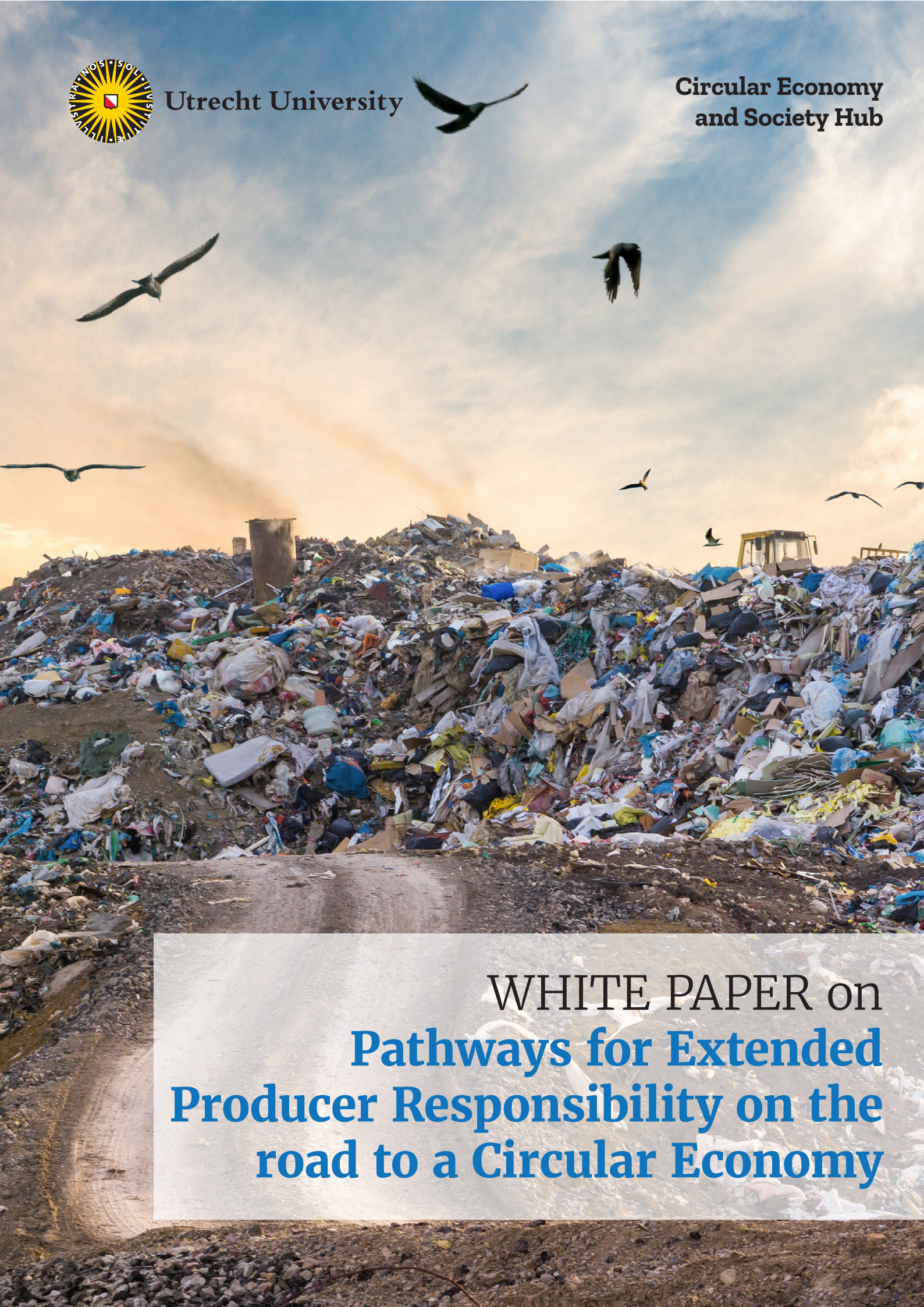

Utrecht University

Circular Economy and Society Hub

WHITE PAPER on Pathways for Extended Producer Responsibility on the road to a Circular Economy

Pathways for Extended Producer Responsibility on the road to a Circular Economy

White paper based on a literature review and the results of a Delphi study on the experiences with EPR in the Netherlands

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Utrecht University – Circular Economy and Society Hub

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Executive Summary

This white paper presents an analysis of the key strengths and limitations of the current organization of Extended Producer Responsibility (EPR) in the Netherlands. Based on our analysis, we present three pathways for improving EPR for the circular economy.

Pathway 1 – Optimizing EPR as an instrument for post-user circularity:
Collection and recycling goals must be balanced with promoting product lifetime extension (repair, refurbishment, remanufacturing, material recycling). The companies engaged in these actions must be formally integrated within EPR in an additional '*circular value chain management organization*'.

Who Supply actors (producers, importers and retailers) bear the financial and organizational responsibility. All value retention aspects (including repair and refurbishment) are integrated in the decision-making about solutions, in addition to material recycling. All these societal actors jointly determine how to achieve the long-term circular economy goals, and provide monitoring and performance data (e.g. the Dutch circular economy policy goals).

How Operational and financial responsibility should be separated from strategic responsibility, i.e. the long-term circular economy objectives and targets. The latter should be dealt with in new *'circular value chain management organizations'*.

What This applies to current EPR schemes and any envisaged ones. New EPR schemes should be applied to remaining parts of the household waste that is currently still incinerated.

Pathway 2 – Re-designing EPR as an instrument for circular economy transformations
Pathway 2 builds on Pathway 1, and it focuses on targets and financial mechanisms for sustainable and circular product design.

Who The new '*circular value chain management organization*' will be involved strategically, setting circular design targets with and for producers.

How Eco-design targets must cover aspects such as share of recycled content, arrangements for repair, component stocking, product disassembly and circular business models. Implementation agreements must be connected to current sector transition agendas. The fee structure should cover all costs related to developing and implementing the *circular transition strategy* for the product group (Pathway 1). The fees should also be modulated, such that they reward front-runners and spur on laggards.

What For all EPR schemes, the producer's participation fee must cover the organization costs of the supplier side Producer Responsibility Organizations (PRO), the organization costs of the *'circular value chain management organization'*, post-user collection and recycling (an upcharge covering the public costs made for uncollected post-user disposals), the market deficit of close-to-application high-quality value retention options (as identified in the strategic assessments by *'circular value chain management organization*'), and the cost of information campaigns for users/consumers on behavioural requirements and recycling practices.

Pathway 3 – Beyond EPR: other means of support
We provide recommendations for institutional arrangements and further options to support the EPR instrument. These include increased eco-design and design-for-sustainability regulations, eco-taxation options, and the essential roles of consumers and municipalities.

1 Background

Both government policies and research on the circular economy (CE) are rapidly evolving. At the national level in the Netherlands as well as at the European level, new programmes and targets for the circular economy were announced in 2020. Utrecht University has published a growing volume of research on the CE.* In addition, in 2020 it created the university-wide CE and Society Hub, in which scientists from different disciplines collaborate. Some of this work focusses on the lessons learnt from earlier recycling-oriented policies and their implication for the future.

One of these earlier instruments is *extended producer responsibility* (EPR). Both the European Commission and the Dutch government have announced a wider and more systematic application of this instrument, whilst the Dutch government has announced a new target of 50% reduction in primary raw material by 2030 in the Netherlands. For the *UU CE and Society Hub*, this has offered an opportunity to make existing research and expertise available for policymaking.

In this study we used a Delphi study to explore practitioner experiences and academic knowledge of EPR, to answer the question: how can EPR be further strengthened or transformed to contribute to the Dutch CE goals? This Delphi was conducted in five phases: (1) selection of stakeholders, (2) identification of available views on the future of EPR in a first survey; (3) validation and valuation of the resulting views; (4) reflection on the most supported and contested views; and (5) a workshop to discuss the results. Initial views on adjustments in the current EPR practices were derived from all relevant sources available: academic publications on EPR; stakeholder input during the recent public consultation, held by the Dutch Government about the new draft decree on EPR;[1] and a workshop with policymakers in January 2020 on redesigning EPR to contribute to the CE. The results of this Delphi will be published in an academic article.[2]

This white paper presents the academic views of the authors, based both on the discussions around this Delphi, and on their own research and experience in the field of circular economy. It takes note of the views of the stakeholders consulted, but the authors are solely responsible for the analysis and conclusions.

In this white paper, we first briefly outline the history and current application of the instrument. Then we take a wider view on the new context of creating a circular economy and summarize the strengths and limitations of the current practice. In Section 6, we present three pathways to further develop EPR to enable it to contribute to the CE policy goals. In Section 7, the legislative implications of these pathways are discussed. Finally, we provide suggestions for further research.

* See www.uu.nl/en/research/sustainability/research/towards-a-circular-economy-and-society

2 Historical roots

Extended Producer Responsibility (EPR) is originally based on the idea that producers are responsible for the environmental impact resulting from the life cycle of a product. It builds on the 'polluter pays principle'. EPR was originally defined in 1992 as *"an environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal of the product"*.[3] EPR was initially introduced as an environmental policy instrument in the late 1980s in various north-western European countries, including Germany, Denmark, France, Sweden and the Netherlands, with the first national regulations in the early 1990s.[4] In the Netherlands it was first announced in parliament by Hans Alders, Minister of Public Housing, Spatial Planning and the Environment in 1990, stating: *"The producer (and importer) will have to be given responsibility for his product in the waste stage ... by establishing that take-back systems must be created for identifiable and distinct streams ... such as batteries, packaging, durable consumers goods, such as electronic equipment (for example televisions and PCs), cars and refrigerators ... I want to create these cycles by means of take-back obligation in combination with a recycling scheme ... I adopt the basic principle that the costs of collection and recycling of products in the waste stage will be included in the product price"*.[5]

During the late 1990s, the instrument was adopted at the European level as a part of the waste management legislation through specific directives addressing the recovery and recycling of specific waste streams. The EU introduced directives implementing EPR for end-of-life vehicles in 2000 (2000/53/EC), for waste of electrical and electronic equipment (WEEE) in 2003 (2002/96/EC), and for batteries in 2006 (2006/66/EC). The Waste Framework Directive (2008/98/EC) sets the general framework for waste management in the EU. In these EU regulations, the introduction of EPR was initially motivated in 2008 as *"one of the means to support the design and production of goods, which take into full account and facilitate the efficient use of resources during their whole life cycle including their repair, re-use, disassembly and recycling without compromising the free circulation of goods on the internal market"*.[6]

The key characteristics of EPR in the European context, as described in Directive 2008/98/EC, Article 8, are the following:

1. Member states implement legislative or non-legislative measures on EPR, as obligation for producers to accept returned post-consumer products/waste, management of the treatment and bearing the financial responsibility, as well as providing information about its re-usability and recyclability.
2. Member states encourage the design of products in order to reduce their environmental impacts and the generation of waste during production and subsequent use of products, and in order to ensure proper recovery and disposal of products, applying the waste hierarchy and pollution prevention.
3. In applying these measures, technical feasibility, economic viability, environmental, human health and social impacts, and functioning of the internal market should be considered.

The EPR regulations allow individual implementation by producers as well as collective approaches. Many collective EPR schemes have been created for a wide variety of product groups. Often these EPR schemes cover a whole country, but in various countries multiple (regional) systems co-exist. Systematic monitoring is lacking, but a 2014 inventory counted 169 EPR schemes in Europe.[7] EPR is also applied outside Europe: an OECD review showed a growing application up to 400 cases worldwide in 2015.[8]

While in some literature broader definitions of EPR are used, in this *white paper* we use the European, narrower, definition that is limited to product take-back systems for which the organizational, financial and informational responsibility is delegated to market actors, either voluntary or obligatory, and which can be taken on either individually or collectively. In the collective

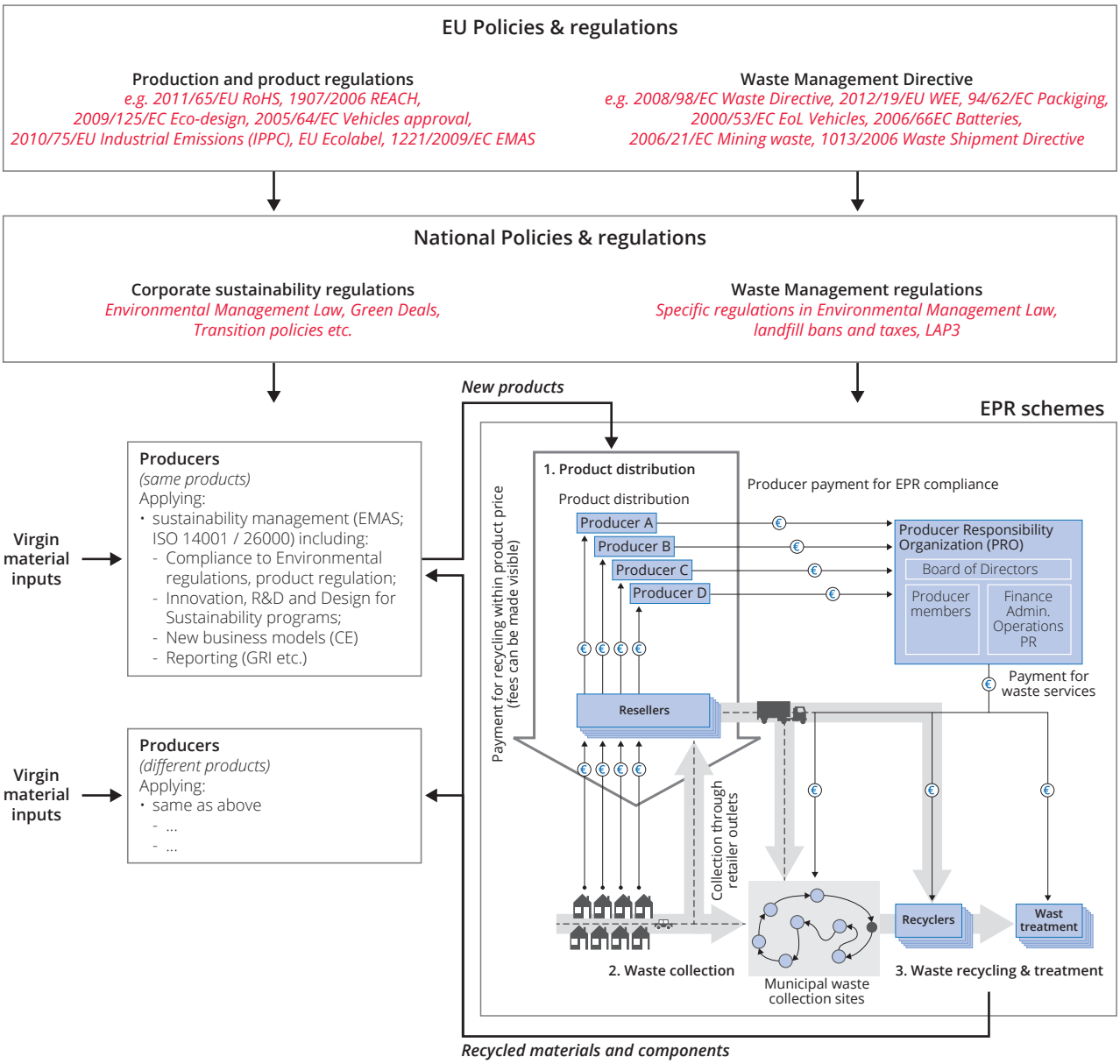


Figure 1 *EPR schemes in the context of wider policies and regulations (contextualizing the presentation by (Mayers and Butler 2013, see also Mudgal et al. 2013) (European Union Network for the Implementation and Enforcement of Environmental Law, 2019)*

alternative, *Producer Responsibility Organizations (PROs)* have the key role of organizing the collection and treatment for recycling, under supervision of the national governments, who provide legal conditions, including the targets for recycling.

Figure 1 shows how this collective uptake is organized by means of PROs (right-hand section of the figure), which in practice focus on organizing the collection and recycling by recycling companies, whereas the costs are covered by the fees of the member producers/ importers. Figure 1 also illustrates that the responsibility for sustainable design (or redesign) of products is regulated in parallel European directives and national laws and policies. At the end of 2015, the European Commission adopted the Circular Economy Action Plan, which reaffirmed the assumption that extended producer responsibility creates incentives for better product design, and which announced additional requirements for EPR schemes. It also announced more incentives and requirements for the wider application of eco-design.[9]

As a result of the 2018 amendment to the Waste Framework Directive, more detailed requirements for EPR have been regulated.[10] In this renewal, the 'EPR scheme' is defined as a *"set of measures taken by member states to ensure that producers of products bear financial responsibility or financial and organizational responsibility for the management of the waste stage of a product's life cycle"*. Article 8a now contains new requirements on defining the roles of all actors, including companies enabling re-use, and wider stakeholder involvement, including social enterprises; on reporting on the treatment methods applied; on providing information about prevention and re-use; on control systems, auditing and transparency; and on linking the financial responsibility to recyclability. The member states are currently in the process of transposing this into their national regulations. The Dutch government organized a public consultation on this topic in 2019, the inputs of which have also been used in the Delphi.

3 Application of EPR in the Netherlands

Extended producer responsibility has been implemented in the Netherlands as an essential element in the sustainable production and consumption policies (Figure 1). The Dutch waste management policy focusses on a wider set of 85 waste sectors in the Dutch industries and product categories, for which the policy waste management plans are determined in National Waste Management Plans (*Landelijk Afvalbeheerplan* (LAP)); currently the third LAP (for 2017-2029) is in force. A wider set of instruments is applied that ban landfilling (legislative ban and taxation[11]) and that regulate incineration, exports and imports, waste separation, separate collection as well as recycling for industry sectors, service sectors and consumers.

Most waste sectors relate to waste streams coming from businesses, before the use/consumption stage in the value chain. EPR is applicable to waste streams coming from the user/consumer stage. It moves the responsibility for recycling or disposal after the post-consumption/use phase to the original producers. This orientation on the post-consumption/use phase limits the instrument to 21 of the 85 product categories and/or sectors in which collection from the user in the value chain takes place (see Appendix I).

In these cases, it is possible for producers and importers to organize an EPR structure either individually or collectively. However, in some cases it is obligatory for producers to join a collective EPR organization. Such obligatory EPR schemes have been introduced for five product groups: waste electrical and electronic equipment (WEEE),[12] batteries and accumulators,[13] end-of-life vehicles,[14] passenger car tyres,[15] and packaging and packaging waste.[16] The EPR schemes for the first four sectors are based on EU Directives, while the EPR scheme for packaging waste is a national EPR scheme.[17] The EPR schemes are applicable to all producers or importers that are the first to introduce one of the abovementioned products to the Dutch market.

Besides these obligatory EPR schemes, there are also voluntary EPR schemes, based solely on 'general binding statements' (AVVs). Producers and importers of a certain product can ask the Minister of Infrastructure and Water Management to make an agreement on the payment of a waste management fee 'generally binding' (Article 15.36 of the *Wet milieubeheer*). This allows producers and importers to finance EPR initiatives, including both voluntary and obligatory EPR schemes. However, it should be noted that the request for an AVV is only possible if the producers and importers represent a significant majority of the total number of companies that produce or import the product in question (Art. 15.37 (1) of the *Wet milieubeheer*). Both the request and the AVV itself must meet certain requirements, and these are laid down in a by-law (formerly the *Regeling verzoek afvalbeheersbijdragen*, which was replaced in 2020).

If an AVV is adopted for a specific EPR stream, all producers and importers are obliged to pay a waste management contribution fee to the corresponding PRO. This is also the case if the producer or importer was not party to the agreement. Currently, AVV-EPR schemes are in place for lightbulbs, float glass, and paper and cardboard.[18]

Furthermore, there is a connection with the National Waste Management Plan (LAP), which imposes the obligation to establish waste prevention programmes in Article 28 (1) of the Waste Framework Directive. The LAP3 for 2017-2029 contains relevant information on EPR, such as criteria for introducing an EPR for a new waste stream.[19]

In 2020, the Dutch government published the Regulation on EPR (*Besluit regeling voor uitgebreide producentenverantwoordelijkheid*), aiming to lay down general minimum requirements for existing and future legislative EPR schemes. A new regulation for the 'general binding statement' (*Regeling algemeen verbindend verklaring overeenkomst afvalbeheerbijdrage*) was also accepted in 2020.[20] With these legislative acts, the Dutch government has incorporated the new obligations in national law under Article 8a of the amended Waste Framework Directive, mentioned in Section 2.

Meanwhile, new EPR schemes are being prepared for mattresses, textile, floorings, single use plastics, building fronts, renewable energy equipment, roof coverings, gypsum and timber.[21]

4 System perspective: promoting the circular economy with a value retention options perspective

How does *extended producer responsibility* fit in the promotion of the circular economy? In the last decade the circular economy has gained increasing attention. However, it is not a new concept, as it builds on earlier efforts to prevent and reduce pollution and resource depletion.[22] Resource depletion has always been one of the motives for recycling, but recently stricter policies have been announced in order to move towards the reduction and even phasing out of the input of primary raw material (described in the Dutch policy as a 50% reduction in the use of primary raw material by 2030, and fully circular by 2050).

Many definitions of the circular economy are available,[23] some from a more technocratic perspective and others stressing the transformation of the economic structure of society.[24] Without providing an explicit definition, the Dutch CE policy's strategic goals focus on a transformation of the economic structure, shifting towards reducing the demand for resources, using non-critical and renewable resources, and introducing new production methods, new products and alternative modes of consumption.[25]

Earlier policies (described as circular economy 1.0 and 2.0, see Table 1) also addressed both the design (and redesign) of products and the implementation of recycling infrastructures. The current approaches in science and policy regarding the circular economy focus on business opportunities in which the 10Rs are applied in new product design or alternative service provision. The new 10R hierarchy (see Figure 2) is the result of an

Table 1 *Features of Circular Economy 1.0, 2.0 and 3.0 policies*

	Circular Economy 1.0 (1970-1990)	**Circular Economy 2.0** (1990-2010)	**Circular Economy 3.0** (2010-now)
Focus	***Away from landfilling***: incinerating and first public recycling efforts	***Connecting Input and Output side*** in eco-efficiency strategies	***Maximizing Value Retention*** in age of resource depletion
Principles / tools / instruments	First formulations of waste hierarchies like 3R: reduce / reuse / recycle Ladder of Lansink	Input side: pollution, prevention pays, environmental management systems, Design for Sustainability, Design for Disassembly, Industrial Ecology, Cradle to cradle etc. Output side: extended producer responsibility, eco-industrial parks, industrial symbiosis etc.	Input side: replacing all virgin material inputs by secondary resources Relying on new business model incentives Output side: more and deeper extended producer responsibility
Key challenges	Mostly oriented on output side of value chain: what to do with waste after user phase?	Upscaling sustainable business practices Organizing recycling infratsructures	Transfer from downcycling to higher level of value retention. Promote short loop and middle-long loop value retention options

extensive literature review of waste hierarchies in academic literature and synthesizes the definitions of the Rs in detail.[26] It has also been adopted in national policies and abroad, albeit with small adaptations.[27]

During the earlier phases of circular economy 1.0 and 2.0, more simplified waste hierarchies (of 3Rs or 4Rs) guided the policy. 'Recycling' and 'useful application' have been described in general terms as requirements. However, the concept of the circular economy has evolved, creating a more inclusive perspective, and this has resulted in more attention for the middle-long and short loops in Figure 2.

For our reflection on the challenges of EPR schemes in their contribution to CE, we need to apply this more inclusive full system approach. A circular economy can be presented in a simple version as cycles where products or materials after the user phase are directed back to earlier phases of the life cycle (like in the well-known Ellen MacArthur Foundation butterfly figure, showing the biological and the technical cycle, but also many others[28]). Such figures may certainly be helpful for explanatory purposes, but they also have their limitations.

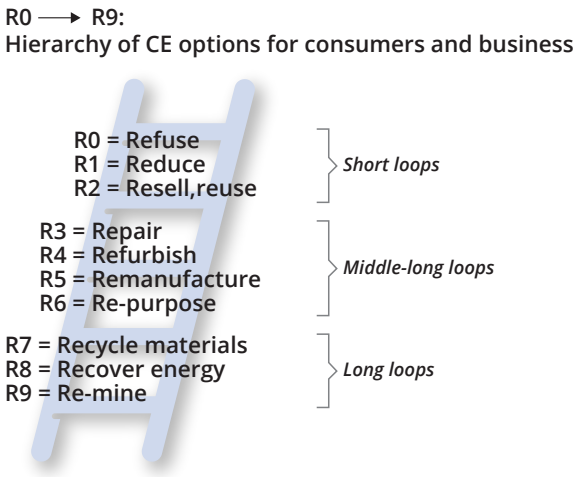


Figure 2 *Value retention options for circular economy, see more detail in Appendix II (Reike et al. 2018)*

We identify five essential limitations:

- In practice the economy is a complex web of material flows in a large number of sectors and product groups. These flows are interlinked and the current practice of recycling only partly brings back materials into the original product groups (closed loop recycling). Often low-value options are *applied in other sectors and product groups* (open loop recycling). After collection, choices need to be made to arrive at the best applicable recycling option. Often the most sustainable value-retention options are not the cheapest. Current policy practice allows choosing affordable options with an agreed price level as a limit, based on the third characteristic described in the Waste Framework Directive 2008/98/EC (see Section 2). There is no explicit practice of systematically assessing the sustainability of existing and innovative recycling options, in order to determine which recycling choices can be allowed. With the given price limits, the decision is left to the market.

- Presenting the circular economy as a single production and consumption cycle is also too simple. We need to distinguish two versions of product life cycles: first, the *'produce and use' life cycle* of day-to-day large volume production of products and their use; and second, the *'design and concept' life cycle*, where producers design or redesign their products regularly, so that they can apply new approaches to address sustainability challenges, including circular design (for example by using fewer and only recycled materials, and organizing recyclability and take-back). These two versions of product life cycles have different key actors, different value retention options, and a different governance context (see also Figure 1).

- In the *'produce and use' life cycle*, the imperatives for the key actors can be displayed as the 10R value-retention options (Figure 2). The longer-loop Rs are relevant for producers, retailers and other commercial actors, whereas the shorter-loop Rs rely also on consumer behaviour. In the *'design and*

concept' life cycle, it is the designers in existing industry and innovative start-ups that are the key actors, applying designer-specific versions of the 10R value-retention options (see also Appendix II). The circular economy requires that *both life cycles are addressed simultaneously and in connection*.

- Circularity is one goal in a broader set of sustainability goals. Any re-design of products or services requires an assessment of all sustainability aspects for the whole range of related activities in the circular value chain. Performance improvements in one sustainability aspect should not be at the expense of other aspects. This refers both to the wider range of environmental aspects (for example resource depletion versus climate change, biodiversity, and toxicity) and to the trade-off between environmental and social sustainability (for example human health, working conditions, and fair trade). *Full circularity will not be realistic*, both due to such trade-offs and for thermo-physical reasons.[29]

- In practice, *product cycles and value chains often expand globally*, with production taking place on one continent and consumption on another. The subsequent parts of the product chain/cycle are governed in different jurisdictions with different levels of stringency. Returning products or materials would imply long transport distances. For this reason, direct recycling of materials or components by the original producer is often not an option. Moreover, the distinction between end-of-life disposal and re-use is not a clear-cut distinction. Re-use by others may occur multiple times, possibly including repair or refurbishment.

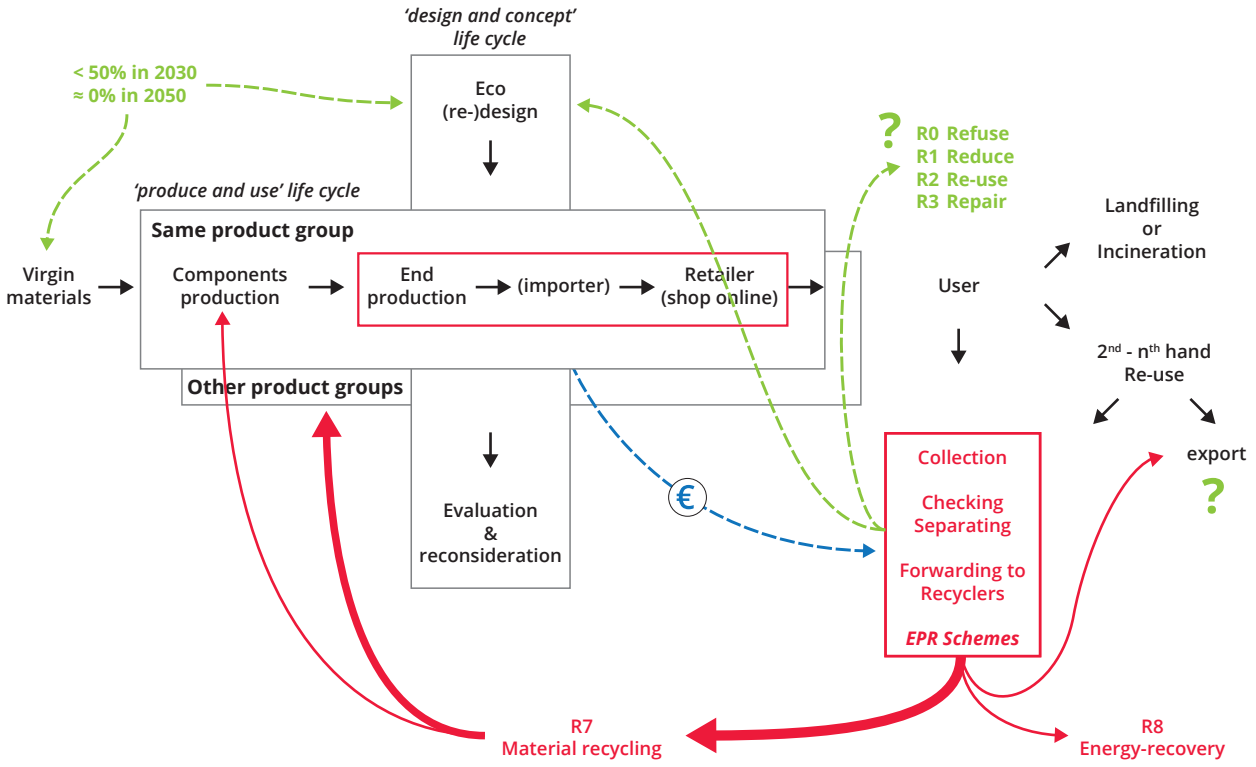
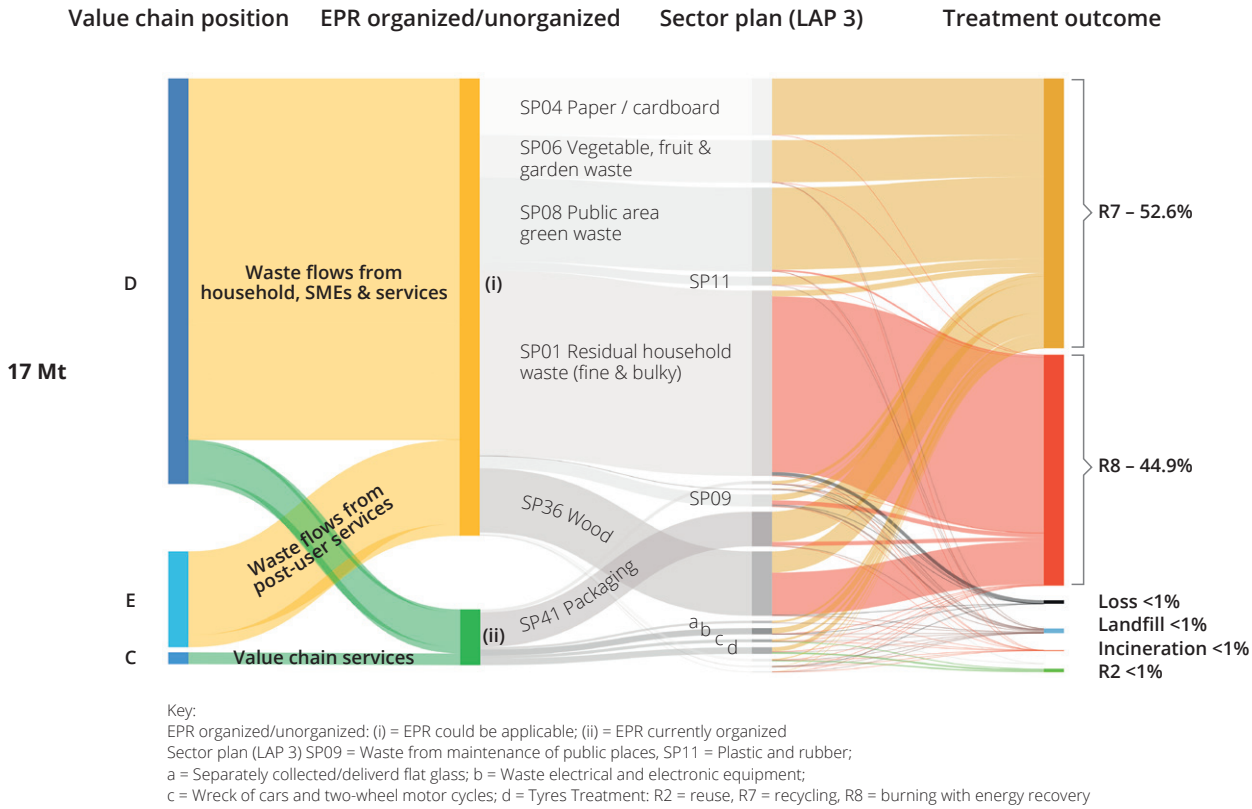


Figure 3 *Simplified presentation of EPR supplemented with key challenges and limitations the context of Circular Economy 3.0*

In practice, different product groups (such as cars, mobile phones, kitchen equipment and furniture) can go through various cycles of use (second-hand use, third-hand use and even many more usage cycles). Often, products flow 'downstream' to legislative areas with lower levels of stringency, first within Europe and eventually outside Europe. These transboundary movements are barely traceable using nationally- or even regionally limited EPR schemes.

The limitations are illustrated in the double visualization of the *'produce and use' life cycle* and the *'design and concept' life cycle*, which also highlights the separate but related positions of management of post-consumer/user disposal and the design or redesign of products (see also Appendix II).

We can illustrate the position and future challenges of EPR in a simplified way as an instrument in the wider system, as in Figure 3. As applied in practice, if EPR is organized under a collective Producer Responsibility Organization (PRO; the inner red box in the Figure 3), it is mostly organized by a third party (the PRO) with specified, limited tasks. The focus of circular economy 2.0 has been on R7 (mass material recycling) and R8 (energy recovery), while the challenge of transforming to a circular economy 3.0 with a future ban on the input of



Key:
EPR organized/unorganized: (i) = EPR could be applicable; (ii) = EPR currently organized
Sector plan (LAP 3) SP09 = Waste from maintenance of public places, SP11 = Plastic and rubber;
a = Separately collected/deliverd flat glass; b = Waste electrical and electronic equipment;
c = Wreck of cars and two-wheel motor cycles; d = Tyres Treatment: R2 = reuse, R7 = recycling, R8 = burning with energy recovery

Figure 4 *Post-consumer/user waste sectors, application of EPR and modes of waste treatment (2016, data Rijkswaterstaat) (see also Appendix I)*

primary raw material is currently outside the scope of EPR schemes. The current scope also does not require contributing to the shorter-loop Rs (in green in figure 3).

In Section 3 we explained that EPR is relevant in sectors of post-consumer/user disposal (21 of the 85 LAP3 sectors). Together, these sectors produced 17 Mt (29%) of the total 58 Mt waste in 2016. Figure 4 gives an overview of these post-consumer/user waste sectors and the sectors applying EPR (in green), and it shows to what extent R7 (recycling) and R8 (incineration with energy recovery) were applied.

With this in mind we assess the current practice in the next section.

5 Current strengths and limitations

Currently, the practice of implementing EPR in the Netherlands is ambiguous. Compared to elsewhere, this implementation is fairly successful, but it also faces limitations and challenges, which have also been identified in other countries in Europe and beyond. In assessing the current status, we need to acknowledge that EPR was introduced as a response to circular economy 1.0, at a time when most waste was still landfilled or incinerated. However, in the 2020s we are now facing new challenges that need to be addressed in the new circular economy policies, stressing the need to replace primary raw material input by recycled materials as well as the need to promote the shorter value retention loops more strongly. In this new context, we identify six strengths and seven limitations of the current EPR practice in the Netherlands.

5.1 Six strengths

Strength 1: *Applied to relatively many product categories*
EPR has been applied to five waste categories and then voluntarily to another three categories in the Netherlands (Section 2). This goes beyond current EU requirements. More waste categories are currently under consideration. As shown in Figure 4, EPR is mostly relevant for post-consumer waste categories. These categories cover 29% of the waste generated in the Netherlands. The volume of waste in post-consumer waste categories organized with EPR schemes covers 6.6% of the total waste, thus affecting 23% of the post-consumer waste. The three EU EPR Directives only address 0.9% of the total waste. In other words, the Dutch EPR policies address seven times more waste than is actually required by the EU.

Strength 2: *Successful in organizing collection for recycling*
Most Dutch EPR schemes have been successful in reaching government targets. Over time the systems have led to higher collection rates of waste for recycling. The EPR scheme for passenger car tyres has reached a collection rate of 100%, while for cars the collection rate is 85%. However, other EPRs are less successful: only 58% of WEEE and 48% of batteries were collected in 2019, although these numbers are still increasing (Figure 5 shows the achievements of all schemes).

Strength 3: *Legal targets mostly met and exceeded*
In most cases, for example tyres, cars, glass, paper, metal and timber, the EPR schemes reach far higher rates of collection and recycling than the national targets and also than the EU targets. This is partly related to the relatively low EU targets in these cases. So far, the targets have been met in most cases, with the exception of glass, where the Dutch target was raised recently while the target for 2018 had not yet been met. Also, the renewed targets for WEEE in 2019 were not yet met.[30]

Strength 4: *Landfilling and incineration of resources prevented*
Applying EPR within the mix of policy instruments has contributed to the shifting away from incineration and landfilling of domestic waste, with almost zero landfilling (down from 9% to 1% in 2000-2019) and less incineration of domestic waste (down from 29% to 24% in 2000-2019).[31] The recycling rates achieved (see Figure 5) equally imply prevented landfilling and incineration (as far as R7 is applied). Passenger cars and car tyres are examples of product groups with zero landfilling in the Netherlands. The PROs provide multiple examples of prevented CO_2 emissions and other environmental benefits on their websites.

Strength 5: *Cost of collection and recycling covered by producers*
The core concept of making producers financially responsible has been implemented in the systems: all operating costs of the PROs are covered by the producers and importers participating in the EPR schemes. In cases where almost full collection takes place, this implies that the 'polluter pays principle' has been implemented as originally intended. In practice the participants pay the costs of managing the share that has actually been collected by the PRO. In cases where only a limited share is collected for recycling, for example when consumers still put e-waste or packaging in the grey bin, the remaining waste treatment costs are still covered by governments (and thus taxpayers).

Strength 6: *These achievements are created very efficiently*
The organization of recycling by means of PROs can be described as very lean solutions, since fairly small organizations orchestrate the collection and recycling. With a limited number of employees (10-20), most PROs are able to organize the recycling very efficiently at a low-cost level of 0.15-2% of the original total sale prices in the market (see Appendix III).

Referring to these six strengths, some international scholars explicitly describe the Dutch as being among the front-runners in the application of EPR.[32] Nevertheless, various limitations have also been identified.

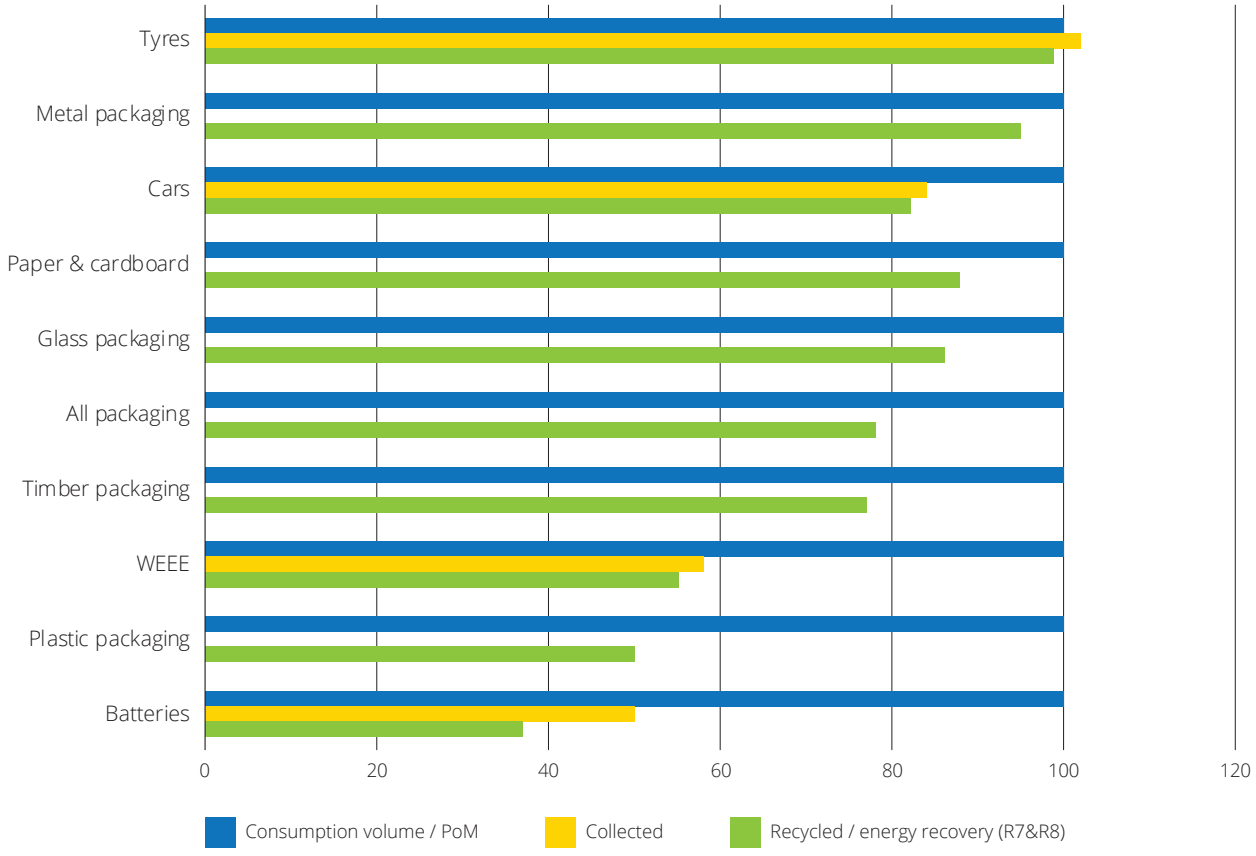


Figure 5 *Performance of EPR schemes in the Netherlands (2019, details in Appendix III)*

5.2 Seven limitations

Limitation 1: *Often EPR schemes do not cover the full waste stream*
The legitimacy of EPR schemes depends on the degree of full participation of all producers and importers as well as the level of control over the full volume of the post-consumer waste generated. Such a level playing field is challenged in two ways: (1) some of the actors may be free-riding, and (2) part of the waste stream is still ending up in landfill or is still being incinerated or exported outside Europe.

In the Netherlands, free-riding is partly solved by applying AVVs (see Section 2), but non-participation and foreign internet sales are still seen as a market distortion. Even in a sector with low levels of internet sales, such as car tyres, free-riding is estimated at 5% (including internet sales),[33] while for packaging free-riding is estimated at 2.4%.[34] These free-riders do not contribute financially, but their products are treated in the EPR schemes if consumers hand them in correctly. This can result in various problems, such as lower collection rates for end-of-life products, financing problems for waste management activities, and a potential over-estimation of national recycling rates.[35] As recognized by the OECD, there is little data available on this problem, but it is probably most prevalent for product categories that are characterized by a high value-to-weight ratio, such as WEEE.[36]

Furthermore, the EPR schemes may not cover all products included in the product group. For instance, the EPR scheme for passenger car tyres does not cover all tyre types. This may result in the neglected tyres being both a burden for the environment and a financial burden for the municipalities.[37]

Incomplete coverage is also the result of lower collection results. The waste that is not collected in the EPR schemes is collected as general household waste and in the Netherlands this means that it is incinerated (in Figure 2 this amounts to 42% of WEEE, 52% of batteries and 52% of plastic packaging). The costs involved are not covered by producers, thus weakening the incentives to design out resource losses.

Limitation 2: *What is collected is not recycled at the highest level*
For some waste categories, material is recycled into the same product (e.g. glass and paper/cardboard[38]), but in many cases low-value material recycling dominates (i.e. downcycling). This is currently the case for passenger car tyres: recycling such tyres produces low-quality granulate that cannot be used in new tyres in large quantities[39] but is used on artificial sport fields, which has caused a great deal of criticism.

A considerable share of the recycling takes place outside the Netherlands, both for reasons of cost reduction and due to a lack of domestic recycling capacity. In 2017, 33% of Dutch end-of-life tyres were exported for reuse and re-treading.[40] While car tyres are commended for their high reuse and re-treading rates, exporting such products for recycling leads to lower carbon emission savings. Similarly, roughly one-fifth of discarded EEE in the Netherlands has been exported abroad, around one quarter of which is estimated to having been exported illegally.[41] Plastic packaging waste is reported to be processed in the Netherlands and Germany mostly, and exports to China ended after the 2018 Chinese import ban. However, clear data on how much and where and how plastics are processed is lacking, both in the reports from the PROs and in the reports from the recycling companies.[42] PROs are not well-equipped for controlling the quality of such foreign recycling facilities, be it inside or outside Europe. Quality assurance systems have been created (such as WEEELabex and RecyBEM Certification), but PROs do not need to collect and monitor information on processing after export.

Limitation 3: *Economic considerations cast a shadow over sustainability criteria*
The lower-quality recycling also relates to how the acceptability of recycling methods is negotiated with the government. The acceptable forms of 'recycling' and 'useful application' (including energy recovery from

incineration) are determined in relation to the general principle of cost-effectiveness laid down in LAP3: 'high-value management of waste' should still be affordable and LAP3 determines a general *'threshold value'* of € 205 per ton of waste,[43] for which adjustments may be agreed for sectors. Each sector plan describes these requirements, also linking them to EU Best Available Technology reference documents.[44] The direct sector negotiations promote affordability of methods (mostly R7 and R8) rather than the most sustainable alternatives for value retention. This is in line with Waste Framework Directive 2008/98/EC, Article 8, which calls for a mixed environmental and economic assessment (see Section 2). However, in practice, integrated sustainability assessment of available technologies is not systematically conducted as a base for such decision making on preferred value-retention technologies. What is also lacking is an assessment of the options available to achieve the long-term circular economy goals (i.e. phasing out the use of primary raw material) and applying the cascading principle (organizing the form of re-use with the highest value first, before applying lower value forms of recycling).[45] Within the boundaries of the negotiated maximum recycling costs, the selection of recycling methods is thus *de facto* left to the market.

Limitation 4: *Markets for secondary materials are not being actively strengthened*
If we look at the product categories regulated by EPR schemes, we see that the reuse of secondary materials for the same type of products only takes place in a few of these (i.e. glass and paper). Markets for the other recycled materials are poorly developed, and higher prices of recycled materials and quality concerns are barriers for replacing primary raw material by recycled materials. EPR schemes do not play an active role in improving the functioning of markets for secondary materials. It is left to the recycling companies and the original producers to make their choices on economic grounds. Currently, no data is available on the rate of application of recycled materials in EPR-regulated product categories, such as electronic equipment, batteries, plastic packaging, cars and tyres.

Limitation 5: *Monitoring and transparency is limited*
PROs are obliged to report to the government on key performance indicators that are related to the formulated collection and recycling targets. PROs provide this information publicly on their websites in very different formats and levels of detail and openness. Annual reports are audited by auditing consultancies. In the case of WEEE, monitoring is organized in cooperation between the various market and government actors in the National (W)EEE Register. Beyond showing the collection rates and general recycling rates, little detail is given about the relative shares of specific modes of treatment, the location of treatment in other countries inside or outside the EU, the application of the secondary materials in relevant product and production sectors, and the re-use of secondary materials by the producers participating in the EPR schemes. For example, a substantial share of the collected tyres is exported for reuse and re-treading, but as monitoring may be insufficient at the destination of these tyres, environmentally safe recovery is uncertain.[46] Regarding batteries, NGOs have raised questions about the reported collection targets, suggesting that STIBAT (the PRO for batteries) highly overestimates the in-home stock of batteries, thus painting a more positive picture.[47]

Limitation 6: *There is no assumed stimulus for eco-design*
EPR has been defined both in science and in policy as aiming for the redesign of the full life cycle of products (see Section 2). Three decades after its introduction there is a clear consensus in the scientific community that the application of EPR has so far hardly stimulated producers to widely apply eco-design or Design for Sustainability,[48] which is also acknowledged by the Dutch government.[49] Various authors suggest that EPR could stimulate the application of eco-design,[50] but no direct connection has been found between applying eco-design or proven improved environmental performance and the participation in the EPR scheme. Design incentives in EPR are not explicit, while only few of the 'producers' addressed in EPR schemes are manufacturers designing original equipment (OEM) and most are thus not in a position to apply eco-design [51].

Meanwhile, eco-design and Design for Sustainability approaches address more sustainability aspects than energy use, resource use or preparations for recycling,[52] and some approaches are especially designed to address aspects of circularity.[53] While eco-design approaches have to some extent been adopted in industry, the main drivers for this are related to strategic positioning and market strategies connected to certification and reporting, while research on eco-design implementation does not show evidence of the influence of EPR schemes.[54]

Limitation 7: *Intended financial incentive for re-design is not targeted, is too weak and is only partial*
The assumed design incentive is based on the general economic assumption that by creating financial responsibility for externalities, which is the core feature of EPR, producers will respond by reducing these externalities, by designing out the waste. However, in the case of EPR schemes this assumption does not hold, for two main reasons: first, the incentive is weak, and second, the incentive is not linked to responses to achieved improvements in product performance.

The weak incentive is the downside of **strength 6**, the efficiency of the system: collective recycling has been organized at rates of less than 2% or even 0.1% of the product price, but this leads to a failure to generate a strong driver for eco-design. In addition, as discussed under **limitation 1**, not all externalities are included in the costs, but only the costs for part of the waste that has been collected. A third cause of the weakness of the incentive is the limitation to affordable recycling options, as described under **limitation 3**. This also encourages the export of waste to be recycled to countries with cheaper facilities.

The missing link refers to the principle that for an incentive to be effective, it needs to reward adjusted performance. So far none of the Dutch EPR schemes contain a participation fee modulation that rewards better performance by original equipment manufacturers (OEM). This may be related to the recycled content level of new products, or sustainability certification, including more sustainability aspects. Such approaches have been suggested, but not yet applied. In practice however, the additional cost of organizing take-back and recycling is low compared to the product price (see the table in Appendix III). As a result, the financial incentive is small and the effect on eco-design remains limited.

The EPR Delphi contained statements that are related to this overview of strengths and weaknesses, which is based not only on our literature review, but also on input by stakeholders (see Appendix IV for details).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6 Pathways for EPR in a CE 3.0 perspective

In the Netherlands, EPR efficiently organizes collection and recycling of materials for the waste streams as shown in section 5.1. However, it is clear that the original wider rationale behind EPR, the assumption that EPR induces product redesigns for the environment [55], is not evidenced in practice. In reviewing the practice of EPR from the perspective of the current CE policies, this is an essential point. The national and European CE policies strongly focus on a ***transformation of the economy by redesigning value chains into closed loop cycles***, phasing out the input of primary raw material and maximizing the use of secondary materials, while also continuing the application of EPR.[56] While the focus of the current national policy is on a large number of showcase projects of re-designing products and business models in five prioritized transition agendas, EPR is also seen as an important element of the CE policy. In the recent report in the *Broad Societal Reconsiderations* programme of the National Financial Inspection on circular economy, the key bottlenecks identified were lack of economic incentives, slow innovation, institutional barriers based on short-term orientation and lack of a sense of urgency.[57] In this white paper, we observe these bottlenecks for the practice of EPR as well.

In the latest Dutch annual policy review 'CE Implementation programme 2020-2023', the government holds on to the assumption that EPR will stimulate the sustainability and the sustainable use of products, while also promoting innovation in the collection and the recycling of discarded products. Meanwhile, it promotes the application of the 10R hierarchy of value retention options.[58]

Based on the analysis above, it can be concluded that the assumed effect on redesigning of products is unlikely to take place, if the EPR instrument is not adjusted and embedded in a stronger regulatory environment. We need to acknowledge the limitations of EPR. In its current form, EPR is an interesting example of public-private governance,[59] with stakeholder involvement limited to the producers and importers who are directly involved. Our advice is in line with the recently published Integrated Circular Economy Report 2021, but further elaborates on the suggestions on optimizing the ERP instrument.[60]

We see *three pathways* for the future of EPR, each including packages of innovations in the system that link to the limitations shown in Section 5 and the statements discussed in the Delphi. These pathways are relevant for the existing EPR schemes as well as for the anticipated new EPR schemes.

6.1 Pathway 1: *Optimizing EPR as an instrument mainly for post-user circularity*

The first pathway takes EPR in its current form, focusing on efficiently organizing collection and recycling, and enhances its effectiveness in contributing to the new CE policy goals. It acknowledges the current EPR strengths, while addressing limitations 1, 2 and 5, which are related to targets, choice of recycling technologies and transparency. The core challenge here is to better connect to the 10R value retention hierarchy. Not all 10Rs are relevant in the context of EPR, if we focus on the post-consumer/user phase. However, the current focus on affordable material recycling and energy recovery needs to be complemented, using the promotion of lifetime extension by means of repair, refurbishment, remanufacturing and so on. This implies including economic actors engaged in these activities for the product groups addressed. It also requires a systematic assessment of the applicability, impact and financial implications of applying all value retention options R3 to R8 (Figure 2) in an integrated strategic programme for the product group. The core principle of EPR is then maintained: producers (and importers) are financially responsible for the infrastructures of the respective value retention options. They can still decide to take on that responsibility either individually or collectively. However, all economic actors related to R3-R8 (repair, refurbishment, remanufacturing, material recycling and energy recovery) need to be represented in an additional *'circular value chain management organization'* that decides on the *'circular transition*

strategy' for the product group. Decision making needed for achieving the governmental goals on CE requires a wider representation of the stakeholders involved in the transition.

This has the following implications for the 'who', 'how' and 'what':

WHO

On the *supply side* of the products, producers, importers and retailers should all be included in the PROs, both from physical shops and (international) online shops. The supply side bears the financial responsibility and is expected to facilitate the solutions.

On the side of *value retention solutions*, economic actors engaged in collection, repairing, refurbishing and re-selling should also be included. Their roles are in operating the solutions and participating in strategic decision making; their activities are financially compensated (partly or fully) by the supply side.

Society is responsible for the long-term goal of the CE transitions and sets the boundaries and targets, promoting international harmonization (EU policy) and ensuring application of up-to-date knowledge.

HOW

The operational and financial responsibility should be separated from the strategic responsibility. The first two responsibilities are currently organized very efficiently in the PROs representing the supply side. However, the strategic choices require a more inclusive governance approach and are best organized separately in a *'circular value chain management organization'* with the wider representation as described above. The key tasks of the *'circular value chain management organization'* are assessment, strategic decision making, and monitoring transparency. This translates the longer-term government CE goals into a systematic sustainability assessment of the available and envisaged technologies and infrastructures for the R3-R8 value retention options and their contribution to achieving the target of a 50% reduction in the input of primary raw material. This includes an analysis of the market for high-quality secondary material and the related innovation systems.

Based on this, a *'circular transition strategy'* is determined for a limited period of time. Principles of product lifetime extension and cascading are leading in this. Targets are more specifically formulated in terms of modes of the value retention applied (e.g. R2 reuse and R3 repair). The three groups of actors jointly engage in monitoring and communicating with all stakeholders. Monitoring includes information about the specific types of value retention applied (e.g. volumes and geographic locations). Shipments to other EU countries and to countries outside the EU are more strictly controlled at borders, and the national government checks for illegal shipments.

WHAT

This pathway applies to both current EPR schemes, newly implemented EPR schemes, and new EPR schemes envisaged in the implementation plans. In Section 4, we showed that the current schemes address a small share of the post-consumer waste stream. The new plans will mostly reduce the parts of residual household waste that are currently incinerated, and parts of construction waste.

6.2 Pathway 2: *Re-designing EPR as an instrument for the transformation to CE 3.0*

This pathway focusses on enabling the assumed – but in practice weak – incentive for producers to sustainably design more circular products. While eco-design is promoted in another part of the policies and regulations, the design of EPR can be linked better to promoting eco-design.

So far, EPR has only implicitly stimulated eco-design, and direct links are absent. In addition to *Pathway 1*, direct links can be created in two ways: circular product design aspects should be addressed in the formulation of *targets*, and stronger and more direct connections are needed in the *financial mechanisms*.

This has the following implications for the 'who', 'how' and 'what':

WHO

The *'circular value chain management organization'* described above plays a key role here. The sector-specific targets included in its strategic decision-making should incorporate the determination of applicable circular product design-related targets for the producers in the value chain.

Stronger and linked incentives relate to the fee structure of EPR. The form and volume of the participation fees are currently determined by the PROs themselves, indirectly influenced by the *'high-value management of waste threshold value'* of € 205 per ton of waste.[61] This has historically been derived from the cost of landfilling. This delegated and diffuse mode of decision making needs to be replaced by collective and explicit decision making. The government needs to set the general requirements of elements to be included in the fee structure, while the *'circular value chain management organization'* regularly provides details and announces them.

HOW

The eco-design *targets* cover various relevant aspects related to eco-design, including the share of recycled material content, arrangements created for repairing, component stocking, disassembly of the product and circular business models. Agreements on the speed of implementation can be included in the *'circular transition strategy'*. These targets need to be linked with the transition agenda for the sector.

The fee structure will take the original rationale of EPR *('making the manufacturer of the product responsible for the entire product life-cycle and especially for the take-back, recycling and final disposal'*, see Section 1*)* to its ultimate consequence, thus making it a stronger incentive. This justifies including all costs related to the full volume of products put on the market and costs related to developing and implementing the *'circular transition strategy'* for the product group (Pathway 1) in the fee.

The fee structure will then be modulated in such a way that front-running producers will be charged with a substantially lower fee than laggards.

WHAT

Both for existing and for newly developed EPRs, the *participation fees* for producers in PROs will include:

- organization costs of the supplier side PRO.
- organization costs of the *'circular value chain management organization'.*
- the cost of collecting and recycling the post-user disposals.
- an upcharge covering the public cost made for the uncollected part of the post-user disposals.
- the market deficit of close-to-application high-quality value retention options (as identified in the strategic assessments by the *'circular value chain management organization'*).
- the cost of information campaigns for users/ consumers on behavioural requirements and recycling practices.

This extended fee structure will result in higher financial incentives, depending on the distance to the targets for the national and/or European circular economy policy. The decisions about which expenditures are covered by the fees will be made in the 'circular value chain management organization'.

In order to directly link the fee to eco-design performance, the fee structure will be *modulated*, based on:

- the recycled content in new products (also related to the share of eco-designed products in the full portfolio of the producers).
- the extent to which a producer also engages in the self-organization of (individual) producer responsibility.
- the eco-design improvements applied for better repairability and a better infrastructure for repair and refurbishment.
- the relative lifetime of the product (as proven).
- participation in product sustainability certifications (including circularity aspects).

- participation in approved voluntary compensation schemes (like TCO Certified Edge, E-waste Compensated).[62]

The sum of such fee modulation discounts will need to add up to a very substantial share of the full fee (60-80%), in order to be able to influence the corporate sustainable design strategies of producers.

The recently published detailed review of fee modulation options by Eunomia Research & Consulting for the European Commission assesses a wide range of options but does not include our advice for the wider base of participation fees.[63]

6.3 Pathway 3: *Beyond EPR: how other instruments can support EPR and CE*

EPR was introduced when waste in the Netherlands was still largely landfilled and incinerated. It was introduced as a game changer, and partly fulfilled this expectation; however, as it is an example of public-private governance, it has its limitations, like we showed above. At the same time, it remains a useful instrument within the wider toolkit of sustainability and circularity policies. EPR will better fulfil its role if elements of this wider toolkit are also further attuned to the longer-term CE ambitions.

In *Pathways 1 and 2* we proposed a more detailed description of the roles of all business actors in the circular value chains in a more inclusive EPR system. However, EPR functions within the wider regulatory architecture and other (non-)business actors than producers also play an important role. Although it is not the main purpose of the study and the white paper, we wish to present some additional directions in this wider context, as these would strengthen EPR schemes.

Other instruments in the toolbox:

Eco-design regulations are mainly based on EU directives; they are limited to a longlist of energy-related products[64] and provide rules for energy labelling. This applies to the EPR for electronic equipment, but not to any of the other product groups. It has been argued that more effort should be devoted to the systematic inclusion of CE aspects.[65] For some electronic equipment, the recent eco-design regulation (2019/424) has stipulated circularity-related requirements (enabling repair and dismantling).[66] Meanwhile, efforts have been made to integrate circularity aspects into the eco-design directive-related methodologies, such as the material-efficiency eco-design module to the Methodology for the Eco-design of Energy-related Products (MEEPR).[67] For other products, general Design for Sustainability methodologies and specific circularity-focused approaches have been developed. This application to all other product categories should be more explicitly supported in corporate sustainability policies and regulations.

Eco-taxation may also provide a more general approach to setting the right financial incentives than the financial mechanisms in the current EPR approach, i.e. the fees paid by PRO members. The suggestions in Pathway 2 are limited to the supply side actors in the EPR value chains. Taxation of primary raw material input and exemption from value added taxation for activities to be promoted, such as repair and refurbishment services, may provide strong additional signals to markets for circular products.

Other actors:

Consumers play an essential role. Both in their purchasing role (e.g. selectively choosing sustainable alternatives, preventive attitudes (R0, R1), re-use and sharing options (R2)) and in their disposal role (proper separation and delivering at return points), they are crucial for the success of the circularity transition. Communication programmes of EPR schemes address some of these aspects, but not all. NGOs and government-supported information programmes (including Milieucentraal) can contribute positively to the required transformation in consumer culture. More intensive collaboration would be beneficial here.

Municipalities continue to play a key role in separate collection. In the current waste policy, they are expected to reduce the volume of residual household waste, both fine and bulky, to 30 kg per inhabitant; in 2019 this was still 61 kg and 29 kg for fine and bulky waste, respectively.[68] In the current EPR schemes, public and private collection points are operated in collaboration between PROs and municipalities. The additional EPRs may enable part of this required reduction, but close collaboration between PROs, municipalities and contracted waste collection companies will be essential to achieve this behavioural transition.

7 Legal implications

Having identified two pathways in Section 6 as to how EPR could and should be adjusted and further developed, this section examines whether these pathways are already being addressed in current discussions on the legal framework for EPR at the European and national level. The aim is to analyse which legal instruments at which level would have to be amended to facilitate the further development of EPR according to the pathways outlined in section 6.

7.1 Circular value chain management organization (Pathway 1)

EU law

None of the EU-directives that call for EPR-schemes[69] prescribe the inclusion of other actors than the producers or importers of the goods in the EPR scheme. Most of the directives do not even refer to the possibility of including other actors. An exception is Directive 2006/66/EC on batteries and accumulators. This directive aims at improving the environmental performance of batteries and accumulators as well as of the activities 'of all economic operators involved in the life cycle of batteries and accumulators, e.g. producers, distributors and end-users and, in particular, those operators directly involved in the treatment and recycling of waste batteries and accumulators' (Art. 1). According to Art. 8 (2) sub b of Directive 2006/66/EC, member states may (*not* must) require other economic operators than producers to participate in the collection schemes for waste batteries. Art. 19 (2) of this directive obliges member states to ensure that all 'economic actors' and all competent public authorities are able to participate in the collection, treatment and recycling schemes with regard to waste batteries. 'Economic operators' is defined as 'any producer, distributor, collector, recycler or other treatment operator'. Hence, the directive on batteries and accumulators explicitly addresses the life cycle approach (see Art. 5 of this directive), and it also encourages member states to include actors other than producers into the legal schemes, in order to enhance the environmental performance of the products. However, the directive does not oblige member states to include these other actors in the schemes for collection, treatment and recycling or for them to take part in EPR organizations.[70]

EU law generally allows the involvement of economic operators other than producers and distributors in the activities and organizations of EPR, whilst the Waste Framework Directive actively encourages member states to do so. In Section 2 of Art. 8, the provision on EPR, member states are encouraged to take measures to promote a more circular design of products and to apply a life cycle approach when doing so. Art. 8a (1) asks the member states to clearly address roles and responsibilities, including those of local authorities, and 'where appropriate, re-use and preparing for re-use operators and social enterprises'. Hence, the Waste Framework Directive, like the directive on waste batteries, acknowledges that EPR schemes can include actors other than producers and distributors, and it even encourages member states to take this into account. However, it does not prescribe that PROs should have such a broad scope.

National law

Dutch law has not taken up the suggestion of Art. 8a of the Waste Framework Directive to include in the organization of PROs also operators or social enterprises involved in re-use and preparing for re-use as well as other operators within the lifecycle of a product. The Dutch regulation on EPR, the *Besluit regeling voor uitgebreide producentenverantwoordelijkheid*[71] solely addresses 'producers', who are defined in Art. 1 as those who place products on the market, which may include distributors. The PROs should solely consist of 'producers' (Art. 6). The existing and proposed (or discussed) EPR schemes and mandatory PROs do not include anyone else than producers and distributors. For example, distributors are explicitly mentioned in the Regulations for the management of batteries and accumulators 2008. Distributors of portable batteries or accumulators are obliged to inform the end user of the possibility to return the portable batteries or accumulators, and they are obliged to take them back (and hand them over to the producer).[72]

Prospective national law

EU law does not hinder or restrain our suggestion regarding Pathway 1 that promoting a more circular economy requires a more inclusive governance approach, which is organized in a *'circular value chain management organization'*. In reality, this inclusive approach would be in accordance with the spirit and approach of the Waste Framework Directive. This is also true for the mandatory EPR schemes on packaging and packaging waste, on end-of-life vehicles and on WEEE, which are required by EU law, but do not address economic operators other than producers or social enterprises. The directives in these areas only set minimum requirements, but do allow member states to go beyond them.

If a circular value chain management organization were to be introduced in national law, the current regulation (*Besluit regeling voor uitgebreide producentenverantwoordelijkheid*) will have to be amended. The legal basis of this regulation, Art. 9.5.1 (1) of the Environmental Management Act (*Wet milieubeheer*), seems to be broad enough to serve as a legal basis for such extension of the current regulation on EPR (*Besluit regeling voor uitgebreide producentenverantwoordelijkheid*) as it empowers the government to issue a regulation 'on the manufacture, import, application, possession, making available to another, receipt, collection, recovery and disposal of substances, mixtures or products or waste materials'. Hence, a provision could be added to the regulation, directing the establishment of value chain management organizations complementary to the PROs. As an alternative to altering the existing regulation on EPR, a new, complementary regulation could be introduced on circular value chain management organizations. Art. 9.5.1 (1) of the Environmental Management Act (*Wet milieubeheer*) could serve as a legal basis for such a regulation. No matter which way is chosen, the altered or new regulation will have to define the relationship between these value chain organizations and their tasks and the tasks of the PROs.

Prospective EU law

The introduction of *'circular value chain management organizations'* also needs to be discussed at the EU level. An amendment of the general legal framework, for example in the Waste Framework Directive, would not be needed. As mentioned above, Art. 8a (1) of this directive already encourages member states to address the responsibilities of operators and social enterprises involved in re-use and in preparing for re-use. Value chain management organizations and their role and relation to PROs could be mentioned more frequently and described more explicitly. However, this does not seem to be the most urgent legal measure to be taken.

What should be discussed is the introduction of obligatory circular value chain management organizations at a European level, with regard to certain groups of products, such as WEEE, packaging waste, batteries and end-of-life vehicles. This would make sense for some of these product categories because of the international scope of the value chain. The proposed *'circular transition strategies'* for the product groups, including the assessment of available technologies, would be more effective if they were to be developed jointly for all EU countries. Furthermore, the need for such organizations to develop targets for circular product design (Pathway 2, discussed in 7.2 below) is a strong argument in favour of European organizations, as mandatory circular product design requirements cannot be determined at the national level. In such cases, the related directives must be altered to enable the introduction of such a requirement.

7.2 Re-designing EPR as an instrument for the transformation to CE 3.0 (Pathway 2)

Pathway 2 comprises two different elements which, when their legal implementation is analysed, need to be discussed separately: the introduction of targets for circular product design and the introduction of modulated fees.

7.2.1 Targets for circular product design

The legal implication of setting targets for circular product design will only be discussed briefly as this measure seems to be on or even beyond the edge of what is called extended producer responsibility. However, if value chain management organizations are introduced in order to develop circular transition strategies for groups of products, targets for circular product design would clearly be a key element and important means of operationalizing this task. Furthermore, Art. 8 (2) of the Waste Framework Directive already mentions and promotes circular product design measures.

EU law

Several EU directives already prescribe European circular product design measures or provide an explicit legal basis to do so.[73] Examples include Art. 6 of Directive 2019/904 on the reduction of the impact on the environment of certain plastic products, which prescribes various requirements for certain single use plastic products, including minimum percentages of recycled material, and Directive 2000/53/EC on end-of-life vehicles, which prohibits the use of lead, lead compounds and certain other materials in vehicle components. With regard to 'energy-related products', the legal basis for eco-design requirements is to be found in Directive 2009/125/EC. Potentially, the directive covers all products that have an impact on energy consumption during their use (Article 2, sub 1). Appendix I makes clear that the criteria that may be taken into account when setting the requirements to gain the European conformity CE-mark, which is necessary for the marketing of such products, may relate to all phases of the lifecycle of the product. These phases include (a) raw materials selection and use; (...) up to (f) end-of-life, meaning the state of a product having reached the end of its first use until its final disposal. For each phase, a range of relevant environmental aspects must be assessed, including (a) predicted consumption of materials, of energy and of other resources; (...) (d) expected generation of waste material; (e) possibilities for reuse, recycling and recovery of materials and/or of energy, taking into account Directive 2002/96/EC. Hence, the directive potentially addresses all aspects relevant to a more circular design of products, and thus it has a huge potential to serve as a legal basis for setting ambitious requirements that promote innovations, even though it is limited to 'energy-related products'.[74] However, this potential has not been used yet. None of the daughter directives on certain products or groups of products defines the targets for circular product design.

National law

Generally speaking, binding requirements for circular product design cannot be set in national law as this would mean an equivalent to quantitative import restrictions, which are prohibited under Art. 34 of the Treaty on the Functioning of the European Union (TFEU), and which usually cannot be justified under the exemptions of Art. 36 of the TFEU or the rule of reason (Court of Justice, case 8/74, Dassonville and case 120/78, Rewe). However, measures of national governments and parliaments aiming at promoting circular product design are not completely excluded, as for example recent French measures demonstrate. In 2020, the French 'Act on the Circular Economy' introduced Art. L. 541-10-1 into the French *Code de l'environnement*, empowering the government to require producers to draft a prevention and eco-design plan for certain products, with the aim of reducing the use of non-renewable resources, increasing the use of recycled materials, and increasing the recyclability of these products. Such a plan must be revised every five years. Hence, the government does not set any specific standards or targets for certain products but requires the producers to make and implement plans for a more circular design of their products. French law allows and encourages producers to jointly draft such plans and to establish an 'eco-organization' which can then develop such plans for all their members. Thus, this French legal provision to some extent breaks through the impasse that results from the fact that product-related rules in the internal EU market can in principle only be set in EU law, but that EU product standards focused on circularity have so far been almost completely absent.[75]

7.2.2 Introduction of modulated fees

Legally speaking, the introduction of modulated fees is a much simpler issue.

National law

Art. 6 (4) of the Dutch Regulation on EPR (*Besluit regeling voor uitgebreide producentenverantwoordelijkheid*) already urges for modulated fees. According to this provision, 'the financial contributions of the producers to the producer organization should ..., if possible, differentiate, taking into account the whole life cycle, durability, reparability, reusability and recyclability of the substances, mixtures or products and with the presence of hazardous substances therein.' Hence, the legal basis for the modulation of fees is not only present, but Dutch law also positively requires such a modulation, at least in principle.

Another question is whether current Dutch law would allow more comprehensive fees that cover all costs related to the full volume of products put on the market, as well as the costs related to developing and implementing the 'circular transition strategy' for the product group, which also includes the organization costs of the 'circular value chain management organization'. The current Art. 6 (3) of the Regulation on EPR only defines which costs should 'at least' be covered. These are the costs for the tasks of the producers and PROs mentioned in the other articles of the regulation. The law does not rule out including other

costs in the fee. However, it may be argued that costs for tasks which are not assigned to the producers or the PROs, for example the organizational costs of the 'circular value chain management organization', are not covered by Art. 6 (3) of the Regulation on EPR, even though this provision is not conclusive. The argument would then be that Art. 6 (3) of the Regulation on EPR forms a legal basis for obliging producers to finance PROs, but not a legal basis for obliging producers to finance other organizations that are needed to help reach the circular economy aims. Therefore, an additional legal basis would be necessary to require producers to pay such costs.

European law

Art. 8a (4) of the Waste Framework Directive already requires the member states to introduce fees that *'are modulated, where possible, ..., notably by taking into account their durability, reparability, re-usability and recyclability and the presence of hazardous substances, thereby taking a lifecycle approach'*. This provision, introduced in 2018, clearly favours and to a certain extent ('where possible') even requires modulated fees. Art. 6 (4) of the Dutch Regulation on EPR implements this EU requirement. Hence, there is already a legal basis for fee modulation; it 'simply' has to be applied.

EU law is not the place to provide the legal basis for requiring producers to participate in the costs of PROs or circular value chain management organizations. This has to be done at the national level. EU law requires that the financial contributions paid by the producers and, required on the basis of national law, should cover, at the very least, specified categories of costs. It does so in Art. 8a (4) sub a of the Waste Framework Directive. However, this includes only minimum requirements. If EU law, at a certain moment, were to oblige member states to organize circular value chain management organizations, it would clearly be consistent to also include the costs for those organizations in the minimum requirements in Art. 8a (4) of the Waste Framework Directive. However, this is not a prerequisite for national regulations obliging producers to bear the costs for such organizations.

7.3 Final remarks

A final point of discussion is at which level the pathways mentioned in this paper should be pushed forward. Legally speaking, eco-design targets for products must be introduced by the EU. All other measures can also be taken at the national level. European action has clear advantages as it ensures a level playing field within the EU, at least to some extent, and as circular transition strategies for products or product groups can be developed most effectively at the EU level. The disadvantage of such an approach is also clear: progress depends on the European legislator and the will of the (qualified) majority in the Council and in Parliament. On the other hand, national initiatives have a much smaller scope and effect, but they enable front-runners to move forward more quickly. In such a situation, which is typical for new policy initiatives in the EU, a two-tiered approach is often the most effective strategy: starting with the joint action of some front-runner member states, followed by EU action at a later stage, but as soon as possible. The Netherlands has set itself the target of a 50% reduction in the use of primary raw material by 2030, which is why it needs to adopt such a leading role, preferably together with some other frontrunning member states.

Regarding further legal steps in the improvement of EPR in the Netherlands, the discussions about introducing an Act on the circular economy could be taken as a window of opportunity. It has recently been emphasized that there is a need to improve the instruments to promote circularity and to let high ambitions be followed by more binding requirements.[76] If the response to this plea were to include the introduction of a Circular Economy Act, this act could be used to provide the necessary legal basis for realizing the pathways towards an EPR 3.0 as discussed above.

8 Research agenda

- The proposed pathways can be further detailed in various research projects, filling a current knowledge gap.
- Pilot projects on the *'circular transition strategy'* (Pathway 1) for existing and recently proposed new EPR categories. This includes technological innovation system assessment, a market analysis of recycling options, and a review of the diversity of approaches in the European market.
- An analysis of the financial implications of the wider base for the participation fee (as described in Pathway 2 under 'What').
- Designing new target formulations and specifying value retention options and eco-design requirements for selected existing and proposed ERP categories.
- Designing scenarios for fee modulation for selected existing and proposed ERP categories.
- An analysis of the material flows of EPR waste and re-usable products categories between European countries and from EU countries to outside the EU, and the recycling technologies applied for these material flows.
- An analysis of the rate of application of recycled materials in EPR-regulated product categories, such as electronic equipment, batteries, plastic packaging, cars and tyres, where such data is currently not available, or only available for limited showcases.
- An analysis of the variation of organizational national EPR schemes and the implication for the proposed *'circular value chain management organization'.*
- Identifying common ground for joint legal action of several front-runner EU member states.

Abbreviations

AVV	Algemeen verbindend verklaring (general binding statement)
CE	Circular economy
CO_2	Carbon dioxide
EC	European Commission
EPR	Extended Producer Responsibility
ErP	Energy-related Products
EU	European Union
LAP	Landelijk Afvalbeheersplan (National Waste management plan)
MEEpR	Methodology for the Eco-design of Energy-related Products
NGO	Non-governmental organization
PRO	Producer responsibility organization
OECD	Organization for Economic Co-operation and Development
OEM	Original equipment manufacturer
STIBAT	Implementation organization of the Batteries Foundation of the battery producers
TFEU	Treaty on the Functioning of the European Union
WEEE	Waste of electric and electronic equipment
WMF	Waste Management Framework (EU)
10Rs	10 value retention options (framework)

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Appendix I

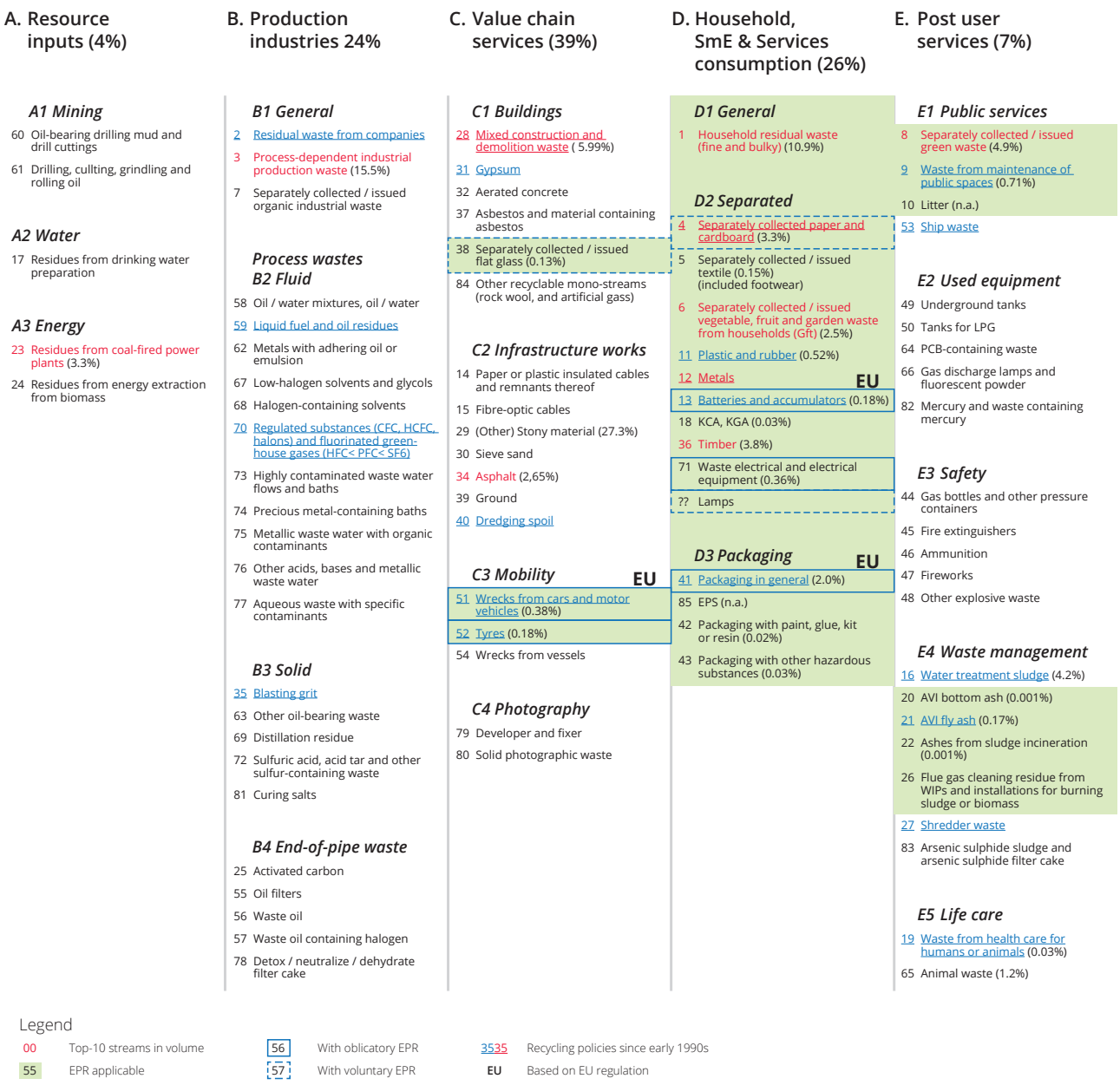

Figure 6 *Sector waste management plans in the Dutch LAP3 and the application of EPR shown in a value chain perspective (% = share in total national waste generated, 2016, data Rijkswaterstaat)*

The Dutch waste management policies are regularly updated in the National Waste Management Plans (LAP), the most recent one covering 2017-2029 (LAP3). Apart from providing general policy, LAP3 addresses a long list of 'waste sectors' (combinations of materials and specific actors disposing of it). For each of the 85 sectors, detailed plans ('sector plans') describe the goals, regulations and arrangements. In this appendix, the 85 sector plans have been displayed in a value chain perspective (A, B, C, D and E, also showing the weight share of the total Dutch waste in 2016). Sector plans partly address business sectors in which environmental regulations directly allocate the responsibility for disposal to companies. EPR is relevant where it addresses disposal after the user phase, indicated in green. The figure also shows for which sectors EPR is applied (either based on EU or on national obligations, or voluntary).

Appendix II

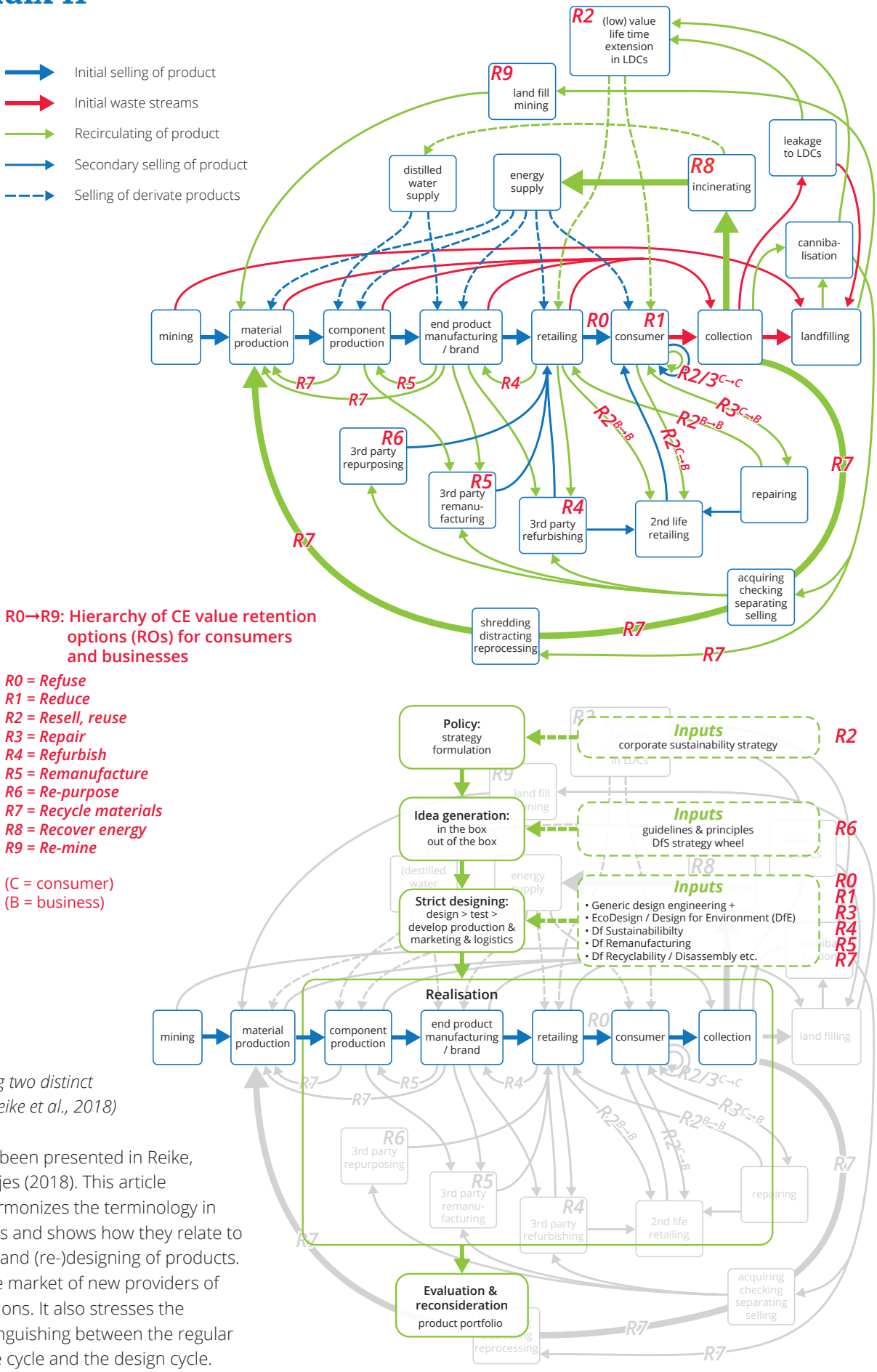

Figure 7 *Visualizing two distinct product life cycles (Reike et al., 2018)*

These figures have been presented in Reike, Vermeulen and Witjes (2018). This article synthesizes and harmonizes the terminology in recycling hierarchies and shows how they relate to regular production and (re-)designing of products. It acknowledges the market of new providers of value retention options. It also stresses the importance of distinguishing between the regular production and use cycle and the design cycle.

Appendix III

Table 2 *Organizational costs in relation to sales of product group for current EPR Schemes*

	2018			2019		
Product group	**Sales**	**PRO costs**	**PRO costs/ sales ratio**	**Sales**	**PRO costs**	**PRO costs/ sales ratio**
Obligatory EPR						
waste electrical and electronic equipment (WEEE) [1]	€ 3,027 mln	Est. € 57 mln	1.88%	€ 3,120 mln	Est. € 61 mln	1.95%
batteries and accumulators[2]	9.58 mln kg	Not publicly available	n/a	8.76 mln kg	Not publicly available	n/a
end-of-life vehicles[3]	Est. M€ 15,135	€ 25,647,634	0.17%	Est. M€ 15,706	€ 28,709,973	0.18%
passenger car tyres [4]	Est. M€ 826	€ 10,200,000	1.2%	Est. M€ 826	€ 10,300,000	1.2%
packaging and packaging waste[5]	n/a	Est. € 220 mln	n/a	n/a	Est. € 240 mln	n/a

1 WeCycle does not publicly show its finances. In its 2019 report it claims collection of 116,200 ton and a cost price of € 306/ton. WEEE Register reports 198,650 ton collected in total. Using the WeCycle cost ratio, the total costs are 198,650 x 309 = € 60,786,900. Cost claims for 2018 were not available, which is why we used the same per ton costs, with the total according WEEE Register: 184,947 ton / sales best estimation based on https://www.retailinsiders.nl/branches/consumentenelectronica/electronicawinkels/

2 Ministerie van Infrastructuur en Waterstaat (2020) 'Kennisgeving van het algemeen verbindend verklaren van een overeenkomst inzake de afvalbeheersbijdrage voor draagbare batterijen, Ministerie van Infrastructuur en Waterstaat', *St*aatscourant, (5-6–2020);

3 https://arn.nl/2019/financieel-verslag/ (sales estimated: cars sold x average price, using: https://www.bovag.nl/BovagWebsite/media/BovagMediaFiles/Cijfers/2019/Autoverkopen-december-2019.pdf?ext=.pdf)

4 Ministerie van Infrastructuur en Waterstaat (2020) 'Kennisgeving van het algemeen verbindend verklaren van een overeenkomst inzake de afvalbeheersbijdrage voor draagbare batterijen, Ministerie van Infrastructuur en Waterstaat', *St*aatscourant, (5-6–2020), p. 3. (8,77 million tyres in 2018 x average prices)

5 https://zoek.officielebekendmakingen.nl/stcrt-2018-23202.html gives costs from 2014-2017, these have been extrapolated to 2018-2019 as estimates.

Table 3 *Percentage collected and recycled for EPR obligatory product categories in the Netherlands in 2018 and 2019*

Product group	2018			2019		
	Collection **target** (C) Recycle target (R) R7/R8	**Collected**	of which **recycled** [a] (R7, R8)	Collection **target** (C) Recycle target (R) R7/R8	**Collected**	of which **recycled** [a] (R7, R8)
Obligatory EPR						
waste electrical and electronic equipment (WEEE) [6]	(C) 45% (R) R7: 55-80% [b] R7+R8: 75-85% [b]	**58.8%** [c]	**95%** (15% as R8) (15% abroad)	(C) 65% (R) R7: 55-80% [b] R7+R8: 75-85% [b]	**57.7%** [c]	**96%** (14% as R8) (15% abroad)
batteries and accumulators	(C) 45% (R) Pb 65%; NiCd 75%; rest 50%	4.31 mln kg (**47.4%**)	Pb **78%** NiCd **79%** rest **54%**	(C) 45% (R) Pb 65%; NiCd 75%; rest 50%	4.60 mln kg (**50.6%**)	Pb **78%** NiCd **79%** rest **68%**
end-of-life vehicles [7]	85%	83.7%	**98.4%** (11.3% as R8)	85%	84.3%	**98.4%** (11.2% as R8)
passenger car tyres [8]	(C) no explicit %, 'all' (R) R7+R8: 50%	~ 100%	**97%**	(C) no explicit %, 'all' (R) R7+R8: 50%	~100%	97%
packaging and packaging waste[9]:	(R) EU/NL	n/a	78% of put-on market	(R) EU/NL	81% of put-on market	n/a
- glass	60%/90%		**86%**	60%/90%	**87%**	
- paper and cardboard	60%/75%		**88%**	60%/75%	**91%**	
- plastics	22,5%/48%		**52%**	22.5%/48%	**57%**	
- metal	50%/85%		**95%**	50%/85%	**95%**	
- timber	15%/37%		**77%**	15%/37%	**70%**	

[a] = R7 = material recycling; R8 = incineration with energy recovery (Reike et al., 2018)
[b] = different per category
[c] = compared to 3 years average 'put-on-market' (PoM)

6 National (w)EEE Register (2019) *Rapportage over 2018*; Nationaal (W)EEE Register (2020) *Rapportage 2019*; Gomes, T. (2020) *Evaluating the Dutch WEEE System transition to CE 3.0: Maximising products value retention with a focus on ICT product category*. Utrecht University. p. 44. In 2017/2018 the export is estimated at 31 kton, see Baldé, C. P. and Br*ink, S. Van den (2019) Monitoring Export for Re*use in the Netherlands

7 https://duurzaamheidsverslag2019.arn.nl/arn-in-cijfers/ ; Kok, R. *et al.* (2020) *Trendrapport Nederlandse markt personenauto's.*; ARN (2019) *Key data autorecycling 2018.*

8 Ministerie van Infrastructuur en Waterstaat (2020) 'Kennisgeving van het algemeen verbindend verklaren van een overeenkomst inzake de afvalbeheersbijdrage voor draagbare batterijen, Ministerie van Infrastructuur en Waterstaat', *Staatscourant*, (5-6–2020); Campbell-Johnston, K. *et al.* (2020) 'How circular is your tyre: Experiences with extended producer responsibility from a circular economy perspective', Journal of Cleaner Production, 270, p. 122042. doi: 10.1016/j.jclepro.2020.122042.

9 Afvalfonds Verpakkingen (2019) Monitoring Verpakkingen. Resultaten inzameling en recycling 2018./ (Afvalfonds Verpakkingen, 2020)

Table 4 *PRO fees compared to estimated average consumer product price*

Product group	2018				2019			
	Average product price	Average fee	Other (total costs, application of modulated fees)	Fee/Product price – ratio	Average product price	Average per unit fee	Other fees (impact modulated fees)	Fee/Product price – ratio
Obligatory EPR								
WEEE Example refrigerators[10]	€ 470	€ 2.24	n/a	0.5%	€ 470	€ 3.63	n/a	0.8%
Batteries and accumulators (small)[11]	€ 0.40-1.75	€ 0.02	n/a	2.5%	€ 0.40-1.75	€ 0.02	n/a	2.5%
End-of-life vehicles [12]	€ 33,928	€ 40.00	n/a	0.12%	€ 35,411	€ 37.50	n/a	0.11%
passenger car tyres	€ 95	€ 1.30	n/a	1.3%	€ 95	€ 1.50	n/a	1.6%

10 Based on comparing various online shop, 10 most popular / most sold averages. / https://stichtingwitgoed.nl/praktische-informatie

11 https://www.stibat.nl/assets/uploads/2018/11/Management-Fees-List-from-1-January-2019-1.pdf, example single use non-rechargeable and re-chargeable up to 50 gr, prices for AA and AAA batteries vary between € 0,40 and € 1,75, her we calculate with € 0,80 per AA/AAA battery.

12 https://autorai.nl/gemiddelde-aanschafprijs-nieuwe-personenautos-sterk-gestegen-in-2019/ ; https://duurzaamheidsverslag2019.arn.nl/arn-in-cijfers/

Appendix IV

Figure 8 *Results of the e-Delphi, related to the proposals included in Pathway 1 and Pathway 2 in Sections 6 and 7*

Notes

1 See www.internetconsultatie.nl/besluit_regeling_uitgebreide_producentenverantwoordelijkheid
2 (Campbell-Johnston et al., 2021)
3 (Lindhqvist, 2000, p. 37)
4 (Vermeulen and Weterings, 1997; Lindhqvist, 2000, pp. 44–47, 65–79)
5 TK 1990-1991, 21137, nr. 49, pp. 5-6, (Vermeulen and Weterings, 1997, p. 285)
6 Directive 2008/98/EC, European Parliament and Council, 2008, consideration 27.
7 European Commission – DG Environment, 2014.
8 (Kaffine and O'Reilly, 2015) This does not take into account all the schemes in Europe mentioned in the previous source. It should be noted that the OECD applies a wider definition of EPR than the one given above and applied in the EU and Dutch context, as it also includes performance regulations and economic instruments, such as return-deposit schemes, advanced disposal fees and primary raw material input taxation in the concept of EPR.
9 (European Commission, 2015)
10 DIRECTIVE (EU) 2018/851 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 amending Directive 2008/98/EC on waste
11 Increased from around € 13 per 1000 kg in the mid-2010s to € 32 since 2019 https://www.belastingdienst.nl/wps/wcm/connect/bldcontentnl/belastingdienst/zakelijk/overige_belastingen/belastingen_op_milieugrondslag/tarieven_milieubelastingen/tabellen_tarieven_milieubelastingen?projectid=6750bae7%2D383b%2D4c97%2Dbc7a%2D802790bd1110. Since 2019 this also applies to landfilling abroad.
12 *Regeling afgedankte elektrische en elektronische apparatuur*, see: https://wetten.overheid.nl/BWBR0034782/2016-02-02
13 *Besluit beheer batterijen en accu's 2008 and Regeling beheer batterijen en accu's 2008*, see https://wetten.overheid.nl/BWBR0024491/2011-01-01 and https://wetten.overheid.nl/BWBR0024492/2017-01-01
14 *Besluit beheer autowrakken*, see: https://wetten.overheid.nl/BWBR0013707/2018-01-01
15 *Besluit beheer autobanden and Regeling beheer autobanden*, see: https://wetten.overheid.nl/BWBR0016038/2009-05-01 and https://wetten.overheid.nl/BWBR0016459/2004-04-01 and based on the EPR provisions Waste Framework Directive (2008/98/EC)
16 *Besluit beheer vEPRakkingen 2014 and Regeling beheer vEPRakkingen*, see: https://wetten.overheid.nl/BWBR0035711/2020-07-01 and https://wetten.overheid.nl/BWBR0037392/2016-01-01
17 NJB 20202/2460.
18 See for all current AVVs: https://www.afvalcirculair.nl/onderwEPRen/afvalregelgeving/landingspagina/algemeen-verbindend/geldende-avv/
19 (Ministerie van Infrastructuur en Waterstaat, 2017b, pp. 62–64)
20 (Ministerie van Infrastructuur en Waterstaat, 2020, p. 50)
21 (Ministerie van Infrastructuur en Waterstaat, 2020, p. 51)
22 (Reike, Vermeulen and Witjes, 2018)
23 (Kirchherr, Reike and Hekkert, 2017)
24 (Calisto Friant, Vermeulen and Salomone, 2020)
25 (Ministerie van Infrastructuur en Milieu, 2016; PBL, 2018, p. 5)
26 (Reike, Vermeulen and Witjes, 2018)
27 (PBL Netherlands Environmental Assessment Agency, 2018, p. 11).
28 (MacArthur, 2013; EEA, 2016; PBL, 2018)
29 See for more details at European Environment Agency: https://www.eea.europa.eu/themes/sustainability-transitions/drivers-of-change/growth-without-economic-growth
30 Ministerie van Infrastructuur en Waterstaat – *Uitvoering producentenverantwoordelijkheid voor afgedankte elektrische- en elektronische apparaten* (Brief, 13 November 2020)
31 CBS Statline 2020, https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83558NED/table?ts=1609753848302
32 (Cassells, Holland and Meister, 2005; Tojo, 2006b; Monier et al., 2014; Dubois and Eyckmans, 2015; Winternitz, Heggie and Baird, 2019)
33 Ministerie van Infrastructuur en Waterstaat (2020) *Kennisgeving van het algemeen verbindend verklaren van een overeenkomst inzake de afvalbeheersbijdrage voor draagbare batterijen*, Ministerie van Infrastructuur en Waterstaat', Staatscourant, (5-6–2020), p. 3. (0,5 mln tyres compared to 8,77 mln tyres in 2018)
34 (Afvalfonds Verpakkingen, 2019, p. 30)

35 OECD & RE-CIRCLE - Extended Producer Responsibility and the Impact of Online Sales (2018), p. 3. See also (Hermann, Gailhofer and Schomerus, 2020)
36 Idem. (Nationaal (W)EEE Register, 2020, p. 5) (Dubois, Graaf and Thieren, 2016)
37 (Winternitz, Heggie and Baird, 2019, p. 18)
38 (Verrips and van der Plas, 2019)
39 (Campbell-Johnston, Friant, *et al.*, 2020).
40 (Winternitz, Heggie and Baird, 2019, p. 9)
41 (Baldé *et al.*, 2020; Forti *et al.*, 2020, p. 77; Brink *et al.*, 2021)
42 (Afvalfonds Verpakkingen, 2019; Snijder and Nusselder, 2019, p. 47)
43 (Ministerie van Infrastructuur en Waterstaat, 2017, p.32, 43-44, 50, 188) It was originally based in 2009 on 150% of the costs of landfilling (incl. landfill tax).
44 Based on 2010/75/EU Industrial Emissions Directive (IPPC), see also https://eippcb.jrc.ec.europa.eu/reference
45 (Campbell-Johnston, Vermeulen, *et al.*, 2020)
46 (Winternitz, Heggie and Baird, 2019)
47 Recycling Netwerk Benelux – Notitie Batterijen (2013), p. 2-3.
48 (Gottberg *et al.*, 2006; Kautto, 2006; OECD, 2006; Tojo, 2006a; Mayers, 2007; Subramanian, Gupta and Talbot, 2009; Kemna, 2011; Huisman, 2013; Kunz, Mayers and Van Wassenhove, 2018)
49 (Ministerie van Infrastructuur en Waterstaat, 2017a, p. 64).
50 (Van Rossem, Tojo and Lindhqvist, 2006)
51 (Kalimo et al., 2015)
52 (Braungart, McDonough and Bollinger, 2007; Crul, Diehl and Ryan, 2009; Ramani *et al.*, 2010; Deutz, McGuire and Neighbour, 2013)
53 (Mudgal et al., 2013).
54 (Albino, Balice and Dangelico, 2009; Rossi, Germani and Zamagni, 2016; Verrips *et al.*, 2019)
55 (Kunz, Mayers and Van Wassenhove, 2018; Atasu, 2019)
56 (PBL Netherlands Environmental Assessment Agency, 2018, p. 7)
57 (Inspectie der Rijksfinanciën, 2020).
58 (Ministerie van Infrastructuur en Waterstaat, 2020, p. 20 and 50) See also (Ministerie van Infrastructuur en Waterstaat, 2019, p. 54)
59 (Driessen *et al.*, 2012)
60 (PBL, 2021, p. 199).
61 (Ministerie van Infrastructuur en Waterstaat, 2017, p.32, 43-44, 50, 188) It was originally based in 2009 on 150% of the costs of landfilling (incl. landfill tax)
62 See https://tcocertified.com/tco-certified-edge-e-waste-compensated/
63 (Sherrington *et al.*, 2020)
64 Eco-design Directive 2009/125/EC
65 (Egenhofer, Drabik and Rizos, 2018)
66 (Polverini *et al.*, 2018; Mathieux, Ardente and Bobba, 2020)
67 (Mudgal *et al.*, 2013)
68 CBS Statline
69 Directive 94/62/EC on packaging and packaging waste, Directive 2000/53/EC on end-of-life vehicles, Directive 2006/66 on batteries and accumulators and Directive 2012/19/EC on waste electrical and electronic equipment (WEEE), Directive 2019/904 on the reduction of the impact of certain plastic products on the environment.
70 See also (Pouikli, 2020).
71 Stb. 2020, 375.
72 Art. 5 (3) and 10 (2) Regeling beheer batterijen en accu's 2008 (Regulation on the management of batteries and storage batteries). See also the Dutch Regulation on Waste Electrical and Electronic equipment).
73 See (de Römph and Cramer, 2020)
74 (Backes, 2017, p. 37 ff)
75 (Backes, 2017)
76 (PBL, 2021).