleaning of glass packaging waste can theoretically achieve almost 40% reduction of resource use at maximum. More and better recycling together, where all glass packaging waste entering the recycling process end as recycled content in new glass packaging, can theoretically achieve a 100% reduction of resource use. Based on literature, however, in practice just around 60% reduction of resource use is at most feasible. After all, it is unavoidable that glass packaging waste will partly escape separate collection, and there are also limits to the maximum achievable quantity of recycled glass suitable for being reprocessed into new glass packaging.

The results for more and better recycling in figure 2 are based on the recycling rates as calculated according to the new format described in Decision (EU) 2019/665 (EU, 2019). [Brouwer et al. \(2019\)](#) and [Thoden van Velzen et al. \(2019\)](#) have used this new format for recalculating the recycling rates for all packaging materials in the Netherlands (i.e. the percentage of packaging waste entering the recycling process). The recycling rate for glass packaging (71-76%) is comparable to the recycling rate for packaging made from all materials together (74-75%). However, the separate recycling rates range from 35-39% for plastic packaging, 73% for wooden packaging (based on old calculation format), 71-76% thus for glass packaging, 87% for paper and cardboard packaging, and 95% for metal packaging (based on old calculation format). The recycling rate for glass packaging is high compared to that for plastic packaging. The recycled content rate for glass packaging is also relatively high compared to that for plastic packaging. Recycled plastic has now typically too little quality to be reprocessed into plastic packaging again. The recycled content rate for plastic soda bottles on the other hand can be substantially increased by better collection (e.g., as facilitated by a return deposit).



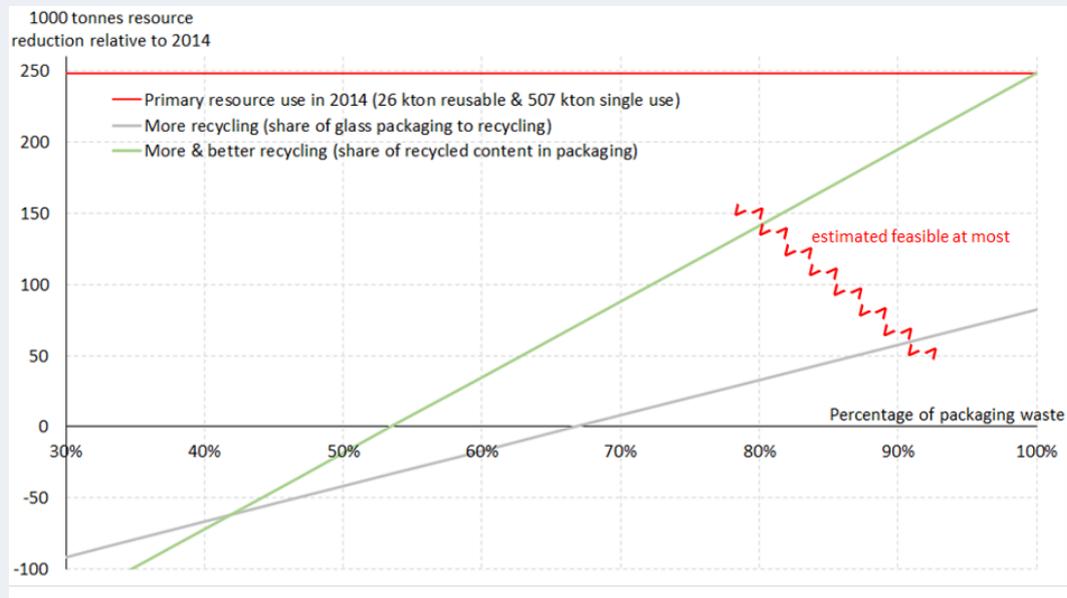


Figure 2: Resource reduction (primary glass reduction) by more recycling (higher recycling rate) and more and better recycling (higher recycled content rate) in case of unchanged use of disposable and reusable glass packaging relative to 2014

10. CRITERIA MET BY CALCULATION RULES & CIRCULAR TARGETS

The circular targets for prevention (using less products), reuse, more recycling and better recycling for in this case glass packaging follow directly from the results achieved with the calculation rules. Based on the desired resource reduction, the optimal combination of prevention (using less products), reuse and more and better recycling can be selected as targets. As explained in sections 4 & 7, the prevention target takes the form of a maximum allowed quantity in tonnes of **new** glass packaging placed on the market (new disposables and new reusables, thus excluding reusables already used before), whereas the targets for reuse, more recycling (recycling target) and better recycling (recycled content target) take the form of a minimum required percentage in the quantity of **new** glass packaging placed on the market. Switching from, in this case, glass packaging to packaging made from other materials is possible but limited since the circular targets for packaging made from those other materials should also be met.

Quantifying the achieved reuse rate, recycling rate, and recycled content rate for a product group in a certain year deviate slightly from the calculation rules. That is because the calculation rules would quantify the achieved resource reduction in a year relative to a reference year. The achieved reuse, recycling



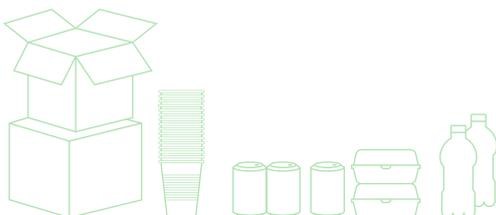
and recycled content rates in a certain year can simply be calculated as the absolute quantity of reuse, recycling or recycled content divided by the absolute quantity of new products placed on the market in that same year. The prevention achieved in a certain year is the quantity in tonnes of new products placed on the market in that year.

Calculating the achieved reuse, recycling, and recycled content rates in a certain year as their absolute quantity divided by the absolute quantity of new products placed on the market in that same year is simple and understandable (criterion 12). It is also consistent with the format of how to calculate the achieved recycling rates for comparison with the already existing recycling targets (i.e., targets for more recycling) (criterion 9). Using the calculation rules instead to quantify the achieved resource reduction in a year relative to a reference year would be slightly less simple and understandable, but most of all would create problems for producers not yet active in the reference year. For these producers, quantifying resource reduction in a year relative to a reference year would lead to dividing by zero (which is mathematically impossible).

The two columns at the right in table 3 show which criteria are met (green) or almost met (orange) by the calculation rules and circular targets. The orange cells have already been discussed above.

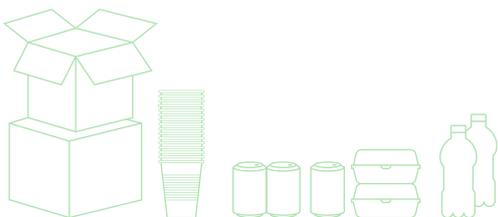
11. SOLID CIRCULAR TARGETS STRENGTHEN EUROPE'S POLICY

The proposed framework, consisting of twelve criteria and calculation rules, provides a solid base for setting separate circular targets for prevention (using less products), reuse, more recycling (recycling targets) and better recycling (recycled content targets). The focus of these circular targets is on reducing resource use, the objective of Europe's circular economy policy, though reducing resources inherently results in reducing waste as well (the opposite is not necessarily true; see section 3). Circular targets focusing on reducing resource use also go hand in hand with reducing environmental impact (like climate change) from extracting these resources and processing them into materials and products, as well as from treating disposed products. Such circular targets thus strengthen Europe's circular economy policy, while at the same time benefiting Europe's waste policy.



The European Packaging and Packaging Waste Directive (PPWD) and Waste Framework Directive (WFD) are currently being revised. This provides the European Commission with an excellent opportunity for introducing circular targets as proposed here in Europe's policy framework.

The ecodesign directive is currently also being revised. Ecodesign can contribute to achieving all circular targets as it may facilitate less material intensive products that can be shared and/or reused, are easier to recycle and are made of recycled materials.



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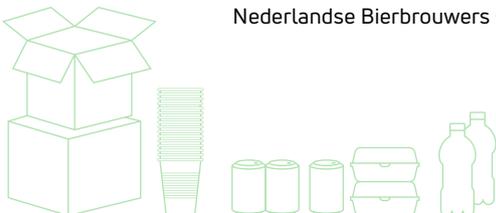
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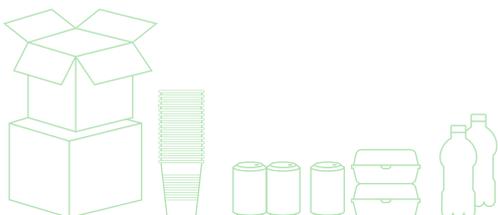
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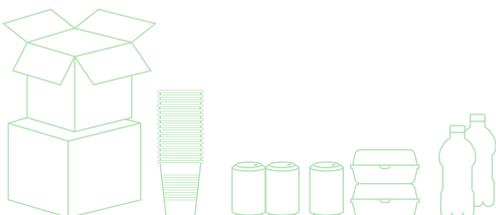
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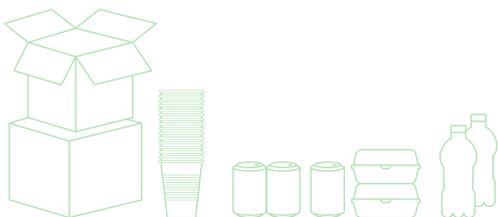
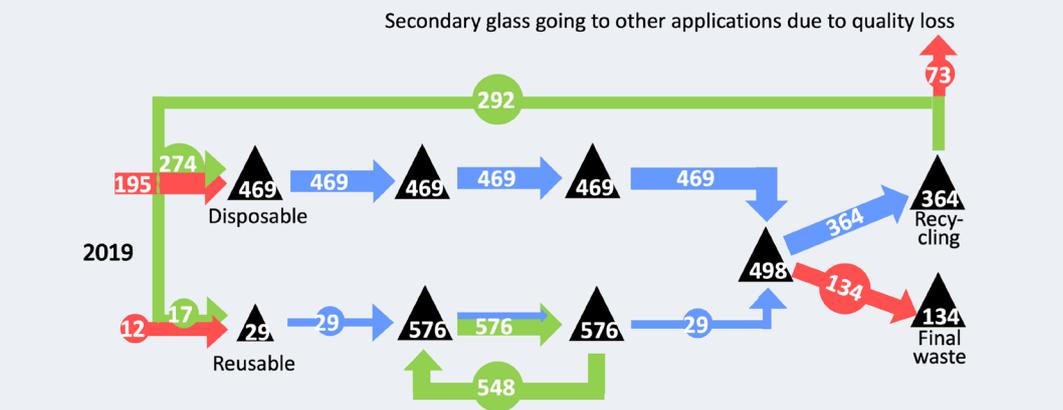
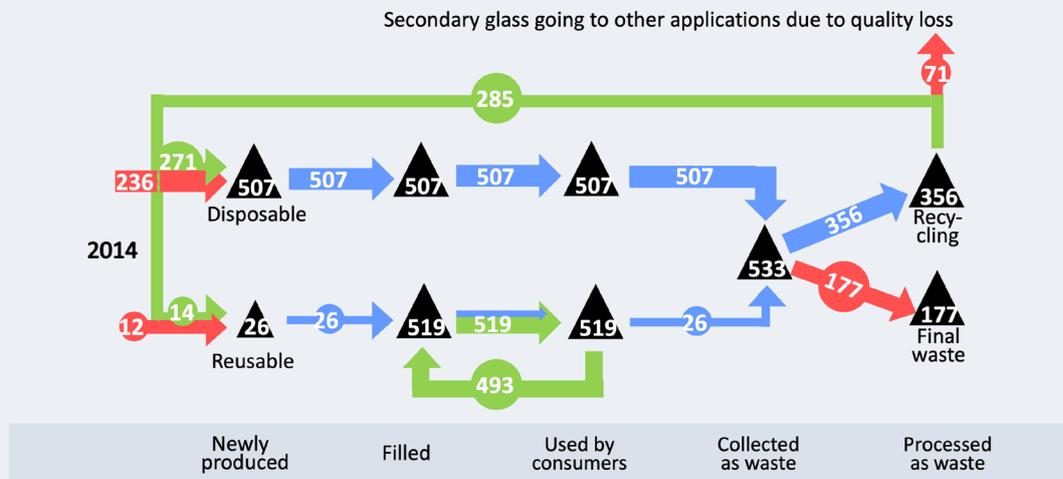
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APPENDIX 1: DUTCH GLASS PACKAGING EXAMPLE

Afvalfonds Verpakkingen annually reports packaging recycling rates on behalf of companies involved in producing, using and waste processing packaging. Their reports contain quantities of new packaging placed on the market, entering the recycling process, and ending up as final waste. Below flow diagram (in 1000 tonnes), which underlies the calculation in sections 7 and 8, is based in data from Afvalfonds Verpakkingen (2016 & 2021). Their quantities of new packaging placed on the market do not distinguish between disposable and reusable packaging. These quantities have been estimated on the basis of the beer consumption in 2019 (Nederlandse Brouwers, 2022a), the estimated consumption of soda drinks and water in glass bottles based on Bergsma et al. (2017), the weight of the Dutch brown return beer bottles in 2019 (Nederlandse Brouwers, s.d.), and an average of 20 returns for this bottle (Nederlandse Brouwers, 2022c). Reusable glass packaging in the Netherlands is mainly used as beer bottles.





APPENDIX 2: CALCULATION RULES

This appendix provides the calculation rules underlying figure 1 and 2 in section 8 & 9. The constants in the formula specifically apply to the Dutch glass example in appendix 1. The rest of the formulas have a generic format basically applying to other products as well.

PREVENTION

1. $\Delta RR-P_{\text{disposable}} = 0.47 * \Delta U-P_{\text{disposable}}$ (provided $\Delta U-P_{\text{disposable}} > 0$)
2. $\Delta RR-P_{\text{disposable}} = \Delta U-P_{\text{disposable}}$ (if $\Delta U-P_{\text{disposable}} < 0$; negative 'prevention')
3. $\Delta RR-P_{\text{reusable}} = 0.47 * \Delta U-P_{\text{reusable}} / 20$ (provided $\Delta U-P_{\text{reusable}} > 0$)
4. $\Delta RR-P_{\text{reusable}} = \Delta U-P_{\text{reusable}} / 20$ (if $\Delta U-P_{\text{reusable}} < 0$; negative 'prevention')

Where (everything in 1000 tonnes):

$\Delta RR-P$ = Resource reduction by prevention (resource use in target year minus 2014)

$\Delta U-P$ = Change in glass packaging use (use in 2014 minus use in target year by prevention)

0.47 = Share of primary materials in glass packaging in 2014

20 = Number of reuses of reusable glass

REUSE

5. $\Delta RR-RU = 0.47 * \Delta U-RU * (0.85 - (1 / 20))$ (as long as $\Delta U-P_{\text{disposable}} < U-P_{\text{disposable in 2014}}$)

Where (everything in 1000 tonnes):

$\Delta RR-RU$ = Resource reduction by reuse (resource use in target year minus 2014)

$\Delta U-RU$ = Change in reusable glass packaging in target year because of replacing disposable glass packaging in 2014

0.47 = Share of primary materials in glass packaging in 2014

0.85 = Weight of disposable in 2014 relative to reusable glass packaging in target year

20 = number of reuses of reusable glass



RECYCLING

$$\Delta\text{RR-Rec} = (\text{RecR}_{\text{target year}} * \text{RCR}_{\text{target year}} - 0,53) * \Delta\text{NoM} \quad (\text{as long as } \Delta U_{\text{disposable}} < U_{\text{disposable in 2014}})$$

Where (everything in 1000 tonnes):

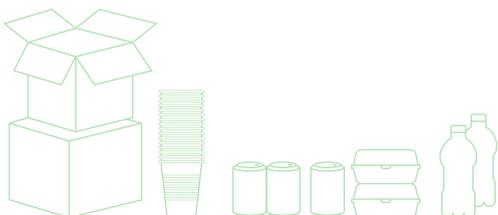
$\Delta\text{RR-Rec}$ = Resource reduction by more and better recycling (resource use in target year minus 2014)

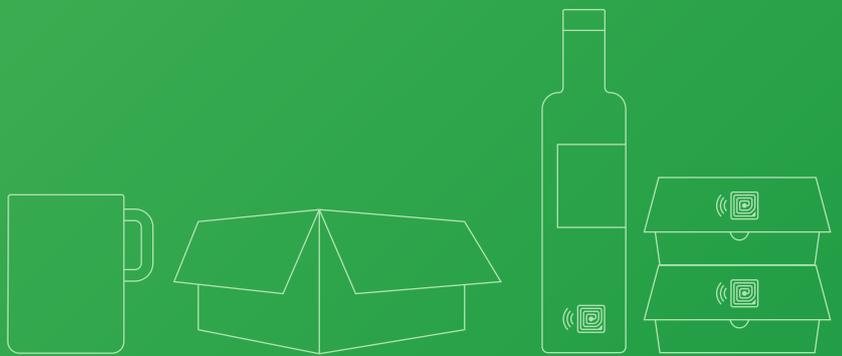
RecR = Recycling rate in target year

RCR = Recycled content rate in target year

0.53 = Share of secondary materials in glass packaging in 2014

ΔNoM = Change in *new* glass packaging placed on the market (new on market in target year minus 2014)





Het Groene
Brew