Master's Thesis – Master Sustainable Business and Innovation

QUALITY ASSUR7NCE

About quality assurance systems in the Dutch recycling industry

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Acknowledgements

After having investigated the functioning of the quality assurance systems in the Dutch recycling industry for the past few months, I am proud to present this thesis. The past year has been very special, and I have learned a lot. At the start of my thesis period, I felt quite unfamiliar with the subject. However, that is what I found so interesting about it: it offered an opportunity to develop myself. I succeeded in doing so. During this process, I was guided by Walter Vermeulen, and I will always be grateful to him for that. I learned a lot from this cooperation. He taught me a lot in terms of research content and technique, but he also managed to convey his passion well. I would like to continue working in this area because I find it extremely interesting. Furthermore, the feedback was always very enlightening, and the contact was very good.

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Abstract

This thesis describes and analyses quality assurance systems (QASs) in the Dutch recycling industry. It focuses on the five product groups that work with Extended Producer Responsibility (EPR) legislation: car tyres, scrap vehicles, batteries and accumulators, packaging, and e-waste.

The introduction explains how the Dutch government uses EPR to increase the level of circularity of specific product groups. The theoretical framework describes the underlying literature to this thesis. This is followed by the methodology chapter that describes how desk research and semi-structured interviews were conducted to collect data.

The results section consists of five different case studies that all describe and analyse one specific product group. Each of these case studies explains how EPR legislation is operationalized for that product. The organization of the QAS is explained by describing the criteria for certification and the procedure that leads to certification.

All QASs are assessed on their functioning in terms of how they work towards higher value retention options by increasing the level of cascading, and by assessing the implementation of corporate sustainability including the incentive to improve business practices continuously. Besides, the auditing processes are evaluated on whether they work towards recognized audit principles for good auditing. The companies in the recycling industry are given space to describe their experiences with the QASs as well.

The discussion chapter explains that no QASs have been organized for the product groups of batteries and accumulators, and packaging. This means that the responsible organizations do not demand a certain level of quality from the companies it works with. Although the QAS for car tyres is assured of good auditing, the certification criteria are not pushing companies towards high level value retention or including corporate sustainability into business practices. The QASs on scrap vehicles and e-waste are well organized. Corporate sustainability principles are included. However, these QASs neither push the companies towards increasing the level of value retention.

The conclusion of this thesis is that the QASs in the Dutch EPR regulated recycling industry are not working towards higher value retention options and that changes must be made to organize this. Three recommendations are given. The first is to reward eco-efficiency. More must be done to push reuse of products and materials. The second recommendation pledges for a radical change of the tax system to incentivize recycling and the use of secondary materials. Lastly, the QASs must demand environmental management systems to the certified companies to adapt to the current market situation and to ensure companies of continuous improvement.

Abbreviations

AVV	Algemeen Verbindend Verklaring (generally binding declaration)
b&a	batteries and accumulators
CC	Collection Company
DC	Dismantling Company
CE	Circular Economy
CS	Corporate Sustainability
EN	European Standard
ED	Erkend Duurzaam
EEE	electrical and electronic equipment
EPR	Extended Producer Responsibility
KZD	KwaliteitsZorg Demontage
KVK	Netherlands Chamber of Commerce
PRO	Producer Responsibility Organization
QAS	Quality Assurance System
RC	Recycling Company
RPC	Reuse Preparing Company
SC	Shredder Company
SD	Sustainable Development
TS	Technical Specification

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1 Introduction

The Brundtland report defines sustainable development (SD) as meeting "the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p. 41). This is needed to provide a better future for the planet and mankind. Achieving this at the corporate level requires organizations to balance their social, environmental, and financial goals (Henry et al., 2018). To show SD achieved by using this, Vermeulen (2018) integrated the triple-P (people, planet, and prosperity) with dimensions of time and place into a framework (Figure 1). The dimension of time is important because of the intergenerational aspect of SD, whilst the dimension of place shows the global dimension of value chains.

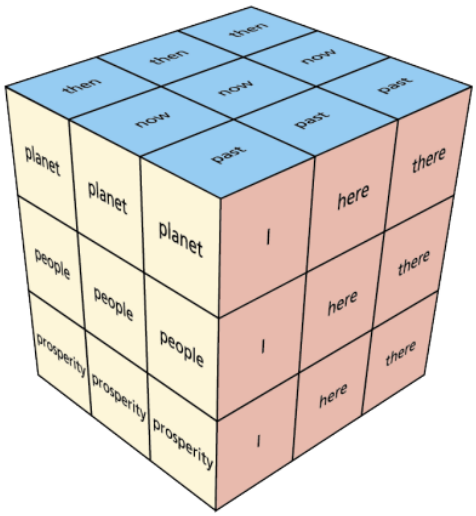


Figure 1: Visualization of sustainable development (Vermeulen, 2018)

Figure 1 shows that environmental performance, or 'planet', is part of the triple-P. Governments work on their environmental performance by addressing planetary goals like reducing greenhouse gas emissions. An example on national scale is the 49% reduction goal (compared to 1990) of the Netherlands on emissions. The country aims to achieve this by 2030 (Rijksoverheid, 2019b). Transitioning to a circular economy (CE) is essential to achieve these goals. An economy free of waste, that demands less raw materials, is critical to reducing emissions (Rijksoverheid, 2019a).

Extended Producer Responsibility (EPR) is one instrument the Netherlands uses to increase circularity on national scale. EPR is defined as "a set of measures taken by member states requiring producers of products to bear financial or financial and organisational responsibility for the management of the waste stage of a product's lifecycle including separate collection, sorting and treatment operations" (European Union, 2018, p. 111). This only includes waste from users and consumers. EPR can be implemented by voluntary or obligatory initiatives, which can be done by individuals as well as by collective parties. If this is done collectively, Producer Responsibility Organizations (PROs) will be in the lead of the entire process from collecting products until recycling (Vermeulen et al., 2021). The five product groups that EPR applies to in the Netherlands are 'car tyres', 'scrap vehicles', 'batteries and accumulators', 'packaging', and 'electrical and electronic equipment' (Rijkswaterstaat, n.d.).

By making producers and importers responsible for the products they provide, the Dutch government aims to close the loop of the selected product groups: minimizing waste and turning scrap products into new resources to decrease the amount of raw materials required in the economy. Closing the loop is important for transitioning towards a CE (Stahel, 2016). Besides environmental benefits through the decreased need for raw material input, economic value of raw material input will increase. Once raw materials have been extracted and when they have become products, their value should be used as

long as possible to maximize economic gains from the raw material input (Korhonen et al., 2018). One way to increase value retention of resources is cascading. This is “the sequential and consecutive use of resources” (Campbell-Johnston, Vermeulen, et al., 2020, p. 1).

The consideration to up- or downcycle after usage is based on three dimensions: monetary value, quality and functionality, and the ‘steering framework’. The decision is based on the triple-P (Campbell-Johnston, Vermeulen, et al., 2020). The choice to up- or downcycle depends on which option has the highest possible added value (Ministerie van Infrastructuur en Waterstaat, 2021b). Therefore, increasing the triple-P value would stimulate the decision to upcycle instead of downcycle. This would lead to higher-value extraction, either in monetary terms or environmental performance (Campbell-Johnston, Vermeulen, et al., 2020). One way to increase this triple-P is pushing the quality of recycling.

EPR was introduced in Europe to increase the quality of recycling and thus, increase circularity. In this way, less raw materials are required in the economy (Vermeulen et al., 2021). To steer recycling companies (RCs) and other companies that collect and dismantle waste into a certain direction, quality assurance systems (QASs) can be created. These set standards that companies must comply to, and they check to what extent these companies adhere to these standards. QASs are used in all kinds of industries (Manghani, 2011). As EPR regulation makes producers/importers responsible for the end-of-life phase of their products and since PROs are made responsible for operationalization of this legislation, a powerful framework has been created to influence companies in the recycling industry. QASs might demand companies to comply to specific standards if they want to work with the PRO.

In the Dutch recycling industry, several QASs are used. These are set up especially for the specific industries, mostly by the PROs, since they are responsible for the implementation of the EPR legislation (Vermeulen et al., 2021). However, it is unclear how the current QASs behind EPR function and how (or ‘if’) they aim for innovation and cascading to obtain high level value retention recycling (Campbell-Johnston, Vermeulen, et al., 2020; Vermeulen et al., 2021). This thesis will aim to fill this knowledge gap. Therefore, the following research question has been developed:

“To what extent do quality assurance systems, created for the companies in the part of the recycling industry that is bound to Extended Producer Responsibility legislation in the Netherlands, result in high level value retention recycling?”

Answering the research question will be done by answering the following sub-questions:

- How are the quality assurance systems for companies in the recycling industry organized and how does this relate to the regulations on Extended Producer Responsibility?;
- To what extent do these quality assurance systems follow corporate sustainability management systems and circular economy principles?; and
- How do companies in the recycling industry experience the functioning of these quality assurance systems?

Five case studies, all applicable to specific EPR regulated product groups, provide an overview of the recycling industry behind the PROs. The answers on research question and sub-questions lead to a better understanding of the current QASs behind the recycling of the product groups that are applicable to EPR in the Netherlands. It is examined how the QASs perform in terms of continuous improvement through adapting corporate sustainability (CS) principles and how they aim for high level value retention recycling. The results of this thesis lead to a recommendation on how the QASs can be improved to achieve a higher level of cascading, what would mean a higher rate of resource value retention. This would contribute to the transition towards a better performing CE. Besides that, it will provide a better understanding of how companies should prepare for the future.

2 Theoretical framework

2.1 Corporate sustainability

A common misunderstanding in SD literature is that the triple-P includes profit for individual companies (Vermeulen, 2018). It is crucial to understand that businesses are embedded in societal systems and therefore, a greater range of stakeholder interest must be included (Jonker et al., 2015) in the triple-P. In this thesis and building on previous research by Vermeulen (2018), 'prosperity' replaces 'profit' in the triple-P. Prosperity involves societal and ecological fairness on community level into SD (e.g., issues like anti-corruption and fair inequality) (Vermeulen, 2018).

As SD is about improving performance of the triple-P in the dimensions of place and time (Vermeulen, 2018), CS is about companies implementing strategies to achieve this. This is gaining more attention, because society is attaching more importance to the environmental and social performance of companies than before. More inclusive CS can be achieved through considering the impact from social interventions that are due to the dual nature of tshe companies, meaning that businesses run on physical and social dynamics that are intertwined with feedback loops. The companies are embedded in larger societal systems that constantly change. It requires companies to focus on long-term strategy instead of short-term. This means that these companies must continually change to meet changing demands (Vermeulen & Witjes, 2016). This is important because companies must respond to stakeholders' interests. Hence, businesses must aim for high quality of management on all sustainability dimensions (Foster & Jonker, 2003).

2.2 Management (system) standards

When companies aim for continuous improvement, they could start using CS management systems. These systems make it possible for companies to integrate SD systematically into all their business practices (Azapagic, 2003). In this way, the companies' performance on sustainability practices could be improved (Pojasek, 2012). The level of quality as set by the standard depends on what the customer expects the company to deliver. When conforming to a certain standard or norm, a company assures its customers of a specific level of quality.

One organization that sets these management (system) standards is the International Organization for Standardization (ISO). ISO has created thousands of standards to provide solutions to global challenges (ISO, n.d.-a). Examples that are relevant to this thesis are ISO 9001, ISO 14001, ISO 26000, and ISO 45001. ISO 9001 is about quality management and thus, aims for efficiency what will increase economic value of products. ISO 14001 is about environmental management, ISO 26000 is about social responsibility, and ISO 45001 is about occupational health and safety for employees (ISO, n.d.-c).

The standards have in common that they work with predetermined criteria that must be met. ISO sets requirements concerning the specific topics of the standards. The organizations that aim to implement the standards, must also report on these topics (Corbett & Kirsch, 2001; Guler et al., 2002; Hahn, 2012). Furthermore, ISO 9001, 14001 and 45001 have in common that they work following a plan-do-check-act (PDCA) approach (Corbett & Kirsch, 2001; Guler et al., 2002). ISO 26000 does not work with a PDCA cycle. This standard is rather a suggestion of how to implement social responsibility in organizations, whilst the PDCA aims for a time-bound, prescribed path that sets out the requirements to improve on the specific topic the standard implies (Hahn, 2012).

It is important that management standards are based on a PDCA approach to make sure that these management systems lead to continuous improvement in the company, which is required to achieve more inclusive CS (Vermeulen & Witjes, 2016). The company must constantly plan new actions to

tackle problems and find solutions to solve them. After planning, the company must implement the solutions and later evaluate the impact that results from this. When the results are positive, the action must become standardized in the company's routines. When the results are negative, new actions must be planned to tackle the occurring problem (Moen & Norman, 2009). This PDCA approach must continually be repeated to achieve continuous improvement in a company and assure the company of a long-term perspective (Vermeulen & Witjes, 2016). Organizations can become certified with the management system standards ISO 9001, 14001 and 45001 (ISO, n.d.-c). ISO 26000 is non-certifiable, because it does not follow a PDCA cycle (Hahn, 2012). However, it does contribute to achieving more inclusive CS by providing a starting point for improving the external social dimension of companies.

2.3 Quality assurance systems

Management systems are part of the quality control of organizations. They set standards and push the organisation to meet requirements. Besides, quality assurance is the process of finding evidence to what extent the requirements are being fulfilled. Auditors are the executives of the quality assurance process. Quality control and assurance together form the QAS (Manghani, 2011).

Whether a company can become certified for these standards, depends on judgement of an auditor that tests the company on the criteria as set by the organization that has set the criteria (e.g., ISO). If complying to the standard, the auditor credits the organization with the certificate. This certificate will remain for a certain period and there will be periodic audits to check whether the organization consistently applies to the requirements for certification (Guler et al., 2002). Two goals of auditing are controlling whether an organization complies to the requirements for certification and if it is improving its (self-)learning capacity to make it improve continuously (Stevens, 2012).

Auditing can be done through three types of audits: first, second- and third-party audits. First party audits are internal audits: an employee checks whether its company fulfils the requirements of a norm. Second party audits are any external party that audits a company without being accredited or certified. Third party auditing is done by accredited/certified audits. The latter type is the only way an organization can become certified on a standard (ISO, n.d.-b).

To ensure good auditing, Karapetrovic & Willborn (2000) identified fourteen audit principles that audits must meet to assess organizations as good as possible. Figure 2 shows these principles. One example is the 'objectivity & independence' principle: if an audit is not objective and/or independent, conflicts of interests might occur. Meeting the requirements is fundamental to achieve good quality audits (Karapetrovic & Willborn, 2000). Hence, it is essential for having good functioning QASs in place.

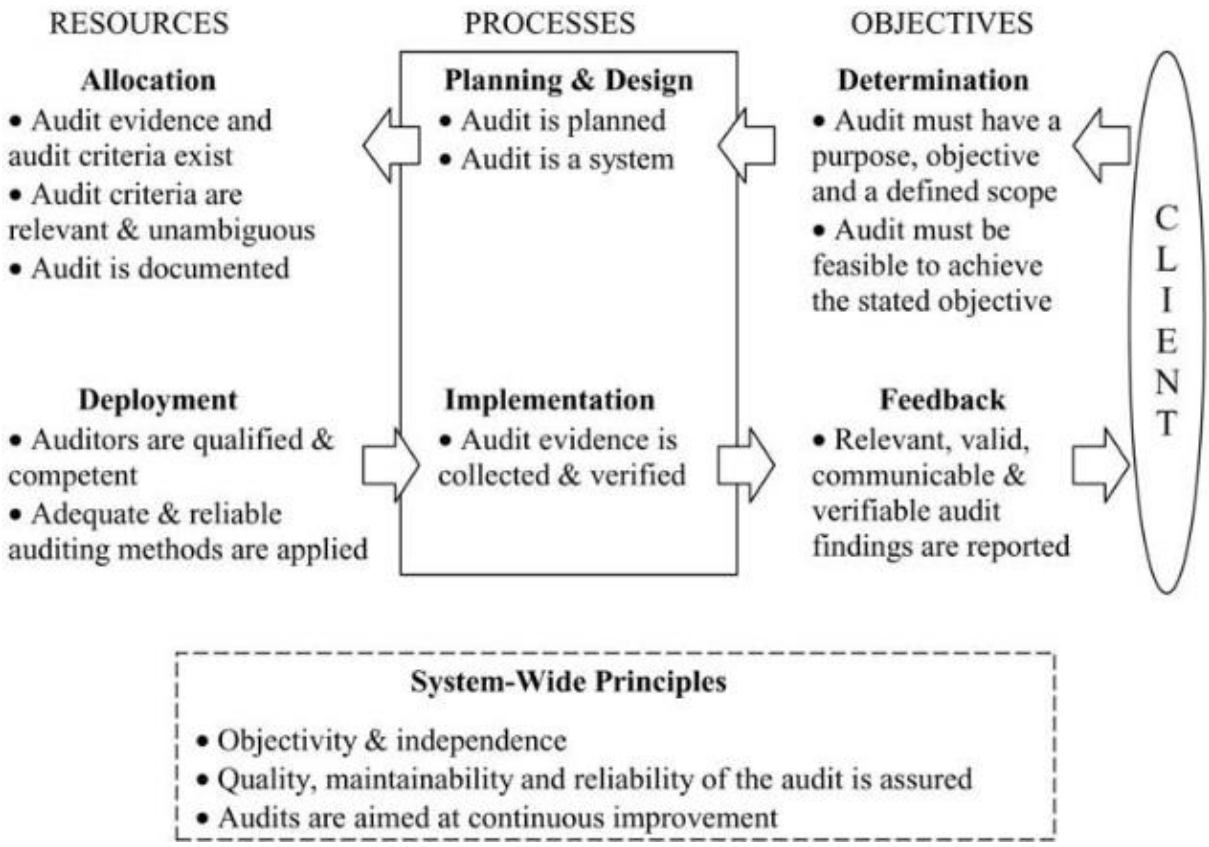


Figure 2: The audit principles (Karapetrovic & Willborn, 2000)

2.4 Corporate sustainability integration framework

Achieving inclusive CS requires QASs to integrate a long-term approach and to aim for continuous improvement, whilst including the triple-P. This integration process can be guided by using an integrative framework that is well-grounded in theory as well as in practice. Vermeulen et al. (2016) reviewed several approaches that are proposed for this. This thesis seeks for a long-term approach through continuous improvement in QASs. The framework as provided by Maon et al. (2009) integrates all required feedback loops demanded for achieving continuous improvement as mentioned by Vermeulen et al. (2016). Therefore, this shows how an organization could integrate a long-term approach, which is required to meet changing demands (Vermeulen & Witjes, 2016). Figure 3 shows the framework.

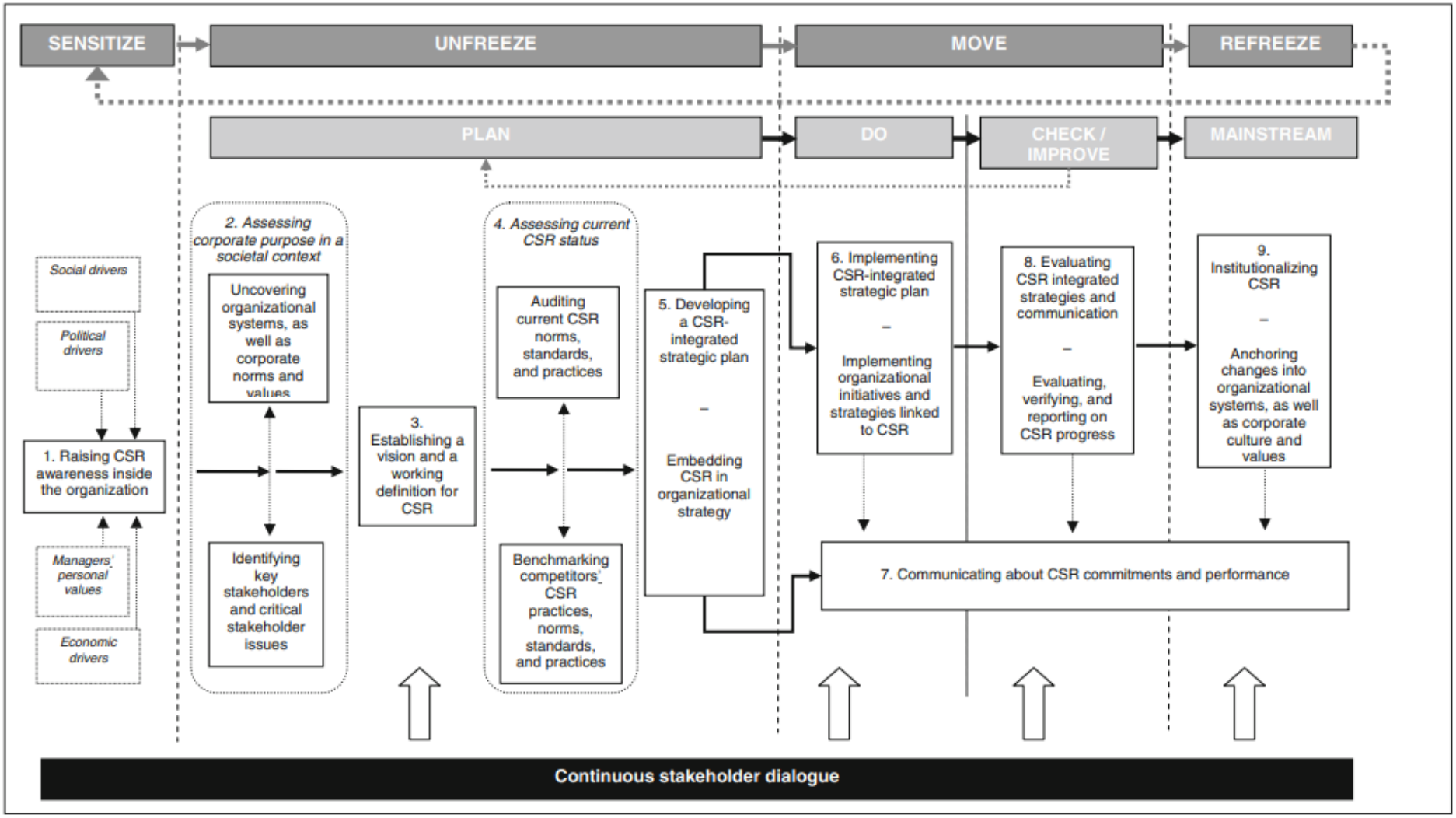


Figure 3: The framework for implementation of corporate sustainability practices in companies (Maon et al., 2009)

The framework of Maon et al. (2009) follows a PDCA approach, although it uses different terminology. This framework categorizes PDCA principles in four stages. The first is 'sensitize'. In this stage, awareness on sustainability issues must be raised amongst the company's top management. In the second stage, 'unfreeze', the status quo must be shaken up to start 'moving' towards a new status quo. If the company has reached a state-of-being that satisfies for that moment, the organization must refreeze this new state so that it does not fall back into old habits. From this moment on, the 'sensitize' phase must start again to detect new opportunities to improve. The framework provides nine steps that guides the company in its integration process. These are numbered from 1 to 9 in Figure 3.

2.5 Extended Producer Responsibility in the Netherlands

In the Netherlands, PROs are responsible for implementation of EPR legislation (Rijkswaterstaat, n.d.; Vermeulen et al., 2021). They connect executing parties to carry this out. They collaborate with RCs and their supply chains that make new resources of used ones together. Therefore, PROs are responsible for the quality of recycling of the product groups that are related to EPR legislation. PROs decide where the waste will be recycled. Thus, they have power to demand certain quality requirements of the companies they work with. Compliance to a management system can be one of these requirements. In this way, PROs have power to steer the Dutch EPR recycling industry towards more inclusive CS and higher-level value retention options.

The Dutch government started using EPR for five specific product groups in the 1990s (Vermeulen et al., 2021). The red square in Figure 4 shows the place of the PROs in the product's lifecycle. The PROs are responsible for collecting, checking, separating, and forwarding waste to RCs from the moment that their user does not want it anymore. Figure 4 also shows the place in the supply chain where products are recycled ('R7 Material Recycling'). For this thesis, the figure of Vermeulen et al. (2021) has been adjusted by showing where QASs for recycling are being applied (if existing). Most PROs have set up QASs to steer the recycling industry towards achieving a certain quality. In this way, car tyre collection companies (CCs) and RCs must become RecyBEM certified (RecyBEM B.V. & Vereniging Band & Milieu, 2019b); car dismantling companies (DCs) must become KwaliteitsZorg Demontage (KZD) certified (Centraal College van Deskundigen KZD, 2013) and all companies in mobility can become Erkend Duurzaam (ED) certified (ARN, n.d.); and Reuse Preparing Companies (RPCs) and RCs that process e-waste must comply to the CENELEC standard (Stichting OPEN, 2021a). For the lasting two product groups, 'batteries and accumulators' (b&a) and 'packaging', there are no QASs in place.

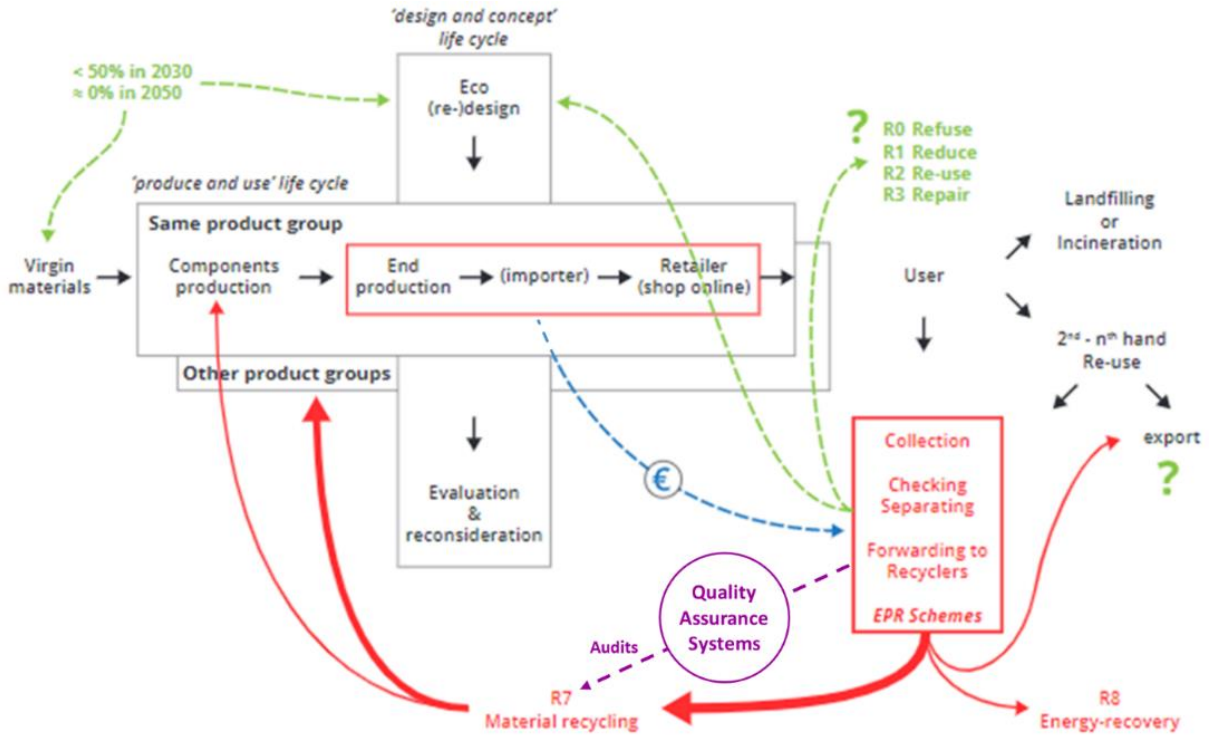


Figure 4: The place of quality assurance systems in the lifecycle of products. Adjusted version of Vermeulen et al. (2021)

2.6 Cascading towards a circular economy

To carry out the EPR legislation as good as possible, it is important for the PROs to lose as least quality of a resource as possible from the moment of extraction on. This is important to acquire the highest possible product value. Figure 5 shows this process of cascading as shown by Campbell-Johnston et al. (2020). The figure shows how value consideration takes place when a product moves between users. These moments are shown as the green circles. This valuation decides whether a product will be up- or downcycled to achieve its next order of use if possible.

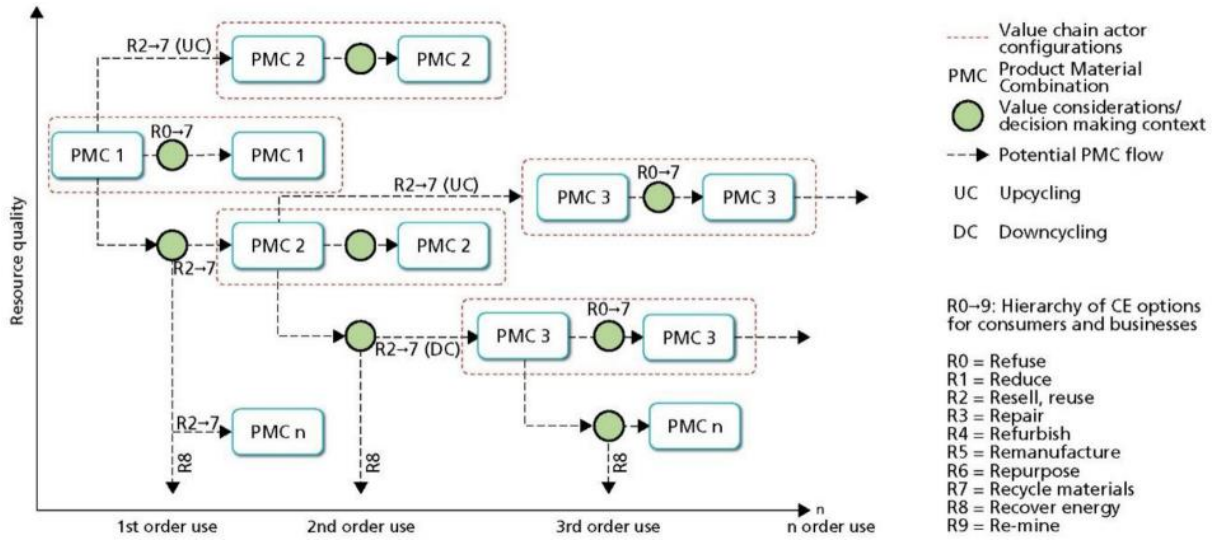


Figure 5: Cascading in a circular economy (Campbell-Johnston, Vermeulen, et al., 2020)

The contribution of cascading to a CE depends on the possibility of applying different R-strategies that are described by Reike et al. (2018), as shown in Table 1. These ten circularity strategies increase the retention of resource value. The lower the R-number, the higher the contribution to circularity. Combining this with cascading principles, tells us that the higher the level of cascading, the higher a resource stays on a certain level of the R-ladder, what results in higher value retention. EPR makes companies financially responsible for their products after use and therefore, this could be beneficial for transitioning to a CE.

Table 1: Ten value retention options in a circular economy (own work, sources: Overheid.nl (2003, 2014, 2018)*, RecyBEM B.V.* (2017, 2018, 2019, 2020)*, and Reike et al.* (2018)*)*

R#	CE concept	Definition	Combination terms	
9	Remine	The retrieval of materials after the landfilling phase	N/A	N/A
8	Recover (energy)	Capturing energy embodied in waste, linking it to incineration in combination with producing energy or use of biomass	N/A	N/A
7	Recycle	Processing of mixed streams of post-consumer products or post-producer waste streams using expensive technological equipment	Material recovery	Material reuse
6	Repurpose (rethink)	By reusing discarded goods or components adapted for another function, the material gets a distinct new lifecycle		Product reuse
5	Remanufacture	The full structure of a multi-component product is disassembled, checked, cleaned and when necessary, replaced or repaired in an industrial process		
4	Refurbish	The overall structure of a large multi-component product remains intact, while many components are replaced or repaired, resulting in an overall 'upgrade' of the product		
3	Repair	Extend the lifetime of the product		
2	Reuse/resell	Bring products back into the economy after initial use		
1	Reduce	Eliminating the production of waste rather than the disposal of waste itself after it has been created	N/A	N/A
0	Refuse	Buy/use less or use less	N/A	N/A

Material recovery includes all ways of reusing products or materials (RecyBEM B.V., 2017, 2018, 2019, 2020). Product reuse is the reuse of components for the same purpose as before, and material reuse is the reuse of materials for the same purpose as before or for other purposes, energy recovery purposes excluded (Overheid.nl, 2003, 2014, 2018). Legislation uses 'material reuse' and/or 'product reuse' for setting targets. This thesis will use all terms if needed in adherence to Table 1.

2.7 Assessment framework

The framework as proposed by Maon et al. (2009) provides guidance for organizations that aim for continuous improvement in the long-term. This thesis aims to assess the QASs in the recycling industry on how they push companies towards high level value retention recycling and how they aim for continuous improvement in the long-term. Therefore, it merges CE principles with the framework of Maon et al. (2009). The QASs that the companies in the Dutch EPR recycling industry are bound to will be evaluated by using the assessment framework as shown in Table 2. The assessment framework shows whether the CS implementation steps have been integrated successfully or not in the specific QAS of the specific product group in the recycling industry. By having two separate perspectives that assess quality control, the current perspective and the upgrading perspective, the incentive to increase circular practices has also been integrated through including the cascading principles as explained by Campbell-Johnston et al. (2020). Appendix 1 sums up the questions that must be answered to grade the integration of the different steps as suggested by Maon et al. (2009). In this way, it will be assessed whether the QAS aims for high level value retention recycling and whether it includes CS principles including a system for continuous improvement. The grading will be explained in the Methodology section of this thesis.

To clarify how the questions can be used to assess the QAS, an example will be given by explaining step 2 of the assessment framework (Table 2). This step is about assessing the corporate purpose in a societal context (Maon et al., 2009). This is important for organizations to be able to 'unfreeze' and to start planning change, what is required for continuous improvement (Vermeulen & Witjes, 2016) since it is one of the four steps of the PDCA cycle (Moen & Norman, 2009). For this thesis, three questions have been set up to assess if this specific step has been integrated into the QAS. Two of these questions make it possible to assess how this step has currently been integrated in the QAS and one of these questions provides a way to assess the QAS on how integration of this step pushes the RCs towards a higher level of cascading.

Besides assessing the quality control part of the QASs, the audit principles as proposed by Karapetrovic & Willborn (2000) have been integrated in the assessment framework (Table 2 and Appendix 1) as well to include the quality assurance aspect of QASs. This assessment of the quality control and assurance part provides a way to measure performance of the entire QAS that is used for each specific product group. Measurement will be further explained in the Methodology section of this thesis.

Table 2: Quality Assurance System assessment framework of this thesis

Quality Assurance System assessment *(name)*				
Quality Control			**Quality Assurance**	
Step #	**Continuing the current technological perspective**	**Upgrading the technological approaches (cascading)**	**Audit principles**	**Compliance**
1: Raising awareness			**A: Objectivity & independence**	
2: Assessing corporate purpose in a societal context			**B: Quality, maintainability, and reliability**	
3: Establishing a vision and a working definition for CS			**C: Continuous improvement**	
4: Assessing current CS status			**D: Purpose, objective, and defined scope**	
5: Developing a CS integrated strategic plan			**E: Feasibility**	
6: Implementing CS integrated plan			**F: Planned**	
7: Communicating about CS commitments and performance			**G: Systemic**	
8: Evaluating CS integrated strategies and communication			**H: Evidence and criteria**	
9: Institutionalizing CS			**I: Relevant and unambiguous criteria**	
			J: Documented	
			K: Qualified and competent	
			L: Adequate and reliable methods	
			M: Collected and verified evidence	
			N: Reported findings	
Subscore	…	…	**Subscore**	…
Final score *(name Quality Assurance System)* **=** …				

3 Methodology

3.1 General

This thesis focuses on describing and assessing the QASs in the Dutch recycling industries that are bound to EPR legislation. It provides a description of five case studies, which are described in Table 3. All five case studies that are included, explain the QAS of one product group that is bound to EPR legislation in the Netherlands. QASs often consist of more than one certification. The choice has been made to elaborate only on the product groups that are obliged to conform to EPR legislation, because EPR legislation provides a powerful framework to steer companies through its binding nature.

Table 3: The five case studies of this thesis

Product group	**PRO**	**Name QAS**
Car tyres	RecyBEM	RecyBEM certification
Scrap vehicles	ARN	KwaliteitsZorg Demontage & Erkend Duurzaam
Batteries and accumulators	Stibat	N/A
Packaging	Afvalfonds Verpakkingen	N/A
E-waste	Stichting OPEN	CENELEC standard

The assessment framework (Table 2 and Appendix 1) has been built upon CS, CE, and auditing literature. The framework that results from combining these three types of literature, is used to assess the QASs that are used in the Dutch recycling industry. This is done by explaining five case studies, since case study methods allow for deepening and intensifying of insights and understandings of underexamined topics (Travers, 2001) such as the functioning of QASs in the recycling industry in terms of CS and cascading. Comparing the five case studies, shows how the QASs in the Dutch EPR recycling industry are set up and how they function in terms of CS performance (including continuous improvement) and how they work towards higher level value retention options.

All five case studies consist of two parts. The first part describes the institutional context of the PRO steered recycling. It has been found out who is responsible for the QAS in the industry and how change is being managed. In the second part, an assessment is carried out that analyses the current QAS according to the assessment framework of Appendix 1.

3.2 Describing the quality assurance systems

Describing how the QAS is currently set up for each case study has been important for the further part of this thesis to become carried out. This part of the research mainly consisted of desk research. If things remained unclear, additional information has been collected through interviews with the PROs and the auditors. These interviews will be explained in section 3.3.

The desk research started with searching for information on the Afval Circulair website, which can be seen as the Dutch knowledge centre for CE (Afval Circulair, n.d.). This website provides information on waste streams in the Netherlands and which parties are involved in processing practices. It contains links that lead to more information on topics like PROs and QASs. These links have been examined to collect information that has been required to start searching for more descriptive information for each case study. The description also includes information about (inter)national collection and recycling targets and rates, the organization of the EPR system, and more in-depth information about the PROs.

3.3 Assessing the quality assurance system's functioning

After the EPR product group organization's description part of this research, an assessment is made on the functioning of the QAS in terms of CS, cascading and auditing principles. First, the standards are described. Mostly, these are publicly available on the internet (if they are in place). Only the CENELEC standard had to be bought to gain insight. The QASs have been described in terms of what the certification criteria include and how the auditing and certification process look like. If the information was not available on the internet, interviews have been used to receive the information. The writer of this thesis spoke to four representatives of PROs, three lead auditors, and three representatives of companies that work in the EPR recycling industry. Appendix 2 shows a list of these interviewees.

The interviews have offered insights in a goal-oriented way (Yin, 2003). These interviews were semi-structured with an interview guide. The interview guide consisted of questions that were led from the questions as explained in Appendix 1. The interviewees have been asked for grounded answers. Many questions were written down on forehand to assure the results of containing answers to the questions. However, there was also room to dig deeper into answers of the interviewees.

Since the semi-structured interviews were based on the questionnaire (Appendix 1) that is led from literature, including the framework that Maon et al. (2009) provided to support implementation of CS practices in organizations, it has been found out how the QAS creates feedback loops to work towards continuous improvement on CS practices and how the QAS pushes the companies towards a higher level of cascading. Furthermore, the interviews provide a way to find out how the audits are organized and what the experiences are of the companies involved.

The QASs have been assessed with the assessment framework, as shown in Appendix 1. The criteria that lead to completing the assessment framework for each case study, are based on literature on CS, CE, and auditing principles. The questions for quality control are based on the framework of Maon et al. (2009) but CE principles have been integrated, such as value retention options. The quality control questions were based on the audit principles of Karapetrovic & Willborn (2000). Since the assessment framework is created by the writer of this thesis, the first case study has been used as a pilot to check if the questionnaire sufficed or should have changed. No radical changes were needed.

The information collected provided a way to assess the QAS. Appendix 1 shows the data that must have been collected for assessment. The included questions have been answered with 'yes', 'no' or 'partly'. Each question is graded on a scale from 1 to 10. This means that a score of 1 means 'no', 10 means 'yes', and 5,5 means 'partly'. If all criteria in one cell have been addressed, the maximum score was given. If no criteria in one cell have been addressed, the minimum score was given. Everything in between was assessed with 'partly'.

The average score of all scores in that column is a subscore. The three subscores grade the QAS on CS performance, to what extent the QAS pushes the companies towards higher levels of value retention, and how good quality assurance is conducted through audits. The average of the three subscores is the final grade of the QAS. The assessment framework shows possible improvement areas for the QAS. This is important for the recommendations in the end of this thesis.

4 The quality assurance system on car tyres

4.1 Description of Extended Producer Responsibility on the car tyre product stream

Case study 1 analyses the EPR product stream of car tyres. Goals and targets for this product stream have been set in 2004 in the Besluit Beheer Autobanden (Bbab). The Bbab is still operative, and it obliges producers and importers of car tyres to usefully apply car tyres that have been acquired. From 1 January 2005 on, a minimum material recycling percentage of 20% was required. Article 6 of the Bbab makes this enter into force of law (Overheid.nl, 2003). Members of the Vereniging Band en Milieu started a PRO called RecyBEM to implement requirements as provided by the Bbab. RecyBEM reports on this performance to the Dutch Ministry of Infrastructure and Water Management (IandW) (RecyBEM B.V. & Vereniging Band & Milieu, 2019b; Vereniging Producentenverantwoordelijkheid Nederland, n.d.-b) and is therefore the PRO for the car tyre recycling industry in the Netherlands.

Car tyre suppliers can join RecyBEM to fulfil their obligations. When they import or produce a car tyre, they are obliged to pay a fee for waste management to RecyBEM, because the Dutch Ministry of IandW provided RecyBEM with an AVV (generally binding declaration) in 2015 (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). This means that the RecyBEM system has been enforced by law and therefore, this AVV might provide a powerful tool to increase value retention in the Dutch car tyre recycling industry. This is demonstrated by the additional requirement that RecyBEM has set of obtaining a minimum material recovery percentage of 50% of all collected car tyres (RecyBEM B.V., 2021). This is an addition to the 20% material recycling requirement as demanded by the Bbab (RecyBEM B.V., 2017, 2018, 2019, 2020). CCs and RCs that want to work with RecyBEM are obliged to meet this minimum percentage of material recovery but must also meet the material recycling goal that has been set in the Bbab (RecyBEM B.V., 2021). Besides this, energy recovery is the other way of processing end-of-life car tyres. RecyBEM B.V. (2017, 2018, 2019, 2020, 2021) describes this as high-quality incineration while recovering energy from this process. This is R8 of the R-ladder as provided by Reike et al. (2018).

In the Netherlands, 100% of the end-of-life car tyres are collected by RecyBEM certified CCs annually (Campbell-Johnston, Calisto Friant, et al., 2020). All these car tyres are fully used for material or energy recovery. In terms of circularity, end-of-life car tyres are preferably reused as the same product (R2). These second-hand tyres are sold by the CCs anywhere in the world (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-e). Mostly, these car tyres go to warmer countries that could use car tyres with less tread depth. It is unclear what happens with these tyres after they are used for a second time.[1]

The second option is to become retreaded, what means that the worn casing of a car tyre is renewed (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-d). This is a form of remanufacturing (R5). The third option is to reuse the entire product for alternative purposes such as bump tyre on a kart track (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-a), which implies the circular strategy of repurpose (R6). The fourth option is material recycling (R7): car tyres are recycled to rubber granules that are used in inter alia civil engineering (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-h). The last preferred option is energy recovery from incineration of the car tyres (R8) (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-c).

Figure 6 shows the material recovery and energy recovery rate of these car tyres that has been realized over the last ten years. Appendix 3 gives the related data.

[1] Interview with M. Alderlieste, General Manager of Granuband, 17 November 2021.

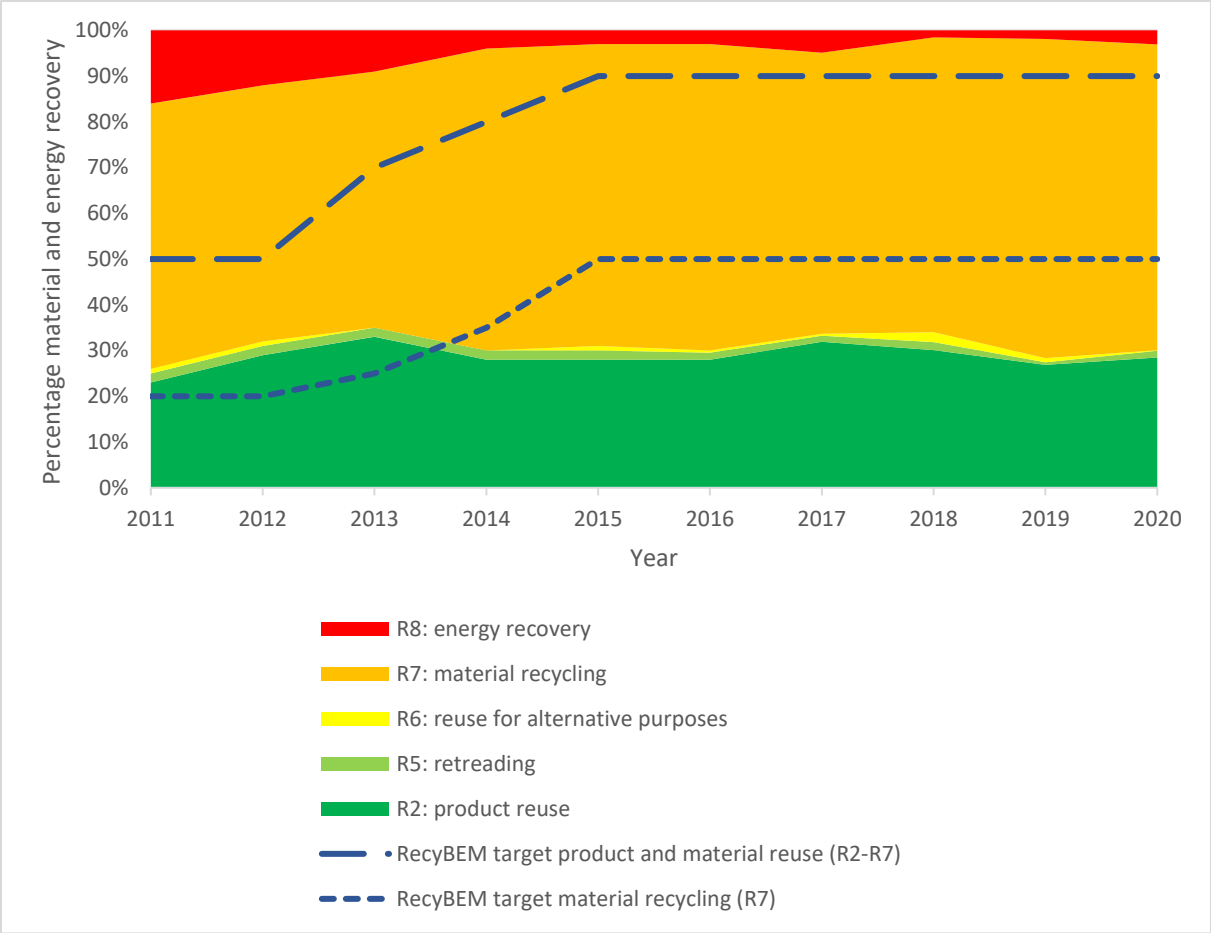


Figure 6: Percentage of material and energy recovery of collected car tyres in the Netherlands (own work, sources: RecyBEM B.V. (2016, 2017, 2018, 2019, 2020, 2021) *and Campbell-Johnston et al.* (2020)*)*

Figure 6 shows an increase of the material recovery rate until 2014, but from that year it fluctuates between 95% and 98,5% over time. It is remarkable that 2015 is the year that the AVV has been introduced. Besides the stabilization of the material recovery rate from that moment on, the national goals have not been changed either. The division of the different R-strategies have neither changed much. This means that the Dutch car tyre recycling industry has not increased its level of value retention recycling in these years. Nevertheless, this does not specifically mean that there is no ambition or aim to improve.

When comparing the Dutch realisation to European averages: in 2019, about 94% of the European end-of-life car tyres has been collected. 57,76% of these collected car tyres was treated for material recovery and 42,24% of the collected car tyres was treated for energy recovery. In the same year, the Netherlands collected 100% of the car tyres: 98,11% has been subjected to material recovery and 1,89% to energy recovery (RecyBEM B.V., 2020). Figure 7 shows a comparison of the collection rates and Figure 8 visualizes the differences of the material and energy recovery rates.

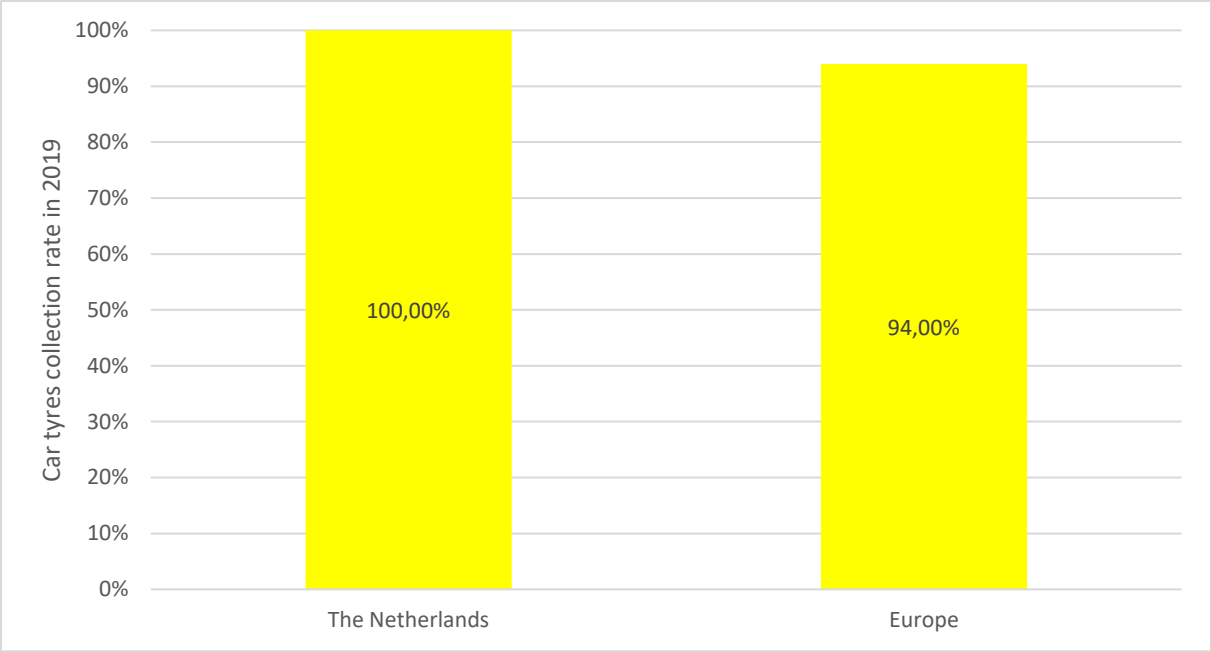


Figure 7: Collection rate of car tyres in the Netherlands and Europe in 2019 (own work, sources: ETRMA (2021) *and RecyBEM B.V.* (2020)*)*

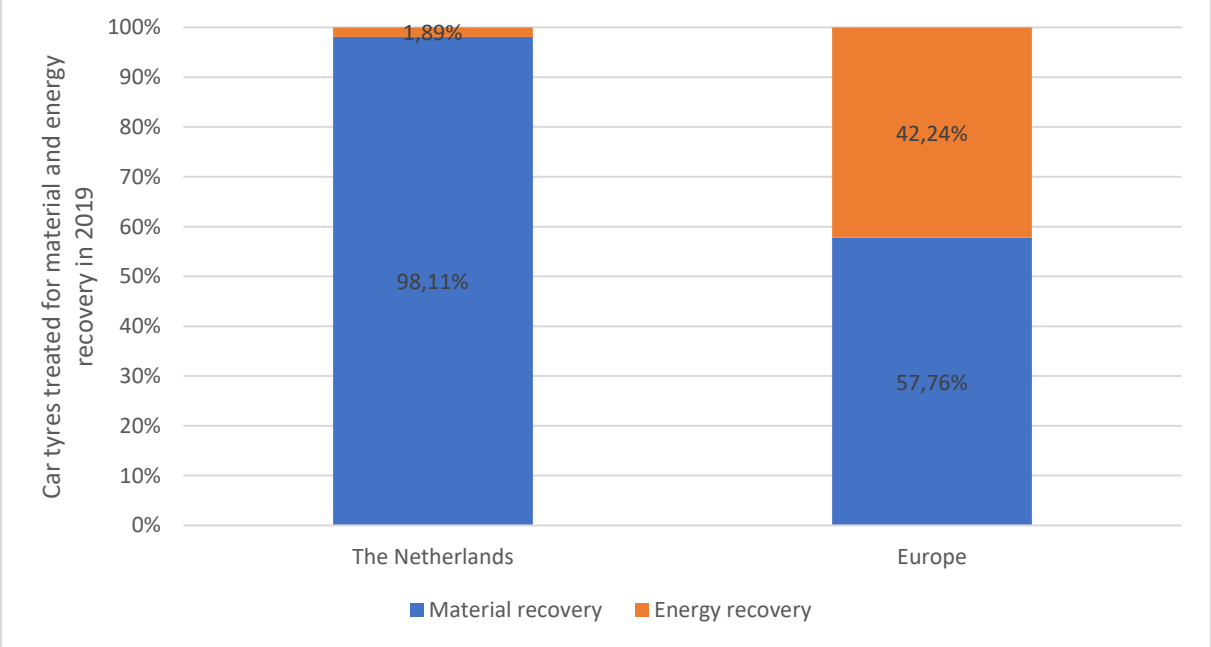


Figure 8: Percentage of all collected tyres that are treated for material and energy recovery in the Netherlands and Europe in 2019 (own work, sources: ETRMA (2021) *and RecyBEM B.V.* (2020)*)*

For the treatment of end-of-life car tyres, RecyBEM cooperates with nineteen certified CCs (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-f) and nine RCs (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-g). Appendix 4 shows the names and locations of these CCs and RCs. Eighteen out of the nineteen CCs are from the Netherlands: one is from Belgium, close to the border in Overpelt. Figure 9 shows that two out of nine RecyBEM certified RCs are in the Netherlands, whilst the other seven RCs are located abroad (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-g). It is unclear how much each company processes. However, Dutch legislation only allows car tyres to become exported when they are meant

to be reused (R2) or recycled (R7). It is forbidden to export car tyres for any other purpose (Ministerie van Infrastructuur en Waterstaat, 2021a).

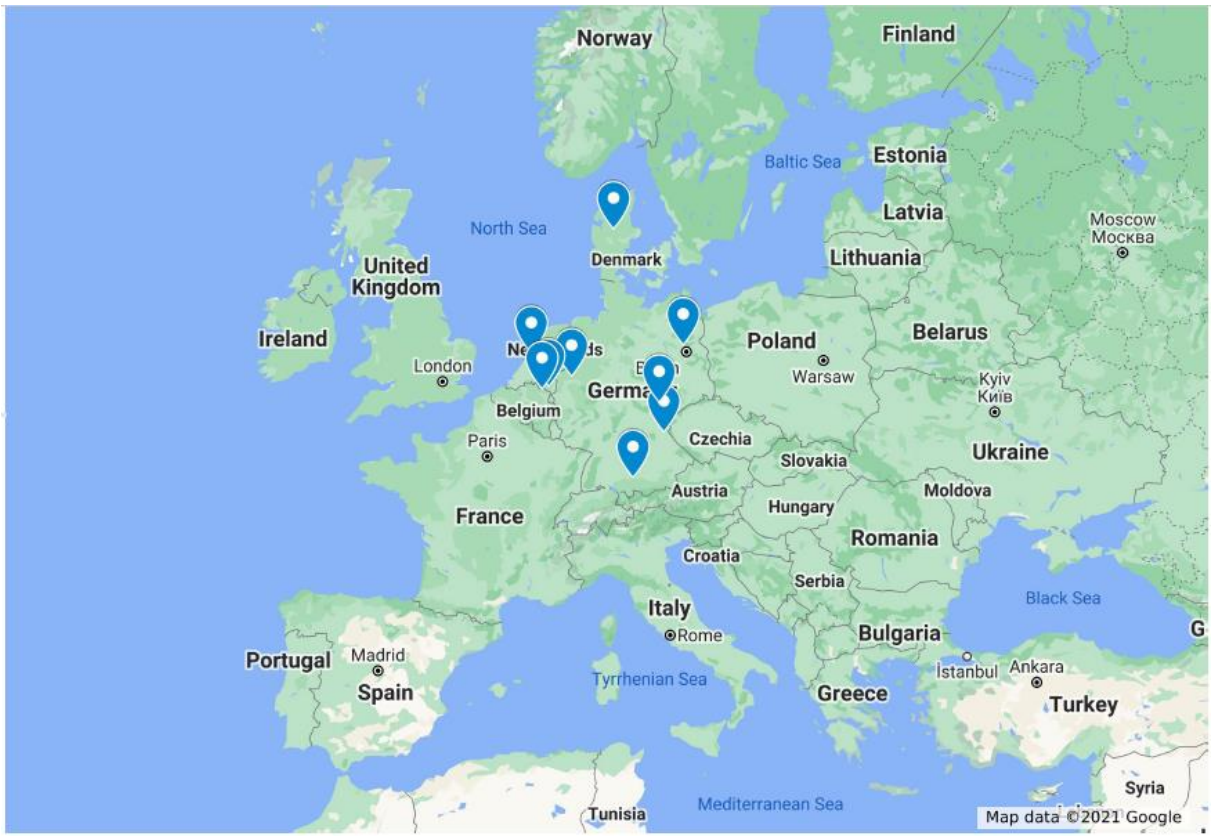


Figure 9: All RecyBEM certified recycling companies (own work, sources: Google Maps and RecyBEM B.V. & Vereniging Band & Milieu (n.d.-g)*)*

These CCs and RCs are rewarded the RecyBEM certification which has been created to assure recycling of car tyres of a certain quality. To become certified, the companies must adhere to the requirements as set in the Assessment Criteria. All CCs and RCs can apply to become RecyBEM certified. Auditors check whether applying RCs are meeting the criteria as set by RecyBEM. After being audited with a positive result, RCs will become certified for the next three years. A yearly audit will be conducted to check the RCs on compliance to the requirements as set in the Assessment Criteria (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). The auditing process will be explained in paragraph 4.4.

By assessing the RCs on the Assessment Criteria, the PRO aims for a level playing field in the Dutch car tyre recycling industry, and for high-quality car tyre recycling (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). This QAS has been created by RecyBEM which is one of three independent organizations within the Band en Milieu (BEM) organization. The board of the BEM organization consists of representatives of car tyre producing companies and importers as well as board members of RecyBEM (RecyBEM B.V., 2012). RecyBEM itself is directed by K. van Oostenrijk. In 2020, he claimed to strive for a high as possible level of circularity of car tyres (RecyBEM B.V. & Vereniging Band & Milieu, 2020). The following paragraphs will analyse whether the QAS that has been created by the organization under his guidance, pushes the car tyre recycling industry to a higher level of circularity and if it assures the certified RCs of continuous improvement.

4.2 Description of the quality assurance system on car tyres

The QAS as setup by RecyBEM covers both the CCs and the RCs. Both parts of the value chain are mandated to meet Assessment Criteria to become RecyBEM certified and will be checked whether they comply to this. The requirements for certification for the CCs and the RCs are like each other but are specified for the specific type of company (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a). Figure 10 shows the value chain for car tyres from the moment of return from the user until the end of responsibility of RecyBEM. The figure also shows how many companies conduct the job in the value chain and what the domestic-foreign rate is. Besides, it shows the percentage of RecyBEM certified companies. Data has been collected from different parts on the RecyBEM website. Official RecyBEM reports refer to these links as the most recent data available (RecyBEM B.V. & Vereniging Band & Milieu, n.d.-f, n.d.-g).

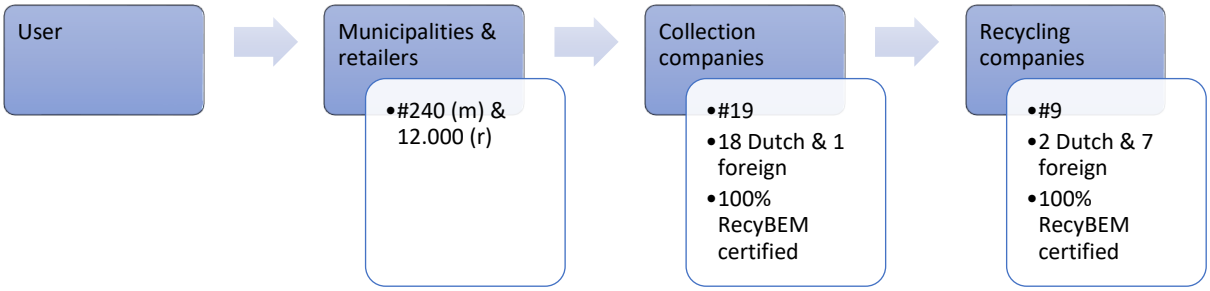


Figure 10: The RecyBEM value chain in 2021 (own work, sources: RecyBEM B.V. & Vereniging Band & Milieu (n.d.-b, n.d.-f, n.d.-g)*)*

4.2.1 Build-up of the certification procedure for collection companies

The RecyBEM certification for CCs sets requirements for business operations. All CCs that apply for certification will be subjected to an audit that checks if the specific CC meets the requirements as set out in the Assessment Criteria. SGS Nederland B.V. (SGS) is the auditing party in the case of the RecyBEM certification. If a CC does not meet the demands, shortcomings are categorized as 'minor flaws' or 'major flaws'. The CC must overcome these flaws to become certified. The differences between both types are that major flaws must become addressed within four weeks (instead of three months) and that major flaws concern main priorities such as safety and maintaining a level playing field between CCs, which is not the case for minor flaws. However, when a minor flaw has not been addressed before the date due, it becomes of major importance (RecyBEM B.V. & Vereniging Band & Milieu, 2019a).

After receiving the auditing report from SGS, RecyBEM is responsible for the actual certification. It bases its decision on the auditing report and all other agreements that are made with the specific CC. Major flaws are normally not allowed before certification, but minor flaws are sometimes condoned if there are maximum up to four of them. After certification, an annual audit will be conducted to assure adherence to the Assessment Criteria (RecyBEM B.V. & Vereniging Band & Milieu, 2019a).

4.2.2 Content description of the criteria for collection companies to become certified

The Assessment Criteria start with thirteen general requirements that the CCs must meet. These criteria aim to check whether the companies fully adhere to legislative demands and to exclude fraudulent activities. Furthermore, adherence to the NEN-EN-ISO 9001:2015 norm is mandated to become RecyBEM certified (RecyBEM B.V. & Vereniging Band & Milieu, 2019a). This standard is globally accepted for quality management (ISO, n.d.-d).

The first is done through, for example, inspecting the CC on their registration at the Netherlands Chamber of Commerce (KVK). The company will also be checked on their environmental permits if

needed. To assure that certified CCs are not guilty of fraudulent activities, the RecyBEM norm inter alia asks for a certificate of conduct for legal entities (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). This certificate is a written statement that businesses can apply for to prove that they have never committed any criminal offenses related to their business activities. Other companies and governments could ask for this certificate before collaboration (Justis, 2018) and so does RecyBEM: CCs that want to work with RecyBEM must hand over this certificate (RecyBEM B.V. & Vereniging Band & Milieu, 2019a).

The following chapter of the Assessment Criteria sets out ten requirements on health, safety, and environment. All CCs must meet all legal requirements concerning these topics and someone should be responsible for legal compliance. New employees must be informed about this, and an annual awareness test must be done. A check must be conducted quarterly on safety requirements as well. Besides, an emergency plan is mandatory and must be communicated internally. RecyBEM provides checklists for operationalisation of the latter two criteria (RecyBEM B.V. & Vereniging Band & Milieu, 2019a).

Becoming certified also demands awareness on the risks that the CCs have by conducting their business practices. They are obliged to take out insurances that cover these risks. Main topics are fire safety, responsibility, and environmental damage. The company site must also be accepted in planning terms (RecyBEM B.V. & Vereniging Band & Milieu, 2019a). This means that the company site must keep distance to quiet residential or rural areas (Kenniscentrum InfoMil, n.d.). Besides, the buildings on this site must meet several criteria (e.g., they must be spacious and clean) (RecyBEM B.V. & Vereniging Band & Milieu, 2019a).

The CC's administrations must keep up with paperwork well. These records must be maintained for a minimum period of seven years. It is important to stick to the commitments as agreed upon in the Bbab. All data should be available to RecyBEM at any time (RecyBEM B.V. & Vereniging Band & Milieu, 2019a).

4.2.3 Build-up of the certification procedure for recycling companies

The RecyBEM certification for RCs consists of two parts. The first part on business operations is like the certification for CCs but specified for RCs. The second part is called the 'BEM norm'. The latter part is only demanded for RCs that produce recyclate that will be exposed to frequent skin contact in its use phase. These are product specific additional requirements to assure a safe use of this type of recyclate: they demand maximum concentrations for certain chemicals in specific recyclates (e.g., rubber granules for synthetic turf fields) and this comes with additional administrative effort to assure these potentially dangerous recyclates of safe use (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). It does not mention the operations of the RCs, and it is not applicable to all RCs that want to become RecyBEM certified. Therefore, this thesis does not consider these extra demands.

SGS also audits the RCs on the Assessment Criteria. This happens in the same manner as it does for the CCs. Minor and major flaws are demanded to overcome in this case as well. RecyBEM is also responsible for the certification itself and decisions are made in the same way as for the CCs. Audits will be conducted yearly too (RecyBEM B.V. & Vereniging Band & Milieu, 2019b).

4.2.4 Content description of the criteria for recycling companies to become certified

The business operations requirements that the RCs are obliged to meet, are very similar to the criteria that the CCs must meet. Only some differences are made that have to do with the type of company that the Assessment Criteria are meant for. For example, the RCs must have an environmental liability insurance with which they will be covered for potentially cleaning up their own terrain, including the

water in and on this (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). On the contrary, the CCs use vehicles to collect and therefore, all their company vehicles must be conducted to a Matters of Testing (RecyBEM B.V. & Vereniging Band & Milieu, 2019a). Furthermore, the RCs must register the in- and output of material flows, and they are obliged to communicate this with RecyBEM quarterly (RecyBEM B.V. & Vereniging Band & Milieu, 2019b).

4.3 Analysis of the RecyBEM certification

Now that the QAS has been described, this paragraph will analyse if (and how) the certification pushes the recycling industry (CCs and RCs) towards high-quality recycling as well as to continuous improvement in the long-term, using the framework as set out in the theoretical framework section of this thesis.

4.3.1 Raising awareness

It is important to be able to sensitize change to make an organization able to adapt to (or even 'benefit from') a changing environment, but the RecyBEM Assessment Criteria for both CCs and RCs demand nothing that will make these companies raise awareness inside the organization that is required to sensitize.

However, since RecyBEM offers CCs a higher price for car tyres that will be subjected to product or material reuse than for car tyres that will be incinerated for energy recovery, it pushes the certified companies to be aware of higher value retention options.

4.3.2 Assessing corporate purpose in a societal context

To unfreeze from current business practices and move towards more integrated CS business, companies must assess their corporate purpose in a societal context (Maon et al., 2009). QASs could steer CCs and RCs into this, e.g., by obliging stakeholder identification and demanding formulation of a certain CS strategy.

RCs must identify stakeholders according to the Assessment Criteria. Section 8.2 and 8.3 (RC requirements) give requirements that contribute to this. By mandating RCs through adding it to the certification procedure, these RCs must adhere to the demands of the Bbab, including transport documents for the car tyres that will be transported before becoming recycled. The in- and outflow must also be registered, and an overview must be produced quarterly (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). Main suppliers and demanding parties, which are key stakeholders, will be identified by using these transport documents and registering these in- and output flows. The same is demanded for CCs (RecyBEM B.V. & Vereniging Band & Milieu, 2019a). However, the certification does not demand the companies to identify critical stakeholder issues.

RCs can start by deciding to formulate a certain CS strategy. The triple-P must be addressed completely to include this as good as possible (Vermeulen, 2018). It would be desirable that the QAS guides this formulation by prescribing an explicit procedure of how to do this, but the RecyBEM certification does not do this. Assessing the corporate purpose in a societal context while continuing the current technological perspective is therefore only partly done.

The certification does neither demand the CCs or RCs to communicate with the RecyBEM on innovation technology related issues. This means that the QAS does not work towards upgrading the technological approaches by means of the certification criteria through starting by an assessment of the corporate purpose in a societal context. However, the RC Granuband declares that it communicates with RecyBEM often since this is mandatory. All kinds of new appliances are communicated with the PRO.

This also happens the other way around. RecyBEM talks a lot to Granuband about innovation topics. It is a natural process that the parties do not even consider to be compulsory.[2] Therefore, it seems that this step is implemented into contractual agreements that RecyBEM has with its RCs. However, the QAS is the scope of this thesis, and it is not included in this. Hence, this will not be considered in the assessment framework.

4.3.3 Establishing a vision and a working definition for corporate sustainability

Even like formulating a CS strategy, the criteria do not push the companies to formulate a vision on CS. Nonetheless, it does require them to comply to legislation on planet and people aspects of CS (section 4.1 for both the CCs and the RCs). They must obey legal requirements on environment, noise, and health and safety of employees (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). Step 3 in the assessment framework (Continuing the current technological perspective) can be assessed with 'partly', because there is no vision required, but legal compliance to a part of the triple-P is.

The QAS demands a monthly report on (material) recycling by the RCs (section 8.5). This report must meet several requirements, including the definition of RecyBEM (and the Dutch Ministry for Infrastructure and Water) of material recycling and the actual amount of material recycling that the RC has realized that month (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). Nevertheless, nothing is said about working towards higher value retention options or towards a higher level of value retention through an increased quality of recycling or through focusing on higher value retention options than R7 (recycling). Therefore, the QAS does not demand the RC to establish a vision on cascading and neither does it demand the CCs to do this.

4.3.4 Assessing current corporate sustainability status

RecyBEM claims to be constantly conducting research on business practices of its certified companies. Energy use of the RCs is one of the themes the PRO can be checking. It mandates the RCs to allow the PRO to cooperate with research to check on energy use (section 9 for the RCs) (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). However, for both the CCs and the RCs, monitoring of emissions is not obliged to become certified.

Some other practices are subjected to internal audits each three months (4.11 for the RCs). This concerns topics that are related to the entire triple-P: the RCs must adhere to safety (people) and environmental (planet) standards. Besides, it must comply to laws and regulations that constantly change, which is part of the aspect. RecyBEM provides a checklist that must be completed and with this checklist, the internal audit is being conducted each time (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). However, the prosperity aspect has not been included in this. The Assessment Criteria do not mention anything about inter alia contracts or competition and neither do they address inequality issues, whilst these are all topics that must be addressed when considering prosperity (Vermeulen, 2018).

Not demanding monitoring of emissions, but including a mandate for auditing norms, standards, and practices that are related to the triple-P means that assessing the current corporate sustainability status (while continuing the current technological perspective) is partly done.

As shown in Figure 7, the circular performance of the car tyre recycling industry has not changed much over the last ten years. The industry has barely worked towards higher value retention options and therefore, the QAS has not pushed the CCs and RCs to work towards a higher level of cascading. However, RecyBEM recently introduced an increase in payment for car tyres that will be subjected to product or material reuse instead of car tyres that will go to energy recovery practices. This means that

[2] Interview with M. Alderlieste, General Manager of Granuband, 17 November 2021.

the QAS makes companies push their circular performance from this moment on. This part, from the upgrading perspective, will be assessed with 'partly'.

4.3.5 Developing a corporate sustainability integrated strategic plan

The RecyBEM certification demands CCs and RCs to adhere to current legislation mainly, but not to aim for improvement of their circular performance through integrating it in the organization's strategy. There are no indications that the Assessment Criteria demand improvement over time. The certificate is valid for three years. An audit is required to become certified again, but this will check the company on the same terms as three years before (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). The QAS does not demand cascading as a focus in the strategy of the companies in the recycling industry and neither do they require that for CS. It neither pushes towards development of a strategy that includes CS. The QAS is neither pushing the development of cascading strategies in any way and is therefore not aiming for an upgrade of the technological approaches in this way.

4.3.6 Implementing a corporate sustainability integrated plan

The RecyBEM certification does not require implementation of CS-integrated strategic plans or organizational initiatives/strategies linked to CS (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a) as provided by Reike et al. (2018). Besides, the QAS does not demand anyone or any group to be responsible for sustainability implementation in the specific companies (both CCs and RCs). This all together means that step 6 (Maon et al., 2009) has not been implemented from both perspectives.

The QAS pushes the PRO to consider value retention options, since it has made the different parties to agree on a raised price for car tyres that will be product or material reused. This is important for considering value retention options before recycling to climb on the R-ladder.

4.3.7 Communicating about corporate sustainability commitments and performance

In terms of communication of CS commitments internally, the RecyBEM certification demands the RCs to periodically discuss health and safety issues with their employees. They are asked to do an awareness test every year, because this is one requirement for certification (section 4.5). The commitments are not being communicated with the external world. After pursuing these commitments, performance is not communicated internally. However, this can also be seen as the audits concerning triple-P performance once every three months (RecyBEM B.V. & Vereniging Band & Milieu, 2019b). The QAS does not demand the CCs to communicate about CS commitments or performance. Therefore, when continuing the current technological perspective, communicating on CS commitments and performance is only partly required through the RecyBEM certification.

The Assessment Criteria do not assure the car tyre recycling process from the sharing of knowledge between the different parties that have to do with car tyre recycling. The requirements do not demand communication between, for example, the PRO, the responsible ministry and/or the RCs about achieving higher levels of cascading periodically by means of sharing knowledge. Important information could be withdrawn from parties that could make any party benefit from this information. If the RCs could benefit from a change in legislation, the QAS does not assure that these parties communicate about this. The QAS does neither demand the RCs to share their knowledge (with RecyBEM or with the responsible ministry) on possible ways to work towards a higher level of value retention. In this way, it provides a way to continue the current way of recycling but prevents valuable materials from a higher level of cascading.

4.3.8 Evaluating corporate sustainability integrated strategies and communication

The internal audits partly check the CCs and RCs on their triple-P performance (section 4.10 for the CCs and section 4.11 for the RCs). As said before, this includes safety and environmental standards, but

does not demand auditing on prosperity-related topics. Besides, there is no form of sustainability reporting demanded.

4.3.9 Institutionalizing corporate sustainability

The collection companies that work with RecyBEM are communicated that the financial reward for car tyres, that will be subjected to product or material reuse, will increase.[3] This means that this recycling option will become more rewarding than energy recovery processes, which are less circular, and which pollute more carbon dioxide. One of the requirements to obtain this higher price, is that the CCs have insight in the way of recycling and that they can also prove who conducts the recycling process. Therefore, the QAS pushes companies to commit resources to achieve the sustainability goals (high-quality recycling targets) that are set by RecyBEM.

Besides, the writer of this thesis has seen that the letters are sent annually, and this year's letter has set more financial sustainability rewards than the previous one. This makes it push the CCs towards increasing their amount of resources spent on sustainability performance periodically.

4.4 Analysis of the quality assurance on the RecyBEM certification

When a CC or RC applies to become RecyBEM certified, audits will be conducted to check whether this company has its business operations in adherence with the Assessment Criteria. Auditors from SGS conduct the audits on business operations that are demanded for certification (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a). If required, FFact Management Consultants does the same for the additional requirements for RCs (RecyBEM B.V. & Vereniging Band & Milieu, 2019b).

SGS belongs 100% to the SGS Nederland Holding B.V., which is fully owned by its parent company SGS S.A. from Switzerland (SGS Nederland Holding B.V., 2020). SGS is globally represented with more than 2.600 offices and 89.000 employees (SGS, 2020). More than twenty of these offices and over a 1.800 of these employees are part of the Dutch part of SGS (SGS, n.d.). Both the holding company and the subsidiary are registered at the KVK as a private limited company. The holding company is registered under the number 24226721 and the subsidiary is registered under the number 24226722 (KVK, 2021c).

SGS conducts several quality related activities. Inspection, analysis, certification, and auditing are four of the company's main businesses (SGS, 2020). The company conducts these activities also on behalf of RecyBEM for certifying the companies that apply to work with RecyBEM. The certificate lasts for three years, and audits will be conducted annually to check whether the companies still meet the Assessment Criteria (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a). This means that SGS is an important party for the car tyre recycling industry because it is responsible for adherence to the quality standards as set by RecyBEM to increase the quality of recycling of all companies in this industry and thus, for increasing the level of value retention. Hence, this paragraph will explain how SGS works according to the audit principles. It is crucial to follow these principles to do good auditing (Karapetrovic & Willborn, 2000).

4.4.1 Objectivity & independence

One of the audit principles is that the auditing party must be independent and objective (Karapetrovic & Willborn, 2000). SGS is fully owned by its parent company in Switzerland (SGS Nederland Holding B.V., 2020). In its integrated annual report 2020, SGS (2020) states that neither the parent company nor any of its subsidiaries have cross-shareholdings in other companies, what means that none of these

[3] Interview with J. Kester Jacobs, COO of RecyBEM, 2 December 2021.

company's has a financial share in any of the RecyBEM certified companies. Besides that, there is only one stakeholder that owns more than 3% of the total share capital of SGS: Groupe Bruxelles Lambert (GBL) (SGS, 2020). GBL is a European investor that focuses on long-term value creation and is primarily family-owned (GBL, 2020). It owns 18,91% of SGS's share capital (SGS, 2020). There is no indication of an interest of GBL in any of the RecyBEM certified companies. Taking this all into account, it can be concluded that the audits conducted for the RecyBEM certification are fully independent and objective.

4.4.2 Quality, maintainability, and reliability

Quality, maintainability, and reliability are explained as mandatory for good auditing by Karapetrovic & Willborn (2000). Audits can be assured of quality, maintainability, and reliability through periodic checks to see whether the CCs and RCs still adhere to the Assessment Criteria. If such a company meets the requirements, it will be rewarded a certificate that will be valid for the next three years. After three years, a re-evaluation will take place. Besides this re-evaluation, an audit will be conducted annually to check periodically if the company meets the criteria in the meantime (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a).

RecyBEM is also allowed to demand a re-evaluation before the date due if it has doubts about the CCs and RCs meeting the requirements (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a). This means that the companies take a risk if they stop adhering to the demands anytime during certification. The annual audits and especially the possibility to check between two audit moments, assures the audits of quality, maintainability, and reliability.

4.4.3 Continuous improvement

Karapetrovic & Willborn (2000) identify 'aiming at continuous improvement' as of material importance for good auditing. RecyBEM provides new Assessment Criteria every three years. This is done to ensure the criteria of being up to date with current market developments.[4] The last two versions of Assessment Criteria show a strong push for continuous improvement (RecyBEM B.V. & Vereniging Band & Milieu, 2016, 2019a). In the previous version of the Assessment Criteria (2016-2018), RecyBEM started to separate the fire safety requirements from the other demands to an additional set of requirements (RecyBEM B.V. & Vereniging Band & Milieu, 2016). This has been done because of the high frequency of fires in the recycling industry in those years and to make the companies extra aware of this.[5] Three years later, in 2019, RecyBEM made it mandatory to possess an environmental damage insurance (RecyBEM B.V. & Vereniging Band & Milieu, 2019a).

The Assessment Criteria as set by RecyBEM B.V. & Vereniging Band & Milieu (2019b, 2019a) demand evaluation of 'major' and 'minor' shortcomings between SGS and the specific company. If a CC or RC does not overcome these shortcomings, it will not be certified. SGS will give the company a time limit within which the requirements should be met, as RecyBEM demands. As paragraph 4.4.2. explains, these checks will be conducted annually and therefore, shortcomings will be figured out and overcome every year at least. This means that the CC or RC is obliged to work towards meeting the requirements every year.

4.4.4 Purpose, objective, and defined scope

Another audit principle explains the need for an audit to contain a purpose, objective, and defined scope (Karapetrovic & Willborn, 2000). The audits that SGS conducts for the RecyBEM certification are done with the objective to allow companies to take part in the car tyre recycling system as controlled

[4] Interview with J. Kester Jacobs, COO of RecyBEM, 2 December 2021.
[5] Interview with J. Kester Jacobs, COO of RecyBEM, 2 December 2021.

by RecyBEM. The scope focuses on specific CCs and RCs alone (i.e., both CCs and RCs must adhere to their 'own' specific Assessment Criteria). RecyBEM's purpose to audit these companies is to increase the quality of car tyre recycling in the Netherlands.

4.4.5 Feasibility

When the auditors do not receive enough documents or when they do not receive documents in time, the order can be returned. SGS is allowed to withdraw from the order until RecyBEM has stimulated the CC or RC to deliver sufficient documentation before the audit. If these companies do still not meet the demands, they must quit the certification process.[6] This gives SGS enough time and assures them of enough documentation to make an audit feasible.

4.4.6 Planned

The audits are planned. Before the initial audit, documents must be sent to SGS to make the auditor able to conduct an audit.[7]

4.4.7 Systemic

Outcomes of the auditing process can be slightly different based on the auditor's interpretation, but the auditors always cooperate with their colleagues by checking each other's reports before it will be finalized. Besides that, the auditors meet sometimes to create a format that could be used as a guideline for the RecyBEM audits.[8] This format is written down in the assessment checklist that the auditors use. It contains concrete points that the auditor must value with 'OK' or 'not OK' (Vereniging Band & Milieu, 2006). This means that the audits are fully systemic.

4.4.8 Evidence and criteria

Besides checking documents, the auditors conduct interview to base their results on.[9] This means that audit evidence exists. The criteria on how the audits should be conducted are written in a checklist (Vereniging Band & Milieu, 2006) and therefore, this audit principle will be assessed with 'yes'.

4.4.9 Relevant and unambiguous criteria

Good auditing demands relevant and unambiguous criteria (Karapetrovic & Willborn, 2000). The RecyBEM certification demands adherence to several specific standards or guidelines. The certified companies must be in possession of the NEN-EN-ISO 9001:2015 certificate (quality management). Besides, both the CCs and RCs must possess a Risk Assessment & Evaluation (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a). It is obvious that the auditing is done by means of unambiguous criteria, since the requirements contain a minimum or maximum value to meet the Assessment Criteria. All criteria are explained concretely and made feasible to meet.

Furthermore, the relevance of the requirements is clear. Several criteria mention the car tyres specifically in both the Assessment Criteria for CCs and RCs. Car tyres must be stored according to specific demands for example (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a). This makes the criteria relevant for the audited companies, since these are companies that work in the car tyre recycling industry.

Although the criteria are relevant to the specific CCs and RCs, experience shows that these criteria not always correspond with similar criteria set by other parties. For example, RCs possess licenses for the shred pile to be seven metres high, but SGS demands a maximum height of three metres. This contrast

[6] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.
[7] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.
[8] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.
[9] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.

is detrimental to RCs. Granuband states that some criteria are not based on facts and that both parties have no idea what the criteria are that are set by other parties that are concerned with the topic.[10] Although it is important to take the experiences of companies into account, this thesis aims for full objectivity in the assessment. Since this experience is only confirmed by one company, it will not influence the assessment score.

4.4.10 Documented

When the audit has been conducted, the results will be sent to a protected SGS box. These documents provide information about the evaluations that have been made by SGS and is internally available.[11]

4.4.11 Qualified and competent

Three SGS auditors are auditing companies that work, or want to work, with RecyBEM. These auditors are all certified to audit other standards as well (e.g., ISO 9001, MRF, KZD). They have an affinity with car demolition processes and are experienced with auditing the industry for several certifications.[12]

4.4.12 Adequate and reliable methods

The RecyBEM auditors work in adherence to the guidelines as set by the International Accreditation Forum.[13] This association offers a program for conformity assessment (IAF, 2021). This means that SGS uses adequate and reliable methods for the RecyBEM certification.

4.4.13 Collected and verified evidence

The auditors collect information from documents that the CC or RC sends to the auditing party before the audit. The auditors check whether everything is in order and if it complies to legislation. This is purely based on the documents that are provided by the applying company. After this, SGS asks the questions it deems important. The audit report will be based on these answers.[14]

4.4.14 Reported findings

When the auditor has conducted its audit, the findings should be reported as Karapetrovic & Willborn (2000) state. Reporting can be done to the CC and RC itself and to RecyBEM, as being the responsible party for car tyre recycling. SGS reports its findings to RecyBEM that informs the applying company about after the audit about major and minor shortcomings to cooperate with them to meet the requirements for certification. When the auditor finds the company ready to become certified, it reports its findings to RecyBEM. The PRO bases its decision to certify the company on SGS's findings and eventually on additional agreements between RecyBEM and the CC or RC (RecyBEM B.V. & Vereniging Band & Milieu, 2019b, 2019a). Hence, the findings are reported to the company and to RecyBEM.

4.5 Score calculation

Combining all scores from both perspectives (current and upgrading) on quality control and the one on quality assurance, as explained in the methodology section, tells us that the QAS on car tyres for CCs and RCs scores 6,4 out of 10 on average (Table 4). Both the current and the upgrading perspective are scored low (4,5/10 and 4,9/10 respectively). This means that the certification criteria on the car tyres EPR product stream do not push the CCs and RCs towards higher value retention and/or

[10] Interview with M. Alderlieste, General Manager of Granuband, 17 November 2021.
[11] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.
[12] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.
[13] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.
[14] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.

continuous improvement. Especially the development and implementation of CS-integrated strategic plans has scored very bad. This means that, although the QAS pushes the CCs and RCs to work on CS and circularity topics, the development and implementation of these plans stay behind.

The audits are fully done according to the audit principles as described by Karapetrovic & Willborn (2000). This implies that there is very good auditing. Although it scores 10 out of 10 points, Granuband experiences difficulties with the relevance of the criteria. The criteria are relevant to the type of companies that the certificate is applicable to, but they seem different than those of other institutions that set demands for the CCs and RCs, e.g., governmental organizations. This leads to ambiguity, and it could be prevented by matching the criteria of the RecyBEM certification and those of other institutions. The question is whether this is the responsibility of RecyBEM or of the other institutions: it is unclear who has set the most fact-based requirements.

The RecyBEM QAS does not work towards a higher level of value retention, although the audit process is organized well. The QAS makes the CCs and RCs to adhere to legislation, but not much more than that. More can be done to push the quality of recycling of car tyres by means of increasing quality control.

Figure 11 visualizes the scores. The radar plot shows the three categories that the QAS is scored on: continuing the current technological perspective and upgrading the technological approaches (cascading) for analysing the QAS on its quality control perspective, and the audit principles to include the quality assurance perspective as well. This type of radar plot will be made for every case study if applicable, to make comparison clear and easy.

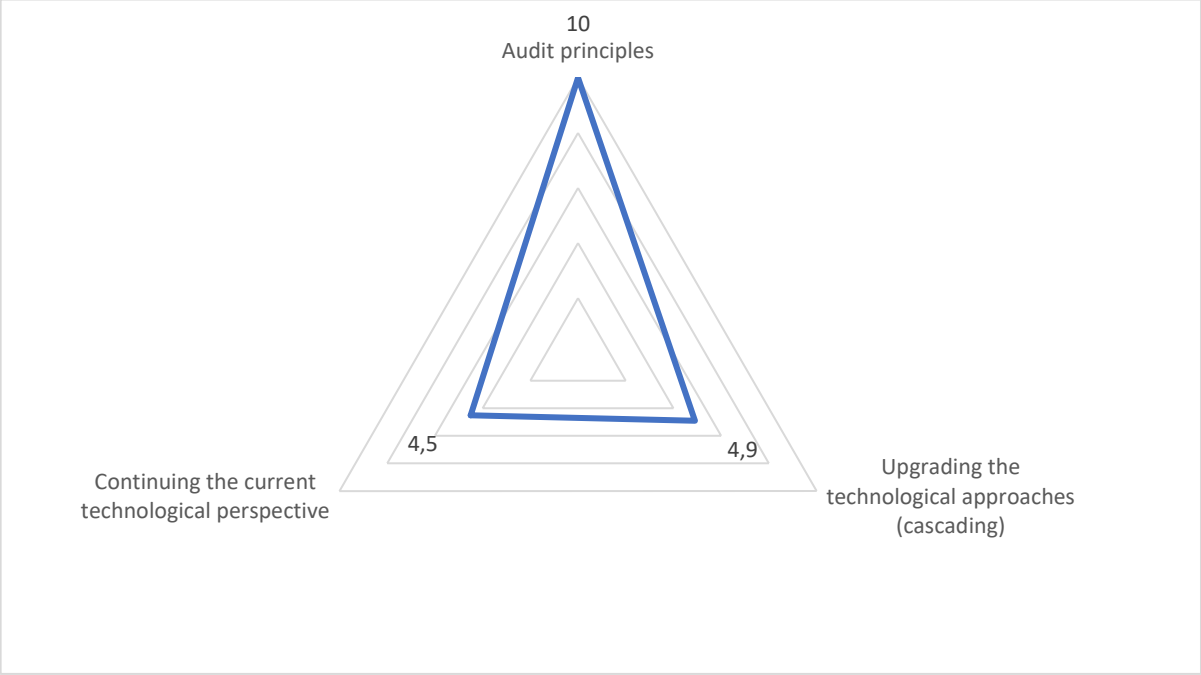


Figure 11: Radar plot that shows the functioning for the QAS on car tyres on a ten-point scale (own work)

Table 4: The Assessment Framework for case study 1: car tyres

Quality Assurance System on car tyres assessment				
Quality Control			**Quality Assurance**	
Step #	**Continuing the current technological perspective**	**Upgrading the technological approaches (cascading)**	**Audit principles**	**Compliance**
1: Raising awareness	1/10 pts.	10/10 pts.	**A: Objectivity & independence**	10/10 pts.
2: Assessing corporate purpose in a societal context	5,5/10 pts.	1/10 pts.	**B: Quality, maintainability, and reliability**	10/10 pts.
3: Establishing a vision and a working definition for CS	5,5/10 pts.	1/10 pts.	**C: Continuous improvement**	10/10 pts.
4: Assessing current CS status	5,5/10 pts.	5,5/10 pts.	**D: Purpose, objective, and defined scope**	10/10 pts.
5: Developing a CS-integrated strategic plan	1/10 pts.	1/10 pts.	**E: Feasibility**	10/10 pts.
6: Implementing CS-integrated plan	1/10 pts.	10/10 pts.	**F: Planned**	10/10 pts.
7: Communicating about CS commitments and performance	5,5/10 pts.	1/10 pts.	**G: Systemic**	10/10 pts.
8: Evaluating CS integrated strategies and communication	5,5/10 pts.	N/A	**H: Evidence and criteria**	10/10 pts.
9: Institutionalizing CS	10/10 pts.	10/10 pts.	**I: Relevant and unambiguous criteria**	10/10 pts.
			J: Documented	10/10 pts.
			K: Qualified and competent	10/10 pts.
			L: Adequate and reliable methods	10/10 pts.
			M: Collected and verified evidence	10/10 pts.
			N: Reported findings	10/10 pts.
Subscore	*4,5/10 pts.*	*4,9/10 pts.*	**Subscore**	*10/10 pts.*
Final score RecyBEM QAS = 6,5*/10 pts.*				

4.6 Audi alteram partem: RecyBEM

The writer of this thesis spoke to K. van Oostenrijk (CEO of RecyBEM) about the analysis that has been made on the QAS they provide. Van Oostenrijk responded by stating "we do sustainability, instead of writing it". There seems to be a gap between theory and the practical side of this story. Every three years, each CC and RC that works with RecyBEM, determines a service agreement with the PRO. In this agreement, targets (including sustainability ones) are set for the specific company. This agreement evolves over the years. It assesses the current state of the car tyre recycling industry, and it looks forward to what should be done in the next three years. However, RecyBEM states that it is not possible to add sustainability and CE in practice to a certification. There are two main reasons for this.[15]

The first reason is a lack of closed-loop technology. It is not possible to reuse every car tyre as a whole or even the materials of each tyre. Last November was the Recovered Carbon Black conference that was attended by several big players in the car tyre industry. RecyBEM attended too. The Dutch PRO mentioned this conference as crucial for the future of high-quality recycling of car tyres since it brings together the important parties and aims for innovative car tyre recycling processes. At this moment, this technology is not good enough (yet).[16]

The second reason is that RecyBEM states that their experience shows that RCs do not want to work with bureaucratic agencies. The less stringent the rules, the more the companies work on increasing performance. This is because they are responsible themselves. Roundtables are the best way to come up with agreements that everyone supports.[17] The RC Granuband agrees to this. The RC states that they would not agree with a PRO deciding what must be done and what not. Granuband says that they are the entrepreneur, and that they do not expect RecyBEM to bureaucratically send demands to the RC.[18]

Kester Jacobs (COO of RecyBEM) adds to this that the Assessment Criteria are not the right place to demand compliance to requirements like the ones proposed in the assessment form of this thesis. He thinks these requirements should not be added to the Assessment Criteria.[19] ISO 14001 could be a way to implement environmental management to a QAS (ISO, n.d.-c). Kester Jacobs explains that demanding ISO 14001 was considered in the past, but that RecyBEM chose not to oblige it. However, the current market situation demands more from companies in the field of CS. Therefore, it could be a good time to restart the initiative to add ISO 14001 to the Assessment Criteria for CCs and RCs. Kester Jacobs states that CS is in the core business of RecyBEM and a place in their QAS could benefit their partners. Reading this thesis gave the final incentive to bring this subject in perspective again and to discuss the value of an ISO 14001 standard with their partners. RecyBEM knows that several CC and RC partners already embrace this standard and so they can start learning from each other.[20]

[15] Interview with K. van Oostenrijk, CEO of RecyBEM, 22 November 2021.
[16] Interview with K. van Oostenrijk, CEO of RecyBEM, 22 November 2021.
[17] Interview with K. van Oosenrijk, CEO of RecyBEM, 22 November 2021.
[18] Interview with M. Alderlieste, General Manager of Granuband, 17 November 2021.
[19] Interview with J. Kester Jacobs, COO of RecyBEM, 3 December 2021.
[20] Interview with J. Kester Jacobs, COO of RecyBEM, 3 December 2021.

5 The quality assurance system on scrap vehicles

5.1 Description of Extended Producer Responsibility on the scrap vehicle product stream

Case study 2 analyses the EPR product stream of scrap vehicles. The Besluit beheer autowrakken (Bbaw) was introduced in 2002 and is still applicable to end-of-life vehicles. Goals and targets are described in the Bbaw. At least 85% of material from scrap vehicles must be recovered from 1 January 2015 on. This includes both product and material reuse. There is a goal that includes energy recovery as well: 95% of scrap vehicles must be material or energy recovered at least in the Netherlands (Overheid.nl, 2018). The European Union (EU) has set the exact same goal on both material and material/energy recovery. Collection rate has already been included in these targets (European Parliament, 2000).

The PRO on scrap vehicles is called ARN. ARN was founded in 1995 by four parties from the car industry: BOVAG, RAI Association, Stiba, and FOCWA. This voluntary initiative was meant to help the Netherlands to adhere to European norms. ARN would aim for clean, sustainable, and complete dismantling and recycling of cars (ARN, 2021c). The organization became the PRO for the scrap vehicle product stream and thus, it became responsible for scrap vehicles from collection to the end of recycling (Ministerie van Infrastructuur en Water, 2021a). In 2019, ARN gained an AVV and therefore, all producers and importers of cars must pay a waste management contribution that is used by ARN to pay for recycling of cars (Rijkswaterstaat, 2021b).

Scrap vehicles in the Netherlands are handed in at an ARN DC. The DC checks the car and then disassembles all components (ARN, 2021a). If possible, components of the car (e.g., the engine and gearbox) will be sold to become reused as a product (ARN, 2021a) for repairing purposes (R3) (VanGilsAutomotive, 2021). All the components and materials that are not possible to become reused will be sent to an ARN shredder company (SC) that grinds it to small pieces of material (R7). All pieces of metal go to the metalworking industry, whilst the leftover materials will be sent to the Post Shredder Technology (PST) factory. The PST factory splits the leftovers in several waste streams from which some can be reused again (R7). When the materials are not reusable anymore, the factory aims for energy recovery (R8) (ARN, 2021a). If this is not possible, the materials are landfilled (Compendium voor de Leefomgeving, 2020). In 2020, this was applicable to 1,7% of all collected cars (ARN, 2021b).

As said, the collection raid has not been specified in the targets, because the recycling rate is leading for this. ARN treated (R3-R8) 82,5% of all scrap vehicles that have been treated in the Netherlands in 2020 (ARN, 2021b). It is unclear what the European average is for the collection rate. Figure 12 shows the material and energy recovery rate that ARN has realized over the past ten years. This is estimated on the number of all end-of-life vehicles they have treated. It also includes the material recovery goal that has been set in the Bbaw, which combines product and material reuse into one goal (Overheid.nl, 2018). As said, this is equal to the EU goal (European Parliament, 2000). Appendix 5 supports Figure 12 with data that was found in the ARN sustainability reports.

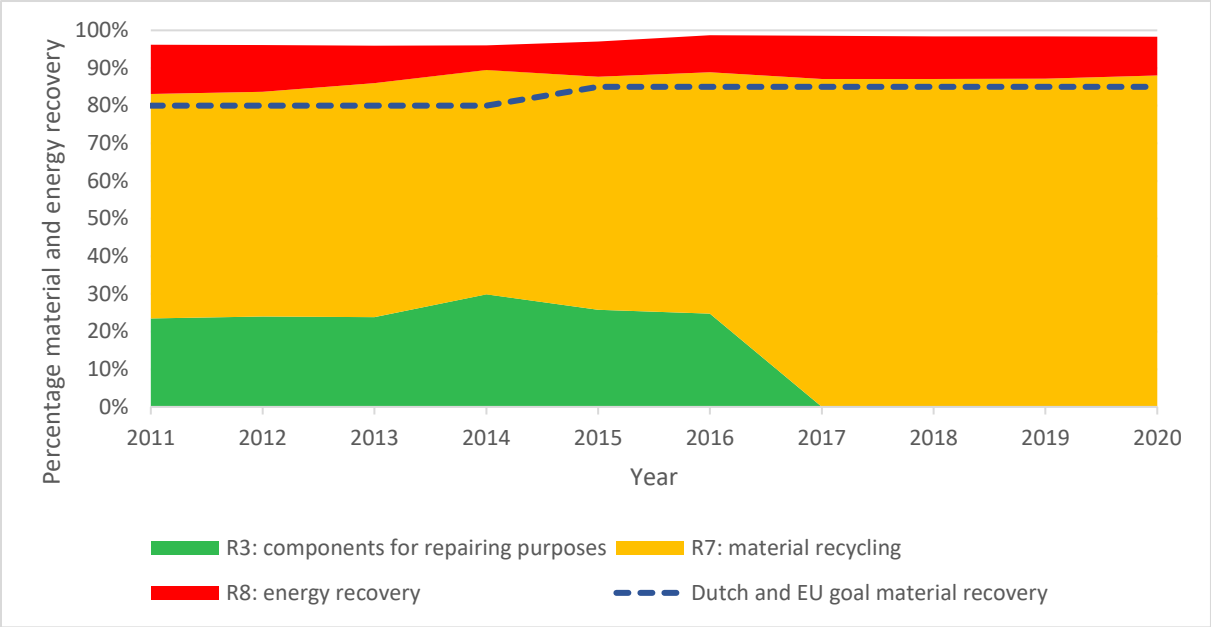


Figure 13: Percentage of material and energy recovery of scrap vehicles in the Netherlands (own work, sources: ARN (2012, 2013, 2014, 2015, 2016, 2017, 2018, 2020, 2021b; European Parliament, 2000; Overheid.nl, 2018)*)*

Figure 12 shows that the rate of material recovery for scrap vehicles is above the required percentage. The Dutch goal on material recycling of scrap vehicles went up. Although the rate is high, there is no sign of improvement more than towards meeting the legislative demands. It is remarkable that in the year before the pre-announced raise of the European and national target the percentage of material recovery increased as well. One year later, it decreased 'back' to just a bit above the target.

ARN has stopped reporting on product reuse. Material recovery was divided in product/component reuse (for repairing purposes) and material reuse/recycling until 2017 and from that year on, it reported the recycling results only as 'material reuse' (R7) (besides energy recovery – R8). This is the reason for the decline of R3 and the increase of R7 in Figure 12. It is unclear why ARN chose to make this change in reporting.

At this moment, the Dutch material recovery rate of scrap vehicles is like the European average. Figure 13 visualizes this. However, the Dutch scrap vehicle recycling industry recovers more energy from the end-of-life cars than the average other European country (Eurostat, 2020b). This might be due to better technologies such as PST. In 2017, the PST factory was responsible for 9% extra energy recovery. If the PST factory would not have been there that year, the energy recovery rate would have been 2,5% instead of 11,5% (and the material recovery rate would be 80,3% instead of 87,1%) (ARN, 2018).

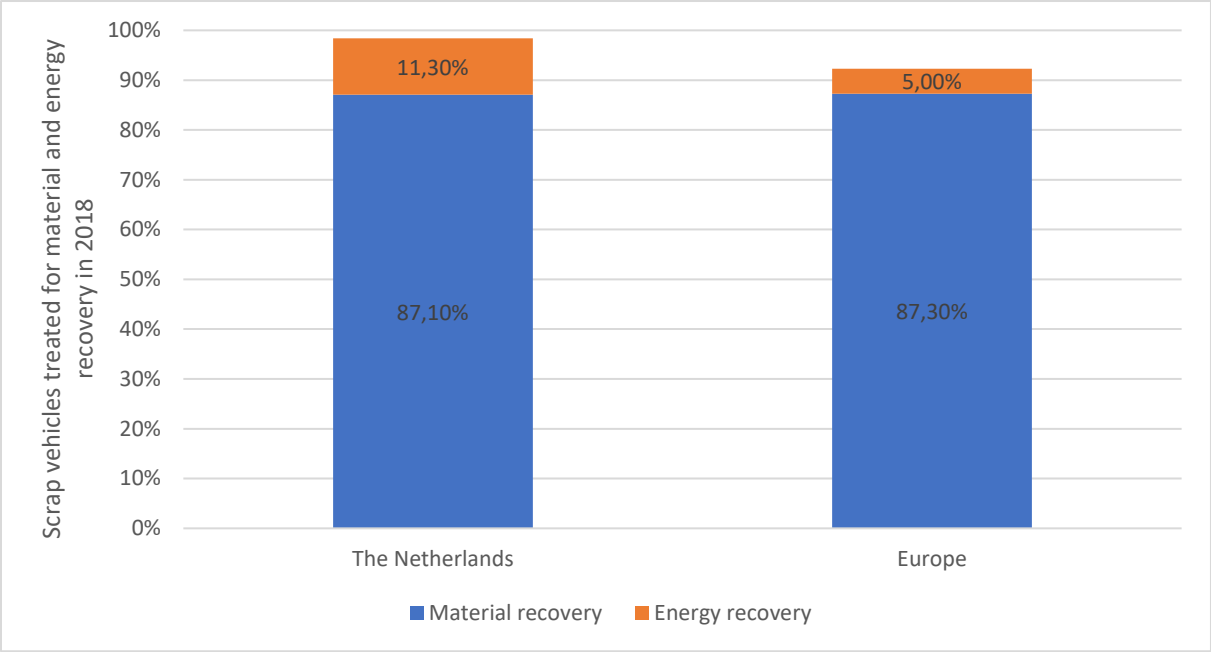


Figure 13: Percentage of scrap vehicles collected and treated for material and energy recovery in the Netherlands and Europe in 2018 (own work, source: Eurostat (2020b)*)*

To organize the collection and treatment of cars, ARN works with more than 210 car DCs that provide the disassembling services and part of the material recovery for ARN. For recycling of the scrap vehicles, thirteen SCs and one PST factory are cooperating with ARN (ARN, 2021a). The SCs and the PST factory are the RCs for ARN. It is not publicly known which RCs work with ARN. The writer of this thesis wrote an email to ARN to find out which SCs work with ARN and where these companies are located, but this email was not answered. Only two SCs are named on the internet (besides the 210 DCs and the PST factory). G.-J. Struijer, lead auditor at Kiwa, confirms that these are the only two SCs that ARN works with in the Netherlands. The others are in Belgium and Germany.[21] In 2017 13% of the scrap vehicles was exported to SCs in these countries (ARN, 2018). Appendix 6 shows the name and location of the two Dutch SCs and of the PST factory.

The responsibility of ARN on end-of-life vehicles starts with the DCs that collect and dismantle the cars. The KZD certification is binding for car DCs that want to work with ARN (Centraal College van Deskundigen KZD, 2013) and is therefore of great importance for quality control provided by ARN. KZD was founded by ARN and Stiba to create a standard for the recycling industry on scrap vehicles, including requirements for health and safety and for material recycling. DCs can apply for certification and then they will be rewarded with KZD*, KZD**, or KZD***. The first level implies adherence to law and legislation, whilst the latter means that a company took some additional measures (Stichting KZD, n.d.-d). Working with ARN requires DCs to be KZD* at least. A KZD certification lasts three years. An annual audit is demanded to check whether the DC still meets the requirements (Stichting KZD, n.d.-a). This thesis will analyse KZD*** because this is the highest level of that QAS. DCs can become certified as high as they aspire. DCs that have the intention to work harder on specific quality issues are supported with this QAS in doing this.

After the dismantling phase, there is no specific QAS for the RCs. ARN only describes the ED certificate on their website (ARN, 2021d). This certificate is not mandatory (Erkend Duurzaam, n.d.). DCs can also become certified and that happens often (Erkend Duurzaam, 2018). Nevertheless, this thesis will take

[21] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.

this certificate into account, because it offers an opportunity for RCs in the scrap vehicle recycling industry to work towards CS with help of a QAS.

ED translates complex legislation into practical standards that are easy to understand for all Dutch companies that are concerned with mobility. This is specified for the different types of companies that are willing to become ED certified (Erkend Duurzaam, 2021c). All Dutch companies in mobility can apply to become certified (Erkend Duurzaam, n.d.). ED has different requirements for each sector. This thesis analyses the certification procedure for metal RCs in the Dutch mobility industry to be able to analyse the QASs in the entire end-of-life phase of vehicles. It is assumed that the requirements are like each other between the different mobility sectors.

ED was founded by the Dutch Institute for Sustainable Mobility (IvDM), what was founded by the same four organizations as ARN: BOVAG, RAI Association, Stiba, and FOCWA (Erkend Duurzaam, 2021c). IvDM recently became part of ARN (Breeuwsma, 2019). BOVAG, RAI Association, Stiba, and FOCWA are all associations that advocate well-being of their specific industries. BOVAG is concerned with mobility entrepreneurs (BOVAG, 2021), the RAI Association with producers and importers of vehicles (RAI Vereniging, 2021), Stiba with vehicle DCs (Stiba, 2018), and FOCWA with entrepreneurs in the Dutch bodywork industry (FOCWA, 2021). Together, via IvDM, they want to help mobility companies to conduct responsible entrepreneurship. Dolf Teuwen is the director of IvDM as well as of ED (Erkend Duurzaam, 2021c). All organizations in this paragraph are strongly related to each other.

The following paragraphs will analyse whether the QAS for end-of-life vehicles that is created by KZD, and ED pushes the scrap vehicle recycling industry to a higher level of circularity and if it assures the certified companies of continuous improvement through quality control and assurance.

5.2 Description of the quality assurance system on scrap vehicles

The QAS for scrap vehicles consists of a mandatory certification for car DCs (KZD) and a voluntary certification for the entire mobility industry, which can be implemented by both the DCs and the RCs (ED). These are two totally different certifications, set up by different parties, but both aiming for sustainability in the recycling industry on scrap vehicles. Figure 14 shows the value chain for car tyres from the moment of return from the user until the end of responsibility of ARN. Additional information is given in Figure 14. It is remarkable that there is no binding certification for RCs, although they are responsible for most of the material recycling. The question marks in Figure 14 show that it is unknown what percentage of that type of company is certified with the specific certificate.

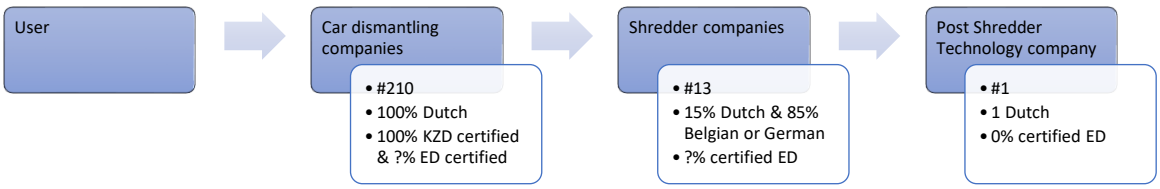


Figure 14: The ARN value chain (own work, sources: ARN (2018, 2021a)*, and KZD* (n.d.-c, n.d.-a)*)*

5.2.1 Build-up of the KwaliteitsZorg Demontage certification procedure

KZD*** is supported by an appendix that describes changes in the norm since the publication of it (Stichting KZD, 2016). An additional certification scheme is also provided. This contains requirements for quality assurance (Stichting KZD, 2013). The criteria in the KZD*** are all supplemented with an

explanation of the requirement plus a tip of how to address it in the company (Centraal College van Deskundigen KZD, 2013). The companies are audited by Kiwa or SGS on if they meet the requirements (Stichting KZD, n.d.-b).

Each of these requirements is categorized as of 'minor', 'major' or '*major*' priority during the initial audit. If a company that applies to become certified does not adhere to a *major*-important requirement, it will not become certified. If it does not meet a major requirement, the company will obtain three months to overcome the flaw. One minor shortcoming (in combination with a maximum of five), without *major* and major flaws means that the company could become certified if it overcomes them before the follow-up audit. If it has not been addressed by then, these minors will be converted into major (Stichting KZD, 2013).

These follow-up audit will be done each year. This audit gives minor, major and *major* priorities too. *Major* flaws will lead to immediate revocation of the certificate. Major shortcomings should be addressed within three months and otherwise a new initial audit is compulsory. Minor flaws should be overcome before the next audit. If this has not been addressed by then, these minors will be changed into majors. In total the certification will last for three years (Stichting KZD, 2013).

5.2.2 Content description of the KwaliteitsZorg Demontage *** criteria for certification

KZD*** is divided into two chapters that consist of requirements for certification. The first chapter contains responsibilities for the board of directors of the DCs, whilst the second chapter explains business process demands.

The first paragraph on responsibilities for the board of directors demands transparency of approvals and permits that the company possesses. The DCs must have an environmental permit for conducting activities that it wants to do (e.g., storage and recycling of scrap vehicles). It must also be registered at the KVK and be recognized by the RDW, which is an independent organization that controls for example registration of cars and documentation in the mobility industry (RDW, 2021). Besides, the company must have its health and safety procedure in order and must be able to show that this has been put in writing. Possession of an RI&E and some specific policies are compulsory as well.

Paragraph two sets rules on personnel and the organisational structures. Staff must be aware of the in-house rules including the power structures within the company. It is also demanded that there is a work meeting periodically, at least twice a year. This meeting should be attended by the entire staff and an attendance list should be signed. Topics related to quality, health and safety, and environment must be discussed, and all outcomes should be minuted. At least one person should be responsible for these topics within the company. Besides these meetings, performance reviews must be held annually at least. Both the manager and employee should be heard in these meetings. At the next performance review, feedback should be given on the agreements made at the previous meeting.

The third paragraph describes criteria regarding education. Employees must be instructed before they dismantle cars or components. When conducting dismantling activities internally, diplomas, and proofs of participation must be kept. Invoices must be stored when outsourcing these activities. Besides, there must always be at least one certified Emergency Response Officer on location.

Paragraph four sets requirements on company housing, equipment, and devices. Business premises must adhere to environmental, and health and safety legislation. Specific criteria are explained to help the companies achieving this. KZD also demands periodic checks on maintenance needs. Sometimes this must be done by external parties. Besides, companies that want to become KZD certified are demanded to present themselves well: they should create visitors a good entrance including a

presentation of the company name on the building. In contrast to KZD*, KZD*** appliers should also provide commercial customers with information on their business activities.

The next paragraph is about quality, health and safety, and environmental requirements. It demands a complaint management system to be functioning, but also a system that manages internal shortcomings. The root cause should be registered plus how the flaw will be overcome. Quality, health and safety, and environment are addressed extensively in this paragraph. The board of directors is mandated to assess their performance on these topics annually (at least) and explore possible opportunities. Based on this evaluation, goals for the year after should be determined. These targets should be clear, quantifiable, realistic, and time-bound, whilst awareness should be raised amongst staff members. Every year, the company should evaluate the operationalization of this QAS internally. This evaluation moment should be scheduled, and the results must be reported. It is unclear whether this report should be published internally of externally.

Business processes should be registered in a scheme that shows the company's main activities and the checkpoints between them. The first paragraph of additional requirements explains criteria that are related to purchases. The DCs must be able to transport the scrap vehicles for example. They must also register the bids they do and make a difference between bids that have been accepted and bids that have not. Suppliers must be checked on meeting the agreements that have been made. When a scrap vehicle has been bought, it should be signed out of the RDW registration. The DCs should keep purchasing records that shows the provenance of the scrap vehicles and their components.

Paragraph two is about dismantling the scrap vehicles. Health and safety and environmental legislation are demanded to adhere to. It is required to document which components are dismantled from the vehicle. These components must be checked on whether they can be reused or not. If they are not, they are not allowed to be sold for reuse anymore. Furthermore, overviews should be made for everything that is dismantled and/or discharged.

The third paragraph sets out requirements on storage. Environmental and health and safety legislation should again be adhered to. Degradation of the stored components should be minimalized. The DC must have a clear view on the stored components to make the components traceable. A minimum requirement for storage is having a covered warehouse.

The last paragraph explains the demands on sales and delivery. It explains minimum requirements on warranty, and mandates DCs to disclose changes in delivery terms before delivery. The invoices must be documented, and they must be easy to trace. The same goes for order acceptances. These orders must also be linked to the storage management system to keep records of the presence of components in storage, and to create a traceability of these components. Lastly, the KZD obliges the DCs to have a structured delivery system in place through setting some demands on inter alia packaging, documenting, and sales administration.

5.2.3 Build-up of the Erkend Duurzaam certification procedure

The ED certification procedure starts with a self-assessment which is available for free on the website of ED after creating an account. It is a survey that contains questions about business operations. A button is added to each question to give more information on the question and another one leads to a question-specific forum that connects you to other companies that are answering the specific question. In this way, representatives of the companies can answer the questions and find help if needed. To answer each question, proof must be provided to underpin the given answers. The answers are scored on importance.

After finishing this self-assessment, the company will be contacted to arrange a meeting with an auditor to potentially become certified. The assessment criteria are like the questions provided in the self-assessment (Erkend Duurzaam, n.d.). The company must meet 70% of the requirements to become certified.[22] DEKRA is the auditing party (DEKRA, 2017). The DEKRA auditor will talk through the self-assessment with the company that applies to become certified and does some checks on location. After this, a report will be written with recommendations. The auditor will explain this report to the audited party so that the latter can start working on these points for improvement.[23]

The certificate lasts for one year. It works with annual thresholds that must be met to remain certified. The first year, the company must be able to show it adheres to 70% of the assessment criteria. The second year, 80% is demanded and the third year 90%. If the 90% is met, the company can apply for a certificate that will last for two years instead of one (Erkend Duurzaam, 2021a).

5.2.4 Content description of the Erkend Duurzaam criteria for certification

The self-assessment consists of seven categories. One part on general matters, and the others are on business operations, communication, finance, purchase, personnel, and service. All categories are introduced with an explanation of the influence of that category on becoming sustainable as well as the opportunities that arise with reducing the negative impacts of the company.

The general part contains three questions on currently owned certificates. Both ISO 9001 (Quality Management) and 14001 (Environmental Management) as well as an MRF certification are demanded to become ED certified. The Metal Recycling Federation (MRF) certification contains requirements to meet legislative demands (MRF, 2016).

Questions on business operations follow on the general demands. The questions ask whether and how the company has anchored sustainability into its business operations and which KPIs it uses to measure performance. It is also asked how it is currently addressing emissions and water use and how it is working on reducing the impact that comes with it. Another requirement is that sustainability topics are addressed during meetings with the board of the company. Furthermore, there must be a point of contact for people with questions/complaints/suggestions to improve.

The questions related to communication ask how the company works on stakeholder engagement and engagement beyond that. Reporting processes are asked for as well. Everything should be in place to promote and perform sustainability as good as possible to be ED certified. The finance-related questions deepen these questions by asking if the company is subsidized for sustainable and/or innovative entrepreneurial activities. A few questions regarding safety of employees are added for when they conduct financial transactions.

The purchasing part includes questions about purchasing and tendering as sustainable as possible. Does the company buy sustainable energy? Does it take environmental and social aspects into account when purchasing?

Personnel information is collected through asking how feedback is conducted within the company. The self-assessment emphasizes the importance of well-being of employees. Health and safety have high priority and besides that, it is asked how the company contributes to the social side of sustainability. People with poor job prospects and people from minority groups are suggested as available employees.

[22] Email from M. Boeting, commercial office assistant at Erkend Duurzaam, 17 May 2021.
[23] Email from M. Boeting, commercial office assistant at Erkend Duurzaam, 17 May 2021.

The last questions are about services the company offers. The self-assessment wants to check how circular practices are motivated and how the company adheres to quality control of other product streams (such as e-waste).

5.3 Analysis of the certifications for scrap vehicle recycling, including KwaliteitsZorg Demontage and Erkend Duurzaam

5.3.1 Raising awareness

To check whether a company is sensitive for certain external and internal drivers and if it tries to use the critics as a source for progress, the ED certification asks if the company has a point of contact in place where people can come with suggestions or complaints. This is important for sensitizing problems that should be tackled. Besides this, legislative changes must be met through adhering to the MRF certification that ED demands. The criteria also demand 360-degree feedback between personnel of the certified company, including the direction. The manager's personal values are considered in this way. Besides this, the certification criteria push the companies to let economic drivers influence them positively, because it pushes the companies to engage in sustainable and innovative business practices to be able to apply for subsidies that are available for this. All drivers for change as mentioned above are demanded to influence the strategy formulation of the companies, because these sustainable practices are demanded to be the start of anchoring sustainability in the company's business practices.

On top of sustainability awareness, the ED assessment criteria demand a certain awareness on circularity topics. This starts with demanding sustainability requirements on purchasing processes. Sustainable tendering is about the products and materials that a company purchases, and this often comes down to circularity in tenders/purchases. Besides this, waste management is demanded for not only metals, but also for other waste streams. This cherishes cascading principles. The opportunities are also explained when ticking the info button. The opportunities of a higher level of value retention are explicitly mentioned.

The self-assessment also brings up that it is important that the companies listen to their supply chain so that they can learn from them. Technical innovations must be known by the company to be able to continuously improve as quick as possible.

Taking all points mentioned above into account, shows that the ED certification is including all aspects that are required to fulfil the sensitize part as explained by Maon et al. (2009) perfectly. However, this includes only half of the QAS. The KZD certification is important for DCs and will therefore be scored together with ED to provide a complete view of the QAS on scrap vehicles.

KZD demands a complaint management system and supports this requirement with a tip that explains the usefulness of a certain complaint management system. This means that KZD obliges companies to make social drivers influence the DC. The certification also mandates the DCs to adhere to legislative demands such as health and safety and environmental legislation. These demands apply to business premises, the dismantling procedure, and storage of waste and residual materials. In this way, KZD makes DCs sensitizing political demands and manage them.

The KZD certification makes managers' personal values influence the DCs by making performance reviews and periodic work meetings with the entire staff compulsory. Managers can talk to their employees during these meetings and speak up for the things they find important. However, economic drivers are not required to be considered as a reason for change. Besides, all drivers above are not

mandated to influence the DC's formulation of strategy, which is important to make the DCs obliged to change when influenced. Therefore, although ED includes criteria to sensitize all kinds of drivers for progress, the QAS on scrap vehicles (ED and KZD together) only partly includes these criteria when continuing the current technological perspective.

Sensitizing to be able to upgrade the technological approaches is demanded in the entire QAS. KZD demands traceability of all car components that the DC purchases. It also requires a check on functionality and quality on all components during the dismantling process. If possible, the KZD demands selling for reuse. Although it is not defined whether they demand product or material reuse, the KZD certification obliges the DCs to sensitize possibilities for higher value retention options.

5.3.2 Assessing corporate purpose in a societal context

ED demands an explicit procedure to formulate a sustainability strategy that includes the triple-P through literally require a plan of action for anchoring sustainability into business practices. It also demands measuring the performance of this by setting KPIs. The people aspect of sustainability is specifically addressed by recommending elder people, people with poor job prospects and people of minority groups as potential employees. Health and safety are not specifically mentioned, but companies must possess an MVO certificate, which is like ISO 26000. It shows that a company is working on planet and people issues (Keurmerk MVO, 2021b). The planet aspect is specifically mentioned several times, e.g., through asking if the company has a plan to reduce energy and water usage of its own business practices. The prosperity aspect is not specifically addressed, but the MVO certificate is mandatory, and this certificate includes a requirement that a company pays according to the collective agreement (Keurmerk MVO, 2021a). This is one example of fair inequality, which is one of the indicators for prosperity (Vermeulen, 2018).

Crucial stakeholders must be identified plus the channels for communication that are relevant. The RC must also be aware of the possible expectations that these stakeholders have concerning sustainability topics. Internal stakeholders' issues must be figured out periodically through annual functioning and evaluation interviews.

Communication to external stakeholders is required, since sustainable business practices, sponsoring and sustainable results/investments must be reported systematically. A social or sustainability report must also be conducted every year. An annual report that includes sustainability will be approved as well.

KZD does require an explicit procedure to formulate a sustainability strategy which includes the triple-P. Someone is directly responsible for quality, health and safety, and environmental issues. This means that someone is responsible for 'people' and 'planet'. These responsible people are annually checked on their performance. Besides, the DCs must adhere to health and safety and environmental legislation. The prosperity aspect is addressed by forbidding fraudulent activities. The DCs are, by means of the KZD, not allowed to be involved in this kind of activities.

Internal stakeholder issues will be brought forward during the periodic performance revies and during the work meetings that take place at least twice a year. External stakeholder issues will be noticed via the complaint management system. This system also requires feedback loops, and a solution must be made to tackle the issues.

The KZD also demands a moment of evaluation. Components that are not ready for reuse are not allowed to be sold for reuse. There must also be overviews of numbers of the waste streams. This makes the DCs assess their corporate purpose in a societal context while aiming for upgrading the technological approach towards high level value retention.

5.3.3 Establishing a vision and a working definition for corporate sustainability

ED and KZD do not demand the companies to establish any kind of vision on sustainability, nor do they demand a vision on cascading.

5.3.4 Assessing current corporate sustainability status

Monitoring of the carbon emissions is required in the self-assessment of ED. It demands a plan of action on top of this to reduce emissions. To check periodically on the sustainable norms, standards, and practices, audits from DEKRA are demanded before certification. Sustainable practices have been given much attention in the certification. However, circularity stays a bit behind. While improving sustainability practices comes forward in several requirements, improvement of circular performance is not mentioned.

The KZD certification does not require any kind of assessment on corporate sustainability status. It does not demand monitoring of emissions, neither does it require auditing of sustainability norms, standards, and practices, nor does it make improvement over time of circular performance compulsory.

This means that the QAS on scrap vehicles does not include this part of the PDCA cycle much. Only ED demands monitoring and auditing of sustainability topics. Therefore, continuing the current technological perspective is assessed with 'partly', whilst upgrading the technological approaches is assessed with 'no'.

5.3.5 Developing a corporate sustainability integrated strategic plan

ED pushes development of a CS integrated strategic plan, including the triple-P, by demanding the anchoring of sustainability into business practices and demanding relevant KPIs to measure performance and build upon. Paragraph 5.3.2. has already explained why the triple-P has been included completely. Cascading principles have again not been mentioned to include into the organizational strategy. Therefore, the requirements neither push development of cascading strategies.

KZD does not push development of a CS integrated strategic plan and it is neither necessary to embed this in organizational strategy. A focus on cascading is demanded through requiring a consideration on reusability of each component. However, development of cascading strategies is not motivated.

5.3.6 Implementing a corporate sustainability integrated plan

Implementation of the CS-integrated plan is obliged when becoming ED certified through inter alia demanding smart meters combined with energy monitoring systems, stimulating sustainable transport of employees, and through mandating sustainability criteria for the company's purchases. Organizational initiatives and strategies linked to CS must also be implemented, because the self-assessment demands policy in respect to social and/or societal projects by means of sponsoring or support. ED also pushes the companies to make someone responsible for realizing these sustainable ambitions through demanding ISO 14001. ISO 14001 requires specific staff to be responsible for implementing sustainability (Zwarts, 2019).

The companies recycle metal from scrap vehicles, but they are mandated to consider better value retention options before recycling. Separation of materials is demanded to consider strategies that are higher on the R-ladder, as explained by Reike et al. (2018), to increase the level of cascading.

The KZD certification does not demand implementation of CS-integrated plans or organizational initiatives. It does neither require someone to be responsible for related topics either. Nevertheless, it

does consider value retention options before recycling since it checks the reusability of dismantled components of the scrap vehicles.

5.3.7 Communicating about corporate sustainability commitments and performance

The ED certification requires external communication on CS commitments and performance through demanding a social or sustainability report or an annual report that takes sustainability into account. Besides this, sustainable business activities, sponsoring, and sustainable results/investments must be communicated with stakeholders.

Internal communication of CS commitments is obliged through demanding to let employees know what they are expected to do in terms of sustainability and ethical behaviour. CS performance is communicated internally through placing sustainability topics on top of the schedule during personnel meetings.

Although the companies must communicate with their stakeholders about achieving higher levels of sustainability, this is not the case for improvement of circular practices. The ED certification does not push the companies to communicate with its stakeholders about cascading principles, neither does it push the companies to inform ARN or the responsible Dutch ministry on promising ideas that could benefit the ignition of a CE.

The KZD does demand DCs to communicate CS commitments internally by requiring the DCs to set up a planning for quality, health and safety, and environmental issues. KZD*** also demands a work meeting on these issues. The management must evaluate the year, and this must be communicated internally, section 2.5.6. demands. During this performance review of the quality, health and safety, and environmental performance of the last year, new commitments will also be communicated internally. The DCs are not obliged to communicate these commitments and performance reviews externally. Therefore, the QAS on scrap vehicles that includes both ED and KZD does not fully include step 7 (communicating about CS commitments and performance) as explained by Maon et al. (2009) when continuing the current technological perspective. This means that this step will be assessed with 'partly'.

The KZD certification criteria do not demand the DCs to communicate with ARN about achieving higher levels of cascading periodically. It does neither oblige them to communicate with other responsible parties, such as the responsible Dutch ministry, about legislation that is beneficial for cascading principles.

5.3.8 Evaluating corporate sustainability integrated strategies and communication

After completing the self-assessment, an audit will be planned to check whether the RC meets the criteria as set by ED. Some of the questions that will be considered when auditing, ask for sustainability performance. Electricity use will be calculated as well as gas use and carbon emissions. However, not only current performance will be measured, but also the improvement compared to the year before.

As said, the ED certification demands a social or sustainability report or an annual report that includes sustainability. The KZD certification demands internal auditing of the entire QAS every year, and this includes topics like quality, health and safety, and environment. Findings and follow-up actions must be reported. Therefore, it seems that the QAS on scrap vehicles includes a proper evaluation of CS integrated strategies and communication.

5.3.9 Institutionalizing corporate sustainability

ED pushes the companies to commit resources to achieve sustainability related goals. One example is given in the introduction of the questions about personnel. It says that investing in the people aspect

of CS, results in an increase of the prosperity aspect of sustainability. This is because employees are more motivated, satisfied, and healthy what would lead to a higher productivity what leads to better business performance. However, ED does not push the companies to increase their amount of resources spent on sustainability performance periodically. The certification does neither push the companies to establish penalties or rewards when (or when not) achieving sustainability goals.

KZD does neither do this, nor does it push the DCs to commit resources to achieve sustainability related goals. Therefore, the entire QAS on scrap vehicles does 'partly' institutionalize CS when continuing the current technological perspective, and it does not institutionalize CS in terms of working towards higher value retention options.

5.4 Analysis of the quality assurance on the scrap vehicle certifications

ED is audited by DEKRA (DEKRA, 2017) and Kiwa (Erkend Duurzaam, 2020). KZD is audited by Kiwa and SGS (Stichting KZD, n.d.-b). This paragraph analyses the audit process of both certifications but will assess them as one. This is the same as before in the quality control part and is done to assess the quality assurance aspect of the entire QAS on scrap vehicles.

Kiwa and SGS audits follow the same procedure for KZD. Product managers have been appointed on behalf of all auditing parties and these will have work meetings where they create guidelines for the auditing process of the standard.[24] Kiwa mostly audits the KZD*** DCs and SGS audits the KZD* and KZD** DCs. This is done because KZD*** DCs are often interested in other certifications as well, e.g., ISO 9001 and 14001. Kiwa auditors can combine the audits for these certifications with the one for KZD.[25]

Kiwa also audits for ED. A KZD and ED audit can be combined on one day. By complying to KZD***, DCs already prove to meet many of the demands for ED. This makes the audit quick and easy.[26] ED is also audited by DEKRA. After the applying companies have assessed themselves on the certification criteria, the auditing parties will conduct the audit for becoming ED certified (DEKRA, 2017). When certified, the ED certificate lasts for one year. An audit will be conducted each year. After three years and meeting the target of adherence to the criteria, the company could apply for a two-year audit (Erkend Duurzaam, 2021a).

DEKRA's parent company DEKRA e.V. works in more than sixty countries and provides work for about 44.000 people (DEKRA, 2021) of which nine hundred work in the Netherlands. The company is specialized in inspection, testing and certification (DEKRA, n.d.-b). DEKRA has several subsidiaries registered at the KVK which all belong to the DEKRA Netherlands Holding B.V., which is registered as a private limited company under the number 37155016 (KVK, 2021a).

Kiwa is specialized in certification, inspection, testing, training, and consultancy. It operates in 35 countries and has 5.500 employees. Kiwa was founded in 1948 by several Dutch drinking water companies. Since then, it has grown. It bought many other companies (Kiwa, 2021). The Dutch head office of Kiwa is based in Rijswijk. Many subsidiaries belong to this. Kiwa N.V. is registered at the KVK under the number 27039108 as a public limited company (KVK, 2021b).

SGS has already been described in paragraph 4.4 of this thesis and will not be described in this paragraph again. Companies that apply for KZD certification are tested by Kiwa or SGS as analysed

[24] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.
[25] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.
[26] Interview with S. Kemna-Broekhuis, General Manager of Autobedrijf Broekhuis, 2 December 2021.

above in this case study. Based on the auditors' report, a certification board of Kiwa or SGS decides whether the DC will become certified. If certification is not allowed, a re-evaluation will be planned with the applying DC. If certification is allowed, the DC will be certified for the next three years. The entire audit process will be done again after this period. In the meantime, follow-up audits take place annually to check whether a DC still complies to the norm (Stichting KZD, 2013).

As being the auditing parties, DEKRA, Kiwa, and SGS are important for the QAS on scrap vehicles. On behalf of good auditing, it is important to stick to the audit principles as described by Karapetrovic & Willborn (2000). This paragraph explains how these processes look like.

5.4.1 Objectivity & independence

DEKRA is the biggest company globally that conducts tests, inspections, and certification, which is not a listed company (DEKRA, 2018). DEKRA e.V. fully owns DEKRA SE, which runs all business operations of DEKRA (DEKRA, n.d.-a) and is therefore, full owner of the DEKRA Netherlands Holding B.V.. Besides this, DEKRA is member of the Independent International Organisation for Certification (IIOC). The IIOC also recognizes DEKRA as an independent organization (IIOC, 2021). Therefore, it seems that DEKRA is independent and objective.

The KZD certification demands that the institution that certifies (Kiwa and SGS) is fully independent. These parties are not allowed to have other interests in the results of the audits. Besides, auditors are not allowed to have been involved with advising the customer. In this way, Kiwa and SGS are obliged to audit objective and independent (Stichting KZD, 2013).

5.4.2 Quality, maintainability, and reliability

If a company becomes ED certified, certification will last one year. A controlling audit will check whether the company improved its adherence to the assessment criteria. The first year, 70% of the requirements should be met, and in the third year this should be increased to 90%.[27] However, this means that the certified company can miss out on some important criteria. Although the maintainability and reliability of audits are assured through the annual checks, quality could be lacking because the goal implies no 100% compliance to the criteria.

KZD certified lasts three years in which the DC will be audited yearly on whether it still adheres to the certification criteria or not. The certification obliges the DCs to meet all requirements to become certified. This means that quality, maintainability, and reliability of the auditing process are assured in the KZD (Stichting KZD, 2013). However, in the assessment framework this audit principle scores 'partly' since quality of the audit process of ED is not guaranteed.

5.4.3 Continuous improvement

The auditor provides the companies with recommendations to improve their business practices based on the criteria for the ED certification. As said before, the first year a compliance of 70% to the requirements is demanded, whilst 90% is demanded after three years. The auditor will provide the feedback to help the company towards 100% compliance but aims for a sufficient rate of compliance that will increase annually. Therefore, the audits for ED aim for continuous improvement.

KZD also aims for continuous improvement. The auditors determine *major*, major, and minor shortcomings of the applying DCs, and repeat this process annually to continuously improve the certified DCs.

[27] Email from M. Boeting, commercial office assistant at Erkend Duurzaam, 17 May 2021.

5.4.4 Purpose, objective, and defined scope

ED's purpose of the audits is to help mobility companies to increase their CS from a perspective of good entrepreneurship (Erkend Duurzaam, 2021c). The objective of the audit is to become ED certified what could be beneficial through more employee satisfaction, access to specific tenders, compliance to legislation, lower carbon emissions and energy use, and an independently conducted certificate of good employment and entrepreneurial practices (Erkend Duurzaam, 2021b). The scope is limited to the mobility industry.

The purpose of the certification procedure for DCs is to certify DCs that adhere to the KZD standard (Stichting KZD, 2013). This KZD standard's objectives are to prevent the car dismantling industry from having a variety of different existing standards, and to create an integral standard that has every type of DC in its scope (Centraal College van Deskundigen KZD, 2013).

5.4.5 Feasibility

Feasibility of ED is guaranteed through letting the applying company fill in the self-assessment before the audit. In this way, all information only must be discussed at the time of the audit. In this way, the audits can be conducted quickly. There is enough time to audit the applying company.[28]

This is also applicable to the KZD. Before the KZD takes place, several documents must be provided to the auditing party to not lose time during the audit (Stichting KZD, 2013). This gives the auditor time to ensure the auditing process of quality. Besides that, the certification scheme for KZD provides standard minimal time commitments for each type of audit (initial or follow-up) and for every type of KZD (KZD*, KZD**, or KZD***) (Stichting KZD, 2013). This has been decided by the product managers that have created the guidelines.[29] Therefore, it seems that these times are well-considered and that the auditing process of KZD is ensured of feasibility.

5.4.6 Planned

ED audits are planned after the self-assessment has been filled in. When an applying company scores 80% of the maximum points, the audit will be planned and after this the auditor and someone of the applying company will go through the self-assessment. The auditor is demanded to fine-tune the given answers.[30]

The KZD audits are planned as well. At the start of the audits, documents must be provided to the auditing party. These documents will be checked in the first stage of the audit procedure. When the auditing party judges that the company is ready for the audit process, the planning will be made. This planning must include information on the team of auditors, the date and time that the audit will take place, and on what the auditors will try to find out within the forms (e.g., by means of interviews). The planning must be communicated with the applying company (Stichting KZD, 2013).

5.4.7 Systemic

The self-assessment for ED is different for each applying type of company, e.g., metal treating companies must meet other requirements than DCs. However, the questionnaire is equal per type of company and therefore, the build-up of the ED audit is systemic. [31]

The KZD auditor must use a standard assessment report for each audit and therefore, every audited company will be subjected to the same criteria. This makes the KZD audits systemic. The certification

[28] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.
[29] Interview with J. Pepers, lead auditor at SGS, 19 November 2021.
[30] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.
[31] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.

scheme substantiates this (Stichting KZD, 2013), and provides extra assurance on the systemic aspect of the audits.

5.4.8 Evidence and criteria

Companies that apply for the ED certification must prove that they comply to the requirements. This can be done through providing the documents that are demanded, e.g., an RI&E. These documents are used to support the results.[32]

Audit reports of the KZD are demanded to consist at least an overview of the interviewees that provided the auditor with answers. All findings must be reported as well (Stichting KZD, 2013). This will explain the evidence that the auditor has found. The criteria have been set in the KZD assessment criteria and these are determined before the audit (Centraal College van Deskundigen KZD, 2013).

5.4.9 Relevant and unambiguous criteria

The assessment criteria are relevant for companies that want to become more sustainable. The triple-P is entirely incorporated in the requirements. People is addressed through paying attention to several groups of potential employees that are having a (relatively) hard time finding a job. Planet is addressed through the reduction goals on carbon emissions and paper use. Promotion of the image of the company's industry stands for considering the prosperity aspect of CS.

However, the criteria are sometimes vague and ambiguous. The self-assessment asks whether a company has a plan of action to reduce energy and water use. To what extent does this demand a plan and how much reduction is required? The same goes for having a plan of action for anchoring sustainability into business practices. How must a company anchor sustainability into these business practices?

KZD provides unambiguous assessment criteria. The requirements are specific and tell the company what must be done to adhere to the standard. The explanation to most criteria also provides a helping hand understanding the demands. Besides, the KZD's criteria are relevant, since it only demands changes that are applicable to all types of DCs, which was the objective of this certification.

Although the KZD scores maximum on this assessment criteria, the QAS on scrap vehicles (KZD and ED) scores 'partly' since the ED criteria are sometimes vague and ambiguous.

5.4.10 Documented

During the self-assessment, the auditing party has insight in the process already. This is on a read-only base. After finishing it, the document will be transformed into a reviewer's mode. From that moment on, the auditing party can write in the document. This document is hidden from the user – the applying company. When the auditor assesses the company of compliance to the demands, the company will be recommended for certification. From this moment on, IvDM (the certifying organization) can read the Excel sheet with the assessment results. These results are communicated with the audited company.[33]

The KZD auditor uses a standard assessment report format. This format will be filled in in this report will be shown which *major*, major, and minor flaws are found in the organization concerning the KZD certification (Stichting KZD, 2013).

[32] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.
[33] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.

5.4.11 Qualified and competent

IvDM decides whether an auditor is allowed to audit ED companies. These people must be experienced in the automotive industry, and they must have experience with sustainability in general. When they meet these demands, they must follow a training given by Dolf Teuwen, director of IvDM and ED. This training will give insight into the audit process. A certificate will be handed out in the end.[34] However, no audit experience or anything related is demanded. This means that unexperienced people that only have had one training and a bit of experience can audit for ED certification. Therefore, it is not guaranteed that ED auditors are qualified and competent.

By contract, a KZD auditor must possess a diploma of higher professional education in technical studies with a minimum working experience of two years or a diploma of secondary vocational education in technical studies with a minimum working experience of four years or have professional and intellectual capacities at the higher professional education level with at least three years of working experience. Besides this, knowledge is demanded on car dismantling processes, sale of components, ISO 9001, and the KZD standard (Stichting KZD, 2013). Therefore, this audit principle will be assessed with 'partly' for the entire QAS on scrap vehicles.

5.4.12 Adequate and reliable methods

ED auditors do not work in compliance to recognized standards. This is due to the high expenses such compliance demands. ED is not mandatory for any company and therefore, the costs must be kept as low as possible. Adherence to a standard would not be beneficial for the prevalence of the certificate.[35] Still, adequate, and reliable methods are not used per definition.

KZD certifying parties must be ISO/IEC17021 certified to be allowed to certify KZD (Stichting KZD, 2013). ISO/IEC17021 sets a standard for institutions that audit and certify management systems (NEN, 2021a). This means that KZD is certified by using adequate and reliable methods. The certifying companies assure the audited parties of a specific level of quality of the audits.

5.4.13 Collected and verified evidence

Evidence must be provided at the moment the auditor arrives. This means that documents must be ready and up to date (e.g., an RI&E) to make it easier for the auditor to immediately check whether everything is in order.[36]

The KZD auditor will base its decisions on collected information from interviews with the responsible staff members. The findings of the documentary part of the evaluation will be sent to the audited company and the auditor will proceed with the interviews from that moment on (Stichting KZD, 2013).

5.4.14 Reported findings

Findings will be reported to and discussed with the companies.[37] The same goes up for KZD, as explained in paragraph 5.4.10.

5.5 Score calculation

Combining the three subscores gives an average score of 6,4 out of 10 for the QAS on scrap vehicles in the Netherlands. Continuing the current technological perspective seems to be going fine, with a 6 out of 10. The certification criteria ensure certified companies of sustainability but working towards better

[34] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.
[35] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.
[36] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.
[37] Email from M. Boeting, commercial office assistant at Erkend Duurzaam, 17 May 2021.

value retention options (cascading) is not well included (4,4 out of 10). The audits seem to assure the quality of the certification well (8,7 out of 10). The audit principles have been considered properly.

Something that is not included in the assessment framework (Table 5), but is worth noting, is that the ED QAS is not mandated by ARN and is therefore not widely spread. ED lacks power and has no leg to stand on. Considering that ED is not mandatory for DCs and RCs, means that analysing the entire QAS instead of only KZD could mean that the reality differs from this analysis. ED increases the score of the assessment on continuing the current technological perspective much when looking at quality control. It demands more sustainability-related themes than KZD does. This could be due to the requirement of adherence to ISO 14001, which is part of ED, but not of KZD. KZD is based on ISO 9001 but does not set as many extra demands concerning sustainability as ED does.

In the near future, the three levels of KZD will be replaced by two new certification schemes: KZD Basis and KZD Plus. It is said that sustainability topics will be considered and that the certification will have more additional requirements for electric vehicles.[38] This is an opportunity for ARN to set extra demands that could steer the companies they work with (especially the RCs) towards more inclusive CS and to push them towards higher value retention options. One possible solution could be making compliance to ISO 14001 mandatory. Besides, the scope of the current certification that ARN offers and obliges (KZD) is not sufficient. It only focuses on the car DCs, whilst it seems that they have no idea how their actual RCs (SCs and the PST factory) are recycling the scrap vehicles they are responsible for. This should be taken into account when considering obligations for the new certification.

The radar plot in Figure 15 shows the three categories that the QAS is scored on for visualization purposes.

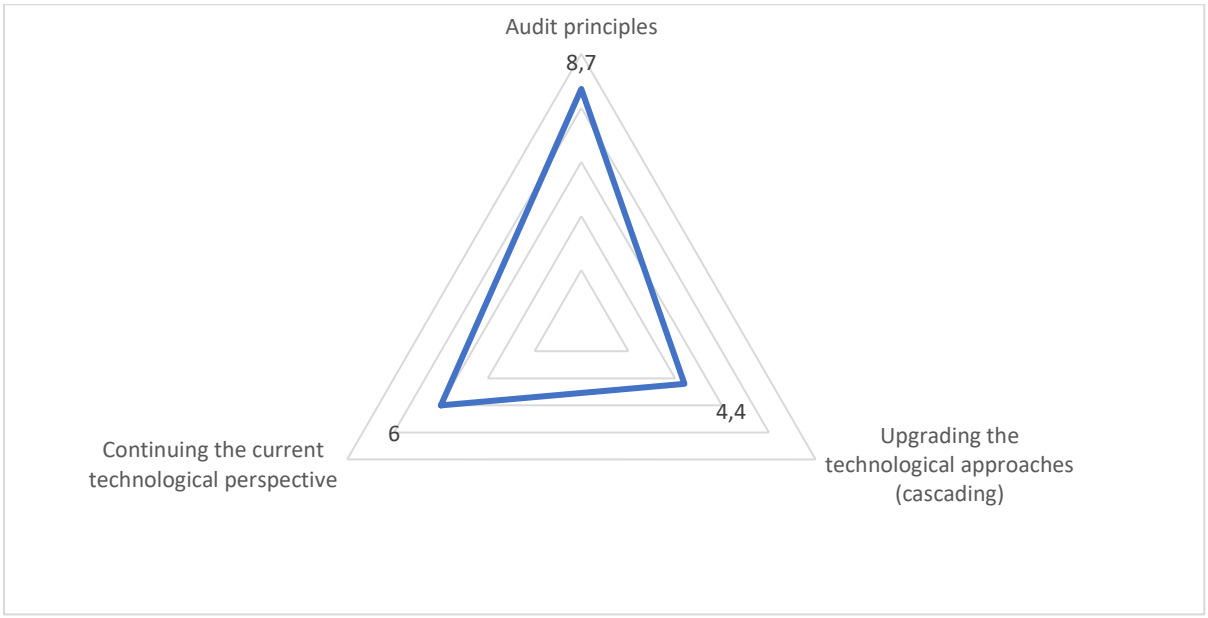


Figure 15: Radar plot for the QAS on scrap vehicles

[38] Interview with G.-J. Struijer, lead auditor at Kiwa and product manager of KZD, 2 December 2021.

Table 5: The Assessment Framework for case study 2: scrap vehicles

Quality Assurance System on scrap vehicles assessment				
Quality Control			**Quality Assurance**	
Step #	**Continuing the current technological perspective**	**Upgrading the technological approaches (cascading)**	**Audit principles**	**Compliance**
1: Raising awareness	5,5/10 pts.	10/10 pts.	**A: Objectivity & independence**	10/10 pts.
2: Assessing corporate purpose in a societal context	10/10 pts.	10/10 pts.	**B: Quality, maintainability, and reliability**	5,5/10 pts.
3: Establishing a vision and a working definition for CS	1/10 pts.	1/10 pts.	**C: Continuous improvement**	10/10 pts.
4: Assessing current CS status	5,5/10 pts.	1/10 pts.	**D: Purpose, objective, and defined scope**	10/10 pts.
5: Developing a CS-integrated strategic plan	5,5/10 pts.	1/10 pts.	**E: Feasibility**	10/10 pts.
6: Implementing CS-integrated plan	5,5/10 pts.	10/10 pts.	**F: Planned**	10/10 pts.
7: Communicating about CS commitments and performance	5,5/10 pts.	1/10 pts.	**G: Systemic**	10/10 pts.
8: Evaluating CS integrated strategies and communication	10/10 pts.	N/A	**H: Evidence and criteria**	10/10 pts.
9: Institutionalizing CS	5,5/10 pts.	1/10 pts.	**I: Relevant and unambiguous criteria**	5,5/10 pts.
			J: Documented	10/10 pts.
			K: Qualified and competent	5,5/10 pts.
			L: Adequate and reliable methods	5,5/10 pts.
			M: Collected and verified evidence	10/10 pts.
			N: Reported findings	10/10 pts.
Subscore	*6/10 pts.*	*4,4/10 pts.*	**Subscore**	*8,7/10 pts.*
Final score QAS on scrap vehicles = 6,4*/10 pts.*				

5.6 Audi alteram partem: ARN

ARN did not reply on the email that the writer of this thesis sent to provide an opportunity for ARN to respond to anything that has been written in thesis.

6 The quality assurance system on batteries and accumulators

6.1 Description of Extended Producer Responsibility on the batteries and accumulators product stream

The third case study analyses the EPR product stream of b&a. The Dutch government aims for a collection rate of 45% of the b&a that have been produced or imported nationally. This has been forced into law with the introduction of the Besluit beheer batterijen en accu's 2008 (Overheid.nl, 2008) and the Regeling beheer batterijen en accu's 2008 (Rbba) (Overheid, 2008). The Rbba mandates producers and importers of b&a to conduct material recycling (R7) to all b&a that it collects (Overheid, 2008). The Dutch legislation follows EU legislation. Hence, from 2010 on, the EU also aims for 45% collection in general of b&a (European Parliament, 2006).

Materials of value such as iron, nickel, and copper are recovered through recycling (Stibat, 2021c). Pb stands for lead-acid b&a, NiCd represents nickel-cadmium b&a. All other portable batteries are summarized as 'rest'. Different material recovery (R2-R7) targets have been set for the different types of waste. From 26 September 2010 on, 65% of Pb b&a must be material recovered (R2-R7), 75% of NiCd b&a, and 50% of other b&a (European Parliament, 2006).

However, achieving the collection targets has been perceived to be an impossible job when working as a single company on this task. Collection must be organized collectively to be able to meet the goals and be able to finance the process.[39] Stichting Batterijen was founded in 1995 and represents more than 900 producers and importers of b&a. To achieve the 45% requirement, Stichting Batterijen instructs Stibat to operationalize EPR legislation as good as possible (Stibat, 2021d). Therefore, Stibat is the PRO for the product stream of b&a. Since 16 October 2018, Stibat has force of law since it possesses an AVV (Rijkswaterstaat, 2018).

Stibat organizes the collection through placing containers at points of retail where b&a are sold. Utility yards also take back b&a. CCs can apply for a contract with Stibat to be allowed to collect b&a by tendering. After this, b&a go to a sorting centre.[40] In these sorting centres, the b&a will be sorted based on chemical composition (Stibat, 2021b). From there, they will be sent to several RCs abroad.[41] There is no processing capacity for b&a in the Netherlands yet. Most of the RCs are in Germany, Belgium, France, and Switzerland. There is also one RC located in Finland.[42] Figure 16 explains the value chain for b&a from the moment of return from the user until the end of responsibility of Stibat.

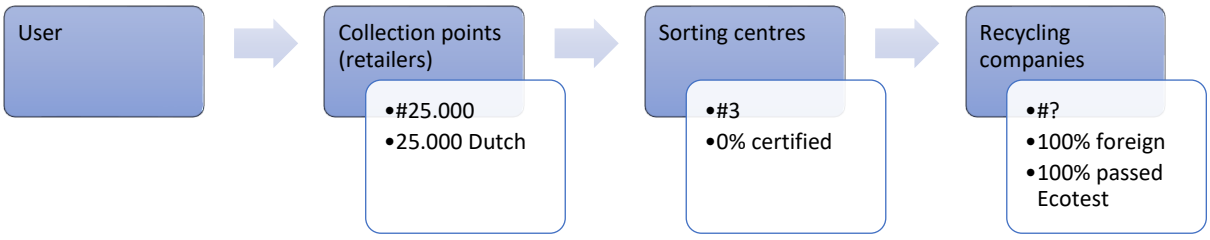


Figure 16: The Stibat value chain (own work, source: Stibat (2021c)*)*

[39] Email from A. Brouwer, Advisor Extended Producer Responsibility at Rijkswaterstaat, 30 August 2021.
[40] Email from A. Brouwer, Advisor Extended Producer Responsibility at Rijkswaterstaat, 30 August 2021.
[41] Email from A. Brouwer, Advisor Extended Producer Responsibility at Rijkswaterstaat, 30 August 2021.
[42] Interview with J. van Lent, Manager of Logistics and Recycling at Stibat, 23 November 2021.

Stibat contracts the RCs.[43] Every contracted company that Stibat works with, must adhere to specific norms (Stibat, 2021d). RCs will be subjected to the Ecotest which was created in 2012. This test makes the RC's performance measurable. It measures impact of the recycling process on environment: the impact on climate, the recovered amount of resources, the toxic gases that the recycling process prohibited, and cost savings. In this way, it checks whether an RC complies to legislative demands (Stibat, 2021a). Ffact Management Consultants B.V. assesses whether an applying RC passes the Ecotest. Stibat then decides if they will allow the RC to recycle b&a in their name. This is done to ensure recycling efficiency of compliance to European and Dutch legislation.[44] However, this test only measures whether the RC complies to European and Dutch targets on recycling efficiency. Therefore, it is not considered a QAS.

Stibat realized a collection rate of 48,1% on average in 2020. Although this is a higher percentage than required from European countries (48,1%>45%), it is important to note that this does not mean that the remaining 51,9% is lost. These b&a can be still at the retailer or in possession of users or sometimes they are exported. When exported, there is no control over these b&a anymore. The rate is calculated by dividing the weight of the collected b&a by the average weights of b&a brought to market of the last three years. However, b&a have a long lifetime and more batteries are used nowadays. This is detrimental for the collection rate, since the collected weight of b&a is divided by the average weight of the b&a that have been brought to market on average over the last three years, while these years might have selling rates that are much higher than of the year that the end-of-life b&a (that are collected now) date from. Therefore, Stibat claims that the calculation methods are incorrect and should be changed in European legislation (Stibat, 2021c). Using the current calculation methods, Figure 17 shows the collection rate of b&a in the Netherlands compared to other countries in the EU. The Netherlands is performing average in terms of collection of b&a.

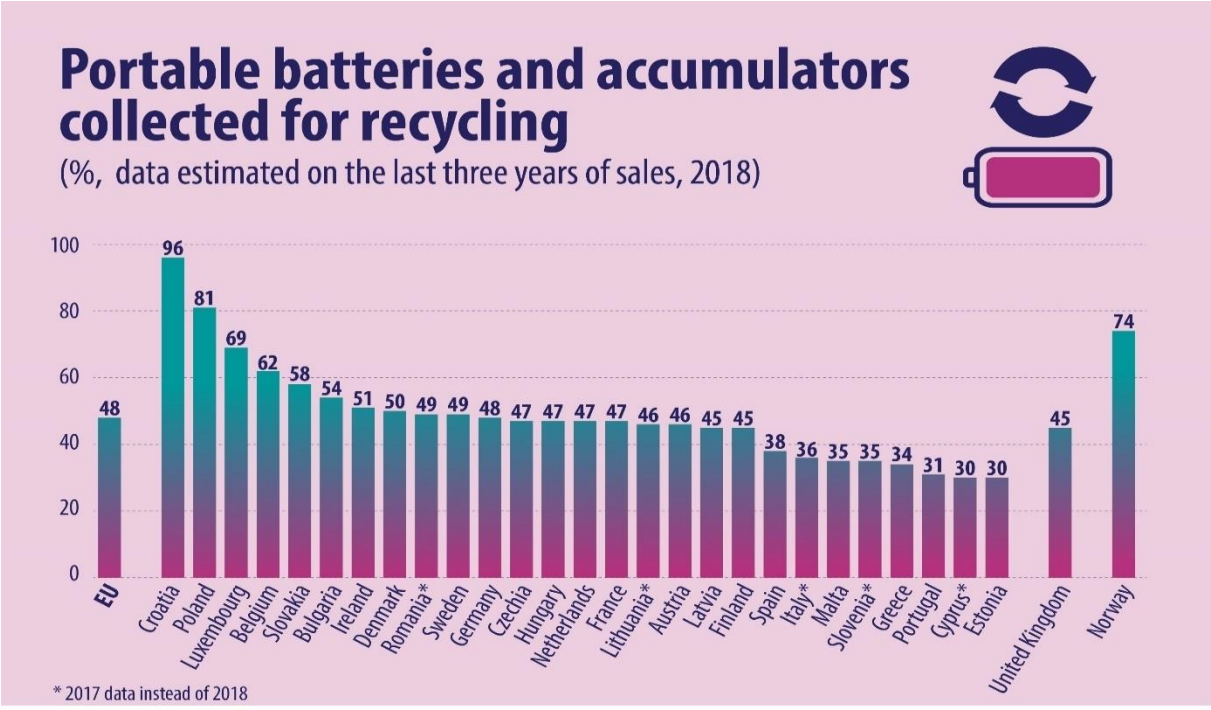


Figure 17: Collection rates for batteries and accumulators in 2018 compared to the amount put on market on average over the last three years (Eurostat, 2020a)

[43] Email from A. Brouwer, Advisor Extended Producer Responsibility at Rijkswaterstaat, 30 August 2021.
[44] Interview with J. van Lent, Manager of Logistics and Recycling at Stibat, 23 November 2021.

Stibat has been responsible for the material recycling rates that have been realized over the last years. Only material recycling (R7) is conducted in this specific recycling industry. This is done with three different technologies: mechanical, chemical (hydrometallurgical) or thermal (pyrometallurgical) recycling (Stibat, 2021c). Mechanical recycling is done by dismantling and shredding of the b&a what will be followed up by sorting the materials; hydrometallurgical recycling subtracts the valuable metals from the battery; and pyrometallurgical recycling decomposes the components by heating it (Yun et al., 2018).

Figures 18, 19, and 20 show the recycling rates estimated on the collected amount of the specific groups of b&a over the last seven years plus the percentage that Stibat aims for. Appendix 7 adds data to these figures. Stibat has set the same targets for recycling as the EU (European Parliament, 2006). There is no data available over 2011, 2012 and 2013 and therefore, these years have been left out in contrast to the other case studies. A. de Jong, Director of Stibat, explains that data on these years is unavailable to them too. He expects the rates to be like the 2014 rates.[45]

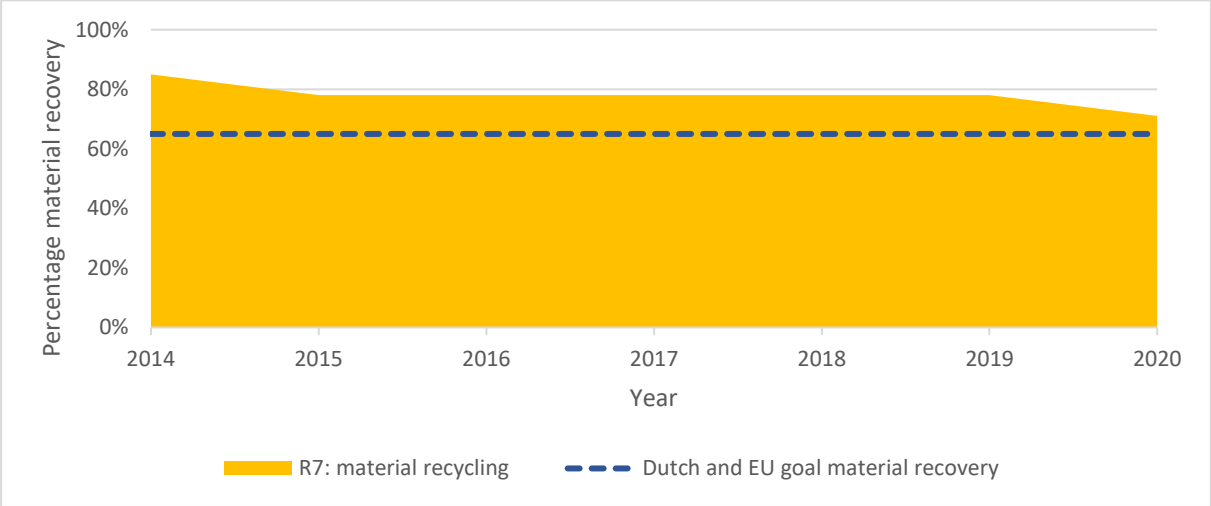


Figure 18: Percentage of material recovery (Pb) of collected batteries and accumulators in the Netherlands (own work, sources: Stibat (2015, 2016, 2017, 2018, 2019, 2020, 2021c) *and European Parliament* (2006)*)*

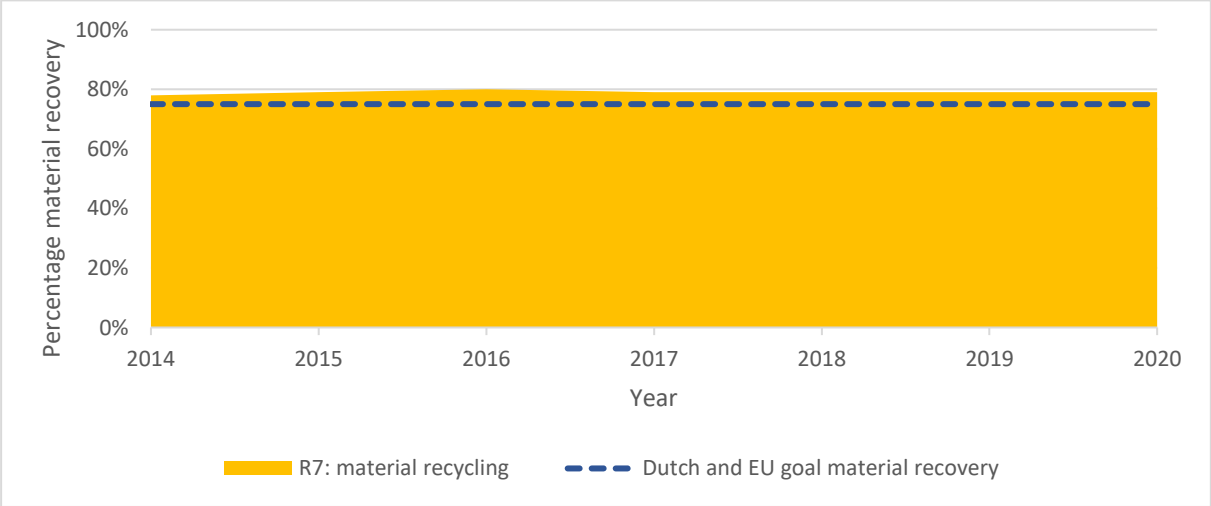


Figure 19: Percentage of material recovery (NiCd) of collected batteries and accumulators in the Netherlands (own work, sources: Stibat (2015, 2016, 2017, 2018, 2019, 2020, 2021c) *and European Parliament* (2006)*)*

[45] Email from A. de Jong, Director of Stibat, 6 December 2021.

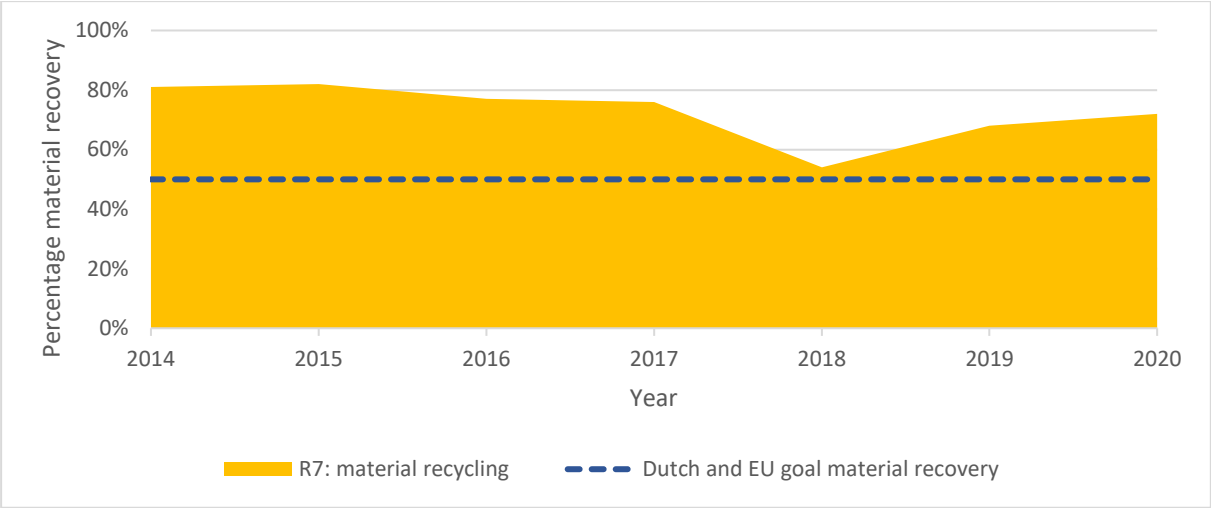


Figure 20: Percentage of material recovery ('rest') of collected batteries and accumulators in the Netherlands (own work, sources: Stibat (2015, 2016, 2017, 2018, 2019, 2020, 2021c) *and European Parliament* (2006))

Figures 18, 19, and 20 show that the recycling rate exceeds the goals that have been set by Stibat. However, improvement has not been booked. The recycling rate of lead-acid b&a decreased over the last seven years, whilst NiCd remained level, and the other's ('rest') rate slightly decreased as well. Besides this, if we look at EU-averages, the Netherlands is not performing well if looking at the recycling rate. Figure 21 shows the Dutch averages of the three types of b&a compared to the EU-averages. Energy recovery (R8) has not been included, because this is no goal of Stibat, or the Dutch government nor are b&a subjected to energy recovery.

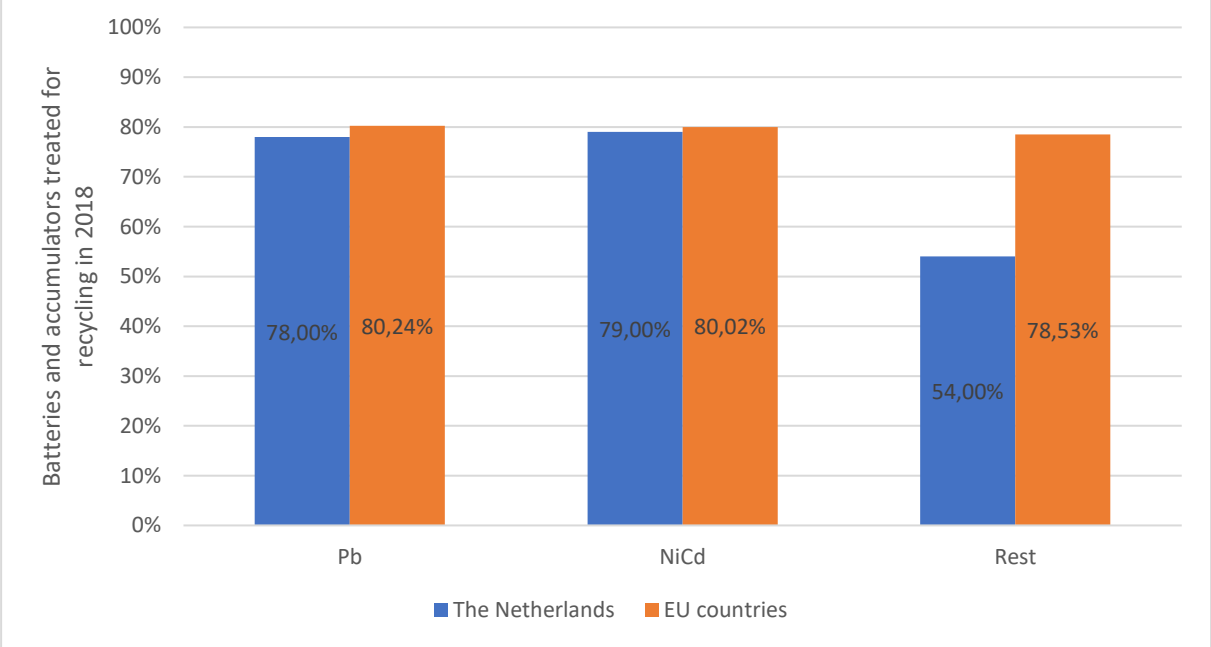


Figure 21: Percentage of batteries and accumulators collected and treated for recycling estimated on the collected amounts in the Netherlands and the EU in 2018 (own work, source: Eurostat (2021a) *and Stibat* (2019)

As shown in Figure 21 and explained in the previous paragraph, the Netherlands is running behind at other EU-countries. Although the goals are met, it is unclear how or if these companies can improve themselves, since there is no QAS that guides the b&a recycling industry towards high-quality recycling.

Parent foundation Stichting Batterijen is led by four members of the board. These are all part of big companies that are working in the same industry as Stibat itself: people from Intergamma, Duracell, Philips, and Varta are responsible for Stibat (Stibat, 2021d) and therefore, responsible for the goals over the last seven years that Stibat has set. Besides these specific persons, about 900 other producers and importers of b&a are represented in the Stichting Batterijen and thus, in Stibat. It is unclear how these companies influence the take-back-system that is required to operationalize the EPR legislation.

It is remarkable that the PRO adheres to European targets, but nothing more. Stibat has not organized a QAS to steer the companies towards high-quality recycling and it neither aims for a higher level of cascading. Higher value retention options are not being worked towards. Currently, recycling goals have remained equal over the last seven years. A QAS does not have to be radical that RCs do not want to work with a company anymore, but a start could be made by including environmental management systems in business practices. Demanding adherence to (e.g.) ISO 14001 could make RCs working towards continuous improvement and better environmental performance which is beneficial for meeting the 49% reduction goals on greenhouse gases that the Netherlands have set for 2030 (Rijksoverheid, 2019b).

6.2 Audi alteram partem: Stibat

The assessment framework cannot be applied for this product stream. J. van Lent, Manager of Logistics and Recycling at Stibat, explains that missing technology is crucial to make a possible QAS work. The small size of the Dutch b&a market also plays a role. An annual volume of about 4.000 tonnes is processed on behalf of Stibat,[46] whilst the European Union processes 88.000 tonnes b&a in total (the most recent data is from 2018) (Eurostat, 2020a). All RCs work in compliance to European legislation. Since the Dutch volume is only a small part of the total volume they process, Stibat has not much control over their RCs.[47] The RCs also work with foreign companies, and they only work with organizations such as Stibat if the costs and benefits balance quality. If the recycling process of the 'Dutch' b&a is too expensive because of additional demands from a QAS, the RCs will work with other organizations than Stibat that 'only' supplies 4.000 tonnes of b&a.[48] The Battery Regulation that is currently being discussed in the European Commission, proposes an increase of the minimal recycling efficiency for all European RCs.[49]

[46] Interview with J. van Lent, Manager of Logistics and Recycling at Stibat, 23 November 2021.
[47] Email from A. de Jong, Director of Stibat, 6 December 2021.
[48] Interview with J. van Lent, Manager of Logistics and Recycling at Stibat, 23 November 2021.
[49] Email from A. de Jong, Director of Stibat, 6 December 2021.

7 The quality assurance system on packaging

7.1 Description of Extended Producer Responsibility on the packaging product stream

Case study 4 analyses the EPR stream of packaging. Packaging is divided in five different streams that all have to do with specific targets and legislation which is embodied in the Besluit beheer verpakkingen 2014 (Bbv). Plastic, glass, paper/cardboard, wood, and (ferrous) metal packaging are the five different kinds. These specific packaging streams have different targets set in the Bbv, so within one piece of packaging can be several packaging streams with different targets. At least 71 percent of the total weight must be reused (≤R6) or recycled (R7). This percentage increases the next years with one percent point a year until 74% in 2025. Figure 22 visualizes the material recovery (R2-R7) targets for the coming years for the specific streams.

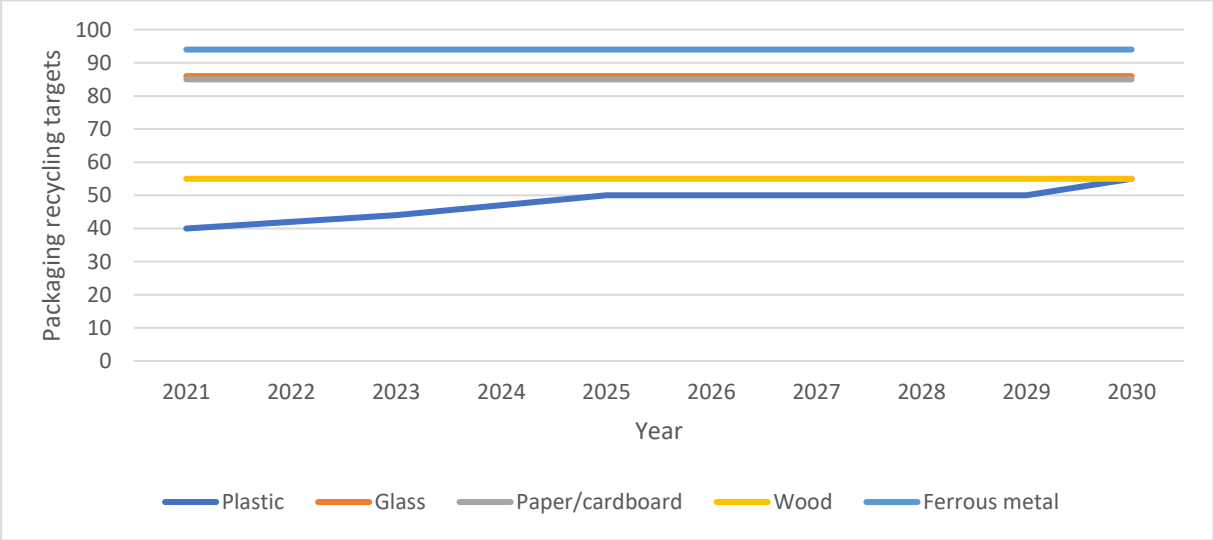


Figure 22: Specific packaging recycling targets over the next ten years (Overheid.nl, 2014)

Afvalfonds Verpakkingen is the PRO that operationalizes the Bbv. Afvalfonds Verpakkingen was founded in 2013 by suppliers and importers that collectively wanted to work towards full compliance to the Bbv. Afvalfonds Verpakkingen takes the responsibility for operationalization of the EPR legislation and does this with help of an AVV. The AVV forces producers and importers by law to pay the PRO for each piece of packaging that the companies bring to market. With this money, Afvalfonds Verpakkingen pays the entire recycling process from collection to recycling (Vereniging Producentenverantwoordelijkheid Nederland, n.d.-a). This process is visualized in Figure 23.

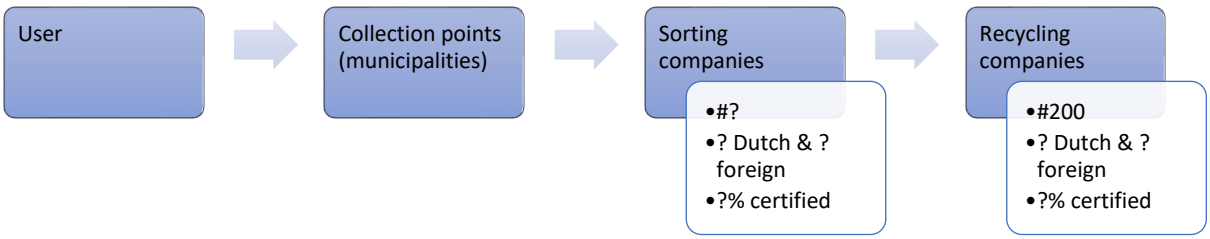


Figure 23: The Afvalfonds Verpakkingen value chain (own work, source: Nedvang (2021))

As Figure 23 shows: the recycling process of packaging starts with the people at home that throw their waste in the bin. Municipalities are responsible for the collection of garbage, and they bring it to sorting companies that sort the waste to make it possible for the RCs to recycle the material (Afvalfonds Verpakkingen, 2021c). Figures 24, 25, 26, 27, and 28 show the material and energy recovery rates that have been realized in the last eight years. These are percentages of the total packaging brought to market that year. There is no separate data available on collection rate and recycling/recovery rate. There is neither information available about 2011 nor 2012. The dotted line shows the Dutch targets on material recovery (≤R7), and the straight line shows the EU targets (≤R7). Appendix 8 gives extra data in addition to these figures. Material recycling is used to reuse the materials, whilst energy recovery is incineration while gaining energy from the process.

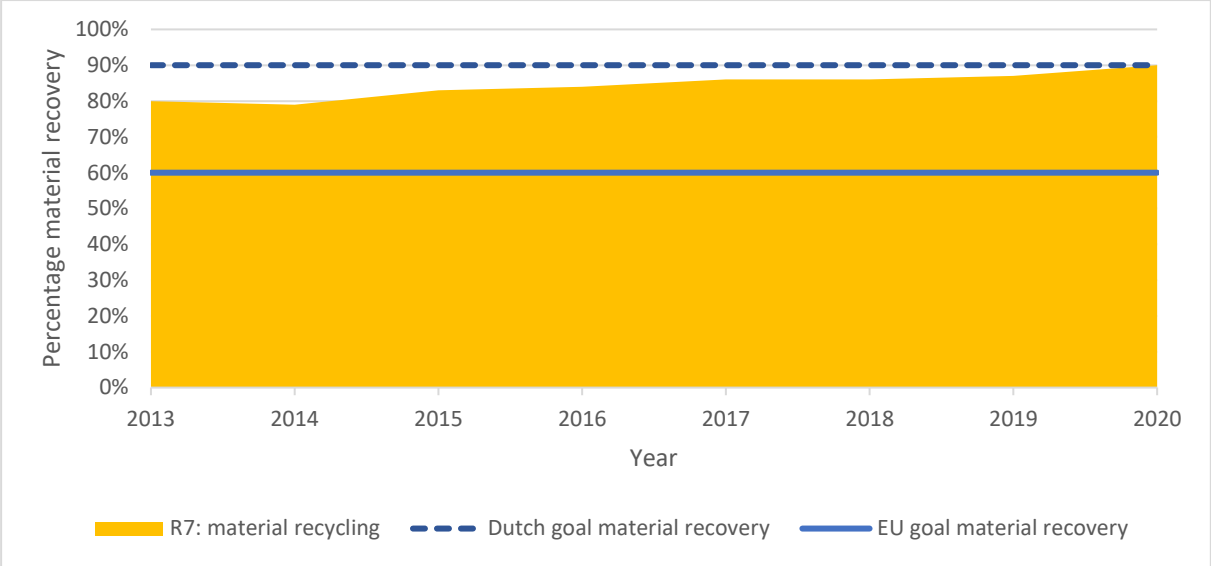


Figure 24: Percentage of material recovery of packaging (glass) in the Netherlands on the total of packaging brought to market (own work, sources: Afvalfonds Verpakkingen (2015, 2016, 2017, 2018, 2019, 2020, 2021b) *and Rijksoverheid* (2015)*)*

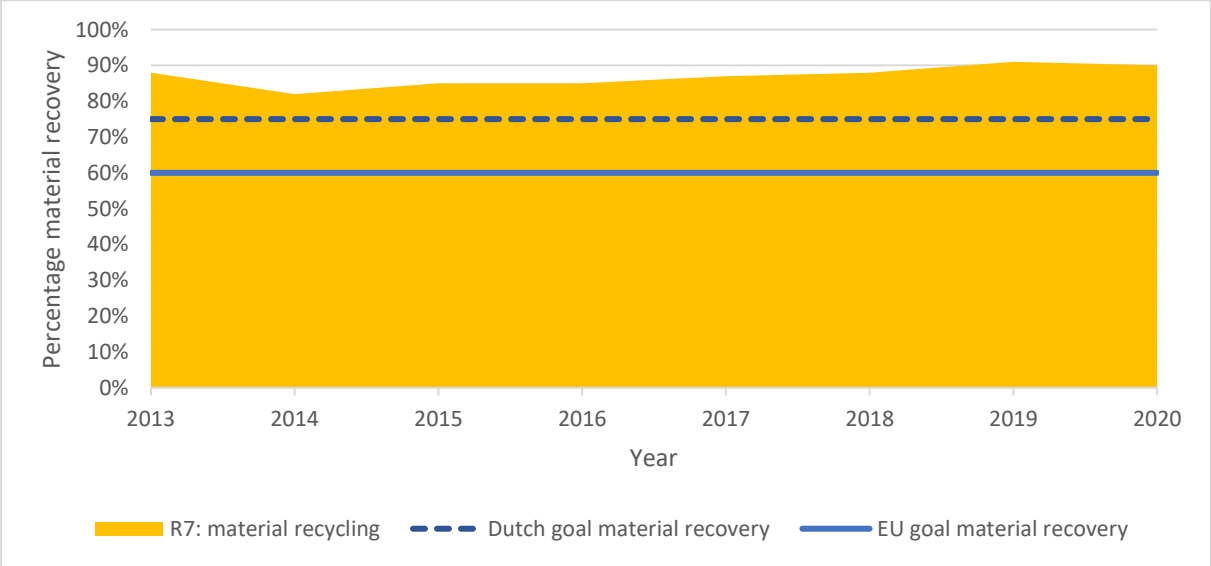


Figure 25: Percentage of material recovery of packaging (paper/cardboard) in the Netherlands on the total of packaging brought to market (own work, sources: Afvalfonds Verpakkingen (2015, 2016, 2017, 2018, 2019, 2020, 2021b) *and Rijksoverheid* (2015)*)*

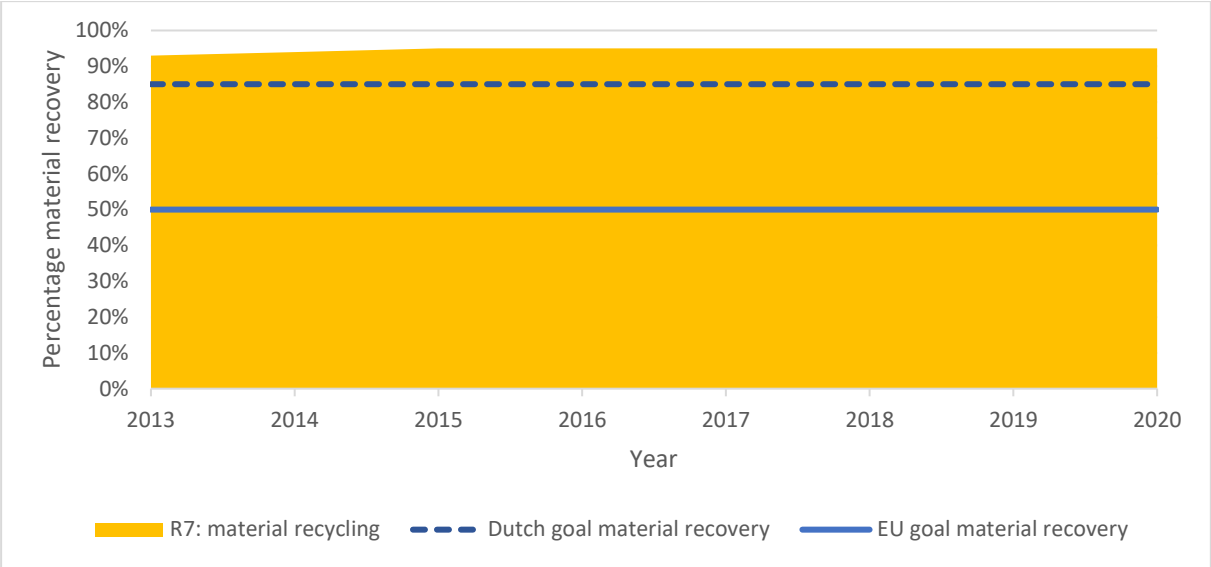


Figure 26: Percentage of material recovery of packaging (metal) in the Netherlands on the total of packaging brought to market (own work, sources: Afvalfonds Verpakkingen (2015, 2016, 2017, 2018, 2019, 2020, 2021b) *and Rijksoverheid* (2015)*)*

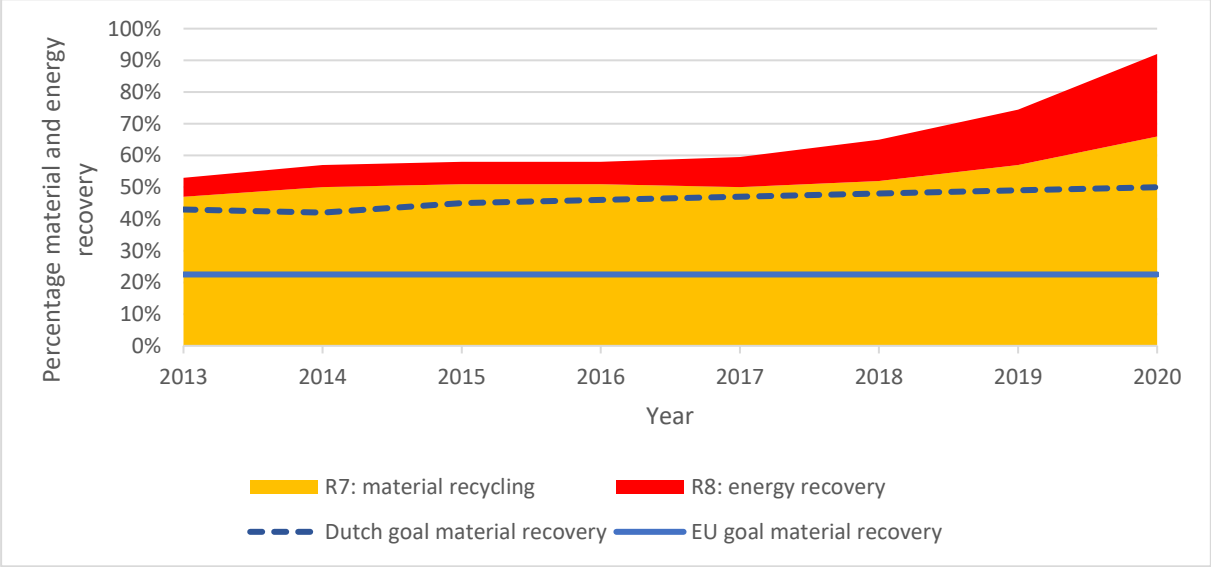


Figure 27: Percentage of material and energy recovery of packaging (plastic) in the Netherlands on the total of packaging brought to market (own work, sources: Afvalfonds Verpakkingen (2015, 2016, 2017, 2018, 2019, 2020, 2021b) *and Rijksoverheid* (2015)*)*

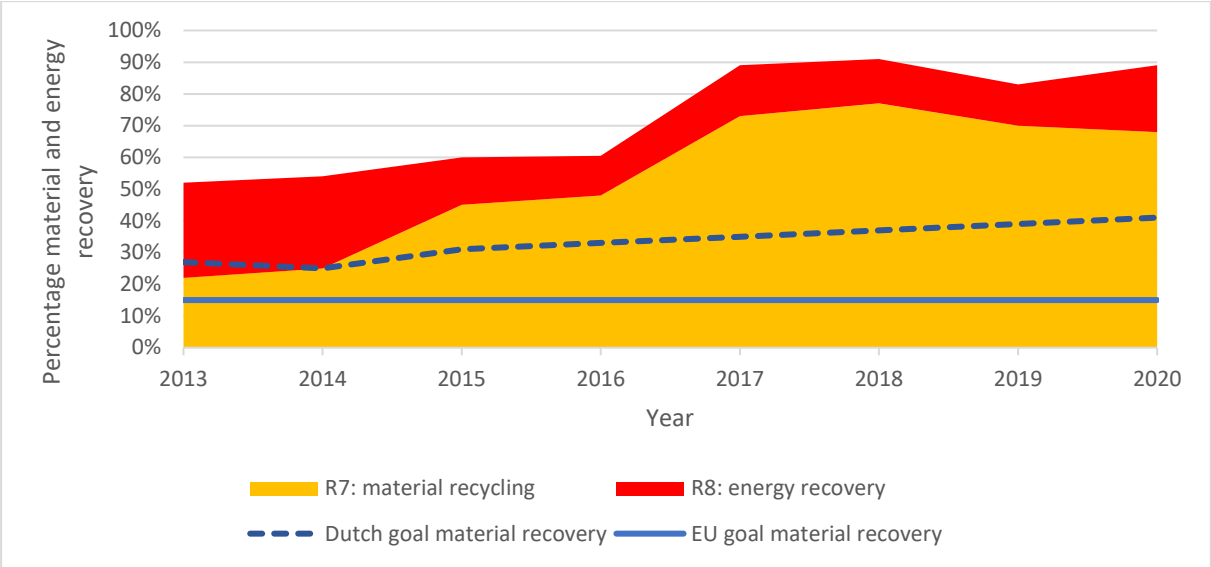
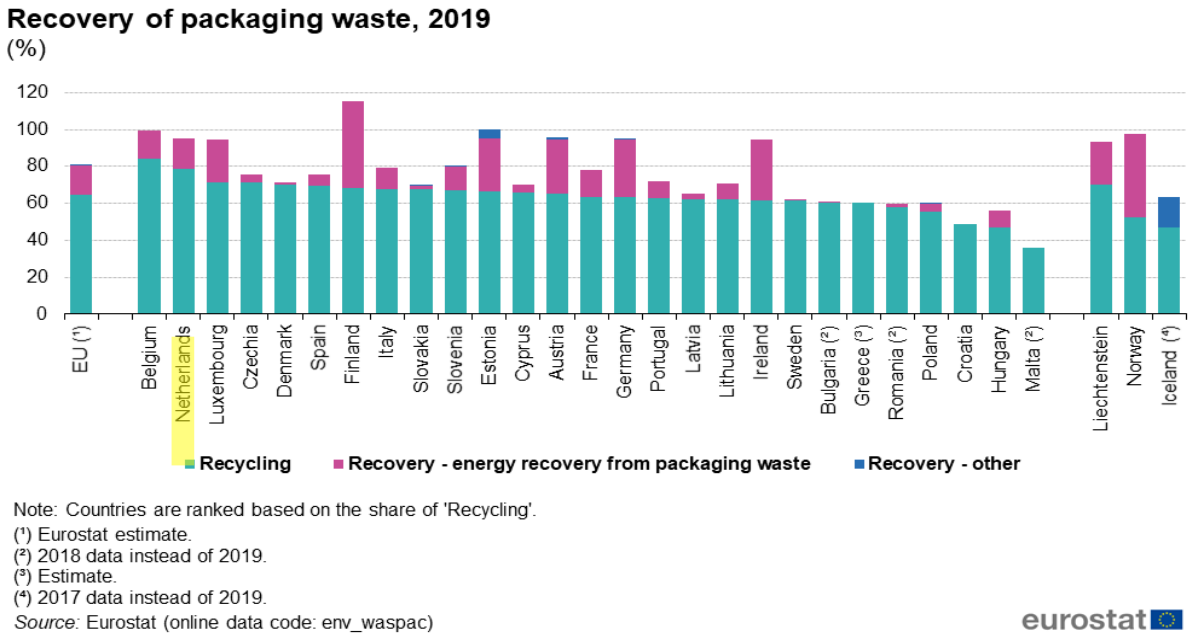


Figure 28: Percentage of material and energy recovery of packaging (wood) in the Netherlands on the total of packaging brought to market (own work, sources: Afvalfonds Verpakkingen (2015, 2016, 2017, 2018, 2019, 2020, 2021b) *and Rijksoverheid* (2015))

The figures above show that the Dutch recycling of packaging easily meets the European targets. Dutch targets are higher than the EU ones. These targets are met as well. Glass achieved the target last year, whilst the other packaging streams already made it before. Wood and plastic are also incinerated while recovering energy from that process. However, although most of the packaging streams are being recycled in the Netherlands well, there is not much improvement over the years (but wood and plastic packaging). Glass packaging made a gradual increase to meet the Dutch target. Compared to European averages, the Netherlands is a top-performing country in terms of packaging recycling. Only Belgium has a higher rate on material recycling (R7) than the Netherlands do. Figure 29 shows the averages compared to each other.



Note: Countries are ranked based on the share of 'Recycling'.
(1) Eurostat estimate.
(2) 2018 data instead of 2019.
(3) Estimate.
(4) 2017 data instead of 2019.
Source: Eurostat (online data code: env_waspac)

eurostat

Figure 29: European averages of material and energy recovery of packaging waste compared to the amount of packaging brought to market in 2019 (Eurostat, 2021c)

To organize the recycling process for packaging waste, Afvalfonds Verpakkingen cooperates with several organizations that conduct the operations for them, e.g., Nedvang. Nedvang communicates with the municipalities that collect the packaging, but also talks to the RCs to know what is going on in terms of recycling (Afvalfonds Verpakkingen, 2021a). These municipalities and RCs must comply to the 'Uitvoerings- en Monitoringsprotocol Verpakkingen' (UMP) what has been founded by Nedvang. The UMP guides any party in the packaging recycling industry. This is important because the packaging recycling value chain (municipalities, RCs, etc.) contains many parties. One of the things that the UMP demands is reporting on recycling quality to Nedvang. Only then, they will receive a contribution from the Afvalfonds Verpakkingen. After this, Afvalfonds Verpakkingen reports to the Dutch government (UMPVerpakkingen.nl, n.d.).

However, these reporting guidelines as provided in the UMP seem to be the only criteria that Afvalfonds Verpakkingen as the PRO on packaging waste demands to be met. The writer of this thesis could not find a QAS on packaging was on the internet. Therefore, he contacted Afvalfonds Verpakkingen, but they replied that he had to talk to Nedvang about it. Nedvang wrote that he had to talk to the municipalities or the provinces, since Nedvang claimed these would be responsible for certification of RCs. When talking to the municipalities and provinces, they only point at each other and say they are not responsible for this. This shows that the parties all point at other parties as the responsible party. No quality assurance system has been set up to perform better in time. Only the government (both national and European) has created legislation, but it seems that nothing has been done more to increase the quality of recycling.

Although Afvalfonds Verpakkingen seems to do a good job on steering the packaging industry towards high-quality recycling, it does not seem to steer towards higher value retention options. Selecting CCs and RCs that meet requirements that are set for working towards a higher level of circularity could advance this.

7.2 Audi alteram partem: Afvalfonds Verpakkingen

Afvalfonds Verpakkingen did not reply on the email that the writer of this thesis sent to provide an opportunity for ARN to respond to anything that has been written in thesis.

8 The quality assurance system on e-waste

8.1 Description of Extended Producer Responsibility on the e-waste product stream

Case study 5 analyses the EPR product stream of e-waste. In 2012, the European Union has published regulation that describes goals and policy on e-waste (Directive 2012/19/EU, 2012). This was translated into Dutch legislation in 2014: the Regeling afgedankte elektrische en elektronische apparatuur (RAEEA) (Ministerie van Infrastructuur en Milieu, 2014). EEE is categorized in several types. Initially, there were ten types of EEE that the legislation was applicable to. From 2019 on, there are six types of EEE included: temperature exchange equipment; screens, monitors, and equipment containing screens having a surface greater than 100 cm^2; lamps; large equipment (any external dimension more than fifty centimetres); small equipment (no external dimension more than fifty centimetres); and small IT and telecommunication equipment (no external dimension more than fifty centimetres) (Directive 2012/19/EU, 2012; Nationaal (W)EEE Register, 2021).

Targets for product/material recycling have been specified for these six categories of EEE. 80% of temperature exchange equipment and large equipment must be material recovered (R2-R7); 70% of screens, monitors, and equipment containing screens must be material recovered; 55% of small equipment and small IT and telecommunication equipment must be material recovered; and 80% of lamps must be material recovered. These are percentages of the collected e-waste (Directive 2012/19/EU, 2012). The European guideline and the Dutch RAEEA have also set goals on the collection rate. From 2016 on, producers and importers of electrical and electronic equipment (EEE) are responsible for achieving a 45% collection rate on the EEE they produce or import. This target has been increased. From 2019 on, a collection rate of 65% is demanded (Directive 2012/19/EU, 2012; Ministerie van Infrastructuur en Milieu, 2014).

To increase the collection rate in the Netherlands, the responsible Dutch Ministry brought several producer organizations together. This resulted in a plan of action to increase the collection rate of e-waste to 65% (Kort & van Grootel, 2020). The producer organizations have joined forces and applied for an AVV. This was needed to be able to let one umbrella organization take the lead and to steer the e-waste industry towards a collection rate of 65%, following the plan of action (Rijkswaterstaat, 2021a). This umbrella organization is called Stichting OPEN, and this has been the PRO on e-waste in the Netherlands from 1 March 2021 on. Stichting OPEN aims for strong cooperation with the e-waste value chain (Stichting OPEN, 2021b).

The PRO organizes the collection of e-waste at 13.000 collection points in the Netherlands (Stichting OPEN, n.d.-b). These are municipal hand-in points, thrift stores, retailers, and some other points (Wecycle, 2021). When collected, the e-waste is systemically inspected on functionality. After this, it goes preferably to certified companies that prepare the e-waste for reuse (R2-R6) (CENELEC, 2020). All the e-waste that is not suited for reuse purposes goes to RCs that will treat (R7-R8) it (WEEELABEX, 2019). In 2020, 86,6% of the e-waste that was meant to be treated, was processed at Dutch RCs (Nationaal (W)EEE Register, 2021). Each RC receives one type of e-waste to make recycling more efficient.[50] The RCs send components that are functioning well to the Reuse Preparing Companies (RPCs). If this is not possible, the RCs preferably recycle the e-waste (R7). The second option is to recover energy from the incineration of it (R8). If the e-waste is not suited for this, the e-waste will be landfilled (WEEELABEX, 2019).

[50] Interview with S. Boven Kaarsmaker, Materials Support Officer of Coolrec, 6 December 2021.

The RAEEA demands Stichting OPEN to only cooperate with RCs that are CENELEC certified. Several norms are included in this CENELEC standard (Ministerie van Infrastructuur en Milieu, 2014). All these norms together form the quality control part of the QAS on e-waste, provided by Stichting OPEN. Figure 30 visualizes the CENELEC standard. An asterisk in Figure 30 means that the specific 'TS' is not mandatory (TÜV Nederland, n.d.-b).

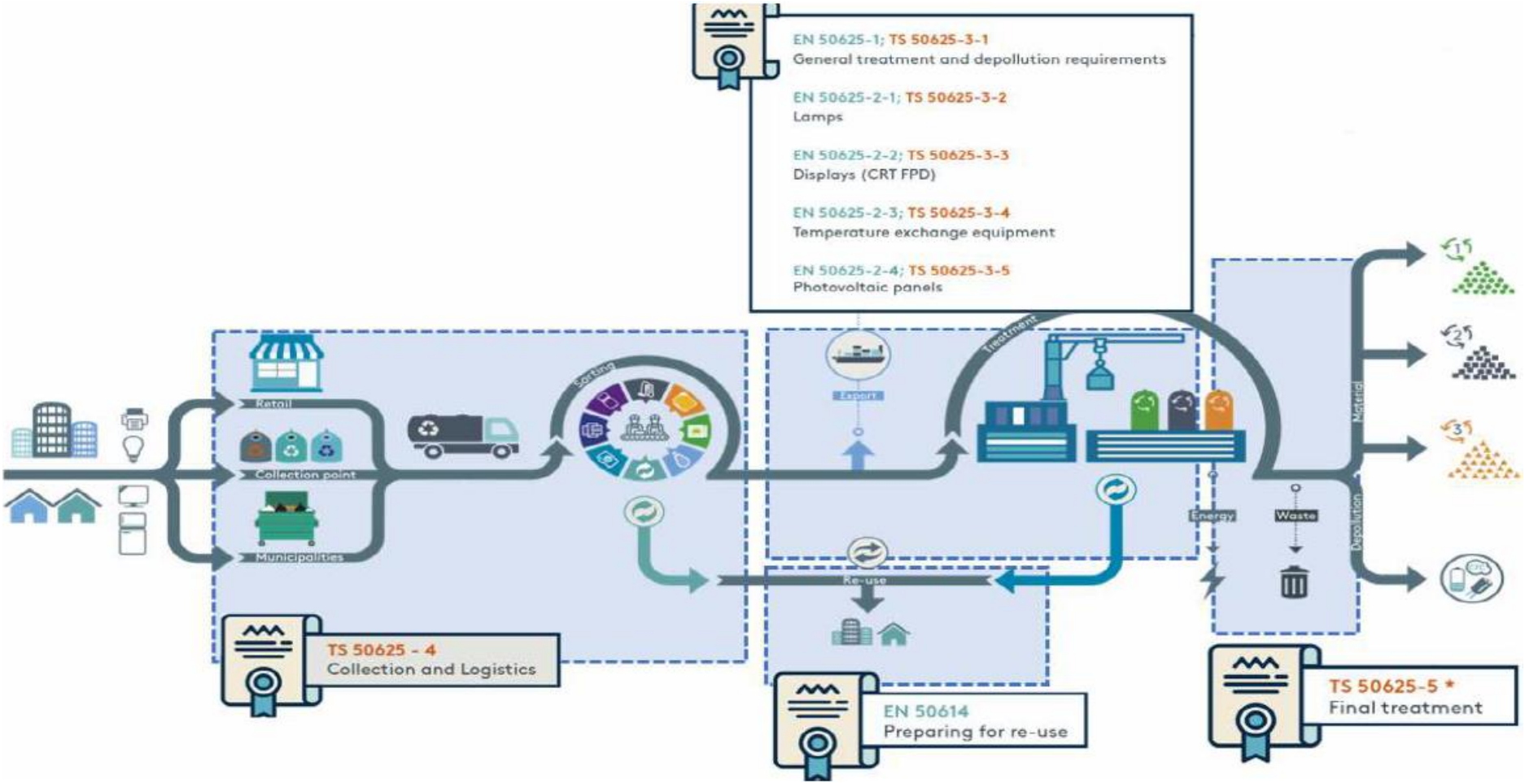


Figure 30: The mandatory CENELEC standards for companies in the e-waste recycling industry (WEEELABEX, 2019)

CENELEC was founded by several European collection systems, including Stichting OPEN. It sets requirements for quality of collection, storage, transport, recycling, and reuse of e-waste, and it works with independent auditors that check whether the companies adhere to the standards (Stichting OPEN, n.d.-c) It is one of the three standardization organizations that are responsible for organizing standards at European level (CEN-CENELEC, 2021a). If CENELEC or one of the other two organizations that are responsible for the standards at European level adapts a certain standard, this standard becomes a European Standard (EN) to create a level playing field between business within one trade entity – in this case the European Union (CEN-CENELEC, 2021b). Technical Specifications (TS) are documents that are meant to support the ENs in countries that are not ready for full compliance to a certain EN (CEN-CENELEC, 2021b).

When a CENELEC member implements ENs as national standards, as the Royal Netherlands Standardization Institute (NEN) did in the Netherlands, the national member must withdraw all standards that conflict with the CENELEC one (CEN-CENELEC, 2021a). The CENELEC standard has been obliged for processing Dutch e-waste from 1 July 2015 on, since the Dutch Ministry of Infrastructure and Environment added this to the RAEEA (article 11.2). The CENELEC standard was called the WEEELABEX Standard at that moment (Ministerie van Infrastructuur en Milieu, 2014). Figure 31 visualizes the value chain for EEE from the moment of return from the user until the end of responsibility of Stichting OPEN and includes information on the companies.

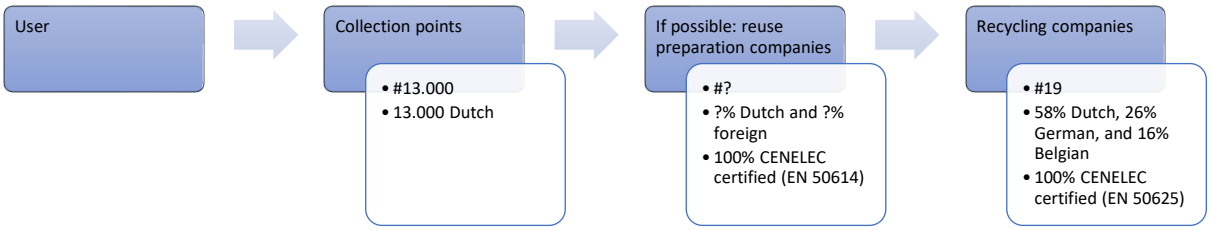
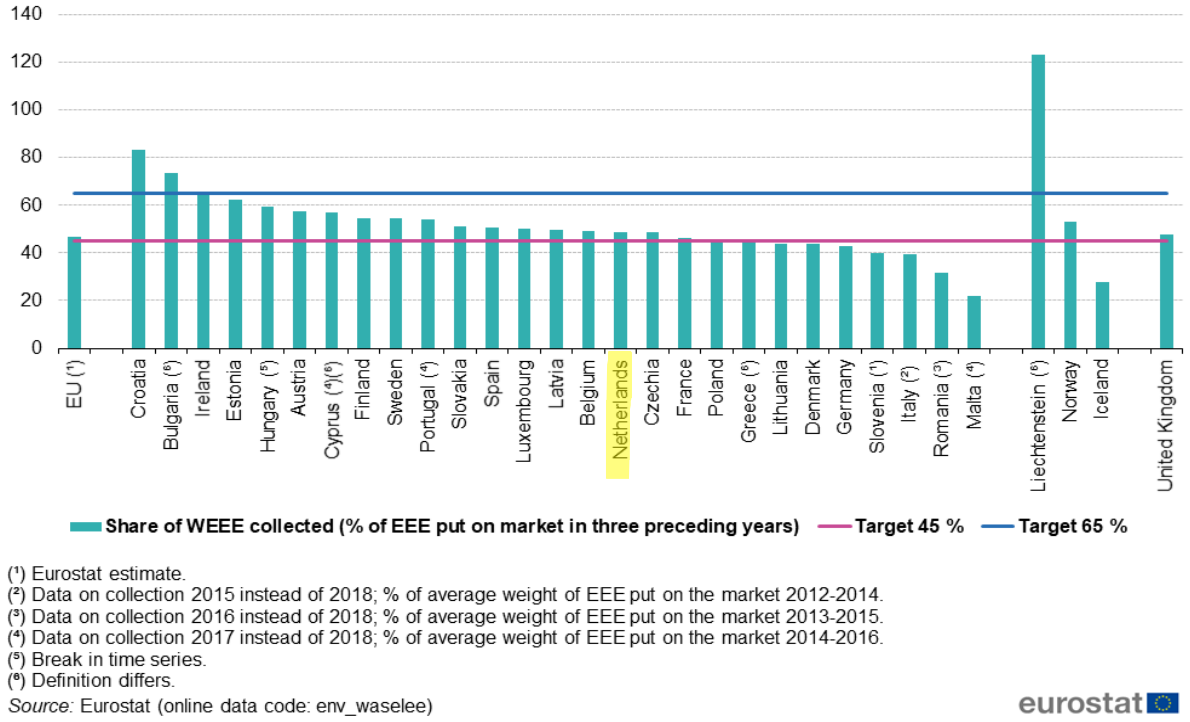


Figure 31: The Stichting OPEN value chain (own work, sources: Stichting OPEN (n.d.-b, n.d.-c, n.d.-a) *and WEEELABEX* (2021b)*)*

Figure 32 shows the collection rate of e-waste of the Netherlands compared to the collection rate of the EU in 2018 (Eurostat, 2021b). Since the collection rate target has increased from 45% to 65%, it is an important issue in the e-waste recycling industry. Only a few countries meet the new demands yet. This means that the EU has set an ambitious goal on e-waste recycling. It wants to increase the total recycling rate (including collection).



(1) Eurostat estimate.
(2) Data on collection 2015 instead of 2018; % of average weight of EEE put on the market 2012-2014.
(3) Data on collection 2016 instead of 2018; % of average weight of EEE put on the market 2013-2015.
(4) Data on collection 2017 instead of 2018; % of average weight of EEE put on the market 2014-2016.
(5) Break in time series.
(6) Definition differs.
Source: Eurostat (online data code: env_waselee)

eurostat

Figure 32: Percentage of e-waste collected (compared to the EEE put on market) in the Netherlands and the EU in 2018 (own work, source: Eurostat (2021b)*)*

If CENELEC certified, the RCs are allowed to recycle this collected e-waste. Appendix 9 shows the names and the listing and expiry dates of the certification of RCs. Only contract partners of Stichting OPEN are listed in Appendix 9. In practice, auditors sometimes visit companies that obtain material via Wecycle and/or WEEE.nl as well.[51] Figure 33 visualizes the performance over de last seven years. Information on 2011-2013 was unavailable. The material and energy recovery percentages are based on the total of collected e-waste. Appendix 10 adds relevant data to Figure 33.

[51] Email from H. van Dijk, lead auditor at TÜV, 6 December 2021.

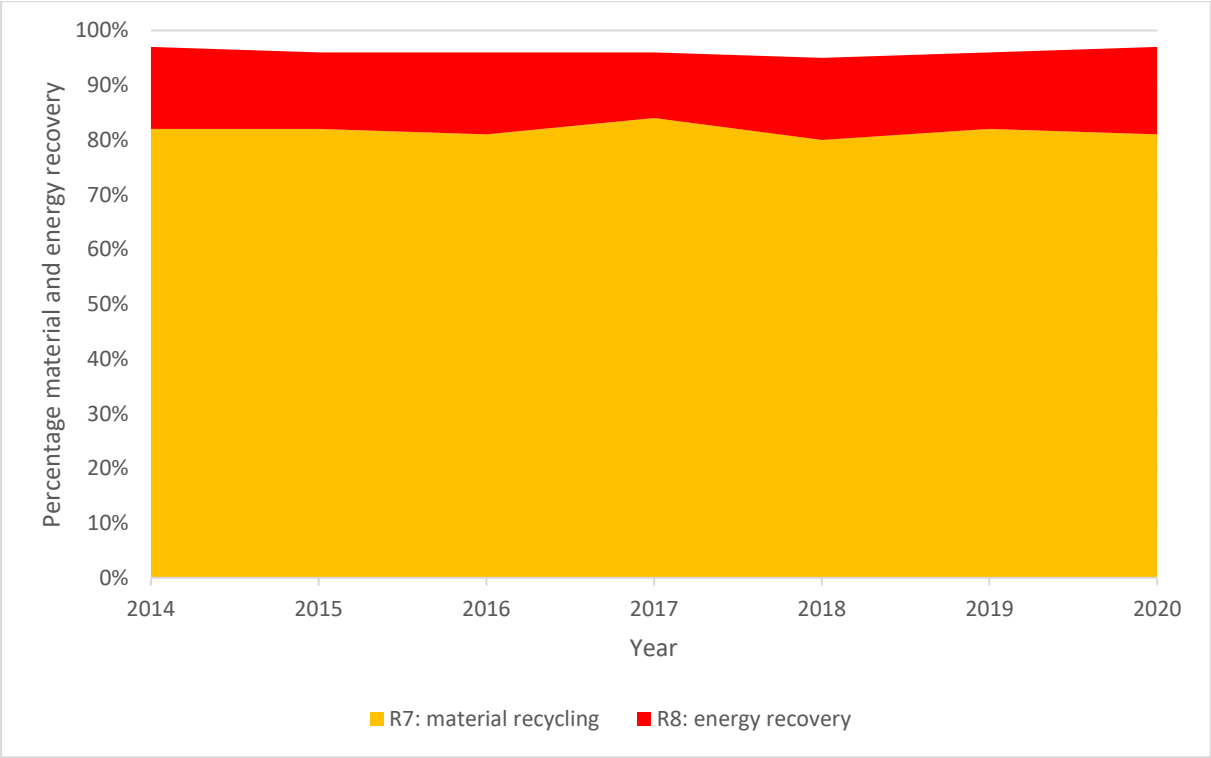


Figure 33: Percentage of material and energy recovery of collected e-waste in the Netherlands (own work, sources: Nationaal (W)EEE Register (2017, 2018, 2020, 2021) and (Directive 2012/19/EU, 2012))

Figure 34 shows a stable material and energy recovery rate over the last seven years. Improvement is barely made, but there is also no decrease visible. Constantly 80% or more of e-waste collected can be recycled. H. van Dijk, lead auditor at TÜV, explains that although there is improvement of recycling technology, the decrease in e-waste quality causes the material/energy recovery rate to remain equal. This decrease in quality is due to the increase of plastic usage instead of using metals for the design of EEE.[52] If we look at EU-averages in 2018 (most recent data available), a slightly worse recycling rate has been realized in the Netherlands. Energy recovery is done twice as much as in an average European country.

[52] Email from H. van Dijk, lead auditor at TÜV, 6 December 2021.

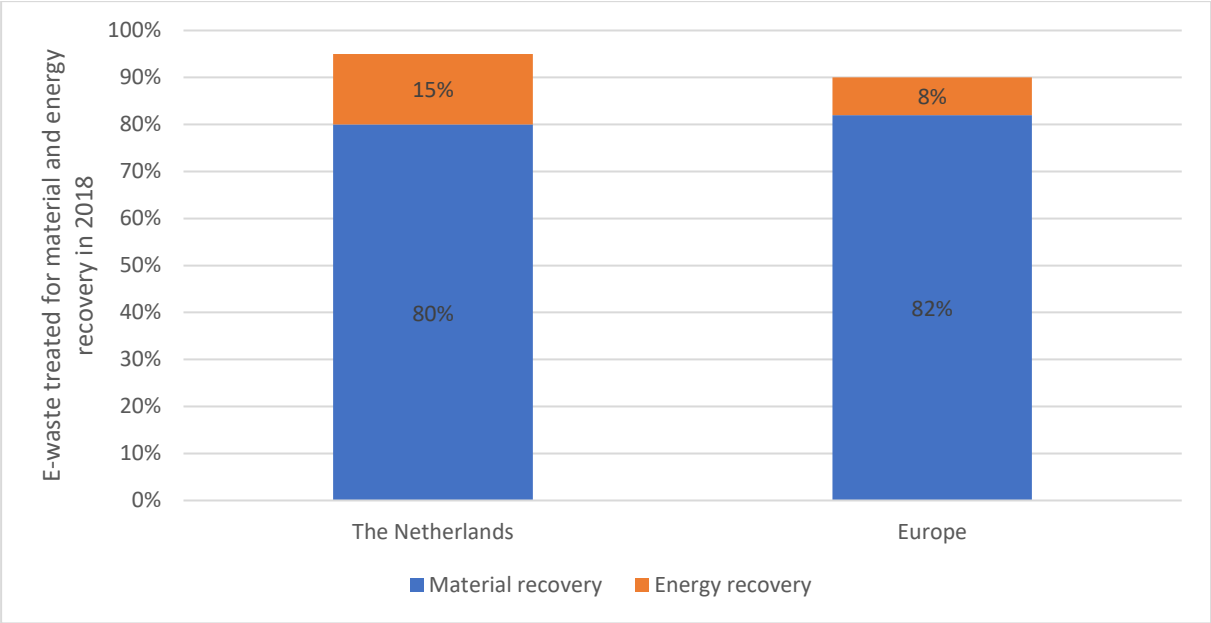


Figure 34: Percentage of e-waste treated for material and energy recovery in the Netherlands and the EU in 2018 (own work, source: Eurostat (2021d) *and Nationaal (W)EEE Register* (2021)*)*

It is remarkable that the Netherlands is running behind on other European countries in terms of collection rate (Figure 32) and recycling performance (Figure 34). The CENELEC standards are compulsory for RCs to process e-waste since 2015 (Stichting OPEN, n.d.-c) and Stichting OPEN possesses an AVV from 1 January 2021 until 31 December 2025 (Rijkswaterstaat, 2021a) what makes them able to take control over the e-waste recycling industry. The coming years will show whether these two changes result in a higher collection and recycling rate for Dutch e-waste. This thesis analyses if the QAS, as provided by Stichting OPEN, works towards high-quality recycling and if it ensures the companies in the e-waste recycling industry of continuous improvement. The CENELEC standards and their audits are assessed on these criteria.

8.2 Description of the quality assurance system on e-waste

The QAS that Stichting OPEN is responsible for, consists of several ENs and TSs that companies must buy to be allowed to collect, transport, and process e-waste. This thesis only analyses the companies that treat the e-waste or prepare the e-waste for reuse purposes. However, if a company (or anyone else) in the Netherlands wants to buy all demanded ENs and TSs at the NEN, it must pay €712 (VAT excluded) (NEN, 2021d). Therefore, this thesis will only use the most recent versions of three specific ENs for the analysis: EN 50625-1, EN 50625-2-1, and EN 50614. EN 50625 has been chosen since this is standard includes the general processing requirements. EN 50625-2-1 is assumed to be like EN 50625-2-2, EN 50625-2-3, and EN 50625-2-4 but then different in some specific respects for the specific product streams. EN 60614 has been chosen because it offers requirements for preparation for reuse (R2-R6) of EEE and could therefore be of major importance to working towards higher value retention options as this thesis is focused on.

8.2.1 Build-up of the CENELEC certification procedure

The CENELEC standards set out requirements that RPCs and RCs must meet if they want to recycle e-waste. The certification will be valid for two years, if the audit reports are positive (WEEELABEX, 2020b). Independent auditors audit the companies that apply to become certified (Stichting OPEN,

n.d.-c). These auditors work for different auditing companies (Stichting OPEN, n.d.-a; WEEELABEX, 2021a, 2021b). There are several types of audits. Figure 35 visualizes this (WEEELABEX, 2020b).

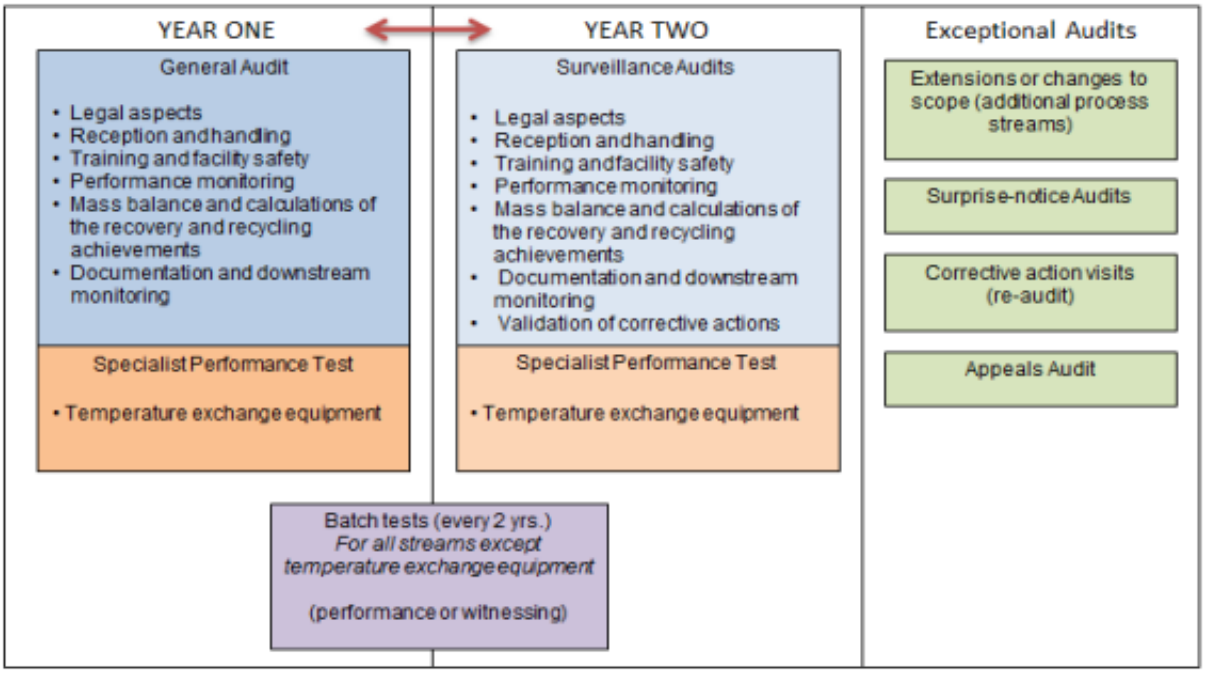


Figure 35: The audit categories for CENELEC certification (WEEELABEX, 2020b)

Before certification, a general audit will be conducted on location to check whether the company meets the requirements for certification. In the second year, a similar audit will be done to check whether the company still meets the demands and what has been done to tackle issues that threatened compliance to the requirements. A specialist auditor will also conduct an extra audit every year if a company wants to include the temperature exchange equipment process stream in the certification. Furthermore, in these first two years there will also be one batch test conducted. The company will then be tested on compliance to the requirements as set in the product specific ENs (e.g., EN 50625-2-1 for lamps) (WEEELABEX, 2020b).

Spread over the two years, there are also 'exceptional audits' besides these 'normal audits'. These audits will only occur when required. This is the case when there are changes within the company (e.g., they want to process an extra e-waste stream); when there are corrective measures needed which should be tested afterwards; when the auditing party wants to double-check compliance of the companies (e.g., mostly when a company is inexperienced); or when a company does not agree to the outcome of the auditing process (WEEELABEX, 2020b).

When a company does not meet the certification criteria, it will have three months to work on this. An exceptional audit could be conducted after these three months to check whether the company does comply. If the company still does not comply to the demands, the auditor will recommend to not certify (or even 'de-certify') the company. If a company does comply, this company will be recommended to become certified (WEEELABEX, 2020b).

8.2.4 Content description of the criteria for EN 50614:2020

The EN 50614 (version 2020) is meant for the parties that prepare equipment for reuse. It starts with an introduction to terminology. The chapters containing requirements follow on this. These start with the administrative and organizational requirements, which are followed by technical demands. Specific demands on return of the equipment to another use phase and criteria for the end of the preparing-

for-reuse phase are specified and documentational demands are finishing this standard. It is completed by an extensive annex that supports the criteria. This annex provides inter alia practical examples of what the specific criteria apply onto (CENELEC, 2020).

The administrative and organizational requirements demand a management system to be in place to address health-, safety-, environment-, and quality-related issues. This must be updated periodically and awareness amongst these topics must be raised through maintaining a procedure that identifies gaps in the system. Besides, damage and theft of e-waste must be prohibited by designing and using storage facilities to be as safe and possible, and by securing the storage to prevent easy access from people that do not work for the company.

Tools and test equipment must be in possession of the company that prepares for reuse. This equipment must be checked regularly, and these checks must be kept. Employees must also be trained to become familiar with the company's policy on health, safety, and environment. The efficacy of the training programmes must be evaluated periodically.

The RPC is obliged to only work with logistics companies that are certified with a TS that is made for this kind of companies: CLC/TS 50625-5 to ensure e-waste transport of a certain quality. A tracking system must also be in place which tracks the e-waste from the moment of receival until the moment that it is ready to become reused. The RPC is not allowed to disassemble the e-waste. Only RCs with a EN 50625 certificate are permitted to do this.

The technical requirements first contain certification criteria for the RPC's e-waste receiving process. The amount of e-waste should be monitored and there should be separate storage of parts that are meant to be reused and parts that are not. E-waste should also be inspected on whether it is meant to be reused by an RPC or treated by an RC. The latter category must be transported to an RC that is EN 50625 certified.

These demands are followed by safety requirements on the product that will be reused. Tests must be conducted, and this process must be registered. The same goes for functionality. When a product does not pass the safety of functionality test, it must be tried to fix the problem or otherwise be transported to an RC that is EN 50625 certified.

The standard also sets requirements on the disassembly part of preparing e-waste for reuse. This must be done by following a prescribed procedure. It is allowed to disassemble parts from the e-waste that have been rejected by the safety or functionality test to prepare for reuse.

Repairing requirements and demands on cleaning are also provided. This contains criteria that ensure the e-waste of being repaired and cleaned safely. Besides, when cleaning e-waste it is important to not remove brand labels and similarities.

EN 50614 also obliges the RPCs to manage quality assurance. Someone must be responsible for testing the reusable product on quality. This person must document this process. If the quality is tested not sufficient, the reasons for this must be figured out and listed.

Compulsory storage demands are also listed in the standard to prevent e-waste from damage to prevent unnecessary emissions. The storage requirements also contain demands on e-waste that has not passed the safety and/or functionality test. This is also extended by transport criteria for this type of e-waste. If the e-waste has passed the tests, they must be transported and packaged in adherence to criteria that are specific for these processes. It is important that this does not decrease the reusability of the packaged or transported products. Staff must be trained for this.

The last chapter of requirements is about documentation. The RPC must be able to prove that it complies to legislation and that it follows the standard in what it demands on health, safety, and environmental aspects. The storage plans of e-waste, the risk management process, and the tracking system must also be managed and documented. This must be done in compliance to what has been demanded in the previous chapters. Some requirements on documentation have also been set for technical aspects such as the documentation of the e-waste flow, safety and functionality test, and the disassembly procedure. The RPCs are obliged to be transparent to any interested party if asked for these documents. All documents must be kept for four years, and they must be made available with open access to prove compliance to anyone interested.

8.2.2 Content description of the criteria for EN 50625-1:2014

The EN 50625-1 (version 2014) is different from the previous standard since it is applicable to another part of the waste flow: the treatment process instead of preparation for reuse. However, it starts with an introduction to terminology as well. The standard describes administrative and organizational, technical, and documentational requirements. Annexes that are like those of EN 50614 support these criteria (CENELEC, 2014).

RCs are also demanded to have a management system in place that addresses health, safety, environment, and quality issues. The RCs are also obliged to keep up to date with legislation concerning these topics. The business location must have an infrastructure that is aligned with the business that is being conducted. Risks must be identified and eliminated structurally. This applies to the business location, but also to the e-waste that will be treated for recycling or energy recovery. These facilities must be secured to prevent, for example, theft of stored e-waste. This e-waste must also be prevented from becoming damaged through rain or other weather conditions.

As the paragraphs above already mention, this standard pays much attention to health, safety, and environment. Staff must be familiar with the policies regarding these topics. If they are not, a training should ensure this. This training will be adapted to the specific employees' abilities, and there should be a periodic check on whether the training works out as it is meant to. If an employee wants more information or a reminder, the training material should be easy to access permanently.

In terms of monitoring, the RC is obliged to register where the e-waste that it stores and/or processes comes from. This monitoring process should be continued by the RC until a next stage in de value chain has been reached, regardless of whether the e-waste will be exported or not. This cross-border monitoring of the product stream should entirely be documented. The parties that buy the e-waste from the RC must be subjected to a scan, carried out by the RC itself. General information on these parties must be documented and they are obliged to possess a nationally accepted certification like EN 50625-1 to be allowed to use the RCs e-waste. The RC is not allowed to contribute to sell their e-waste to other parties.

The criteria that assess technical requirements start with some general requirements. This concerns topics such as handling and storage of e-waste, to make this as safe and environmentally friendly as possible. Treatment possibilities should not be wasted when handling the e-waste. It is forbidden to mix material streams that have different levels of danger due to their compound. E-waste streams must be labelled identifiably.

E-waste sometimes consists hazardous materials or components. When de-polluting these substances, it is important that this process does not damage substances that are not dangerous. It is neither allowed to release these substances to the environment. When de-polluted substances are sold, the

monitor reports of this de-pollution process should be provided to the buying party. This should be done following recognized methodologies.

The RCs are mandated to calculate the recycling and energy recovery rate of each EEE stream. The definitions for recycling and energy recovery that are used are equal to the ones that are used earlier in this thesis. The calculation rules are set out in the annex but are not relevant to this thesis. However, the recycling and recovery rate must comply to legislative targets as set out in Directive 2012/19/EU.

The last requirements that this standard sets are about documentation. It sums up several documents that must be maintained by the RCs. Some of these documents have already been mentioned in the paragraphs above (e.g., documents on the training of staff, records on downstream monitoring, etc.).

8.2.3 Content description of the criteria for EN 50625-2-1:2015

The EN 50625-2-1 (version 2015) is a product-specific (lamps) addition to the EN 50625-1. It has the same structure as 50625-1. The terminology is the same as in EN 50625-1 (CENELEC, 2015).

The chapter that contains requirements for administration and organization is much shorter. It starts with the same requirements for health, safety, environment, and quality as the other two ENs: a management system must be in place for this, and this must be updated periodically. These criteria are followed by some technical and infrastructural demands. RCs that want to recycle and and/or recover energy from lamps must comply to similar criteria as in the EN 50625-1, but this section is specified on lamps by adding another annex. This annex sets requirements on the frequency of checks on concentrations of specific residuals that the treatment of lamps could be responsible for. These checks are on done on employees that work in the recycling plant, but also on emissions. Emissions must be prevented as much as possible and hazardous emissions must be monitored. All risks must be monitored properly. The risk assessment must also describe which locations must be equipped with extra protection measurements. The RC must prevent its employees from potential exposure to hazardous substances by protective measures that every employee is familiar with (e.g., safe clothes, and hygiene measures).

The technical requirements contain similarities to the ones in EN 50625-1 but are also specified on lamps. For example, lamps sometimes contain mercury and if this is unsure in the specific case, these lamps must be handled as if they do contain mercury. Extra safety measures are required. The RCs are also demanded to measure and record all their inputs. The lamps that are stored must be processable within six months. For general e-waste (EN 50625-1) this is twelve months.

Monitoring of mercury values and description of the removing procedures of mercury are demanded in the EN 50625-2-1, and compliance to the recycling and energy recovery targets are also a requirement for lamp RCs. The documentational criteria are the same as in the EN 50625-1.

8.3 Analysis of the CENELEC certification

As paragraph 8.2 describes the content of the CENELEC certification (EN 50625 and EN 50614), this paragraph analyses this certification on whether it pushes the e-waste recycling industry towards high-quality recycling and continuous improvement in the long-term. The framework of Maon et al. (2009) has set the basis for the assessment framework that was created for this (see Theoretical Framework).

8.3.1 Raising awareness

To sensitize a company for external and internal pressures that could be used as a source for improvement, a certification scheme could oblige a company to be sensitive for social, political,

managerial, and economic drivers. The company's formulation of strategy must be influenced by this to achieve the maximum score for this step.

All three standards demand companies to have a procedure in place to identify changes in legislation that concerns health-, safety-, and environment-related topics. The standard mandates this to raise awareness on political drivers at the companies in the recycling industry (RPCs and RCs). The standards include nothing on how the companies must be sensitizing social, managerial, and economic drivers. The companies must comply to legislation, and they are not demanded to become influenced by other stakeholders. Changes in legislation must be translated into changes in the company's business practices and should therefore influence its strategy formulation. This means that only political drivers sensitize the companies in the e-waste recycling industry. Hence, raising awareness is 'partly' pushed by the QAS on e-waste.

However, when aiming for raising awareness on upgrading the technological approach with a higher level of cascading, it is important that companies are made aware on value retention options. The QAS on e-waste includes standards for both RPCs (EN 50614) and RCs (EN 50625). The first standard is applicable to all companies that operationalize value retention options R2 until R6, whilst the latter is demanded for companies that operationalize options R7 and R8. Therefore, companies are demanded to be fully aware of cascading options in this QAS.

8.3.2 Assessing corporate purpose in a societal context

The CENELEC standard partly prescribes an explicit procedure to formulate a sustainability strategy that includes the triple-P. Planet and people have been addressed several times in all three standards. The criteria demand a management system that covers everything that the companies do in terms of health, safety (both people), environment (planet), and quality. Both RPCs and RCs must train their employees to become familiar with the company's environment, health, and safety policy, since both the EN 50625-1 and EN 50614 demand this. However, prosperity has not been addressed in any of the standards. The assessment criteria do neither oblige the companies to identify their stakeholders and their most important issues, nor do they demand communication with Stichting OPEN on innovative opportunities that could be beneficial for recycling efficiency.

8.3.3 Establishing a vision and a working definition for corporate sustainability

The assessment criteria require a working definition on sustainability from the certified companies. E-waste must be prevented from causing unnecessary emissions through damage and/or theft. Therefore, the companies must take measures to prevent this from happening. Business locations must be weatherproof to prevent the e-waste from becoming damaged and these locations must be secured to prevent e-waste from thieves.

The inclusion of the EN 50614 creates a working definition for cascading in the e-waste recycling industry by demanding from the companies that e-waste will be subjected to an inspection that will result in a decision on whether the e-waste (or a part of it) is good enough to become reused (R2-R6) or that it should be treated (R7-R8). The preferred option is reuse and therefore, a working definition is established on cascading.

8.3.4 Assessing current corporate sustainability status

Monitoring of the emission of hazardous substances is demanded for RCs that treat lamps, but not for RCs in general and neither for RPCs. EN 50625-2-1 also demands emissions of hazardous substances to the environment to be included in the risk assessment. As said before, this risk assessment is mandatory for certification. It includes the planet and people aspect of CS, but not the prosperity aspect. The performance of the risk assessment must be internally audited frequently, e.g., monitoring

of mercury concentration in employees and in emissions. Therefore, the QAS partly demands the companies in the e-waste recycling industry to assess themselves on their current CS status.

The QAS does not push the companies to periodically improve their circular performance. Although it has been described that e-waste must preferably be prepared for reuse instead of treatment, the CENELEC standard does not demand improvement of circular performance.

8.3.5 Developing a corporate sustainability integrated strategic plan

The risk management system includes all activities that are health-, safety-, and environment-related. It is demanded to be embedded in the organizational strategy since it is the basis for all other actions the companies do, and the system must be updated if needed. The companies are demanded to identify legal gaps that must be covered in the fields of the topics that the risk assessment is concerned with. It is therefore also meant to continuously improve and to always meet changes in legislation. Development of a CS integrated strategic plan is motivated by the CENELEC standard.

Although value retention options within R7 (different recycling technologies) are not discussed, a focus on cascading is provided by the composition of the QAS: preparing for reuse (R2-R6) is preferred over treatment (R7-R8). However, the QAS does not push development of cascading strategies since nothing is mentioned about improving the circular performance.

8.3.6 Implementing a corporate sustainability integrated plan

Implementation of the developed CS integrated plan is partly addressed when continuing the current technological perspective. Staff must be trained to become familiar with the policies regarding the CS-related themes. These people will have permanent access to these policies if they work for the company. However, the RPCs and RCs are not obliged to make someone responsible for sustainability implementation and organizational initiatives and strategies concerning CS-topics are not demanded to be implemented in the CS integrated plan.

The QAS mandates the companies in the e-waste recycling industry to consider value retention options before recycling as explained before. EN 50614 obliges these companies to prefer preparation for reuse over treatment options.

8.3.7 Communicating about corporate sustainability commitments and performance

The CENELEC standard demands RPCs and RCs to communicate their CS commitments internally through demanding a training for staff to become familiar with policies regarding CS themes. These commitments are not demanded to be communicated externally.

EN 50614 demands communication on CS performance internally by means of documentation that demonstrates compliance to all permits. This is focused on permits regarding environmental, health, and safety. Besides, records must be kept concerning health, safety, and environmental monitoring. All these documents must be kept for at least four years, and they should be made available to provide evidence of compliance. EN 50625 also requires documentation of compliance to permits and records on environmental, health, and safety topics. RCs are obliged to make information available on their recycling performance and they must keep all documents at least three years.

The certified companies are not demanded to talk to Stichting OPEN or other stakeholders about achieving higher levels of cascading through the certification criteria, neither are they motivated to talk to other parties (e.g., the responsible Dutch Ministry) about topics that could benefit cascading (e.g., recommendations on beneficial legislation).

8.3.8 Evaluating corporate sustainability integrated strategies and communication

Both the RPCs and RCs are demanded to review their activities frequently including the activities concerning health, safety, and environment (section 4.1 for both types of companies). Besides, the monitoring of the e-waste stream is demanded for RPCs and this data should be made available to any interested party.

8.3.9 Institutionalizing corporate sustainability

The QAS on e-waste pushes the companies in the e-waste recycling industry to commit resources on monitoring data about the product stream and it also pushes the companies to achieve CS-related goals by means of demanding the companies to update their management process as changes occur or when this is needed as shown by the review of the activities concerning topics like health, safety, and environment. Penalties or rewards are not established for the when the company achieves the sustainability goals or not. The QAS does not push the companies to increase the amount of resources spent on achieving sustainability goals periodically.

8.4 Analysis of the quality assurance on the CENELEC standard

It is unclear how many RPCs Stichting OPEN works with, but on the RCs are listed on their website. The WEEELABEX (previous name of CENELEC) website explains which auditors have audited each specific RC. Another document on this website explains which audit company these auditors work for. This information is merged and summarized in Appendix 9. It tells us that the CENELEC auditors that audited the certified RCs are from several audit companies. TÜV Nederland QA B.V. ('TÜV') has been responsible for more than 50% of all audits that have been conducted for currently CENELEC certified RCs.

TÜV Nederland is part of the international TÜV NORD GROUP which operates in seventy countries and has more than ten thousand employees. Three hundred of these work for TÜV in the Netherlands where they provide independent certification, audit, and training services (TÜV Nederland, n.d.-a). Both the TÜV NORD Nederland Holding B.V. (27320088) and the TÜV Nederland QA B.V. (17091102) are registered at the KVK as private limited companies (KVK, n.d.).

RPCs and RCs that want to become CENELEC certified will be audited by TÜV or one of the other audit companies. These auditors will follow the procedure as set out in the Guidance Document. Certifications are valid for two years, in which several audits place (WEEELABEX, 2020b), see sub-paragraph 8.2.1 of this thesis. In this way, TÜV and the other audit companies are responsible for the quality assurance of the QAS on e-waste. This paragraph will analyse how the CENELEC audit process adheres to the audit principles as described by Karapetrovic & Willborn (2000).

8.4.1 Objectivity & independence

Auditors for the CENELEC standard are demanded to be fully independent. They are not allowed to have any relations with the facility they audit, not even a year before or after the audit has taken place. The only times when this is allowed, is when there is a lack of auditors or when the third-party auditor is in training for becoming a lead auditor, which is an auditor with more responsibilities. However, also these audits will be assessed on adherence to several ISO standards that check these auditors on impartiality and confidentiality (WEEELABEX, 2020a). Therefore, it can be said that the CENELEC audits are fully objective and independent.

8.4.2 Quality, maintainability, and reliability

The CENELEC audit cycle is two years. In both years, a normal audit will take place, as explained in sub-paragraph 8.2.1 of this thesis. During the audit cycle, several 'exceptional audits' take place. Sometimes these are on a surprise-notice, what means that they the certified company will not know that the auditor will show up. This also means that compliance to the standard is demanded during the entire audit cycle, since the certified company does not know when the exceptional audits take place. This is beneficial to the quality of the audits. Besides, several audits will be conducted throughout the audit cycle, and this is beneficial for maintainability and reliability (WEEELABEX, 2020b).

8.4.3 Continuous improvement

When a company does not comply to the demands during any audit, it will have three months to overcome the shortcomings and meet the requirements. An exceptional audit will check whether the flaws have been overcome and if the company is ready to become certified. If the company is not, the audit company will not recommend this company for certification. During all types of audits, the auditor will check the company on whether it has taken corrective actions as a result of the previous audit, to ensure that the shortcomings have been overcome since last time. In this way, audits help the companies to continuously improve (WEEELABEX, 2020b).

8.4.4 Purpose, objective, and defined scope

The objective of the audits is to recommend the applying company for certification or not. The RPCs and RCs form the scope of the audits. The CENELEC certification is meant to increase quality of recycling and the audits have assurance of the quality of the certification as a purpose.

8.4.5 Feasibility

When the audited company has not been prepared enough, and when it offers the auditor not enough material to be audited at that moment, the audit will be suspended to another date. This means that the auditor will normally have enough time to conduct an audit of quality, since the audit could be suspended if there is not enough time or material to conduct the audit.

8.4.6 Planned

The normal audits are planned at set times, whilst the exceptional audits are not. However, the exceptional audits are not randomly timed, but they are tackling specific issues (e.g., checking whether the corrective actions have taken place). This means that although the audits are not planned with the company, the audit will be prepared by the audit and therefore, 'planned' will still be assessed with the maximum score in the assessment framework (Table 6).

8.4.7 Systemic

The Guidance Document (WEEELABEX, 2020b) is provided to make the audits systemic. This is done to provide conformity between auditors and companies that are being audited. Auditors must follow these guidelines.

8.4.8 Evidence and criteria

Auditors are obliged to keep records of each audit to be able to justify the choices they have made during the audit process whenever asked for. These records should contain the support for every decision (WEEELABEX, 2020b). This means that audit evidence exists. Audit criteria are set in the Guidance Document and in the standards.

8.4.9 Relevant and unambiguous criteria

The criteria are relevant for companies in the e-waste recycling industry. The standards are focused on one specific type of company. EN 50614 sets specific criteria for RPCs, whilst the EN 50625 is divided in several standards: a general one that is accompanied by some standards that are specified on the treated e-waste flow – this thesis described the EN 50625-2-1 that has been set up for lamps RCs.

The criteria are sometimes ambiguous. They are not always concrete in how something should be done. An example that is applicable to both the EN 50614 and EN 50625 is about the management system. It is required to have one in place to cover all activities concerning health, safety, environment, and quality. It is unclear when this requirement is met or not. Therefore, this audit principle is partly met.

8.4.10 Documented

Records must be kept that explain the evaluation process that the auditor has made. These records are available on demand for the parties involved. Third parties will not have insight into these documents (WEEELABEX, 2020b).

8.4.11 Qualified and competent

Both lead auditors and 'normal' auditors are obliged to have professional experience in the fields of e-waste or EEE, or they must have auditing experiences with ISO 9001, ISO 14001, or similar. They must already possess knowledge on the specific topics and be aware of European and Dutch legislation concerning the topic (WEEELABEX, 2020a).

Besides, to become auditor, they will be evaluated on several moments. They must do an open-book exam, will follow face-to-face workshops, and they will also do another open-book exam. Without passing these tests and workshops, the applying person will not become auditor for the CENELEC standard (WEEELABEX, 2018).

After being listed as an auditor, the auditor must keep its knowledge up to date. At least one WEEELABEX examination and one experience day must be followed annually. During an examination day, the auditor will be evaluated on the quality of the audits it conducts. The experience day is meant to share knowledge between auditors (WEEELABEX, 2018).

8.4.12 Adequate and reliable methods

Auditors must comply to ISO 17024 and ISO 17065. ISO 17024 is a standard for conformity. It sets requirements on institutes that conduct certification of persons (NEN, 2021b). ISO 17065 is also a conformity assessment that sets criteria for certification parties that certify products, processes, and services (NEN, 2021c).

8.4.13 Collected and verified evidence

When conducting specialist audits, external laboratory tests must be included to verify the evidence. Besides, before an applying company will be recommended or not by the auditor, it will be provided with a concept of the report. It has two working days to give response to verify the collected evidence (WEEELABEX, 2020b).

8.4.14 Reported findings

The lead auditor is responsible for the output of the audit report. It could use the comments of the audited company, but it could also leave these comments out of the end-report. The report should be available one month after the last information was received at maximum (WEEELABEX, 2020b).

8.5 Score calculation

Table 6 shows the assessment framework for the QAS on e-waste. The QAS on e-waste is assessed with a 7,0 out of 10. The QAS pushes the companies to include CS aspects in the organization. It considers value retention options, but it is not working towards improvement of this. There is no aim for working towards higher value retention options what should benefit the ignition towards a CE. However, the QAS demands the companies to be very transparent about the e-waste flows they process. This downstream monitoring was food for discussion when it was introduced, but every company started working on it because of regulations and the transparency obligations. Not many RPCs and RCs have quit because of these new requirements what means that they are still working towards compliance. Besides, experiences show that the bigger companies are satisfied with the requirements because they have more money and complying to the CENELEC standard provides them a way to distinguish themselves.[53] This could be beneficial for the quality of recycling.

The audits are assessed with a nearly perfect score. The audit criteria are set up well and they seem to be conducted as it should be, according to the audit principles as provided by Karapetrovic & Willborn (2000). The only thing that could be changed to receive a perfect score, are the criteria in the CENELEC standard. Sometimes these are ambiguous. Specified targets on when a requirement is met might be useful to add.

What is not assessed, but is still of importance, is that the CENELEC standard is obliged by Stichting OPEN if a company wants to process e-waste. Since the standard is an EN, it is also recognized by other countries. Other EU countries use the standard too and this means that export to these countries will mean that the e-waste is processed according to the same terms and norms. This could be beneficial for the quality of the recycling.

Stichting OPEN provides a good QAS that ensures the certified companies of CS principles. People and planet are well addressed throughout the entire organization. The current situation makes companies consider value retention options, but it lacks the stimulation of continuous improvement. The companies must comply to legislation, but they are not demanded to innovate for the benefit of the level of cascading which is crucial for the ignition of a CE.

Nevertheless, the target on collection rate has recently increased and Stichting OPEN recently became the PRO on e-waste to guide the Dutch e-waste recycling industry towards this new target. Their first goal is to meet the collection rate target within two years (Stichting OPEN, n.d.-b). Stitching OPEN made a concrete plan of action to overcome the distance to 65% collection rate. This plan consists of several points of action with concrete annual targets (Stichting OPEN, 2020). It could also be interesting to examine the way of operationalizing EPR legislation that Croatia and Ireland use. They are the European leader in the field of collection (Eurostat, 2021b) and they might have useful recommendations on top of the plan of action on how to achieve the 65% collection rate within two years.

Figure 36 visualizes the assessment score of the QAS on e-waste in a radar plot.

[53] Interview with H. van Dijk, lead auditor at TÜV, 2 December 2021.

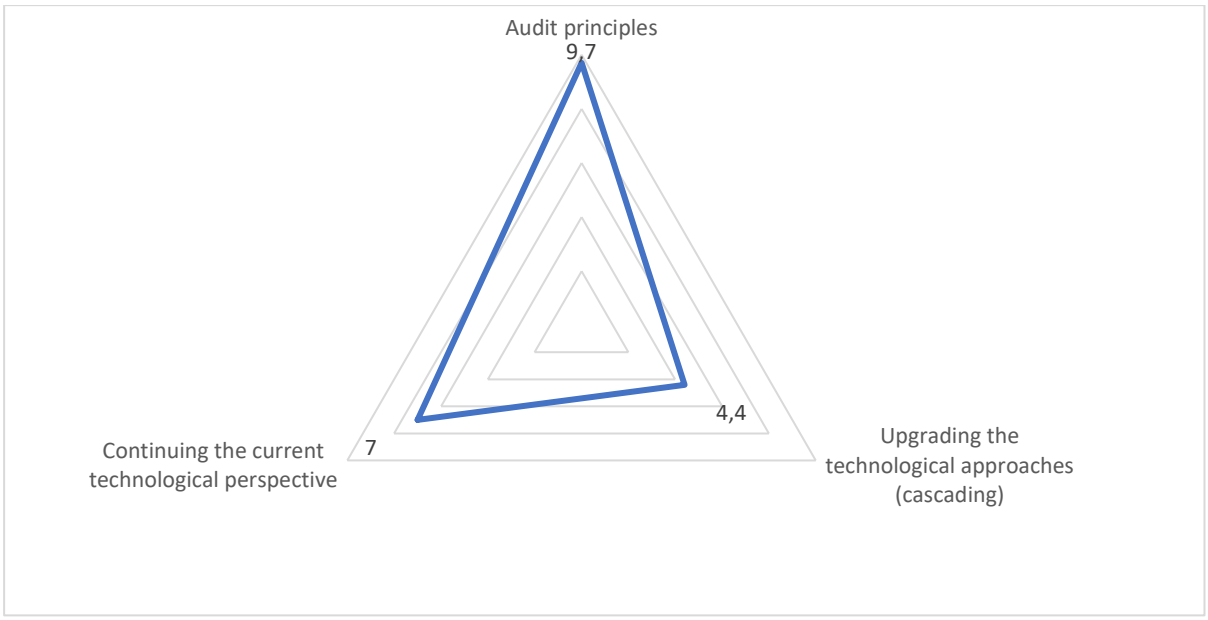


Figure 36: Radar plot for the QAS on e-waste

Table 6: The Assessment Framework for case study 5: e-waste

Quality Assurance System on e-waste assessment				
Quality Control			**Quality Assurance**	
Step #	**Continuing the current technological perspective**	**Upgrading the technological approaches (cascading)**	**Audit principles**	**Compliance**
1: Raising awareness	5,5/10 pts.	10/10 pts.	**A: Objectivity & independence**	10/10 pts.
2: Assessing corporate purpose in a societal context	5,5/10 pts.	1/10 pts.	**B: Quality, maintainability, and reliability**	10/10 pts.
3: Establishing a vision and a working definition for CS	10/10 pts.	10/10 pts.	**C: Continuous improvement**	10/10 pts.
4: Assessing current CS status	5,5/10 pts.	1/10 pts.	**D: Purpose, objective, and defined scope**	10/10 pts.
5: Developing a CS-integrated strategic plan	10/10 pts.	1/10 pts.	**E: Feasibility**	10/10 pts.
6: Implementing CS-integrated plan	5,5/10 pts.	10/10 pts.	**F: Planned**	10/10 pts.
7: Communicating about CS commitments and performance	5,5/10 pts.	1/10 pts.	**G: Systemic**	10/10 pts.
8: Evaluating CS integrated strategies and communication	10/10 pts.	N/A	**H: Evidence and criteria**	10/10 pts.
9: Institutionalizing CS	5,5/10 pts.	1/10 pts.	**I: Relevant and unambiguous criteria**	5,5/10 pts.
			J: Documented	10/10 pts.
			K: Qualified and competent	10/10 pts.
			L: Adequate and reliable methods	10/10 pts.
			M: Collected and verified evidence	10/10 pts.
			N: Reported findings	10/10 pts.
Subscore	*7/10 pts.*	*4,4/10 pts.*	**Subscore**	*9,7/10 pts.*
Final score Stichting OPEN QAS = 7,0*/10 pts.*				

8.6 Audi alteram partem: Stichting OPEN

In this thesis, the QAS as provided by Stichting OPEN has been analysed and the only part of the QAS that was not sufficient was de pushing function of it towards higher value retention options. R. Eijsbouts, Strategy Advisor at Stichting OPEN, explains that working towards higher value retention options falls out of Stichting OPEN's scope. All e-waste that is in the end-of-life has already been reused most of the times via Marktplaats or another platform. The e-waste that is processed by Stichting OPEN is of low quality and nearly falls apart. This does not mean that Stichting OPEN is not aware of better value retention options, but more than 90% of the e-waste is useless for reuse purposes.[54]

Stichting OPEN strives for increasing the quality of recycling by means of adding requirements to the tenders. When tendering, Stichting OPEN does not choose the tender with the lowest price. It demands quality recycling of the RCs. This is done by mandating use of the WF-RepTool. This tool calculates waste flows and therefore, the RCs can provide data on their waste flows to Stichting OPEN. This is a thorough monitoring process, and this provides Stichting OPEN with knowledge that it uses during the tendering phase to take a critical look at RCs that are performing worse than average.[55]

Eijsbouts explains that part of the extra efforts to achieve a 65% collection rate might come from an improvement of the collection of boilers.[56] At this moment, only 2-3% of the boilers in the Netherlands is collected annually. It is unknown how the other 97-98% is treated (Stichting OPEN, 2020).

One way to increase recycling efficiency is to register reused products. At this moment, legislation forbids exportation of e-waste that has other purposes than (preparing for) material reuse (Ministerie van Infrastructuur en Water, 2021b). People can circumvent this embargo by making the e-waste product partly work. In this way, people are allowed to sell it in other countries – without the quality control of the CENELEC standard. This is possible because it is not considered as waste then. Stichting OPEN has talked about this with the Dutch responsible institutions, but these institutions did not want to discuss it.[57]

Another way to increase efficiency is registration of reused e-waste flows. Eijsbouts finds a categorization needed that is based on reusefulness of all e-waste flows. At this moment, e-waste flow categories are all equal and everything must be done to reuse them. However, Eijsbouts says that not many e-waste flows are applicable for reuse purposes and therefore, he explains that it not efficient to try to achieve full reuse of all e-waste flows. He considers it wise to focus on specific e-waste flows that are reusable, e.g., ICT. This could prevent e-waste flows streaming towards foreign countries. Monitoring of reuse can be arranged in contractual agreements.[58]

[54] Interview with R. Eijsbouts, Strategy Advisor at Stichting OPEN, 1 December 2021.
[55] Interview with R. Eijsbouts, Strategy Advisor at Stichting OPEN, 1 December 2021.
[56] Interview with R. Eijsbouts, Strategy Advisor at Stichting OPEN, 1 December 2021.
[57] Interview with R. Eijsbouts, Strategy Advisor at Stichting OPEN, 1 December 2021.
[58] Interview with R. Eijsbouts, Strategy Advisor at Stichting OPEN, 1 December 2021.

9 Discussion

9.1 Comparison of the case studies

Table 7 shows an overview of the assessment of the QASs created for the five product groups, adapted from the results of this thesis.

Table 7: Comparing QASs of the different case studies with data from 2020

		Product group				
		Car tyres	**Scrap vehicles**	**Batteries and accumulators**	**Packaging**	**E-waste**
PRO		*RecyBEM*	*ARN*	*Stibat*	*Afvalfonds Verpakkingen*	*Stichting OPEN*
Collection rate		100%	83%	48%	*	44%
≤R7 & ≤R8 rate		97% & 100%	88% & 98%	71% & 71% (Pb) 79% & 79% (NiCd) 72% & 72% (rest)	90% & 90% (glass)* 90% & 90% (paper/cardboard)* 95% & 95% (metal)* 66% & 92% (plastic)* 68% & 89% (wood)*	81% & 97%
Continuing the current technological perspective	**Step 1**					
	Step 2					
	Step 3					
	Step 4					
	Step 5					
	Step 6					
	Step 7					
	Step 8					
	Step 9					
Upgrading the technological approaches (cascading)	**Step 1**					
	Step 2					
	Step 3					
	Step 4					
	Step 5					
	Step 6					
	Step 7					
	Step 8					
	Step 9					

* Collection and material/energy recovery rate have already been combined.

No comparison has been made of the quality assurance part since all QASs follow the audit principles as provided by Karapetrovic & Willborn (2000) well and the most importance points for improvement can be found in the quality control parts of the QASs.

9.1.1 Comparison of quality control: current perspective

Table 7 shows the collection and recycling performance of the PROs that are responsible for the operationalization of the EPR legislation in the Netherlands. Data from 2020 is used for all product streams. The material recovery (≤R7) and material/energy recovery (≤R8) rates are estimated on the total of collected entities. Only about the product stream of packaging is no separated data available on the collection and efficiency rates.

After showing the recycling performance, the assessment scores of the quality control aspect are shown for each case study. Green means that the QAS for that specific product group fully targets that step of the framework of Maon et al. (2009), red means that the QAS does not push companies in the recycling industry towards integrating it into business practices, and yellow means anything that is between these two. Step 8 in the upgrading assessment is left blank because there are no questions possible that could assess this.

The table shows that the QASs on scrap vehicles and on e-waste include many steps from the framework of Maon et al. (2009) when continuing the current technological perspective. This means that these QASs push the companies that are working with the PRO to include CS aspects in their business practices. Both QASs demand the companies to evaluate CS integrated strategies and communication. This means that the companies are obliged to check (or let themselves be checked) periodically on how the company performs on CS aspects. This is important to know how things can be improved. Continuous improvement is aimed for through the QASs. The QAS on e-waste even considers al steps of de PDCA cycle at least partly.

The QAS on car tyres scores insufficient on quality control. It addresses CS limited. Although the PRO provides much information in its magazine (BEM-circle), the companies that work with them are not demanded to notice the drivers of change. This is where is all should start, by making the companies aware of a changing environment. This is important when striving for continuous improvement. Therefore, the RecyBEM QAS does not work towards continuous improvement.

There are no QASs for the product groups of b&a and packaging. These product groups are fully red coloured in Table 7. This means that they score the minimum score on each aspect. This is due to the lack of a QAS. Nothing is done to guide the companies that work in the specific recycling industries towards continuous improvement or high-quality recycling by means of setting requirements on the companies that want to work for the PRO.

The QAS for scrap vehicles is different than the others. It contains a certification that is not obliged by the PRO: ED. This standard has been beneficial for the total score of the QAS, since it scores higher on quality control than KZD. If ED would have been assessed as a separate QAS, ED would have scored higher that any other QAS. The writer of this thesis calculated that ED would have scored 8 out of 10 points when assessing the implementation of the PDCA cycle as provided by Maon et al. (2009) from the current perspective. Appendix 11 shows the calculation of this score.

The main difference of ED and the other certifications is that ED demands the companies to possess the ISO 14001 certificate. This standard supports environmental management of the certified companies (ISO, 2015). Since the framework of Maon et al. (2009) supports the implementation of CS, the ISO 14001 certification pushes the subscore of the current perspective for ED compared to the subscore of the other QASs.

9.1.2 Comparison of quality control: upgrading perspective

Working towards a higher level of cascading has not been obliged by the different QASs. Although awareness has been raised via all QASs on achieving higher levels of value retention and although the options that cover higher value retention are preferred over lower options, it is not demanded to improve this level of cascading. This level can be increased by working towards higher R-strategies or by improving material recycling technologies (R7) to increase recycling efficiency (Campbell-Johnston, Vermeulen, et al., 2020). This gap must be filled to make the EPR recycling industry more circular.

The relative low price of downcycling compared to recycling (or upcycling) is often used as a refuting to the lack of stimulation of the QASs to work towards higher value retention options. This low price has different causes. RecyBEM is looking forward to affordable devulcanization and pyrolysis technology that can (partly) replace shredder recycling (RecyBEM B.V. en Vereniging Band & Milieu, n.d.). This would increase the level of cascading of car tyres because a higher percentage of recycling can be achieved from the inputs. This would be financially beneficial. Furthermore, Stitching OPEN faces low quality inputs for the recycling process. EEE are being reused until they are scrap and of no value anymore. This e-waste will be recycled since reuse options are not common anymore because of the low value of the product.[59]

9.2 Looking to the future

Although most recycling rates are met for the EPR product groups, Table 7 shows that much more can be done to work towards higher value retention options and more can be done to improve CS practices to work towards continuous improvement. It is questioned whether the responsibility for increasing the level of cascading as explained by Campbell-Johnston et al. (2020) and demanding continuous improvement must lie with the PROs, the government, or with the companies in the recycling industry.

On the one hand, some find governments responsible for SD. The Brundtland Report calls for governments as the main recipients of the report that is meant to stimulate SD (World Commission on Environment and Development, 1987). Persson (2016) adds to this that specific legislation is useful to make companies accountable for their businesses. In terms of CE, companies can be made accountable for their contribution to value retention.

On the other hand, (inter)national legislation on cascading principles could be hard to implement as a goal. When steering businesses towards cascading, it is unclear which part of cascading can be addressed. Cascading legislation could demand the longest possible lifecycles of products and/or components and/or materials, but also requiring products/components/materials to go through as many steps of the cascading framework (e.g., from R2 to R3 to R7 to R8), or demanding products/components/materials to be in the cascading framework as long as possible (Olsson et al., 2018). The same issue of uncertainty applies to CS implementation in regulation.

The author of this thesis has created an opinion from the conversations he has had with PROs, auditors, and companies in the Dutch recycling industry when writing this thesis. Imposing legislation to regulate value retention and stimulation of CS in the Dutch recycling industry will meet much resistance. As such, he is not in favour of a government that dictates top-down what companies in the recycling industry must do. When giving companies more freedom, they might do more since they are responsible for their performance themselves.

[59] Interview with R. Eijsbouts, Strategy Advisor at Stichting OPEN, 1 December 2021.

A helping hand could be given by the government by creating frameworks in which circular business practices are financially stimulated. At this moment, it is not compulsory for PROs to reward eco-design (e.g., design for recycling, maintenance, and longevity (Mulder et al., 2012)) with the waste management levy. Besides, a radical change that could be beneficial for working towards higher value retention options is adapting the Dutch tax system to current societal challenges to stimulate circular business practices. The current tax system makes products more expensive once they are sold more often. This is due to value added tax that is levied on labour. This means that the price of a product that is in its second lifecycle is more expensive because value added tax has already been levied in the first lifecycle. Besides, the value of a product decreases in the end of its lifecycle. There are materials in that product that are valuable which is currently not considered (Jonker, 2020).

9.3 Avenue for further research

This thesis compares the QASs of five different product groups in the Netherlands to learn from strengths and weaknesses of the other groups. Besides this comparison, it could also be helpful to compare the QASs of one specific product group in several different countries that have implemented EPR. In this way, it is possible to learn from best practices but also from worst cases. By comparing different QASs on the same product group, the differences between product types can be overcome (e.g., lack of technology in one product group).

9.4 Limitations

9.4.1 Different circumstances

This thesis considers five different product groups of which operationalization of EPR legislation has been organized differently. There are different technological developments for each group, and this makes it hard to compare: a PRO can perform on the top of its abilities, but when technology is not available, it is not possible to perform better periodically. This makes the collection and/or material recovery rate look bad compared to other product groups that have better technology available. This is also applicable to the different forms of reuse. For some products, it is not possible to reuse (e.g., packaging waste), although this might be easier for other types of waste (e.g., ICT – e-waste).

To tackle this problem, the PROs can add requirements to the QAS that ensure the companies of aiming for the highest possible value retention options at least. In this way, technology can be missing, but the QAS makes the companies use the new technology when it is possible to use it.

9.4.2 Non-transparent agreements

Another limitation is that PROs have agreements with their companies that are not publicly available. This means that this thesis possibly did not take these agreements into account that might be demanded for cooperation. This could be detrimental for the assessment scores of a QAS. However, as transparent communication is key to good sustainability practices (Doppelt, 2003), non-transparent agreements are not beneficial for CS. Hence, the companies should improve their level of transparency to include more CS.

10 Conclusion

This thesis answers the following research question: To what extent do quality assurance systems, created for the companies in the part of the recycling industry that is bound to Extended Producer Responsibility legislation in the Netherlands, result in high level value retention recycling? This is done by means of a description and an analysis of the organization of EPR legislation of five product groups: car tyres, scrap vehicles, b&a, packaging, and e-waste. The QASs that are created for the companies that contribute to the recycling of the waste streams of these products are analysed in terms of quality control and assurance. It was checked whether these QASs work towards continuous improvement through setting out nine steps that the companies must follow to work according to a PDCA cycle. If the QAS results in high value retention recycling is answered by checking if the companies are demanded to consider value retention options and if they are obliged to improve their performance in this area over time.

The research is mostly conducted with desk research. Much information was found on the internet. If possible, the writer of this thesis spoke to any PRO that is responsible for the operationalization of EPR legislation. Besides, he spoke to one company at least per product group that contributes to the recycling of that waste flow. A lead auditor of each certificate has been interviewed to picture the audit process that is applicable to that certification. In this way, the QAS has been analysed on what it does and what it does not.

Although the QASs push the certified companies sufficiently to integrate CS principles into their business practices that make them to improve continuously, they lack incentives to upgrade their performance by means of working towards higher value retention options. The quality assurance on all certificates has been organized well, what means that the biggest gap to be filled is in the quality control parts of the QASs. The level of cascading must increase to close the loop that is important for the transitioning towards a CE.

As explained before, strict regulation will not be beneficial to the quality of recycling. One recommendation to increase the level of value retention is to stimulate eco-design by means of demanding a lower waste management fee for these products. The Dutch government can make this differentiation happen by setting targets for eco-design and PROs must decide how much they must differentiate the fee to achieve both the eco-design goals and the recycling targets. They currently possess an AVV that makes producers/importers financially responsible for the products they produce/import.

A second recommendation implies a radical change of the Dutch tax system. The sequential and consecutive use of materials in our current tax system results in a value added tax that adds to every transaction of ownership. Therefore, recyclates are often more expensive than raw materials what is not beneficial for the demand on recyclates. This tax is estimated on labour, because every transaction of ownership comes with extra tax. When estimating tax on resources, sequential and consecutive use of materials is cheaper and will therefore be incentivized. A second change of the tax system implies the reconsidering of value of waste. An entity of waste still consists of materials that are of value, but this is currently not considered. Hence, it is often too expensive to recycle waste although it still contains materials of value.

The PROs are the recipients of this last recommendation. Taking ED as an example in terms of pushing towards continuous improvement of CS performance, the other QASs are recommended to also demand ISO 14001 certification or similar. This gives companies an extra incentive to adapt to the

current market on which environmental issues are on top of the agenda and where it is obligatory to decrease emissions and scarce material use before 2030.

These recommendations provide ways to support the companies in the recycling industry towards higher levels of value retention. Although this is not done in the current QASs, financial constraints underly the practical implementation of this. Having the right frameworks provided that guide the companies towards circularity and sustainability is of material importance to this. However, the governments cannot do this alone. PROs have been created by the specific industries to help them achieving the (inter)national collection and recycling targets. The time has come for them to take the lead and guide the specific recycling industries towards higher levels of circularity and to practices that do not harm people, planet, or prosperity. Together, we close the loop.

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Appendix 1 – The assessment framework explained

Source: own work, based on Maon et al. (2009)

Quality Assurance System *(name)*				
General information: -Product group (targets; and organization) -PRO (parties involved; and AVV) -Companies (count; and general information) -QAS general information (how it works; and governance)				
	Quality Control		**Quality Assurance**	
Step #	**Continuing the current technological perspective**	**Upgrading the technological approaches (cascading)**	**Audit principles**	**Compliance**
1: Raising awareness	-Are social drivers demanded to influence the company? -Are political drivers demanded to influence the company? -Are managers' personal values demanded to influence the company? -Are economic drivers demanded to influence the company? -Are social, political, and economic drivers as well as managers' personal values demanded to influence the company's formulation of strategy?	-Does the QAS demand circular principles to be considered by the company?	**A: Objectivity & independence**	-Are the audits independent and objective?
2: Assessing corporate purpose in a societal context	-Does the QAS prescribe an explicit procedure to formulate a sustainability strategy that includes the triple-P? -Does the QAS demand identification of key stakeholders and critical stakeholder issues?	-Is the company demanded to communicate with the PRO on innovation technology related issues?	**B: Quality, maintainability, and reliability**	-Is quality, maintainability and reliability of the audit assured?
3: Establishing a vision and a	-Does the QAS demand the company to establish a vision on	-Does the QAS demand the company	**C: Continuous improvement**	-Are the audits aimed at

working definition for CS	sustainability that includes the triple-P?	to establish a vision on cascading?		continuous improvement?
4: Assessing current CS status	-Does the QAS demand monitoring of emissions? -Does the QAS demand auditing of the norms, standards and practices that are related to people, planet, or prosperity?	-Does the QAS push the company to periodically improve its circular performance?	**D: Purpose, objective, and defined scope**	-Do the audits have a purpose, objective, and a defined scope?
5: Developing a CS-integrated strategic plan	-Does the QAS push development of a CS integrated strategic plan, including the triple-P? -Does the QAS demand CS to be embedded in organizational strategy? -Does the QAS demand a focus on cascading in the organizational strategy?	-Does the QAS push development of cascading strategies?	**E: Feasibility**	-Are the audits feasible to achieve the stated objective?
6: Implementing CS-integrated plan	-Does the QAS demand implementation of CS-integrated strategic plans? -Does the QAS demand organizational initiatives and strategies linked to CS to be implemented? -Does the QAS demand the company to have someone responsible for sustainability implementation?	-Does the QAS demand the PROs (the company's supplier) to consider value retention options before recycling (e.g., refuse to reuse)?	**F: Planned**	-Are the audits planned?
7: Communicating about CS commitments and performance	-Does the QAS demand the company to communicate its CS commitments internally? -Does the QAS demand the company to communicate its CS commitments externally? -Does the QAS demand the companies to communicate its CS performance internally?	-Is the company demanded to communicate with the PROs about achieving higher levels of cascading periodically? -Does the PRO communicate with the	**G: Systemic**	-Are the audits a system?

	-Does the QAS demand the company to communicate its CS performance externally?	responsible Dutch ministries about legislation beneficial for cascading principles?		
8: Evaluating CS integrated strategies and communication	-Does the QAS demand auditing of triple-P performance (e.g., circular performance)? -Does the QAS demand any form of annual sustainability reporting?	NA	**H: Evidence and criteria**	-Do audit evidence and audit criteria exist?
9: Institutionalizing CS	-Does the QAS push the company to commit resources to achieve sustainability related goals? -Does the QAS push the company to establish rewards/penalties for achievement of sustainability related goals?	-Does the QAS push the company to increase their amount of resources spent on sustainable performance periodically?	**I: Relevant and unambiguous criteria**	-Are audit criteria relevant and unambiguous?
			J: Documented	-Are the audits documented?
			K: Qualified and competent	-Are the auditors qualified and competent?
			L: Adequate and reliable methods	-Are the applied auditing methods adequate and reliable?
			M: Collected and verified evidence	-Is audit evidence collected and verified?
			N: Reported findings	-Are relevant, valid, communicable, and verifiable audit findings reported?
Subscore	**…**	**…**	**Subscore**	**…**
Final score = …				

Appendix 2 – Interviewees

Type of respondent	Company	Name respondent	Date of interview
PRO	RecyBEM	K. van Oostenrijk, CEO	22-11-2021
PRO	RecyBEM	J. Kester Jacobs, COO	2-12-2021 & 3-12-2021
Auditor	SGS	J. Pepers, lead auditor	19-11-2021
CC/RC	Granuband	M. Alderlieste, General Manager	17-11-2021
Auditor	Kiwa	G.-J. Struijer, lead auditor	2-12-2021
DC	Autobedrijf Broekhuis	S. Kemna-Broekhuis, General Manager	2-12-2021
PRO	Stibat	J. van Lent, Manager of Logistics and Recycling	23-11-2021
PRO	Stichting OPEN	R. Eijsbouts, Strategy Advisor	1-12-2021
Auditor	TÜV	H. van Dijk, lead auditor	2-12-2021
RC	Coolrec	S. Boven Kaarsmaker	6-12-2021

Appendix 3 – Material and energy recovery in the Dutch car tyre recycling industry

Sources: Campbell-Johnston, Calisto Friant, et al. (2020) and RecyBEM B.V. (2016, 2017, 2018, 2019, 2020, 2021).

Year	R2: Product reuse rate	R5: Retreading rate	R6: Reuse for alternative purposes rate	R7: Material recycling rate	R8: Energy recovery rate	Total R2-R7	Total R2-R8	Dutch goal on R2-R7
2011	23%	2%	1%	58%	16%	84%	100%	50%
2012	29%	2%	1%	56%	12%	88%	100%	50%
2013	33%	2%	0%	56%	9%	91%	100%	70%
2014	28%	2%	0%	66%	4%	96%	100%	80%
2015	28%	2%	1%	66%	3%	97%	100%	90%
2016	28%	2%	1%	67%	3%	97%	100%	90%
2017	32%	1%	0%	61%	5%	95%	100%	90%
2018	30%	2%	2%	64%	2%	99%	100%	90%
2019	27%	1%	1%	70%	2%	98%	100%	90%
2020	28%	2%	0%	67%	3%	97%	100%	90%

Appendix 4 – RecyBEM certified companies

Sources: RecyBEM B.V. & Vereniging Band & Milieu (n.d.-f, n.d.-g).

Collection companies:

- AT Bandenexport (Sliedrecht, Netherlands);
- AT Banden Weert V.O.F. (Weert, Netherlands);
- Berkvens Bandenrecycling (Someren, Netherlands);
- B.V. Autobandrecycling.nl (Stadskanaal, Netherlands);
- Euroband B.V. (Werkendam, Netherlands);
- FTS Trading (Middenmeer, Netherlands);
- Granuband B.V. (Amsterdam, Netherlands);
- Gruba Autobanden B.V. (Enschede, Netherlands);
- Groothandel Kranenburg (Asch, Netherlands);
- Limado Autobanden Recycling B.V. (Lieshout, Netherlands);
- Lintire B.V. (Vianen, Netherlands);
- Reedijk Used Tyres B.V. (Dordrecht and Elburg, Netherlands);
- Renewi Nederland B.V., Noord-Oost (Hoogeveen, Netherlands);
- Rubber Recycling Overpelt bvba (Overpelt, Belgium);
- Siba Autobanden B.V. (Uden, Netherlands);
- Bandenhandel Tielemans V.O.F. (Veldhoven, Netherlands);
- Total Recycling Industries B.V. (Leeuwarden, Netherlands); and
- De Zwarte Band (Schagen, Netherlands).

Recycling companies:

- ESTATO Umweltservice GmbH (Weiden in der ObeRCalz, Germany);
- Genan GmbH (Dorsten, Kammlach and Oranienburg, Germany);
- Genan A/S (Viborg, Denmark);
- Granuband B.V. (Amsterdam, Netherlands);
- Kargro Recycling B.V. (Nederweert, Netherlands);
- PVP Triptis GmbH (Triptis, Germany); and
- Rubber Recycling Overpelt bvba (Overpelt, Belgium).

Appendix 5 – Material and energy recovery in the Dutch scrap vehicle recycling industry

Sources: ARN (2012, 2013, 2014, 2015, 2016, 2017, 2018, 2020, 2021b), European Parliament (2000), and (2018).

Year	Material recovery rate	Energy recovery rate	Material/energy recovery rate	Dutch goal material recovery
2011	83,1%	13,1%	96,2%	80%
2012	83,7%	12,4%	96,1%	80%
2013	86,0%	9,9%	95,9%	80%
2014	86,1%	9,9%	96,0%	80%
2015	87,7%	9,3%	97,0%	85%
2016	88,9%	9,8%	98,7%	85%
2017	87,1%	11,5%	98,6%	85%
2018	87,1%	11,3%	98,4%	85%
2019	87,2%	11,2%	98,4%	85%
2020	88,0%	10,3%	98,3%	85%

Appendix 6 – Recycling companies that work with ARN

Source: ARN (2021a).

Known shredder companies:

- Gerrits Recycling (Den Bosch, Netherlands); and
- HKS the Metal company (Moerdijk, Netherlands).

Post Shredder Technology factory:

- HKS Scrap Metals (Tiel, Netherlands).

Appendix 7 – Recycling rates in the Dutch batteries and accumulators recycling industry

Sources: Stibat (2015, 2016, 2017, 2018, 2019, 2020, 2021c).

Pb:

Year	Material recovery rate	Material/energy recovery rate	Dutch goal material recovery
2014	85,0%	85,0%	65%
2015	78,0%	78,0%	65%
2016	78,0%	78,0%	65%
2017	78,0%	78,0%	65%
2018	78,0%	78,0%	65%
2019	78,0%	78,0%	65%
2020	71,0%	71,0%	65%

NiCd:

Year	Material recovery rate	Material/energy recovery rate	Dutch goal material recovery
2014	78,0%	78,0%	75%
2015	79,0%	79,0%	75%
2016	80,0%	80,0%	75%
2017	79,0%	79,0%	75%
2018	79,0%	79,0%	75%
2019	79,0%	79,0%	75%
2020	79,0%	79,0%	75%

Rest:

Year	Material recovery rate	Material/energy recovery rate	Dutch goal material recovery
2014	81,0%	81,0%	50%
2015	82,0%	82,0%	50%
2016	77,0%	77,0%	50%
2017	76,0%	76,0%	50%
2018	54,0%	54,0%	50%
2019	68,0%	68,0%	50%
2020	72,0%	72,0%	50%

Appendix 8 – Material recovery in the Dutch packaging recycling industry

Sources: Afvalfonds Verpakkingen (2015, 2016, 2017, 2018, 2019, 2020, 2021b) and Rijksoverheid (2015).

Glass:

Year	R7: material recycling	R8: energy recovery	Total material and energy recovery	Dutch goal material recovery	EU goal material recovery
2011	-	-	-	-	-
2012	-	-	-	-	-
2013	80,0%	0,0%	80,0%	90%	60%
2014	79,0%	0,0%	79,0%	90%	60%
2015	83,0%	0,0%	83,0%	90%	60%
2016	84,0%	0,0%	84,0%	90%	60%
2017	86,0%	0,0%	86,0%	90%	60%
2018	86,0%	0,0%	86,0%	90%	60%
2019	87,0%	0,0%	87,0%	90%	60%
2020	90,0%	0,0%	90,0%	90%	60%

Paper/cardboard:

Year	R7: material recycling	R8: energy recovery	Total material and recovery	Dutch goal material recovery	EU goal material recovery
2011	-	-	-	-	-
2012	-	-	-	-	-
2013	88,0%	0,0%	88,0%	75%	60%
2014	82,0%	0,0%	82,0%	75%	60%
2015	85,0%	0,0%	85,0%	75%	60%
2016	85,0%	0,0%	85,0%	75%	60%
2017	87,0%	0,0%	87,0%	75%	60%
2018	88,0%	0,0%	88,0%	75%	60%
2019	91,0%	0,0%	91,0%	75%	60%
2020	90,0%	0,0%	90,0%	75%	60%

Metal:

Year	R7: material recycling	R8: energy recovery	Total material and energy recovery	Dutch goal material recovery	EU goal material recovery
2011	-	-	-	-	-
2012	-	-	-	-	-
2013	93,0%	0,0%	93,0%	85%	50%
2014	94,0%	0,0%	94,0%	85%	50%
2015	95,0%	0,0%	95,0%	85%	50%
2016	95,0%	0,0%	95,0%	85%	50%
2017	95,0%	0,0%	95,0%	85%	50%
2018	95,0%	0,0%	95,0%	85%	50%
2019	95,0%	0,0%	95,0%	85%	50%
2020	95,0%	0,0%	95,0%	85%	50%

Plastic:

Year	R7: material recycling	R8: energy recovery	Total material and energy recovery	Dutch goal material recovery	EU goal material recovery
2011	-	-	-	-	-
2012	-	-	-	-	-
2013	47,0%	6,0%	53,0%	43%	22,5%
2014	50,0%	7,0%	57,0%	42%	22,5%
2015	51,0%	7,0%	58,0%	45%	22,5%
2016	51,0%	7,0%	58,0%	46%	22,5%
2017	50,0%	9,5%	59,5%	47%	22,5%
2018	52,0%	13,0%	65,0%	48%	22,5%
2019	57,0%	17,5%	74,5%	49%	22,5%
2020	66,0%	26,0%	92,0%	50%	22,5%

Wood:

Year	R7: material recycling	R8: energy recovery	Total material and energy recovery	Dutch goal material recovery	EU goal material recovery
2011	-	-	-	-	-
2012	-	-	-	-	-
2013	22,0%	30,0%	52,0%	27%	15%
2014	25,0%	29,0%	54,0%	25%	15%
2015	45,0%	15,0%	60,0%	31%	15%
2016	48,0%	12,5%	60,5%	33%	15%
2017	73,0%	16,0%	89,0%	35%	15%
2018	77,0%	14,0%	91,0%	37%	15%
2019	70,0%	13,0%	83,0%	39%	15%
2020	68,0%	21,0%	89,0%	41%	15%

Appendix 9 – Recycling companies that work with Stichting OPEN

Sources: Stichting OPEN (n.d.-a) and WEEELABEX (2021a, 2021b).

Operator	Auditing party	Country	Listing date	Expiry date
BNE Trading & Recycling BVBA	Tüv Nederland QA B.V.	BELGIUM	15.04.2021	14.04.2023
Indaver nv - Plant Indaver Relight	Really Green Credentials Ltd	BELGIUM	02.07.2020	01.07.2022
SA RECYDEL	DEKRA Certification B.V.	BELGIUM	17.09.2021	16.09.2023
Enviprotect Kühl und Elektrogeräterecycling GmbH	Really Green Credentials Ltd	GERMANY	13.03.2019	13.08.2021
REMONDIS Electrorecycling GmbH Rückbauzentrum Berlin	Tüv Nederland QA B.V.	GERMANY	10.11.2020	09.11.2022
STENA RECYCLING GMBH	RAL-Quality Assurance Association for the Demanu-facture of Refrigeration Equipment	GERMANY	02.05.2021	01.05.2023
STENA RECYCLING GMBH	RAL-Quality Assurance Association for the Demanu-facture of Refrigeration Equipment	GERMANY	15.02.2021	14.02.2023
STENA RECYCLING GMBH	RAL-Quality Assurance Association for the Demanu-facture of Refrigeration Equipment	GERMANY	19.11.2020	18.11.2022
COOLREC NEDERLAND B.V.	DEKRA Certification B.V.	NETHERLANDS	18.01.2021	17.01.2023
FISCALE EENHEID RIWALD B.V. EN RIWALD EXPLOITATIE B.V. C.S.	Tüv Nederland QA B.V.	NETHERLANDS	13.03.2020	12.03.2022
HKS DORDRECHT B.V.	Tüv Nederland QA B.V.	NETHERLANDS	27.05.2020	26.05.2022
HKS SCRAP METALS B.V.	Tüv Nederland QA B.V.	NETHERLANDS	07.07.2021	06.07.2023

HKS SCRAP METALS B.V.	Tüv Nederland QA B.V.	NETHERLANDS	15.10.2021	14.10.2023
HKS SCRAP METALS B.V.	Tüv Nederland QA B.V.	NETHERLANDS	09.03.2020	08.03.2022
HKS SCRAP METALS B.V.	Tüv Nederland QA B.V.	NETHERLANDS	26.03.2020	25.03.2022
HKS SCRAP METALS B.V.	Tüv Nederland QA B.V.	NETHERLANDS	18.02.2020	17.02.2022
HUISKES METAAL B.V.	Tüv Nederland QA B.V.	NETHERLANDS	07.04.2021	06.04.2023
Mirec B.V.	Really Green Credentials Ltd	NETHERLANDS	06.11.2020	05.11.2022
STATICE HELDEN B.V.	Kiwa Nederland B.V.	NETHERLANDS	03.05.2021	02.05.2023

Appendix 10 – Material and energy recovery in the Dutch e-waste recycling industry

Sources: Nationaal (W)EEE Register (2017, 2018, 2020, 2021) and European Union (Directive 2012/19/EU, 2012).

Year	Collection rate	Collection target	Material recovery rate	Energy recovery rate	Material and energy recovery rate
2011	?	?	?	?	?
2012	?	?	?	?	?
2013	?	?	?	?	?
2014	?	?	82%	15%	97%
2015	?	?	82%	14%	96%
2016	45%	45%	81%	15%	96%
2017	44%	45%	84%	12%	96%
2018	52%	45%	80%	15%	95%
2019	49%	65%	82%	14%	96%
2020	44%	65%	81%	16%	97%

Appendix 11 – Separate assessment of Erkend Duurzaam

Quality Control	
Step #	**Continuing the current technological perspective**
1: Raising awareness	5,5/10 pts.
2: Assessing corporate purpose in a societal context	10/10 pts.
3: Establishing a vision and a working definition for CS	1/10 pts.
4: Assessing current CS status	5,5/10 pts.
5: Developing a CS-integrated strategic plan	5,5/10 pts.
6: Implementing CS-integrated plan	5,5/10 pts.
7: Communicating about CS commitments and performance	5,5/10 pts.
8: Evaluating CS integrated strategies and communication	10/10 pts.
9: Institutionalizing CS	5,5/10 pts.
Subscore	8,0/10 pts.