The role of Extended Producer Responsibility in the transition to a Circular Economy

An institutional analysis of the circularity of EPR

Master Thesis – Delft University of Technology

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by

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Preface

This thesis marks the end of more than a decade of academic development for me. It has been a diverse journey both in an academic sense, bringing me from a bachelor in philosophy to a master in engineering and policy analysis, as geographically, from Groningen to Delft and The Hague.

This work is written in a period that proved unexpectedly tough, both to the world due to the Covid-19 pandemic, as personally. While I usually intend to refrain from well-worn and maybe exasperating clichés, I could not have produced it without the support of a long list of people.

First off, I would like to thank my team of supervisors. Aad and Udo at the faculty of TPM offered me academic guidance and at times much-needed understanding. The help from Cécile and Marijn at Copper8, to whom my progress at times must have been as frustrating as it was to myself, was sometimes literally incredible. I cannot imagine where I would stand at this point without their mentorship.

I owe gratitude to all my colleagues at Copper8, who were available for discussions, guidance, a cup of coffee and a laugh, both physically and virtually. They gave Copper8 a feeling of home, and I sincerely hope we can keep in touch.

My friends, roommates and family were there for me at troubling times. Hopefully, I can repay them with a celebration of the end of my academic career in a not-too-far future.

At last, I would like to thank Ella for staying patient and understanding while I continuously postponed my deadlines through plans and holidays. We will catch up on those plans.

Jurriaan Vink

Delft, October 2020

Summary

Our current rate of consumption following a take-make-waste pattern is unsustainable. Transitioning towards a Circular Economy (CE) with a minimum of input (of materials) and output (of waste) could benefit society in various ways. The concept of Extended Producer Responsibility (EPR), which extends producers' responsibilities various phases of a product's life-cycle, is often connected to CE. According to policy plans, EPR would stimulate the transition to a CE. However, it is unclear in what way and how much EPR contributes to a CE.

This thesis studies the role of EPR in the transition to a CE from an institutional perspective. It utilises a qualitative research approach, combining a literature review with case studies. EPR instruments are analysed using an institutional framework, consisting of several theories and concepts from (new) institutional economics. The instruments' levels of circularity are assessed by analysing incentivised R-strategies, following the 9R model. Additionally, three EPR schemes in the Netherlands are described and studied using the institutional framework. By combining the results of these analyses, barriers and opportunities for heightening circularity of EPR schemes are distinguished.

EPR schemes often consist of several instruments. This thesis describes various EPR instruments, of which product take-back requirements is the most often used. Product take-back requirements, which assign a physical responsibility to producers to collect and process end-of-life (EOL) products, vary in their set-up. Variations of product take-back exchange individual physical responsibilities for financial responsibilities by setting up collective Producer Responsibility Organisations (PROs). Competition between PROs is enabled or blocked in order to keep transaction costs low. Deposit-Refund Systems (DRS) are another EPR instrument in which EOL products are collected and processed. Other instruments that are studied in this thesis are various forms of taxes, product standards, information-based instruments and voluntary approaches. The context, particularly the type, volume and value of the product, determines what combination of instruments can achieve the best results in terms of low costs and high collection and processing rates.

An assessment of the level of circularity of EPR instruments and their institutional features distinguished three ways in which EPR instruments theoretically incentivise circularity:

- **Taking back ownership over EOL products**: the most effective way of incentivising circularity is through mandating producers to take back ownership over their EOL products, which is a feature of product take-back and DRS.
- **Adjusting costs of processing**: another way that EPR instruments incentivise circularity is by beneficially adjusting the costs and revenues of processing EOL products.
- **Influencing product design: t**he third method is through influencing product design. Design is affected directly through product standards and indirectly, for example through eco-modulation and material taxes.

The research features case studies into the Dutch EPR schemes for WEEE, Packaging and a to-be-implemented scheme for Textiles. The case studies show that EPR schemes prove more complicated in practice because of the divergent interests of stakeholders and comprehensive legislation in which schemes are embedded. However, the three methods in which EPR instruments incentivise circularity are confirmed. The collective nature of the analysed schemes helps to attain high collecting rates with low transaction costs but hinders all R-strategies higher than recycling. As EOL products are collected collectively, individual producers cannot use their knowledge for circular activities and are not always incentivised to improve their product design apart from incentives through eco-modulation.

Three barriers for heightening circularity in EPR schemes are distinguished. The circularity of EPR schemes is often hindered by an inability to incentivise eco-design and attain higher R-strategies than recycling. Causes for these inabilities are found in the collective nature of most EPR schemes and the inherent focus on recycling (rates). The third barrier for circularity is formed by the costs of EPR. As EPR schemes financially burden producers, they are incentivised to choose the most affordable option, often a collective system.

Five opportunities for overcoming these barriers and heightening circularity in EPR schemes are identified:

1. **Returning property rights of EOL products to producers** could incentivise maintaining more value from the products (higher R-strategies) and designing products that are easier to recycle/refurbish/repair.
2. **Promoting chain cooperation** could incentivise circularity throughout the whole chain by promoting the exchange of knowledge and services.
3. **Mandated product standards and methods of processing** are strong instruments but could benefit circularity by raising the demand for recycled materials.
4. **Eco-modulation** is an unfulfilled promise of EPR but could work when based on a straightforward assessment of circular characteristics.
5. **Material taxes** have three benefits. A virgin material tax incentivises designs of products with fewer virgin materials. As material taxes increase the value of materials, they incentivise higher R-strategies. Thirdly, a shift of taxes from human labour to materials could prove a catalyst for circularity.

EPR is often presumed to have an important role in the transition to a CE. This premise is justified when looking at the often high collection and recycling rates of EPR schemes. Collection and recycling of EOL products is vital for a CE. However, the manner of implementation can greatly affect EPR's circularity. This thesis shows that EPR's role in facilitating a transition could be more significant if it could overcome its high costs and inabilities to incentivise eco-design and realise higher R-strategies than recycling. By circumventing identified barriers and seizing opportunities, EPR can take a significant role in the transition to a CE. Further research could designate how this could be done.

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List of abbreviations

ADF	Advance Disposal Fee
AV	Afvalfonds Verpakkingen
AVV	Algemeen Verbindend Verklaring
BBWB	Besluit Beheer Wit- en Bruingoed
CE	Circular Economy
CPR	Collective Producer Responsibility
DRS	Deposit-Refund System
EEE	Electrical and Electronic Equipment
EMF	Ellen Macarthur Foundation
EOL	End-Of-Life
EPR	Extended Producer Responsibility
I&W	Infrastructure and Water management
IPR	Individual Producer Responsibility
KIDV	Kennisinstituut Duurzaam Verpakken
LE	Linear Economy
NIE	New Institutional Economics
OECD	Organisation for Economic Co-operation and Development
PA	Principal-Agent
PMD	Plastics, Metals and Drinking packages
PRO	Producer Responsibility Organisation
RAEEA	Regeling Afgedankte Elektrische en Elektronische Apparatuur
UCTS	Upstream Combination Tax/Subsidy
WEEE	Waste of Electrical and Electronic Equipment

I. Background

1. Problem introduction

The transition to a Circular Economy (CE) is imperative. Our current rate of consumption following a take-make-waste pattern is unsustainable due to the earth's finite resources (Ellen Macarthur Foundation, 2015). The concept of CE refers to a restorative system with a minimum of input (of materials) and output (of waste) and has gained a great deal of academic and practical interest over the last decades. Working towards a CE could benefit both the environment as well as job opportunities in the concerning societies (Wijkman, Skånberg, & Berglund, 2016).

Simultaneous to CE, the concept of Extended Producer Responsibility (EPR) has become increasingly important since its dawn in the 1990s. EPR schemes, in which producers' responsibilities are extended from the production phase into various phases of a product's life-cycle, are a common contemporary element of waste management in many countries.

EPR was initially deployed as a practical tool to unburden municipalities of the responsibility for a constantly growing amount of waste. In recent policy plans, however, EPR is often connected to the concept of CE. An example of the connection is the EU's Circular Economy Action Plan, which calls for more and enhanced implementation of EPR (European Commission, 2020). Dutch plans for extending EPR are an example on a national level. The Dutch Implementation Programme CE 2019-2023 [Uitvoeringsprogramma CE 2019-2023] calls for expansion and enhancement of EPR schemes because this would stimulate the transition to a CE (Ministerie van Infrastructuur en Waterstaat, 2019).

These plans show a clear connection between EPR and CE, but it remains unclear in what way and how much EPR contributes to a CE. An answer to this question could be relevant for future considerations of utilising EPR as an instrument for enhancing a CE.

1.1. The relevance of a study into the role of EPR

A study of the role of EPR in the transition to a CE has societal and academic relevance. Societal relevance stems from the urgent need for societies to transition to a CE (Ellen Macarthur Foundation, 2015), while the path towards this goal is often difficult and ambiguous. This study could enlighten a small segment of this long path by showing in what form way EPR contributes and how this contribution can be maximised.

The academical relevance can be found in the current unclear connection between EPR and CE, two concepts that are have been thoroughly studied in recent times. An academic study of stakeholder views on the two concepts has demonstrated that these concepts do not even bear the same meaning to different actors (Kunz, Mayers, & Van Wassenhove, 2018), let alone their connection. A study of the role of EPR in the transition to a CE could clarify that connection.

1.2. Institutional context of EPR schemes

EPR schemes are not stand-alone systems. They are embedded in a social and legislative or *institutional* context that determines the functioning and outcomes of the scheme. This thesis analyses the institutional context of EPR schemes in order to understand and explain their role in a transition to a CE. An institutional framework, described in chapter 3 and consisting of several concepts and theories, supports the analysis of EPR schemes and their embeddedness in an institutional context.

1.3. Research questions

The proposed goal of this thesis is to analyse the role of EPR in a transition to a CE. The expected outcomes are a framework based in institutional economics which can be utilised to analyse EPR

schemes and instruments, and recommendations on how specific EPR schemes and EPR as a whole can help in the transition to a CE. The main research question is:

How can Extended Producer Responsibility, from an institutional perspective, facilitate a transition to a Circular Economy?

The proposed study presents a theoretical and empirical contribution to the understanding of the working of EPR and its institutional features. The main research question is evaluative in nature, as it proposes research that evaluates the role of EPR.

The main research question consists of four sub-questions:

1. *What is the institutional working of EPR instruments?*
2. *How do different EPR instruments and their institutional features incentivise circularity?*
3. *What is the institutional environment of EPR schemes in the Netherlands?*
4. *What are opportunities and barriers for EPR schemes in the transition to a circular economy from an institutional perspective?*

The answer to the first sub-question should give an overview of EPR instruments and their institutional working. The second sub-question should provide an overview of how the different categories of EPR schemes can theoretically stimulate the transition to a circular economy. The answer for the first sub-question should be used as input for answering sub-question 2. Answering the third question should lead to a description of the working of Dutch EPR schemes from an institutional perspective. The answer to the first sub-question should provide guidance in analysing the Dutch EPR schemes in practice. Combining the answers of the other three sub-question should give insight into ways that institutions hinder circularity or could be arranged to facilitate the transition from a linear to a circular economy.

Chapter 2 describes the approach and methods that are used to answer the research questions.

1.4. Reading guide

This thesis follows a layout that begins with the background (chapter 1 – 3), followed by results (chapter 4 – 7) and is completed by a conclusion and recommendations (chapter 8 - 10). Several appendices are included at the end of this thesis.

Chapter 2 describes the research approaches to the sub-questions and the methods that are used for these approaches. Chapter 3 describes the theoretical framework, which forms the basis for answering the research questions. Chapters 4, 5, 6 and 7 each answer a sub-question. These answers are combined for the conclusion in chapter 8. The conclusion is followed by a discussion of the significance of the findings in chapter 9. Chapter 10 presents recommendations based on the conclusion and discussion.

2. Methodology

This chapter describes the research approach to answering the main research question and sub-questions, followed by a description of the research methods.

2.1. Qualitative research approach

There are two methods for researching the role of EPR in the transition to a CE: quantitative and qualitative. The first category would require statistical analysis or modelling and simulation of EPR schemes in order to determine and compare volumes of materials for input and output of production processes. Qualitative research is done by analysing unstructured and non-numerical data, such as interviews and literature, focusing on the structure and context of EPR schemes and the perspectives of actors.

Quantitative research into EPR is difficult for two reasons. In the first place, comparable data on EPR schemes are scarce (OECD, 2016). For example, national schemes stemming from the same European directive often provide only a couple of comparable indicators such as collecting and recycling rates. The second reason refers to the inherent uniqueness of EPR schemes. As every scheme is implemented for a different product system in different legislation, it is challenging to distinguish impacts from EPR schemes from other factors quantitatively. Qualitative research circumvents most of these difficulties.

This thesis presents a qualitative analysis of the institutional context of EPR schemes in the Netherlands, in order to signify the barriers and opportunities for EPR in the transition to a CE. The institutional context refers to systems of established and prevalent rules in which an EPR scheme is embedded. Institutional analyses of EPR has been conducted in the past by Tojo, Lindhqvist and Davis (2001) and by Favot (2014). As these studies had other research goals, they are useful but do not answer the question of this thesis.

The proposed qualitative research approach requires a robust theoretical understanding of several concepts and theories. The need for theory is visualised in Figure 1.

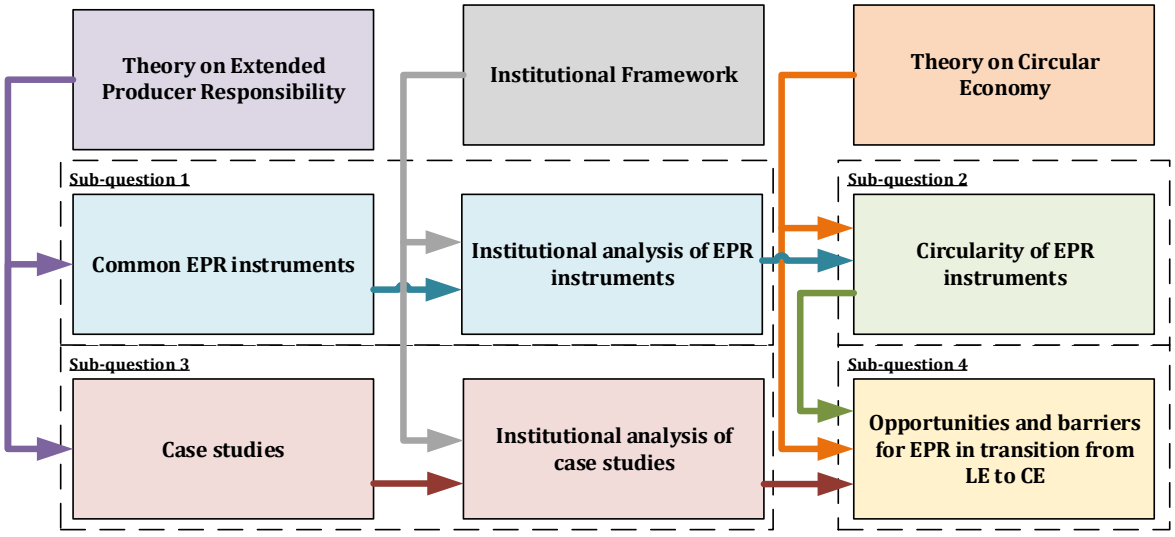

Figure 1, abstract visualisation of relation between theory and sub-questions.

Figure 1 shows an abstract visualisation of how the four sub-questions are related to theory and other sub-questions. It shows the theory necessary for answering sub-questions and how these answers provide input for subsequent questions.

The following section describes the theoretical input that is needed for answering all sub-questions. The required theoretical input is followed by sections on the approach to answering the four sub-questions.

2.1.1. Theoretical input

There are three bodies of theory used for answering the research questions. The first main body of theory is on (new) institutional economics. Several concepts and theories from this movement are used to form an *institutional framework*. The framework is designed and utilised to analyse EPR instruments and schemes in a structured manner. The institutional framework should make an analysis of circularity easier and more straightforward. Therefore, the institutional analysis of EPR instruments and the case studies is input for answering sub-questions 2 and 4. The institutional framework is introduced and explained in section 3.1.

The second body of theory focuses on EPR. This includes an understanding of what the concept of EPR entails and how and to what goal it is used in theory and practice. Theory on EPR, found in section 3.2, provides input for a description of EPR instruments for sub-question 1 and the case studies with sub-question 3. Both the descriptions of EPR instruments as the case studies are input for institutional analyses.

The third main body of theory is on CE. This part of the theoretical framework is used to assess the circularity of EPR instruments (sub-question 2) and to identify opportunities and barriers for EPR in the transition to a CE (sub-question 4). Without a theoretical understanding of CE, the role of EPR in a transition towards CE is hard to interpret. The theory on CE is found in section 3.3.

2.1.2. Approach to sub-question 1

The first question involves an institutional analysis of EPR to distinguish relevant institutional features. EPR instruments are selected and described using academic and influential non-academic literature. Instruments should be covered by the definition of EPR in section 3.2.2 and described in literature on EPR. The selected instruments are analysed by utilising the institutional framework. The outcome should be a description of the instruments, their working and their institutional features.

2.1.3. Approach to sub-question 3

Sub-question 3 is answered by performing three case studies into EPR schemes in the Netherlands. The knowledge from sub-questions 1 and 2 could prove helpful here. However, the main modes of input are literature (reports and legislation) on these schemes and interviews with stakeholders involved in these schemes. Their perspectives are used to describe the EPR schemes and subsequently analyse the schemes with the institutional framework. The output is a structured overview of the schemes and their institutional features.

2.1.4. Approach to sub-question 2

The instruments and their features, outcomes of sub-question 1, are analysed for their level of circularity. Because of the many definitions of circularity, the assessment is done by analysing whether the instruments and their features incentivise circular strategies, using the 9R model and additional literature on circularity (explained in section 3.3). The outcome is an overview of the R-strategies that separate EPR instruments could incentivise and to what extent their institutional features incentivise or hinder circular practices.

2.1.5. Approach to sub-question 4

The fourth and last sub-question requires the combined results of sub-questions 2 and 3 and literature on CE. The goal is to distinguish barriers for EPR to attain a higher level of circularity. Subsequently, opportunities are proposed to either avoid these barriers or attain a higher level of circularity in an alternative manner. Similar to sub-question 2, a higher level of circularity refers

to higher or more incentives for circular strategies. The outcome of sub-question 4 is an overview of barriers and opportunities for EPR as a whole, and specifically for the analysed schemes in sub-question 3.

The next chapter describes the methodology that is used to answer the research questions.

2.2. Methods

This chapter describes the research methods that are used to answer the research questions proposed in chapter 1. Figure 2 shows the steps in the main methods: a literature review and case studies. The methods and steps are described in sections 2.2.1 and 2.2.2.

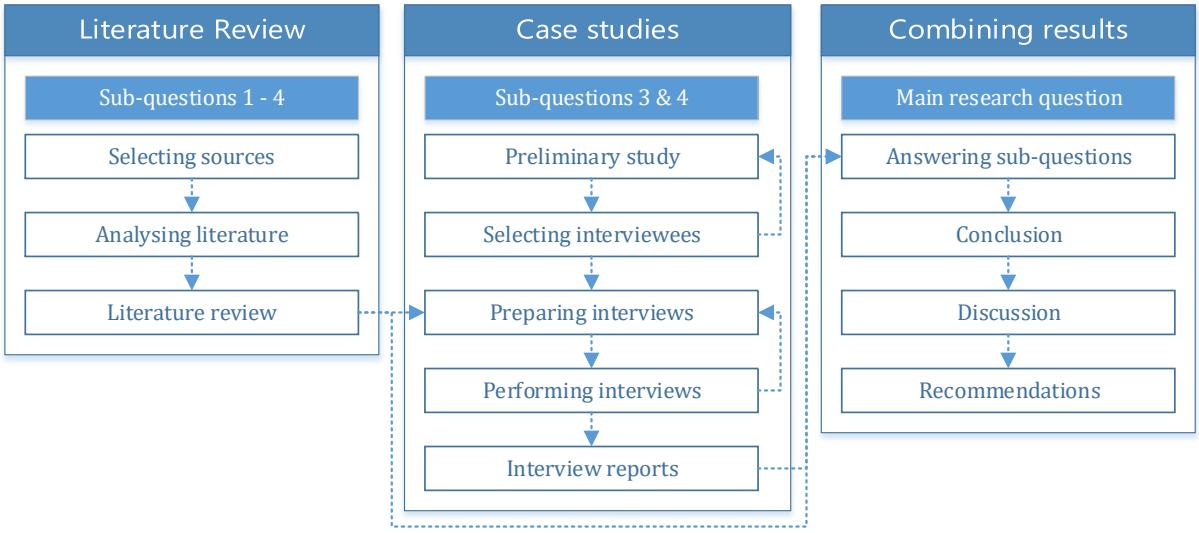

Figure 2, steps in main methods of the performed research.

The research question and sub-questions, as stated in chapter 1, are answered using two main methods, a literature review and case studies. As shown by Figure 2, sub-questions 1 & 2 and part of 3 & 4 are answered using the literature review. The case studies are used to answer sub-questions 3 & 4. The following sections explain the choice for these methods and their working.

2.2.1. Literature review

A literature review is done in order to answer the first, second, and part of the third and fourth sub-question. With a literature review, an up-to-date and well-structured overview of relevant literature on the topics of EPR, institutional economics, and CE can be presented. The methodology is described following Van Wee and Banister's guide in how to write a literature review (2016). This guide is broadly aimed at literature reviews in transport policy. As the subject of the literature review for the described research was policy, but in the environmental field, using Van Wee and Banister's guide seems appropriate.

The rationale behind the choice for a literature review is twofold, methodological and practical. First of all, it can give a funded answer to the first and second sub-question, as they are descriptive in nature. As a review looks to generalize empirical insights, both institutional concepts and their role in EPR and the transition from a linear to a circular economy can be researched. In other words, a literature review offers a structured method to build and validate a theoretical framework.

A literature review has practical benefits as well. Van Wee and Banister (2016) state that performing a literature review implies that the researcher gains a substantial amount of knowledge in the research area. In turn, this allows researchers to position their research in existing academic literature. For the research described in this thesis, the knowledge acquired in

a literature review has undoubtedly provided guidance in performing case studies. An extra practical benefit of the literature review is its stand-alone nature. It was combined with preparing the case study research, which took considerable time. The section on the case studies elaborates on this process.

2.2.1.1. Steps in literature review

A review is done on three main subjects: extended producer responsibility, institutional economics and the circular economy. Overall, time was the main constraint for the reviews, as there is a comprehensive amount of literature on all three subjects.

A comprehensive pearl growing technique was used in order to use time efficiently. This technique uses *gold standard papers* (or *pearls*) and their characteristics in an iterative process of searching through databases (Papaioannou et al., 2009). Utilised databases were *Google Scholar*, *Scopus*, and *Semantic Scholar*, with help from open-source software as *Citation Gecko* and *Mendeley* that recommended connected articles. Some non-peer-reviewed reports were included, as they provide information on the connection between academic literature and the work in practice.

In several cases, interviewees or other people in an expert role recommended certain (academic or non-academic) sources. If these proved to meet set standards (trusted source and proved useful), they were added to the literature review.

The selected sources were read and analysed for relevancy. Relevant findings were documented and eventually processed in either the relevant part of the theoretical framework in chapter 3 or used for answering sub-questions.

The result of the literature review was an extensive array of literature applicable to the research questions.

2.2.2. Case studies

In order to answer the third and fourth sub-question, three case studies are done into EPR schemes in the Netherlands. Case studies were chosen because the method can be used to 'illuminate understanding of complex phenomena' (Harrison, Birks, Franklin, & Mills, 2017, p. 12). As the method is explanatory in nature, it can be used to describe the EPR schemes and their institutional context. It is a misunderstanding that one cannot generalize based on a single case (Flyvbjerg, 2006). As long as the case is carefully chosen, case studies can contribute to scientific development. The cases were in a constant feedback loop with the literature review to strengthen and ensure their contribution.

Case studies offer a perspective on EPR in practice. This thesis aims to understand the role of EPR in the transition to a CE by identifying barriers and opportunities for EPR in that transition. Without a practical perspective on EPR, there are two risks to the research. The first is that identified barriers and opportunities only exist in theory. Problems that exist on paper might be easily solved in practice. Secondly, barriers and opportunities that are perceived by stakeholders in EPR schemes might go unnoticed without studying EPR in practice. The utilisation of case studies safeguards this research from these risks.

In order to ensure a thorough study, the research consisted of reading official accounts of the cases, e.g. legislation, policy documents, websites and non-academic reports, combined with semi-structured interviews with stakeholders that are active in the systems.

2.2.2.1. Case selection

For this research, three cases in the Netherlands were selected. Two are standing EPR schemes of packaging and waste of electric and electronic equipment (WEEE). The other one is on exploring possibilities of implementing EPR for textiles.

These case studies were chosen for practical and methodological reasons. The choice for systems in the Netherlands is practical, as the author masters the Dutch language and resides

there. In addition, the author's internship offers direct connections to parties in the chosen systems. Choosing two longstanding systems and one system in the making provides different perspectives on EPR and its possible circularity which helps in answering the main research question. Barriers for circularity differ with systems in the phase of implementation and those that are in operation for a longer time.

2.2.2.2. Performing interviews

Expert interviews represented an important source of data for the case studies. An open-question, semi-structured approach was chosen. Semi-structured refers to the middle road between strictly structured interviews with closed questions and open conversations without consistency (Leech, 2002).

The interviewees were selected for their role in the EPR scheme, their expertise and whether they were willing to cooperate. The latter was greatly helped by an internship with Copper8, as it brought many direct connections to possible interviewees who were interested in the subject. The greatest limit in choosing interviewees, however, proved to be time. The total time investment for one interview, from the first contact to processing the report, was high. In total, seven real-time interviews and three written interviews were conducted. Table 1 shows the organisations and roles of the interviewees and in what EPR scheme the interviewee's organisation is active. The last column shows the way the interview was conducted.

Table 1, overview of interviews performed.

Organisation	Role of interviewee	Active in EPR scheme	Mode
Ministry of I&W	Policy officer	Every scheme in NL	E-mail
Rijkswaterstaat	Legal adviser	Every scheme in NL	E-mail
Wecycle	Director of operations	WEEE	Videocall
WEEE Nederland	Project director	WEEE	Phone call
BSHG	Head of field-service	WEEE	Videocall
Coolrec	Manger sales	WEEE	Videocall
Afvalfonds Verpakkingen	Manager	Packaging	E-mail
KIDV	Packaging expert	Packaging	Videocall
Renewi	Manager sales	Packaging	Videocall
Sympany	Program manager	Textiles	Videocall

The interviews were based on a prepared set of questions, which was the same for all interviews (see Appendix A for the interview guideline). However, as the interviewees had different roles and expertise, the selection, order and wording of questions were changed per interview according to the judgement of the interviewer. The interview guideline was mostly used to choose questions from that were relevant to the specific interviewee, and to check during the interview whether all topics and questions were handled. Due to the variety in interviewees and therefore sets of questions, the interviews were very different from each other but handled the same subjects.

Some potential interviewees, most notable from Rijkswaterstaat and the ministry of Infrastructure and Water management [Infrastructuur en Waterstaat] (I&W), did not prefer a real-time interview and chose to answer questions in a written reply via e-mail. Reasons were either a lack of time, political sensitivity around the subject, or indirectly related to the Covid-19 outbreak. However not optimal – a semi-structured interview allows for directly asking more in-depth questions on interesting answers – this proved an acceptable alternative to doing the interview real-time.

The interviews had to be performed virtually, either via video- or phone calls, because physical visits conflicted with national guidelines following the Covid-19 outbreak. The virtual interviews proved no direct problem for the research, other than an occasional technical failure.

After each interview – real-time or written – an interview or correspondence report was made up (found in Appendices B and C). Because of the variety in choice and wording of the questions, these reports do not follow a particular outline or order. Before publishing, the report was checked by the interviewee for misinterpretations. After approval, only the interview report was used as input for this thesis.

The names of the interviewees are anonymised in order to comply with privacy regulations.

3. Theoretical Framework

This chapter presents a theoretical framework, utilised as a modus for analysis in this thesis. This framework outlines and structures the research theoretically and shows the basis of scientific knowledge that is used in this thesis.

The theoretical framework consists of three main components. The first component presents an institutional framework which enables a comprehensive analysis of EPR schemes. Five institutional theories and concepts are described, followed by an explanation on their use and focus in the framework. The second part defines the concept of Extended Producer Responsibility (EPR) and the different ways in which the concept is used, followed by its goals. The third component of the theoretical framework offers an account on Circular Economy (CE). This section describes the concept of CE and a method for assessing the circularity of EPR schemes and instruments. The chapter ends with a summarising conclusion.

3.1. Institutional analysis

In order to analyse EPR policy, schemes and instruments in a structured way, this thesis utilises an institutional perspective. Several concepts and theories are used to form an *institutional framework*. The institutional analysis of EPR instruments and case studies provides structured input for answering subsequent sub-questions.

Institutional refers to the movement of New Institutional Economics (NIE), rooted in the works of Ronald Coase (1937, 1960) and John R. Commons (1931). Mainstream economics has narrowed the scope of economics by leaving out the context of economic activity. NIE, however, attempts to extend this scope to the social and legal norms (i.e. institutions) as these are an important determinant for economic activity itself.

The work of Williamson (1998) describes the field of work of NIE. He provides four levels for social analysis, depicted in Figure 3. The focus of NIE is mainly on the second and third level (Williamson, 2000). The subject of the second level is the institutional environment or, in other words, the formal rules of the game and especially property rights. The third level of Williamsons' model is focused on governance, i.e. the interactions of actors and described as the play of the game. Because of its analytical style, NIE can be seen as a toolbox. A toolbox that has been broadened and deepened since the foundations were laid by Coase and Commons (Richter, 2005).

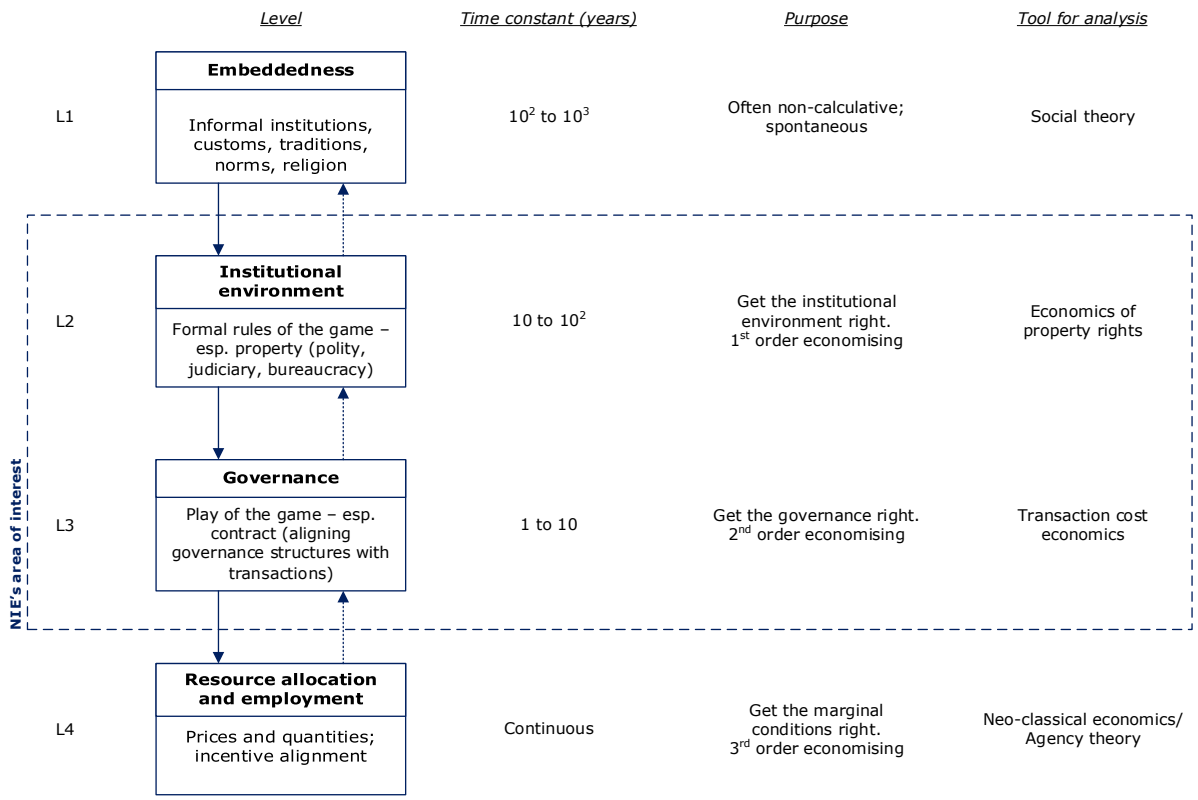

Figure 3, four levels of social analysis, adapted from Williamson (1998).

The remaining part of this section on institutional analysis provides a framework to analyse EPR, using various concepts and theories out of the toolbox of NIE. Taking into account that 'NIE is internally diverse and has unclear boundaries' (Hodgson, 2014a, p. 8), choices are made into what theory fits best in order to analyse EPR schemes. The following section gives an outline of the framework, followed by more extensive descriptions of and argumentation for the used concepts and theories.

3.1.1. An institutional framework

The framework for analysing EPR instruments, EPR schemes and their institutional context consists of the concepts of institutions, transaction costs, property rights, responsibilities and agency. These concepts are selected because they appear to allow for a thorough analysis of EPR in its different forms. This thesis forms the first exploration in whether and to what extent the framework and its concepts are useful.

Figure 4 shows a conceptual visualisation of the framework. The visualisation shows all aspects of an EPR scheme that should be analysed in order to gain a complete image from an institutional perspective. It should be seen as a list of requirements to cover all the relevant aspects of EPR schemes that are in L2 and L3 of Williamson's levels of social analysis, found in Figure 3.

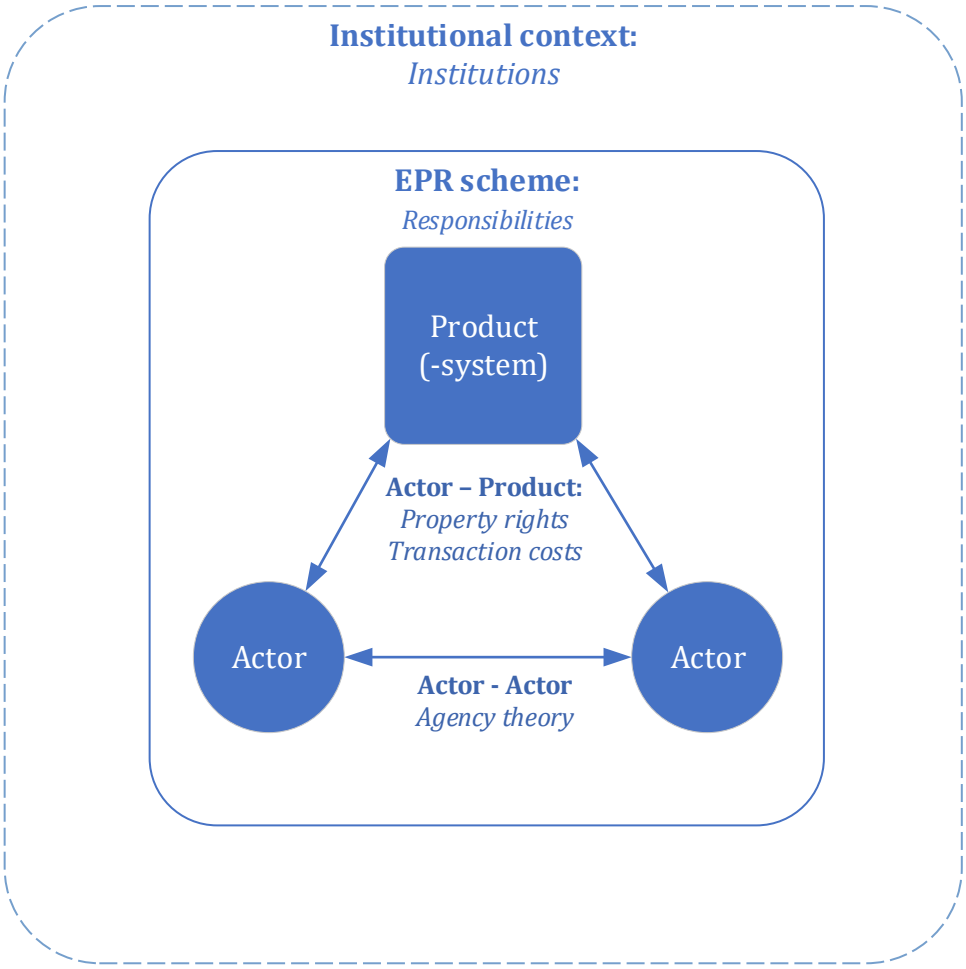

Figure 4, visualisation of the proposed institutional framework for analysing EPR.

Starting with the EPR scheme, its inner workings are described using three theories. The transaction cost theory, using the definition by Furubotn and Richter (2005), is used to describe the costs associated with the scheme. Section 3.1.3 provides more information on the definition and theory. The distribution of property rights affects these transaction costs. Property rights theory, in particular the theory by Hodgson (2014b), is used in the framework to describe the distribution and exchange of property in the scheme. See section 3.1.4 for elaboration on the theory. A division of responsibilities is described using Lindhqvist's theory on responsibilities (2000) in order to analyse the EPR scheme and enhance the property rights and transaction costs analysis. See section 3.1.5 on this.

Within an EPR scheme, there are a product and the actors that are involved in the scheme. The product or product-system is central. For analysing the scheme, it is important to understand and explain the nature of the product. This means a clear explanation of the characteristics of the product, but also its features and required materials. In other words, it must be clear what sets this product apart from other products. The nature of the actors and their activity in the EPR scheme should also be explained. The relationship between actors and the product is explained using property rights and transaction cost theories and by describing the responsibilities in the scheme. The relationship between actors and how this affects their behaviour and possibilities is described using agency theory. See section 3.1.6 for a brief description of the theory.

Figure 4 shows the embedding of an EPR scheme within an institutional context. The outer lines are dotted for a reason, as there is no clear demarcation to this context. Section 3.1.2 gives a definition of institutions, which makes clear that the lack of a clear demarcation is a fundamental feature of an institutional context. Institutions, either formal or informal, are taken into account

when they are relevant to the working of the EPR scheme. Most often, this will involve institutions on L2 or L3 of Williamson's levels of social analysis (see Figure 3), but occasionally from L1 as well.

The visualisation of the institutional framework in Figure 4 is an abstract portrayal of what should be analysed of an EPR scheme. Therefore, some relevant elements are not specifically depicted, even though they could be valuable for understanding the scheme. It is important to keep this in mind while using the framework.

3.1.2. Institutions

The term institution has been used since the 18th century but lacks a unanimously used definition. There have been endless disputes over the precise definition leading to writers having given up and trying to find consensus in practical matters instead (Hodgson, 2006).

This thesis uses the definition proposed by Geoffrey Hodgson as it enables a broad analysis of EPR and is built upon several other definitions. Hodgson defines institutions as 'systems of established and prevalent social rules that structure social interactions' (Hodgson, 2006, p. 2). This is a broad definition that encompasses the formal and informal *stuff* that make up social life. Examples given by Hodgson are among others language, money, law, table manners, and all sorts of organisations (i.e. firms). Hodgson follows Sugden (2005), Searle (2005) and others by defining the particular instance of an institution as a convention. The given examples, from language to organisations, underline this as they exist as the result of convention between people.

In order to fully understand Hodgson's definition, it is useful to compare it to other definitions. Douglas North states that institutions are 'the humanly devised constraints that structure political, economic, and social interactions' (North, 1991, p. 97). This definition sees institutions as constraints which is the main difference to Hodgson's definition. Wherewith Hodgson, institutions can be conventions that do not constrain interactions per se, North's definition rules these out as institutions. As the goal is to analyse EPR schemes and how these *enable* circularity, using North's definition might leave out relevant elements. Constrains are without a doubt important when analysing circularity, but these fall under Hodgson's definitions as well. Therefore, Hodgson's definition focusing on convention is chosen over North's definition focusing on constraints.

Other institutionalists see institutions as behaviour. John Fagg Foster, for example, defined institutions as 'prescribed patterns of behaviour' (Ranson, 1981, p. 908). This notion is countered by stating that this definition supposes that institutions stop existing when the associated behaviour is discontinued (Hodgson, 2006). A system of parliament, for example, is an institution because it exists as part of a system of prevalent social rules that structure interactions. It does not cease to exist when the members of parliament are at home and behave like every other person. The system and its rights and powers keep existing, even when not directly shown in behaviour. Nonetheless, Foster's definition is useful to be taken into account, as it is true that institutions are observed through behaviour.

This thesis will use the definition of institution articulated by Hodgson when analysing EPR schemes and instruments. Hodgon's definition is built upon and generally in correspondence with other definitions in seeing institutions as conventions. Analysing institutions thus means analysing the conventions in place that structure social interactions, whether they are formal/legal or informal/social.

The institutional framework in this thesis uses institutions to analyse the institutional source of EPR schemes and instruments and the behaviour that parties in the scheme display. This source is often national legislation. EPR schemes and instruments with sources other than national legislation are therefore special. Describing institutions could, for example, distinguish voluntary from mandatory systems and identify differences between non-profit organisations and

for-profit firms. Relevant institutions other than legislation should be described sufficiently using the other concepts and theories in the framework.

Signifying the institutional foundation of actors and EPR schemes and instruments should improve understanding of their working and role in the transition to a CE. By comparing the effects of institutional foundations on this role, potential barriers and points of improvements could be identified.

3.1.3. Transaction cost theory

The transaction cost theory put forward in Ronald Coase's 1937 article, can be seen as the start of the NIE movement. Coase asked why firms exist, and he answered by stating that there are costs to transacting in a market. These costs come into being because a market transaction is not an isolated action. North (1991) identifies costs that occur with making transactions on the market like legal fees, title insurance, and credit rating searches, added to the costs of time devoted to gathering information and searching deals.

In EPR schemes, transaction costs come to the surface as the costs of collecting and processing products. Because these costs are substantial, systems are aligned to be cost-effective. Therefore, analysing transaction costs could prove to be essential for understanding the system.

Property rights literature often defines transaction costs as the costs of establishing and maintaining property rights (Musole, 2009). This definition cuts across all organisations (markets, firms, households) and any other theoretical constructs (Allen, 1999), but it ignores enforcement-type costs within organisations (Musole, 2009). As enforcement is an important feature in EPR schemes, the proposed definition does not fit its purpose of analysing EPR schemes in this thesis. A definition of transaction costs that includes enforcement costs is preferable.

This thesis uses the definition of transaction costs by Furubotn and Richter (2005), who state that transaction costs refer to search and information costs, bargaining and decision costs, and policing and enforcement costs. This statement applies to EPR schemes, as it includes costs of enforcement. This definition of transaction costs should help explain the allocation of costs between actors and why they would prefer collective over individual approaches.

When using theories of transaction costs, it is important to be aware of the criticisms towards them. Musole (2009) reviewed many different theories of transaction costs and concluded that sceptics regard transaction costs as an opaque concept, due to its multivalent and sometimes cryptic definitions. Allen states that 'the words 'transaction costs' have evolved to the point where some sceptics claim they include any cost that is convenient and elusive enough to avoid critical examination' (1999, p. 893). According to Hodgson (2014a), transaction costs have a well-deserved bad name as a theoretical device, because the assumed form of costs often heavily influences the solution to a problem. In other words, one could choose a specific definition of transaction costs to get to the preferred solution.

In order to avoid the criticisms described above, this thesis uses transaction costs as an analytical tool to understand EPR schemes and not as a rationalisation or argumentation to base solutions to a problem. The concept of transaction costs is utilised in the institutional framework by describing costs of establishing property rights - in EPR schemes this often refers to collecting – and processing the products when the scheme or a contract requires this. A greater understanding of these costs should provide insight into EPR schemes and could help in identifying points of improvements.

3.1.4. Property rights

In EPR schemes, products and materials often change owners, whether this is between a producer and consumer or from a recycler back to a producer. These changes of ownership are often closely monitored as producers have the responsibility to keep track of collected or

processed products. In order to analyse the working of EPR systems, a close look into the division of property rights seems useful.

Neoclassical economics assumes that people trade physical or virtual commodities. Coase argued that what they trade are rights, specifically the rights to perform specific actions (Ménard & Shirley, 2011). Coase's observation is generally accepted within NIE. It indicates that 'property rights are rights people have or acquire over the use of resources' (Musole, 2009, p. 54). However, on a more specific definition, there have been many long discussions. Within the NIE, there are different perspectives on the precise meaning of property rights.

This thesis will abstain from adding to discussions on property rights, as this is a subject for another master's thesis (or dissertation) on its own. This section will provide a definition to use in this thesis and arguments for using the definition, without trying to defend it in a broader academic discussion. However, as the conceptualisation of property rights has been the subject of analysis itself (Foss & Foss, 2015), it can be assumed that the theory of property rights is developed thoroughly as an analysis tool.

This thesis will use a strictly legal perspective on property rights, even though this goes against much of 'the economics of property rights' (Musole, 2009). Following the definition stated at the beginning of this section, this thesis' perspective is that rights designate a legal status and property is therefore not the same as possession. This perspective is explained following the argumentation of Hodgson's 2014 article, aptly titled *'The Economics of Property Rights' is about neither Property nor Rights*.

Hodgson's article critically discusses the tendency of many property rights theorists to focus on possession instead of property. They mistake property for an agent-object relation, where a person has control over an object or resource. Property, however, is an agent-agent relation, that refers to formal acknowledgement by public authority. Hodgson states:

> Property is more than possession and not simply a relationship between owner and object. It is a relationship between people involving rights with regard to tangible or intangible assets. The exchange of property involves a minimum of not two parties but three, where the third is the state or a 'superior authority' (2014b, p. 5)

The focus on the third party is essential for property. In short, it means that an exchange of possession between two parties via a contract is not an exchange of property when there is not a third, *superior*, party that acknowledges the contract and with that the exchange. This makes the status of a right clearer as well. A right designates a legal status that is fastened in a legal system. This right does not exist without the third party that acknowledges it. Hodgson states that, because many property rights economists do not recognise this, they are neither talking about property nor rights (2014b).

Whether Hodgson's reasoning is entirely right is left for others to discuss. His definition is, however, useful for analysing property rights in EPR schemes.

For this thesis, the focus is on property rights as rights that people or organisations have over the use of resources. These rights have to be recognised by a superior third party, therefore referring to property and not possession. When something is a case of possession instead of property, it should be mentioned clearly.

3.1.4.1. Bundles of property rights in Roman law

Property signifies various types of possible rights, bundled in the package of property. These owe their origin to Roman law, of which four components will be used in this thesis. They are the right to use an asset (*usus*), the right to the returns of an asset (*usus fructus*), the right to alter the form or substance of an asset (*abusus*), and the right to transfer all or some of the rights to another individual (*transfer*) (Pejovich, 1990).

These four fundamental rights are utilised to analyse property, analogue to the approach used by Elinor Ostrom. She identifies five rights (access, extraction, management, exclusion, and alienation) in her analysis of property rights of common-pool resources (Schlager & Ostrom, 1992). As EPR is not (only) about common pool resources (but mainly about products made by private parties), Ostrom's distinction of rights is not used in this thesis. However, her distinction between bundles of rights could prove relevant and useful when detached from common-pool resources. We speak of ownership or property when all four distinguished rights are bundled. When someone rents or leases a product, this person is granted a bundle of rights that only contains usus and usus fructus. In theory, all sorts of different combinations of bundles of property rights are possible.

3.1.4.2. Using property rights in analysis and recommendations

Analysing the bundles of rights of different actors can strengthen the understanding of a system and help awareness of incentives for the different actors. In the case of EPR schemes, property rights are often fixed in the law that determines the EPR scheme or in contracts or covenants between parties in the scheme. Therefore, these are important subjects of analysis to understand and explain the working of EPR schemes. The strict legal definition of property rights by Hodgson seems to complement the analysis of EPR.

When advising or suggesting improvements to EPR schemes via alteration of property rights, it is important to understand that property rights are in itself institutions (as they are social rules that structure social behaviour). Therefore, when altering property rights arrangements (or advising on them), it is a case of institutional change. There is a wide collection of literature on institutional change and its possible consequences. Taking Musole's (2009) extensive review into account, three conclusions arise from the literature. First of all, when interfering with the system of property rights, problems of resource allocation and use will always arise. Secondly, following the first conclusion, however justified state intervention may be, they will not only change property right arrangements but also have unanticipated side-effects. The last conclusion is that inefficient property rights may persist, often as a consequence of the clash between formal rules and prevailing informal constraints. These conclusions should be taken into account when making recommendations on change in property right arrangements.

3.1.5. Types of responsibilities

In EPR schemes, contracts often do not pertain to property rights but responsibilities. Therefore, when analysing EPR schemes, it is essential to distinguish the different responsibilities that are exchanged (or extended) as it strengthens the understanding of the working of the scheme.

In NIE, responsibilities are analysed as part of systems of institutions, but there seems to be no literature dedicated specifically to distinguishing different forms of responsibilities. Literature on the subject of EPR does offer distinctions between different responsibilities. Therefore, academic literature on different forms of responsibility in EPR schemes is used.

Lindhqvist (2000) identifies five types of responsibilities that are essential for the implementation of successful EPR. These are informative, physical, financial, liability, and ownership responsibilities. The institutional framework in this thesis will only utilise the first three because liability and ownership overlap with property rights. In other words, describing property rights results in the same findings as ownership and liability responsibilities. However, the fact that Lindhqvist included ownership hints to the importance of the right allocation of property rights. Table 2 describes the different responsibilities.

Table 2, description of different responsibilities, adaptation of Lindhqvist (2000).

Responsibility	Description
Informative	The producer is responsible for providing information about its products. For example, informative responsibility refers to a requirement to supply information on the environmental properties of the product. Informative responsibility is comparable and often coincides with administrative responsibility.
Physical	The producer is responsible for physically collecting and/or processing of the products and/or their effects.
Financial	The producer is responsible for covering part or all of the expenses of, for example, collecting or recycling the products he is manufacturing.

By describing the various responsibilities that stakeholders in EPR schemes obtain, their role and the inner working of EPR schemes is clarified. Additionally, their description could signify weaknesses or points of improvement for EPR and its role in a transition to a CE.

3.1.6. Agency theory

Agency theory is proposed in order to analyse relationships between actors in EPR schemes and effects on the capacity of these actors to act. This theory, initially conceptualised by Jensen and Meckling (1979), analyses the relationship between an individual (principal) that concedes authority to another (agent) to act in his or her name (Cuevas-Rodríguez, Gomez-Mejia, & Wiseman, 2012). Agency is defined as the capacity of an actor to act. Agency theory states that when such relationships develop in economic exchange, the separation of ownership and control between the principal and agent can result in costs for the principal, known as agency costs. Costly mechanisms are required and often put in place to control agency costs. Inefficiencies arise in the form of agency costs because agents 'pursue interests that do not necessarily coincide with those of the principal' (Cuevas-Rodríguez et al., 2012, p. 526). When approached from the side of the agent, agency theory holds that individuals must have a vested interest in order to cooperate (Zumofen, 2016). The problems of misalignment of interests are called Principal-Agent (PA) problems. Agency theory state that PA problems lead to efficiency problems because the agent will always partly act out of self-interest (Jensen & Meckling, 1979).

The connection between willingness to cooperate and the availability of information is an interesting point of study when analysing EPR schemes, as it focuses on organisational aspects. As authors such as Kim and Mahoney (2005) and Cuevas-Rodríguez, Gomez-Mejia, & Wiseman (2012) have demonstrated, there is a clear connection between agency theory and property rights.

The institutional framework in this thesis will flexibly utilise agency theory to analyse the effect of EPR schemes and relationships between parties within the schemes on the agency of actors. Where possible, relationships are described as economic exchanges (recorded in contracts or covenants) where authority (or responsibility and information) is conceded. In other words, (dis)alignment of interests as a result of relationships in the schemes are described. Constraints or opportunities stemming from exchanges are emphasised in order to understand the behaviour and motives of the parties involved. Moreover, potential PA problems are described as these could lead to inefficiencies in EPR schemes.

Agency theory, as described in this section, encompasses a broad range of phenomena that could influence the capacity actors to act. Observed phenomena are deemed relevant when they influence the working EPR schemes or instruments. By describing these phenomena, motives and rationales of actors in EPR schemes and instruments are analysed. This analysis improves the understanding of EPR and its role in the transition to a CE and could indicate barriers or potential enhancements.

3.1.7. Conclusion on the institutional framework

The institutional framework that is introduced from section 3.1.1 onwards provides an analytical tool that should be able to analyse EPR schemes thoroughly. Analysing the institutional source of EPR instruments and schemes and the organisations in it should provide fundamental insight into the base of an instrument and its working. Describing property rights and transaction costs will help understanding material flows and connected costs. An analysis of responsibilities provides an understanding of the role of producers and other parties in EPR schemes and instruments. Agency should explain the incentives and behaviour of actors in these schemes and instruments. Together, these concepts should provide for a comprehensive analysis. Moreover, this analysis could indicate barriers and opportunities for strengthening the role of EPR in the transition to a CE.

Table 3, institutional concepts' and theories' main focus of analysis.

Concept or theory	Main focus of analysis
Institution	Analysed by describing the institutional foundation of EPR schemes. This is (often national) legislation, and therefore other institutional foundations are remarkable. Other relevant features are the distinction between voluntary and mandatory systems and the legislative base of stakeholders, e.g. non-profit organisations vs for-profit firms. Most other relevant manifestations of institutions are described by the other concepts and theories.
Transaction costs	Describes the costs of establishment or exchange of property rights and costs of processing the products when the scheme or a contract requires this. In EPR schemes, establishing property rights often refers to collection of End-of-Life (EOL) products.
Property rights	Analysed by describing distributions of property rights that follow from legislation, contracts or covenants between parties in the scheme. Where possible, distinctions are made between different bundles of property rights.
Responsibilities	Describes the responsibilities that are obtained by stakeholders through legislation, contracts or covenants. Three types of responsibilities are distinguished. • Informative responsibilities are expressed in obligations to provide (any form of) information about products. • Physical responsibilities in EPR often refer to an obtained burden to collect and/or process EOL products, or requirements in designs of products. • Financial responsibilities occur through legislation, contracts or covenants that burden stakeholders with covering expenses, for example of collection or processing of EOL products.
Agency theory	Describes a wide arrange of phenomena following from relationships between stakeholders in EPR, such as (dis)alignment interests, potential PA problems, willingness to cooperate and the availability of information with different parties in a scheme. All features of EPR schemes or instruments that influence the capacity of an actor to act could be analysed under the denominator 'agency theory'.

Table 3 summarises the concepts and theories presented in this section and states their main focus of analysis.

In practice, the institutional framework provides questions that help in analysing EPR schemes and instruments. These questions follow from the focus of the analysis described in Table 3. Example questions for EPR instruments in chapter 4 are:

- In what type of institution is the instrument based (other than legislative)?
- Are property rights exchanged in the instrument (and how)?
- Can transaction costs be distinguished in the instrument?
- What responsibilities are assigned or exchanged in the instrument?
- What is the likelihood of the instrument influencing the agency of involved parties (e.g. through a mismatch or alignment of interests)?

The answers to the questions above should provide an institutional perspective on EPR instruments. When the nature of the product and actors is taken into account as well, the analysis should be thorough enough for an assessment of the level of circularity of an EPR scheme. A theoretical perspective on EPR is presented in the following sections.

3.2. Defining EPR and its goals

This section's theory on EPR specifies an understanding of what the concept of EPR encompasses and its implementation in theory and practice. The theory provides input for the description of EPR instruments in chapter 4 and the case studies in chapter 6.

After a short sketch of the historical context of EPR, this section will distinguish between different meanings of the concept: EPR as policy principle, EPR schemes, and EPR instruments. The two main definitions of EPR back these. The distinction between the three definitions should clarify what the term EPR refers to in this thesis. The following section discusses common goals of EPR schemes to provide insight into the motives for setting up EPR schemes and how these compare to characteristics of a CE.

3.2.1. Beginnings of EPR

Approaches into reuse of materials have been around for a long time, if not forever, but the general interest in them grew tremendously during the 1990s (Lindhqvist, 2000). Recycling schemes were already up and running in North-America and Europe. These schemes had increasing rates of discarded products recovered for recycling up until the '90s, mainly because of municipal efforts (Sheehan & Spiegelman, 2017).

Improvements in recycling rates, however, decreased over time. This decrease was partly because of the sheer increase of waste – municipal waste production grew with 40% on average between 1980 and 1997 (OECD, 2001) – and partly because of the growing complexity of the waste. By the late 1980s, the volume of waste already exceeded the municipal management capacity in some developed countries (OECD, 2016). A 1999 report by the US Environmental Protection Agency highlighted the problem with growing complexity. They took plastics in products as an example, as they were 'often in products such as appliances or furniture where recovery is difficult if not impossible' (1999, p. 128). The use of plastic made recycling of appliances and furniture increasingly difficult.

To cope with these problems, governmental organisations looked into new policy concepts and instruments that could shift the burden of waste management away from municipalities and incentivise design of products to take into account the waste phase. EPR is one of these concepts. The term EPR was first used in a report for the Swedish Ministry of the Environment in 1990 and further build upon in subsequent reports (Lindhqvist, 2000).

3.2.2. Various ways of defining EPR

The concept of EPR is defined and used in various ways in literature. Therefore, the term 'EPR' can refer to different meanings. This thesis distinguishes three meanings: EPR as a policy principle, EPR schemes, and EPR instruments. Figure 5 shows how the three are connected. EPR as a principle is put into practice by setting up EPR schemes. These schemes consist of one or a combination of policy instruments. The following sections will expand upon the three forms and their connection to definitions of EPR.

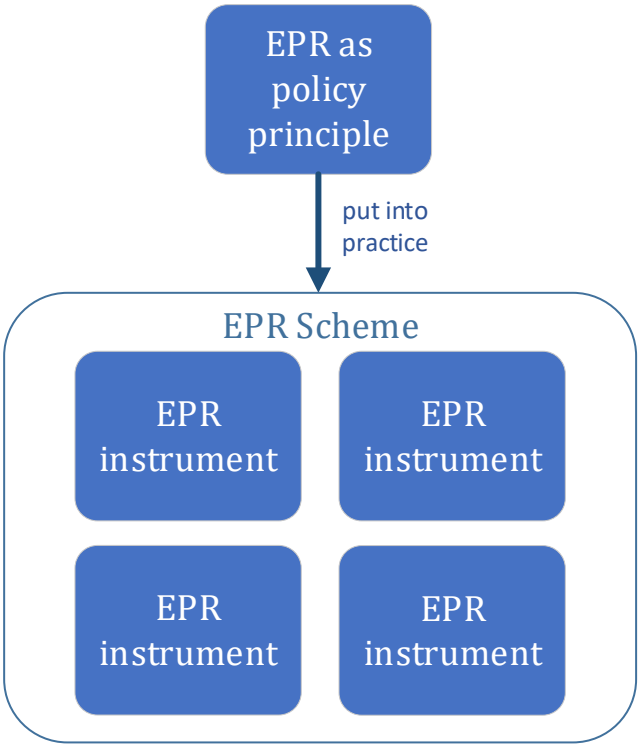

Figure 5, visualisation of the connection between three forms of EPR.

3.2.2.1. EPR as a policy principle

The concept of EPR was coined in the early 1990s to label policy strategies such as product take-back (Lindhqvist & Lifset, 1997). Its conceptual founder, Thomas Lindhqvist, has been EPR's main academic proponent during the '90s. His dissertation, in which he refined earlier academic work, defines EPR as:

> [A] policy principle to promote total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the entire life cycle of the product, and especially to the take-back, recycling and final disposal of the product. (Lindhqvist, 2000, p. 154)

When analysing the definition, the first and most important observation is that Lindhqvist uses the term *policy principle*. Referring to EPR as a principle implicates that it is not a tool or strategy, but a more overarching concept or guiding principle comparable to (and consistent with) the Polluter Pays Principle (Lindhqvist, 2000). When EPR is referenced as a principle, it should be seen as 'guidance for policy making rather than a ready package of policies' (Lindhqvist, personal communication, February 25, 2020).

The remainder of the definition elaborates on the goal and working of the principle. The second part, *to promote total life cycle environmental improvements of product systems*, explains the goal

of EPR according to Lindhqvist. Section 3.2.3 will further expand on the goals of EPR. The third part of the definition, *by extending the responsibilities of the manufacturer of the product to various parts of the entire life cycle of the product*, answers the how-question of the goal of EPR. It emphasises that EPR broadens the responsibility of the producer; not of other parties in the value chain. The last part of the definition indicates focal points of EPR, i.e. *take-back, recycling and final disposal of the product*.

3.2.2.2. EPR schemes

Since (and arguably before) its conceptualisation, the EPR principle has often been brought into practice. Systems set up to bring EPR as a policy principle into practice, are referred to as EPR schemes. EPR schemes are implemented for specific products or product groups in specific jurisdictions – often a country (and in the US sometimes a state).

The definition by the Organisation for Economic Co-operation and Development (OECD) emphasises the more practical nature of EPR schemes, compared to EPR as a principle. The OECD has worked on EPR since 1994 and published a guidance manual on EPR in 2001 to provide governments with practical information on the subject (OECD, 2001). This manual, widely used in academic and non-academic literature (Lifset, Atasu, & Tojo, 2013), defines EPR as:

> [A]n environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. There are two related features of EPR policy: (1) the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities, and (2) to provide incentives to producers to incorporate environmental considerations in the design of their products (OECD, 2001, p. 9).

There are two notable attributes of the definition, the first of which is the characterisation as *a policy approach*. The use of approach indicates that the OECD sees EPR as a strategy to shift responsibility to producers and emphasises the more practical nature of the OECD's definition, compared to Lindhqvist's. The two related features in the OECD's definition illustrate this: they state what EPR schemes usually include. The second attribute of the definition is that the extension of the producer's responsibility is specifically to the post-consumer stage of a product's life cycle. This stands in contrast to Lindhqvist's definition in which the responsibility is extended to the entire life cycle of the product.

The definition by the OECD is clarified further in the recently updated guidance manual (OECD, 2016). After the definition, the manual states that '[i]n practice, EPR involves producers taking responsibility for collecting end-of-life products, and for sorting them before their final treatment, ideally, recycling' (OECD, 2016, p. 21). The manual continues explaining that EPR schemes allow producers to exercise responsibility in two ways: providing the financial resources required or by taking over the operational and organisational aspects of the process from municipalities, either individually or collectively. This account on the practical reality confirms the OECD's pragmatic interpretation of EPR.

3.2.2.3. EPR instruments

EPR schemes that are set up for specific product (groups) and specific jurisdictions are often composed of a combination of policy instruments (OECD, 2016). The concept of policy instrument is frequently used in literature on policy design and refers to 'the means of government intervention in markets or, in a broader perspective, society in order to accomplish goals or to solve problems' (van Nispen tot Pannerden, 2011, p. 4).

Academic literature on EPR distinguishes many different policies that extend the responsibilities of producers (Nash & Bosso, 2013; Walls, 2006). These range from practical

systems with take-back targets to various kinds of information-based instruments. However, authors categorise and describe similar sets of instruments differently. For example, the sets of categories provided by the OECD (2016), Widmer et al. (2005), and Gupt & Sahay (2015) are different from each other whilst these authors cite one another. Table 4 shows the sets of instruments mentioned by these authors. An X indicates that the source mentions the specified instrument.

Table 4, overview of categories and examples of EPR instruments.

Category	Instrument	OECD (2016)	Widmer et al. (2005)	Gupt & Sahay (2015)
Product take-back requirements	Mandatory take-back	X	X	X
	Voluntary take-back	X	X	X
	Reuse and recycling targets			X
	Recovery obligation			X
Economic instruments	Deposit refund	X	X	X
	Advanced disposal/recycling fees	X	X	X
	Material taxes	X	X	X
	Upstream combination tax/subsidy	X		X
	Fees on disposal		X	
	Subsidies			X
Regulations and performance standards	Minimum product standard	X	X	X
	Combination standard with tax	X		
	Prohibition of hazardous materials/products		X	
	Disposal ban		X	
	Mandated recycling		X	
	Emission limits			X
Information-based instruments	Reporting requirements	X		X
	Labelling of products/components	X	X	X
	Communication to consumers	X		
	Informing recyclers	X		X
	Consultation with authorities			X
Voluntary practices	Public/private partnerships		X	
	Leasing and "servicizing"		X	
	Social contracts			X
	Gentlemen's agreement			X

Chapter 4 of this thesis describes and analyses the most commonly used and mentioned EPR instruments. The instruments described in Table 4 are used as a starting point.

3.2.3. Goals of EPR

Specific sets of goals that stem from the EPR principle differ in literature, but overall goals can be identified. This section will provide an overview of the goals given by several authors, as this provides insight into the motives for setting up EPR schemes.

The OECD's updated guidance manual states that EPR schemes are often implemented to achieve 'one or more of four goals: reducing the use of (virgin) resources and materials; waste prevention; reducing the environmental impacts of products; and closing material use loops' (OECD, 2016, p. 39). Walls (2006) goes further and distinguishes six goals: reduction in waste volumes generated, reduction in waste disposed, reduction in hazardous constituents in the waste stream, decrease in virgin material use, lowering of pollution in the production stage, and increased design for the environment. Some of Walls' goals are very similar to or fall under one of the goals of the OECD. Table 5 presents a synthesis of both sets.

By analysing the sets of goals by the OECD (2016) and Walls (2006), two overarching goals and five underlying goals are determined. The original goal of shifting the responsibility of waste management from municipality to producers is added as a goal on its own, as stakeholders in EPR schemes still see this as an important aim (Tasaki, Tojo, & Lindhqvist, 2019).

Table 5 shows an overview of the goals and motives when setting up EPR schemes. It gives three overarching and the five underlying goals. The goal 'reduce use of (virgin) resources and material' is placed under two overarching goals, as it is part of both.

Table 5, overarching and underlying goals of EPR.

Overarching goals	Underlying goals
Shift burden of waste management from municipalities to producers	-
Promote Design for the Environment/Eco-design.	Reduce hazardous content of waste
	Reduce environmental impact of products
	Reduce use of (virgin) resources and material
Close material loops	Reduce use of (virgin) resources and material
	Reduce waste disposal
	Reduce waste generated

When the goals in Table 5 are compared to characteristics of circularity (see section 3.3.2), the connection between EPR and CE is clear. Promotion of eco-design and closing material loops and their underlying goals are general examples of circular strategies. However, shifting the burden of waste management from municipalities to producers is not circular in itself. This means that EPR schemes that manage to achieve the goals to promote eco-design or close material loops (or underlying goals) can be deemed circular to a certain extent. To what extent is examined in this thesis. A shift in waste management does not affect circularity, at least not directly.

Section 3.3.2 goes deeper into the assessment of circularity of EPR schemes.

3.2.4. Conclusion on EPR

Section 3.2 provided a theoretical account of the difference between EPR as a policy principle, EPR schemes and EPR policy instruments and the definitions that connect the three. The first sees EPR as a guiding principle for policymaking and connects to Lindhqvist's definition of EPR. EPR schemes refer to the systems that are set up to bring the EPR principle into practice. These systems closely connect to the definition by the OECD. EPR schemes consist of one or more EPR instruments. To avoid confusion for the reader, the remainder of this thesis will indicate clearly which of the three forms is meant when mentioning EPR.

The goals of EPR schemes are summarised in Table 5 and show that two of three overarching goals of EPR directly relate to promoting circularity. EPR schemes that achieve these goals, promoting eco-design and closing material loops, can be deemed circular to a certain extent.

The next section presents a theoretical explanation on CE and how EPR can be assessed for its circularity.

3.3. Circular Economy

The Circular Economy (CE) is a concept based on theories from a wide array of thinkers, for example Walter Stahel (1982) and McDonough & Braungart (2002). CE has gained momentum in recent years among academics and professional practitioners. The main reason for this growing interest is the view that CE is an operationalisation for businesses, which gives the 'vague' concept of sustainable development a concrete form (Ghisellini, Cialani, & Ulgiati, 2016; Kirchherr, Reike, & Hekkert, 2017). Various stakeholders with considerately different paradigms employ CE, and therefore there is a wide range of definitions and frameworks that represent CE differently.

The next paragraph will state the requirements to a definition of CE for this thesis. A section on the used definition follows this. After this, a section will state the characteristics of CE, as these are more important to assess circularity than the definition itself. Why the latter is the case, will be explained in the following paragraph.

For utilisation in this thesis, it is not only important to signify what the concept of CE entails, but more so how to assess EPR schemes in terms of their *level of circularity*. The first is a challenge because of the vast amount of varying definitions in academic literature. For example, one review analysed 114 different definitions of CE (Kirchherr et al., 2017). Assessing the level of circularity of EPR schemes proves to be a significant challenge. There are a vast amount of circularity indicators of which the meaning changes when based on different principles or frameworks. As reviewing all possible indicators and principles is a subject for another study, the focus of this thesis will be on the goals and characteristics of CE. This focus makes assessing EPR schemes less complicated and more straightforward.

3.3.1. Definition of CE

CE can be seen as an umbrella concept (Blomsma & Brennan, 2017), which means that it is a broad concept that is used loosely to include and clarify a set of different phenomena (Hirsch & Levin, 1999). Therefore it is essential to state what it includes and what not. CE is often described in contrast to a Linear Economy (LE), thus explaining what CE is be accompanied by a clarification of what LE embodies.

The core proposition of CE is to move away from the LE practices of 'take-make-waste' and replacing these with the notion of waste and resource cycling (Blomsma, 2018; Blomsma & Brennan, 2017). Therefore, a CE is seen as 'an industrial system that is restorative or regenerative by intention and design' (Ellen Macarthur Foundation, 2015, p. 7). Following the Ellen MacArthur Foundation (EMF), CE's core principle is the non-existence of waste (Ellen Macarthur Foundation, 2015). In a CE, waste is 'designed out', by devising products in a way that optimises them for cycles of disassembly and use. Scholars and governments generally adopt the definition posed by the EMF (Moreau, Sahakian, van Griethuysen, & Vuille, 2017).

Taking the above in mind, it should be apparent where the term circularity in CE originates. In a LE, resources go linearly from extraction to disposal, becoming waste (Stahel, 1982). In a CE, however, resources are circled back into the system for new cycles of use, thereby diminishing waste flowing out of the system. A consequence of redirecting EOL products back to Input material is that there are less (or preferably close to no) virgin materials needed in the system. This mechanism shows how the CE cuts both ways; there is less waste at the end of the process and fewer materials needed in the beginning.

Figure 6 (LE) and Figure 7 (CE) on the next page portray the difference between a LE and a CE in a highly abstract form. While the figures visualise a general production chain, an important note is that this could refer to anything that requires resources to produce and could end up as waste. Circularity ranges from packaging to buildings, from food to electronic devices.

Figure 6, abstract visualisation of the linear economy.

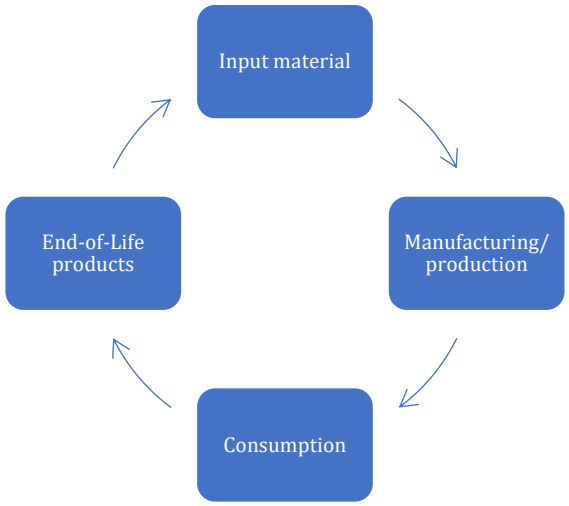

Figure 7, abstract visualisation of the circular economy.

3.3.2. Assessing characteristics of circularity

This thesis aims to assess EPR schemes on their level of circularity and distinguish opportunities and barriers for strengthening this level. Determining an EPR scheme's circularity by only by using a definition of CE is challenging. It would require examining whether an EPR scheme is restorative by design or intention.

As this thesis aims to assess circularity in a straightforward manner, it examines EPR schemes for circular characteristics. Examining for circular characteristics is done by analysing whether schemes' characteristics encourage minimising virgin input materials and waste. The analysis utilises the 9R model, used by the Dutch government. Using the 9R model will not lead to a quantification of circularity indicators. However, it enables a comparison of EPR schemes in order to indicate barriers and opportunities for improvement.

3.3.3. The 9R model

There are various models of circularity. Most of them use one of the various R frameworks (Kirchherr et al., 2017). The Dutch government uses a 9R model, alternatively referred to as the R-ladder, that exists of 10 steps or R-strategies (R0 to R9) (Potting, Hekkert, Worrell, & Hanemaaijer, 2017).

The 9R model is an elaboration of several concepts. One is *Lansink's Ladder* [Ladder van Lansink], a waste hierarchy model named after the author of a Dutch government resolution adopted in 1979 (Blomsma, 2016). The second is the 10 R's theory by Cramer (2017) that proposes an order of preference in ten circular strategies or R-strategies.

The EMF framework is an often-used model that relates closely to the 9R model, as they both propose circular strategies to maintain material value. The framework by the EMF proposes four methods or strategies of value creation in a CE. These are using inner circles, longer circling, cascading, and using pure, non-toxic and easier-to-separate inputs (Ellen Macarthur Foundation, 2015). Both the EMF framework and the 9R model could be utilised for assessing circularity in EPR. This thesis utilises the 9R model as it facilitates a more straightforward comparison between EPR instruments and schemes because of the hierarchical order of the R-strategies.

Table 6 describes the steps in the 9R model. In order, the R-ladder consists of the following gradations: refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover. Every step is a circularity strategy or R-strategy that decreases the consumption of virgin materials in a product chain. In the described order, the effect of Refuse (R0) is generally the highest and the effect of Recover (R9) the least. Therefore, R-strategies with *lower* numbers are referred to as *higher* R-strategies. R0 is the highest R-strategy and R9 the lowest.

Strategies Refuse (R0) and Rethink (R1) do not necessarily involve an increase of reusing products or components. They do, however, decrease consumption of natural resources and materials and are therefore circularity strategies.

Table 6, the ten steps of the 9R model, adaptation of Potting et al., 2017.

Smarter product use and manufacturing	R0 – Refuse	Make product redundant by abandoning the function or coming up with a radically different product
	R1 – Rethink	Intensify product use (e.g. by sharing products or using multifunctional products)
	R2 – Reduce	Fabricate more efficiently by using less resources and materials for the product or in using it
Extend lifespan of product and its parts	R3 – Reuse	Reuse disposed products that are still useful in their original function, but by another user
	R4 – Repair	Reparation and maintenance of broken products for usage in its original function
	R5 – Refurbish	Renew or modernise an older product
	R6 – Remanufacture	Use parts of a disposed product in a new product with the same function
	R7 – Repurpose	Use whole or parts of a disposed product in a new product with different function
Utilise materials efficiently	R8 – Recycle	Process the materials of a disposed product to the same (high grade) or lesser (low grade) quality
	R9 – Recover	Recover energy in materials by incineration

Figure 8 is an adaptation of figures by the EMF (2015) and Potting et al. (2017), and visualises the steps of the 9R model in a product chain. It shows how higher R-strategies create tighter circles than low R-strategies. The figure does not visualise R0, as it removes or shrinks the flows in the product chain altogether.

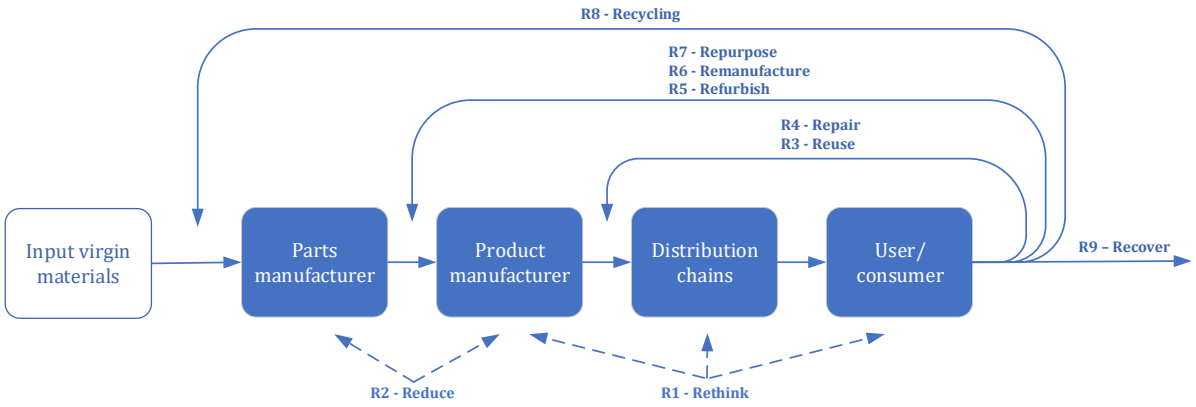

Figure 8, visualisation of 9R model in the product chain.

The 9R model facilitates analysis of EPR instrument or scheme's level of circularity by examining the R-strategy that is incentivised by the instrument or scheme. Appendix B and Chapter 5 use this method to answer the question of what the level of circularity of EPR instruments is. An analysis of the instruments and their institutional features provides insight into likely resulting R-strategies. When generalising the findings in chapter 5 and combining them with information from case studies in chapter 6, barriers and opportunities for EPR to attain higher levels of circularity can be identified. Barriers are structural elements that prevent higher R-strategies. Opportunities are possibilities to circumvent these barriers or find other ways to attain higher R-strategies.

3.3.4. Conclusion on CE

This section on CE has stated its definition and a model that ranks circular strategies. EPR instruments and schemes will be analysed for circularity by examining incentives for R-strategies. Instruments and schemes that incentivise no or low R-strategies are deemed as low in circularity. Their counterparts that incentivise high R-strategies are labelled as highly circular. These analyses are used for finding barriers and opportunities for EPR to attain higher levels of circularity.

3.4. Conclusion on theoretical framework

The first section of this chapter specifies an institutional framework that provides a tool to analyse the working of EPR schemes. The framework consists of the following concepts and theories, followed by their area of focus when analysing EPR.

- **Institutions,** as defined by Hodgson (2006), refers to institutional foundations of EPR schemes and instruments and parties in them.
- **Transaction costs,** as defined by Furubotn and Richter (2005), will direct the analysis to costs of collection and processing EOL products.
- **Property rights,** as defined by Hodgson (2014b), will help to analyse the distributions of property rights that follow from legislation, contracts or covenants between parties in the scheme.
- **Responsibilities,** as defined by Lidhqvist (2000), will help to map the informative, physical and financial responsibilities of parties in EPR instruments or schemes.
- **Agency theory,** as defined by several authors (Cuevas-Rodríguez et al., 2012; Jensen & Meckling, 1979), structures the analysis of interests of stakeholders and the resulting behaviour.

Describing how the institutional concepts and theories are featured in EPR provides an understanding of its working. Moreover, the institutional analysis helps indicating points of improvement to strengthen the role of EPR in the transition to a CE.

The second section provides a theoretical account on EPR. The section describes EPR as a policy principle that is put into practice in EPR schemes. EPR schemes consist of one or more EPR instruments. The sets of EPR instruments provided by several influential sources differ from each other. A clear description and categorisation of EPR instruments are therefore needed when analysing their institutional working. Two of the three main goals of EPR correspond with circular strategies.

The characteristics of a circular system have been described in the third section. EPR instruments and schemes are deemed as higher in circularity when they incentivise a lower input of virgin materials and lead to less waste. In practice, circularity will be assessed by analysing to what R-strategy EPR instruments and schemes lead. EPR instruments and schemes that lead to higher R-strategies are deemed more circular. Barriers and opportunities for EPR schemes are assessed along these lines:

- **Barriers** are structures that hinder (higher) R-strategies.
- **Opportunities** are possible changes to overcome these barriers or attain higher R-strategies in another way.

Altogether, this chapter fulfils the requirements proposed in section 2.1.1 and should provide a sound theoretical foundation to support the research in this thesis.

II. Results

4. Categories of EPR instruments

In literature, EPR schemes and corresponding policy instruments are categorised in various ways. This chapter presents a summary of the categorisation and analysis of various forms of EPR instruments that are extensively described in Appendix A. Where this chapter is inconclusive or unclear, the reader is referred to Appendix A for the in-depth analysis. The instruments are analysed and categorised according to the institutional framework in chapter 3. This method should provide an answer to the first sub-question: '*what is the institutional working of EPR instruments?*'. These instruments should be covered by the definition of EPR in section 3.2.2 and described in literature on EPR.

4.1. Analysed instruments

Several sources are used in order to make sure that all EPR policy instruments are taken into account in this study. The starting point is the categorisation in Table 4 on page 22, which shows the instruments referred to by three influential authors. The table shows that the set of instruments listed as 'EPR instruments' varies. Most (academic and non-academic) literature on EPR refers to the work by the OECD, most notably their 2001 guidance manual and the updated version from 2016. This manual has been instrumental in designing EPR systems in many countries (Gupt & Sahay, 2015). Therefore, the categorisation from the 2016 OECD manual is regarded as leading. Other influential sources such as Widmer et al. (2005) and Gupt & Sahay (2015) complement the OECD manual. Occasionally, these sources offer clearer distinctions between EPR instruments than the OECD.

Five categories of instruments were distinguished. The set of instruments and overarching categories that are studied in this analysis is shown by Table 7. Instruments were chosen to analyse when either the OECD or other mentioned influential sources mention them. A second prerequisite is that the instrument is described extensively enough to enable further analysis. Where no clear description by the mentioned sources was found, the instrument was not included in the analysis in this thesis.

Table 7, analysed instruments.

Category	Instrument
Product take-back requirements	General take-back requirements
	Collective Producer Responsibility (CPR)
	Competition between PRO's
	Individual Producer Responsibility (IPR)
	Voluntary take-back requirements
Economic and market-based instruments	Deposit-Refund Systems (DRS)
	Advance Disposal Fee (ADF)
	Material taxes
	Upstream Combination Tax/Subsidy (UCTS)
Regulatory approaches	Minimum product standards
	Prohibition of materials
Information-based instruments	
Voluntary approaches	

4.1.1. Product take-back requirements

The first category is product take-back requirements or in short take-back. The instruments in this category are so common in EPR schemes that interviewees often referred to this category when mentioning EPR. In general, these instruments are put into practice by setting collection and recycling targets (OECD, 2016), which are coupled with the amount of products put on the market by producers. Often, producers are allowed to set up a Producer Responsibility Organisation (PRO) that fulfils the responsibility of collection and recycling for a collective of producers. In these schemes with Collective Producer Responsibility (CPR), the physical responsibility of producers is exchanged for a financial responsibility towards the PRO. In some cases, there is one PRO while other EPR schemes feature more than one PRO in competition with each other. In schemes where producers are individually responsible, the take-back instrument is referred to as Individual Producer Responsibility (IPR). The distinction between IPR and CPR is non-binary, which means that an EPR scheme with product-take back can feature aspects from IPR and CPR. Take-back schemes are deemed voluntary when they are not implemented to adhere to governmental law legislation but are the result of an industry initiative. This type of take-back is comparable to the larger category of EPR instrument referred to as Voluntary approaches in section 4.1.5.

The different types of take-back instruments are described as distinct instruments. However, an implemented EPR scheme often features a product take-back requirement instrument that could be seen as a combination of these types. Figure 9 shows how take-back instruments can feature aspects of different types. This figure would be even more realistic if the types at the end would describe 'collective scheme with/without competition with a degree of IPR'. This would, however, greatly complicate analysis in this and the next chapter. Therefore, the described types of take-back instruments are seen as distinct from each other.

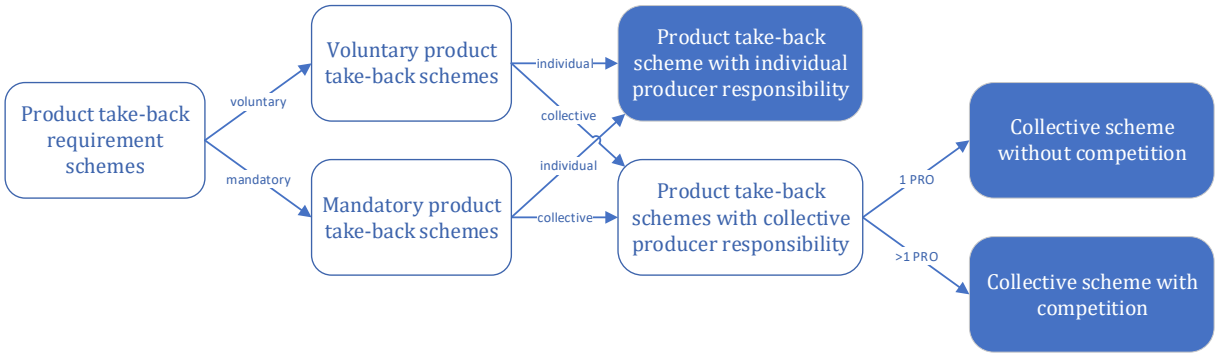

Figure 9, different types of product take-back requirement schemes.

4.1.2. Economic and market-based instruments

Four types of economic and market-based instruments were distinguished in appendix A. The first, Deposit-Refund Systems (DRS), features an initial deposit that is made at purchase of a product. When a consumer returns the EOL product to a specific location, this deposit is fully or partially refunded (OECD, 2016). The deposit can be seen as a tax that incentivises the consumer to bring back the product after the use-phase.

The other instruments in this category feature taxes as well. Advance Disposal Fees (ADF) are taxes paid by producers when they put products on the market. The revenue of the taxes is used for disposal of the products after the use phase. Material taxes can come in two forms. The first is a special tax imposed on the use of materials that are potentially harmful and difficult to recycle (OECD, 2016). Such a tax encourages producers to use less harmful materials. The second is a tax on the use of virgin material that incentivises the use of secondary (recycled) materials. Ideally,

both taxes are set at a level where the marginal cost of the tax equals the marginal cost of treatment (Gupt & Sahay, 2015). The fourth type of instrument in this category is an Upstream Combination Tax/Subsidy (UCTS), where upstream producers (in contrast to the producer of the end-product) pay a tax that is used to subsidise waste treatment (OECD, 2016). UCTS provides producers earlier in the production chain with incentives to alter material input and design of products while providing a financing mechanism to support treatment and recycling.

The four instruments in the economic and market-based category are often deemed similar, which makes the distinction between them ambiguous. ADF essentially is a simpler version of the other instruments, as it is similar to a deposit without refund. In case material taxes are used for financing of post-consumer treatment of products, they technically are an ADF as well. Moreover, product take-back requirements are sometimes combined with ADF (OECD, 2016).

4.1.3. Regulatory approaches

Regulatory approaches are instruments that regulate product designs, disposal or emissions. This description could refer to many instruments, but in literature on EPR, it almost exclusively refers to product standards and prohibitions of materials or products.

Minimum product standards obligate producers to design products that conform to specific product standards. These standards can apply to different parts of the design or even the method of the design itself. However, in the light of EPR, product standards often address a minimum recycled content that products should contain (OECD, 2016). Standards can be mandatory but are often applied as voluntary industry initiatives.

Standards obligate producers to use certain materials or processes, and this instrument does the opposite: it prohibits the use of certain hazardous materials or products. Prohibitions can be mandated from a government or voluntary as an industry initiative. In EPR schemes, prohibitions are often used in case of materials or products that are not recycled easily.

4.1.4. Information-based instruments

The set of instruments listed under information-based instruments is diverse, but these instruments have one thing in common: producers have the responsibility to provide information about their products or work processes. In this way, these instruments indirectly enhance or support EPR by raising public awareness or providing recyclers with knowledge of products and used materials (OECD, 2016).

4.1.5. Voluntary approaches

The category of voluntary practices is a common denominator for a wide range of instruments that can be part of EPR schemes. This category is very diverse and has unclear demarcations. Therefore, only some general remarks will be made on the subject.

Technically, all voluntary initiatives in which producers extend their responsibility to additional parts of the life cycle of their products would belong to this category. Examples from EPR literature are public/private partnerships, leasing and servicing, social contracts, and gentlemen's agreements. These examples have in common that the producer's interests are aligned either with another party (partnerships/social contracts/gentlemen's agreements) or an alternative business model (leasing and servicing).

4.2. Method of analysis

The instruments are analysed by utilising the institutional framework in section 3.1. Table 3, on page 18, shows the concepts and theories in the institutional framework. The table further summarises the focus of analysis of the institutional framework and shows how the EPR instruments in this thesis are analysed. All listed EPR instruments are analysed using the table. When deemed as a relevant, the institutional feature was described. The concept or theory is

deemed relevant when a change of the feature could affect the outcome of the instrument or scheme. However, the choice of whether an institutional concept is relevant remains somewhat arbitrary. The analyses of all instruments are found in Appendix A.

4.3. Institutional analysis of EPR instruments

This chapter is a summary of Appendix A, where standard EPR instruments are described and analysed from an institutional perspective. This section summarises the chapter in order to answer the sub-question '*what is the institutional working of EPR instruments?*'. Table 8 (on page 33) shows an overview of the institutional features of the analysed instruments. An X indicates that the concept or theory was deemed relevant for the instrument and was used for the institutional analysis. The abbreviations in the upper row refer to the institutional concepts and theories.

The by far most used EPR instrument is product take-back requirements. Producers are assigned the physical responsibility to collect a target of property rights over EOL products in order to process them. The required processing method is most often recycling. A variety of product take-back instruments exists. They are implemented with the aim to achieve targets efficiently and keep associated transaction costs low. The variations trade individual physical responsibilities for financial responsibilities (resulting in a shift from IPR to CPR) and keep transaction costs low by enabling or blocking competition between PROs, or avoid PA problems when set up voluntarily. The context, particularly the type, volume and value of the product, determines what variation achieves the best results.

Of the described economic and market-based instruments in this chapter, only DRS involves the collection of EOL products and the associated property rights. DRS and all other instruments in this category assign financial responsibility to producers in the form of a tax. This tax is often used to finance the collection and recycling of EOL products, i.e. transaction costs.

Regulatory approaches such as product standards and prohibition of materials and products are straightforward and assign physical and informative responsibilities to producers. Additionally, the process of standardisation can affect the agency of the parties involved.

Information-based instruments and voluntary approaches are broad categories under which various instruments are categorised. Their main institutional feature is an effect on agency. Both categories align interests of parties, either via institutional foundations (voluntary pacts between producers) or an exchange of information (between producers, consumers and recyclers).

Table 8, institutional concepts/theories used for analysis of instruments.

Category	Instrument	In	PR	TC	PhR	FR	IR	Ag
Product take-back requirements	General take-back		**X**	**X**	**X**		**X**	
	CPR	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	Competition			**X**				
	IPR		**X**	**X**	**X**	**X**		
	Voluntary	**X**						**X**
Economic and market-based	DRS		**X**	**X**	**X**	**X**	**X**	**X**
	ADF			**X**		**X**		
	Material taxes	**X**		**X**		**X**	**X**	
	UCTS			**X**		**X**		**X**
Regulatory approaches	Minimum product standards				**X**	**X**	**X**	**X**
	Prohibition of materials				**X**		**X**	
Information-based instruments							**X**	**X**
Voluntary approaches		**X**						**X**

Appendix A, where the institutional analysis is extensively described, was used as input for the analysis in the following chapter and Appendix B.

5.Circularity of EPR instruments

Chapter 5 answers the following sub-question *'do different types of EPR instruments and their institutional features incentivise circularity?'* The chapter is a summary of Appendix B, where the analysis of EPR instruments is described extensively. Input for answering the sub-question is the descriptions and institutional analyses from Appendix A (summarised in chapter 4) combined with the theory on CE in chapter 3.

5.1. Determining EPR instruments' circularity

This chapter describes to which R-strategy EPR instruments can lead and whether and how its institutional features affect the level of circularity of the instrument. For every instrument, the following questions are answered:

- To which R-strategy does/can the instrument lead?
- What effect do the institutional features have on the level of circularity of the instrument?

The working of the instrument is evaluated in order to answer these questions.

The term 'R-strategy' refers to the 9R model, introduced in chapter 3. The R-strategies in the 9R model are visualised in Figure 10. This model facilitates analysis of EPR instruments' level of circularity by examining the R-strategy that is incentivised by the instrument or scheme.

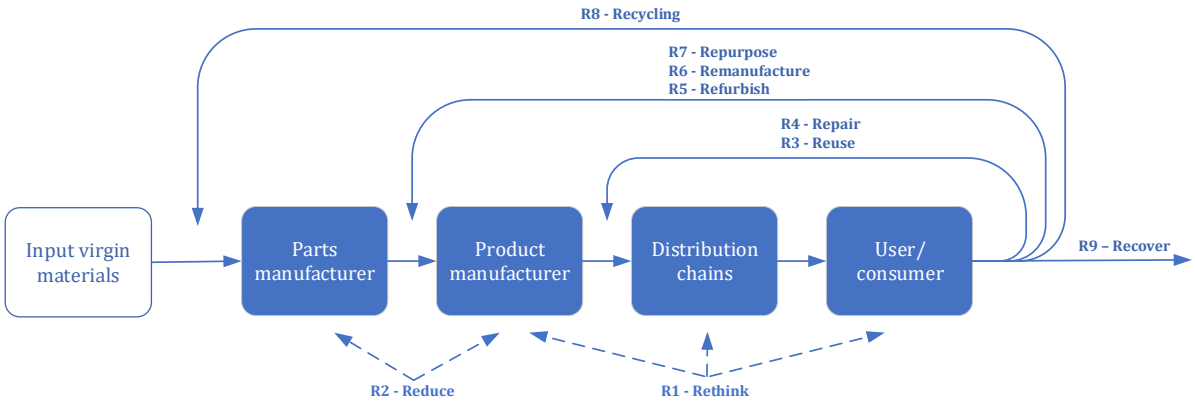

Figure 10, visualisation of 9R model in the product chain, copy of Figure 8.

Appendix B describes which R-strategies are possible or incentivised by the EPR instrument introduced in Appendix A and chapter 4. This varies from recover (R9, the lowest) to refuse (R0, the highest). See section 3.3.3 for a detailed description of the R-strategies. Additionally to describing the incentivised R-strategy, the logical or probable effect of the institutional features on the level of circularity is analysed. These effects are deemed positive (+), negative (-), both negative and positive (±), no effect (0) or unclear (?).

5.2. Three ways of incentivising circularity

In this chapter, the analysis in Appendix B is summarised and generalised in order to answer the sub-question *'how can different types of EPR instruments and their institutional features incentivise circularity?'*. The sub-question was answered by analysing to which R-strategies different EPR instruments lead or may lead, followed by an analysis of the effect of separate institutional features on the instrument's circularity.

The analysis shows that EPR instruments can theoretically incentivise R-strategies in varied ways. The results are joined with the effect of the instruments' institutional features on circularity in Table 9.

Table 9, overview effects of EPR instruments' institutional features on circularity.

Instrument	Leads to R-strategy	In	PR	TC	PhR	FR	IR	Ag
General take-back requirements	R3 - R9		+	0	±		+	
CPR	R8 - R9	0	-	0	-	+	0	±
Competition	-			±				
IPR	R3 – R8 & R1 – R2		±		±	+		
Voluntary take-back	-	?						+
DRS	R3 – R8 & R1		+	-	+	+	+	±
ADF	-			+		+		
Material Taxes	R0 – R8	+		+		+	+	
UCTS	R3 – R9			+		+		+
Standards	R1 – R2 & R3 – R9				+	+	+	?
Prohibition of materials	R1 – R2 & R3 – R9				+		+	
Information-based instruments	-						+	?
Voluntary approaches	-	0						+

Three main ways in which EPR incentivises R-strategies were found: 1) mandating producers to take back ownership over EOL products, 2) adjusting costs and revenues of processing EOL products beneficially, and 3) promoting product design. The following sections describe these three workings in more detail.

5.2.1. Taking back ownership

The first and arguably most effective method in which EPR instruments incentivise circularity is by mandating producers to take back ownership over EOL products, e.g. with product take-back requirements and DRS. In these instruments, ownership of EOL products incentivises producers to apply processes that retain the highest value of the product. Not only are producers in these instruments incentivised to choose an R-strategy that extends the life span of their products, i.e. repurpose (R7) up to re-use (R3). Producers are incentivised to adjust their product design to these strategies as well (R2 and R1). However, these incentives are in only in place when the producer is individually responsible for processing the EOL products. When systems are set up to process products collectively, most incentives for redesigning products are removed from the scheme as producers do not directly experience the benefits of their design changes.

5.2.2. Adjusting costs of processing EOL products

A second method by which EPR instruments incentivise R-strategies is by adjusting the costs and revenues of processing EOL products beneficially, often by implementing a subsidy for the preferred form of processing. ADF and UCTS, for example, tax (upstream) producers and use the revenue to subsidise processers of EOL products. Material taxes incentivise R-strategies in the same manner but more subtly. Taxing virgin materials makes them more costly for producers resulting in more expensive products. As recycled materials are not taxed, demand for recycled materials or re-used products will probably rise, which heightens the incentive to apply R-strategies.

5.2.3. Promoting product design

Promoting product design is the third way in which EPR instruments incentivise circularity. Minimum product standards and prohibition of materials and products directly influence product design. When done correctly, this will incentivise circularity. Other instruments could influence product design indirectly. The first of two examples is described above: when producers are required to regain ownership over products, they can be incentivised to adjust product design in such a way that more value can be retained after the consumer phase. The second example is material taxes. When virgin materials are more expensive through taxes, producers are incentivised to use less or other (for example recycled) materials, which boosts circularity.

5.3. Effect of institutional components of EPR instruments

The following sections generally describe the effects of institutional components in EPR instruments.

5.3.1. Institutions

The formal institutional base of EPR instruments is only relevant to CPR, voluntary take-back, material taxes and voluntary practices. In what matter institutional base influences circularity is somewhat unclear, but it seems that there is no direct effect between the two. Indirect effects probably can occur, as the institutional foundation of schemes or organisations within a scheme can influence agency with involved parties.

5.3.2. Property rights

In the four instruments where property rights were distinguished as an institutional feature, a pivotal role in their possible circularity was played by those property rights. When producers are required to gain ownership over EOL products, instruments offer direct possibilities to carry out all R-strategies up to R3. With instruments that lack the requirement to regain property rights, incentives for R-strategies from R9 up to R3 are indirect. For example, regulation-based instruments offer incentives for strategies R3 – R9 trough a physical responsibility. However, because there is no obligation to gain ownership over EOL products, the incentives are indirect. The instrument does not offer possibilities to bring R-strategies into action.

5.3.3. Transaction costs

Transaction costs are a significant institutional component of product take-back schemes and DRS. However, they relate more to the efficiency of the system than circularity. Efficiency is vital for EPR, yet it seems that transaction costs do not have an important role in the circularity of a system or instrument. The only exception is transaction costs in DRS. With DRS, producers (or operators of the system) are disincentivised to aim for 100% collection.

5.3.4. Responsibilities

Arguably not surprising, but physical responsibility seems to be an important factor in the circularity of instruments, especially when it concerns an individual responsibility. This can be deemed unsurprising because higher circularity is a logical consequence of assigning individual producers with the responsibility to physically redesign products, collect EOL products and/or act out R-strategies.

Maybe more surprising is the observation that financial responsibilities affected circularity positively in all analysed instruments. All the various forms of assigned financial responsibilities incentivise producers to carry out R-strategies. It could have been expected that some instruments showed financial incentives against circularity, but none were found.

Informative responsibilities in described instruments were all deemed to affect circularity positively. Information-based instruments were deemed too broad to analyse the effects of the

provided information. However, administrative responsibility linked to providing information provided circular incentives in these instruments. This observation tells us that tracking the use of materials and products, followed by spreading information about products to either consumers or other parties in EPR schemes generally has a positive influence on circularity.

5.3.5. Agency

The effects of agency in EPR instruments show varied results. With some instruments, the effect on circularity is positive. With others, they are positive as well as negative. The effects were unclear in the third group of instruments. In general, EPR instruments change agency for involved parties because interests are either aligned or contrasted, often both simultaneously. The outcome depends on the specific application of the instruments and the parties involved.

6. Case studies of EPR schemes

This chapter answers the sub-question '*what is the institutional environment of EPR schemes in the Netherlands?*' It does so by describing two operating EPR schemes in the Netherlands, for Packaging and Electronic and Electric Equipment (EEE). Additionally, a case study of the process of implementing EPR for textiles in the Netherlands is described.

6.1. EPR scheme for WEEE

The Dutch scheme for Waste of Electronic and Electric Equipment (WEEE) or e-waste was initially implemented in 1999 (Minister van Volkshuisvesting Ruimtelijke Ordening en Milieubeheer, 1998). Affected by European legislation, it has been extended and changed through the years. The system has been up for debate continually, as parties disagree over what is an ideal system. Figure 11 visualises the current scheme. It shows material flows (full arrows) and monetary flows (dotted arrows). The roles of the depicted actors are described in section 6.1.4.

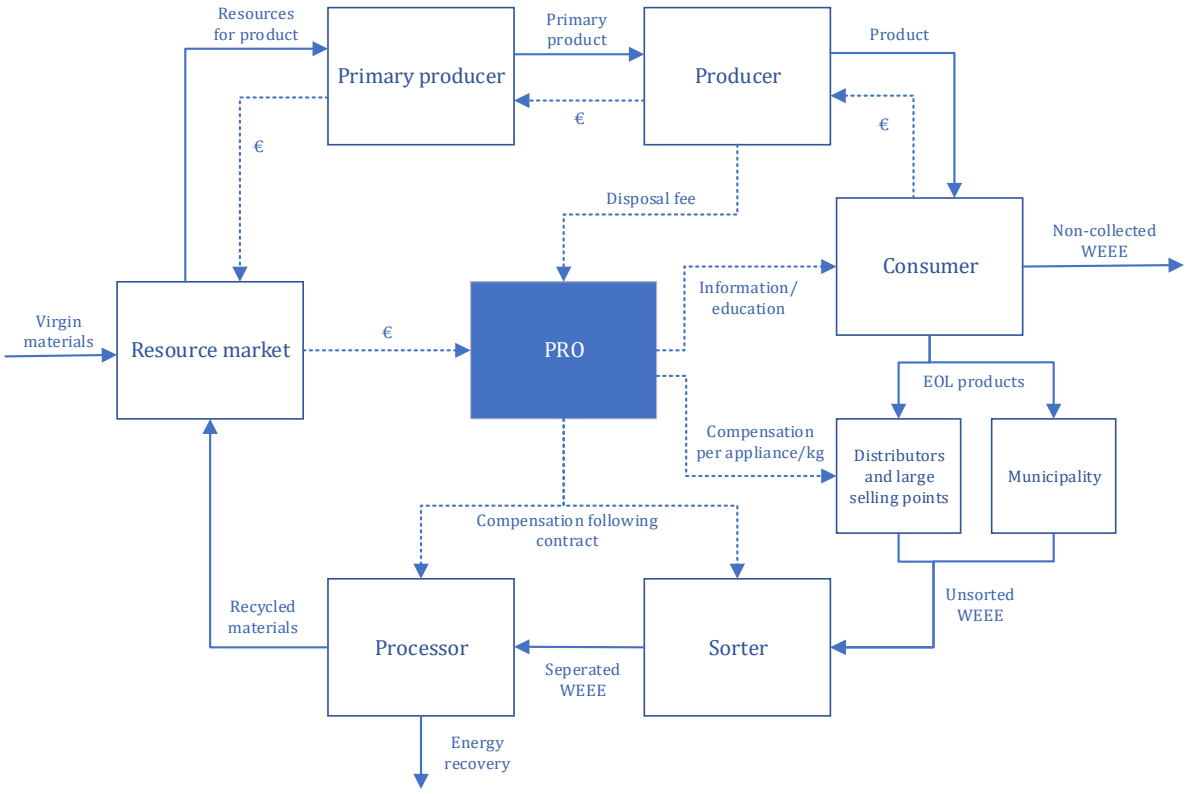

Figure 11, visualisation of Dutch EPR scheme for WEEE.

Figure 11 visualises the route of materials in the EPR scheme for WEEE. The primary producer manufactures primary materials or components for producers. Producers (or importers) put their products on the market and pay a disposal fee to a PRO for every product. An exception is producers who keep their products as property (for example via lease contracts). According to an interviewee, producers that can monitor and process their own products could receive an exemption from the system. Consumers are informed and educated by PROs to return WEEE at retailers or designated municipal locations. PROs monitor and subcontract logistics, sorting and processing (recycling and recovery) of WEEE until the processor puts the recycled materials on the market.

An alternative route for WEEE was described by an interviewee. Many appliances are sold in thrift shops and therefore withdrawn from the EPR scheme. However, some producers (such as the interviewer's employer) offer repair services to these thrift shops in order to protect their high-quality branding. This route of repair and reuse is not included in the EPR scheme.

6.1.1. EPR instruments

Following the categorisations in chapter 4, the Dutch scheme for WEEE currently in place is a collective product take-back requirement system with competition between PROs. The system is combined with a prohibition of products with inbuilt batteries.

The scheme was initially implemented in 1999. Its primary instrument was an ADF on home appliances. Revenues were used to set up Wecycle, an organisation that was tasked with collecting and recycling these appliances. Influences by European Directives, starting in 2003, changed the scheme by setting targets for collecting, recycling and recovery WEEE (European Parliament and Council, 2003). Until implementation of the WEEE Arrangement [Regeling Afgedankte Elektrische en Elektronische Apparatuur] (RAEEA), Wecycle was the only PRO in the system. By now, several active PROs are competing with one another.

Currently, there is no eco-modulation applied in the Dutch EPR scheme for WEEE, other than an incidental disposal fee based on weight. According to an interviewee, eco-modulation would be possible, but it has two difficulties. Firstly, products have to be assessed on eco-design, and the question is how this assessment is done best. Secondly, eco-modulation leads to an extra administrative burden for producers and PROs.

Theoretically, following the analyses in chapter 5, a collective product take-back requirement system with competition between PROs could lead to Recycling (R8) and Recovery (R9). The prohibition of inbuild batteries should incentivise R-strategies R9 up to R3 and might lead to Rethinking (R1) or Reducing (R2) the products.

6.1.2. Legislation

The Decision on Management of White and Brown Goods [Besluit Beheer Wit- en Bruingoed] (BBWB) initially implemented the EPR scheme (consisting of an ADF and setting up Wecycle) in the Netherlands (Minister van Volkshuisvesting Ruimtelijke Ordening en Milieubeheer, 1998).

In 2003, the European Directive 2002/96/EC was installed to prioritise collecting, reuse, recycling and recovery of WEEE in European member states (European Parliament and Council, 2003). It set WEEE collecting, recycling and recovery targets member states and penalties when these targets were not met. The Directive was updated in 2012 with the European Directive 2012/19/EU with higher targets and among other additions a categorisation of products (European Parliament and Council, 2012).

The European Directives are implemented in Dutch law in the RAEEA, which altered the existing EPR scheme for WEEE, based in the BBWB, to comply with the EU's Directives. The RAEEA has been updated through the years to adhere to the Directives and streamline the scheme in place. The latest update of the RAEEA is as recent as August 2020, adding a registration requirement for exporting second-hand EEE and adjusting norms for waste processors (Staatssecretaris van Infrastructuur en Milieu, 2020b).

The influence of stakeholders on legislation is unclear. The Ministry of I&W stated that there is no protocol for the decision-making process around EPR schemes. This statement aligns with differing accounts of interviewees regarding their influence on legislation.

6.1.3. Product system

The EPR scheme for EEE broadly applies to products that depend on electricity to operate (Rijkswaterstaat, Ministerie van Infrastructuur en Waterstaat, & Inspectie voor Leefomgeving en Transport, 2018). The European Directive 2012/19/EU used to classify WEEE in ten categories,

but the number of categories was reduced to six in 2018. Table 36 displays the current categories and the targets and results of collecting, recycling and recovery in 2019 (Nationaal (W)EEE Register, 2020). Collecting targets are stated in the RAEEA and imply that producers must either collect and process a minimum of 65% of average weight EEE put on the market in NL in last three years, or a minimum of 85% of average weight EEE put on the market in NL in that same year (Staatssecretaris van Infrastructuur en Milieu, 2020b).

Table 10, overview of categories, targets and results of EPR scheme for WEEE in 2019.

	Collecting	Recycling		Recovery	
Category	Result	Target	Result	Target	Result
Temperature exchange	70%	80%	85%	85%	99%
Screens and monitors	99%	70%	81%	80%	98%
Lamps	44%	80%	93%	-	96%
Large equipment (> 50 cm)	51%	80%	83%	85%	97%
Small equipment (< 50 cm)	45%	55%	76%	75%	93%
Small IT and telecom	96%	55%	84%	75%	93%

The results in Table 10 indicate that targets for processing are met with comfortable margins. Collecting results, however, do not approach the targets between 65% and 85%. Only in the categories *screens and monitors* and *small IT and telecommunication equipment* the collecting targets are more than met.

EEE are often complex products consisting of many different materials such as plastics, glass and several precious metals. Hazardous materials such as CFCs and batteries with cadmium are often found in EEE as well. The WEEELABEX norm describes how processors have to process EEE safely. After removal of hazardous and valuable materials, WEEE is often shredded. The resulting shreds are sorted in metals and non-metals. The end-product of the process are different granulates that form the base for new products. Metals are often molten down, which results in high-grade metals. The other end-materials, mostly plastics, are often of lower quality than the original. Coolrec provided two examples of products made from these granulates: a circular vacuum cleaner and the drip tray of a coffee machine.

6.1.4. Actors in the WEEE scheme

Table 11 provides an overview of stakeholders and their role in the EPR scheme. The table describes actors that are actively involved in the scheme. Parties that are affected but do not play an active role. For example, consumers and primary producers are left out.

Table 11, overview of stakeholders in the EPR scheme for WEEE.

Actor	Description and role
Producers of EEE	All parties that produce or import EEE for the Dutch market are responsible for physical collecting, recycling and recovery of their products.
PROs	Organisations that bear the responsibilities of producers in exchange for a disposal fee. In practice, PROs oversee the process from collecting to recycling and outsource physical tasks to logistic partners, sorters or processors.
Municipalities	Responsible for separate collection of WEEE. Every municipality is required to assign a designated location where inhabitants can bring WEEE. Municipalities are compensated by PROs per kg of e-waste.
Distributors and large selling points	Required to accept returned EOL products. Retailers that are partnered with a PRO can have WEEE-bins where consumers can deposit e-waste.
Sorters	Service centres, contracted by PROs, where different material streams are separated and prioritised.
Processors	Subcontractors that are only allowed to perform recycling or recovery of WEEE when WEEELABEX-certified, which means they 1) have the right equipment, 2) can prove that final materials match with reported materials, and 3) can declare where materials go to after processing. Processors put recycled materials on the market and share the profits with PROs according to a contract.
Ministry of I&W	Legislator and in that role responsible for implementing and enforcement of EPR legislation including instrumental linking to other legislation. Initiates explorations to new EPR schemes or improvements to existing schemes.
Rijkswaterstaat	Monitors EPR schemes and uses this knowledge in setting up new EPR schemes. Assesses reports on EPR and reports the ministry of I&W on them.
Stichting National (W)EEE Register	Non-profit organisation that registers and reports collecting, recycling and recovery rates in the Netherlands.

Producers are defined in the RAEEA as legal entities that either design and produce EEE for the Dutch market themselves or market EEE that is produced outside of the Netherlands (Staatssecretaris van Infrastructuur en Milieu, 2020b). The primary indicator for whether parties are seen as producers by the RAEEA is whether a party brings products on the Dutch market. This mechanism enables assignment of responsibilities to producers that are not based in the Netherlands or to distributors that import EEE for the Dutch market.

6.1.5. Upcoming changes

Since its start with the Besluit Beheer Wit- en Bruingoed, the Dutch EPR scheme for WEEE has never stayed unchanged for long. Even though a change in the RAEEA has just been implemented, new changes are in the making. Two of those, both initiated by PROs, are discussed in the sections below.

6.1.5.1. Disposal fee for refrigerators

WEEE Nederland, a PRO that broke the monopoly of Wecycle with its establishment in 2013, has proposed a recycle plan for refrigerators as part of a 54 points plan by Urgenda (Urgenda, 2019). As there are an estimated 3 million refrigerators older than ten years - and therefore very polluting - in use in the Netherlands, this plan proposes a one-time offer for consumers of 35 euros

to change their refrigerators for newer ones. The one-time offer is combined with a proposed DRS for refrigerators where buyers pay a high disposal fee when purchasing of which half is refunded upon return.

The Dutch government partially has partially accepted the plan (Rijksoverheid, 2020a). The one-time offer for owners of old refrigerators is deemed too costly. The DRS for refrigerators is adopted. It is unclear, however, when the addition to the system will be implemented. An interviewee of WEEE NL stated that they have not heard from the responsible ministry after the news that the plan was adopted.

6.1.5.2. Stichting OPEN

Non-profit organisation Stichting OPEN has been set up in December 2019 by six product organisations (NVMP, 2019). These product organisations are presently connected to NVMP, of which Wecycle is the executive branch. Stichting OPEN has requested an order declaring a collective agreement binding or Algemeen Verbindend Verklaring (AVV), which would require all producers of EEE to join Stichting OPEN. The Ministry of I&W has issued a positive draft decision on the requested AVV in September 2020. This will effectively grant a monopoly status to Wecycle, which would be the executive organisation of Stichting OPEN. Reasons for the change are a supposed higher efficiency in collecting WEEE and a fair distribution of costs between producers (Stichting OPEN, 2020).

Competing PRO WEEE Nederland is, unsurprisingly, very discontent with the plans. Approvement of the AVV would essentially discontinue WEEE Nederland and require their 750 member producers to join Stichting OPEN. According to WEEE Nederland's critique, Stichting OPEN's plans would not lead to higher efficiency and go against European competition rules (WEEE Nederland, 2020). On the contrary, WEEE Nederland claims to add visible value to the WEEE scheme since its establishment in 2014, given the fact that since then 750 producers and one in four municipalities in the Netherlands have joined them. An interviewee at WEEE NL stated that they will file for an exemption to the AVV.

6.1.6. Institutional analysis

Concerning institutional characteristics, the EPR scheme for WEEE is based in a European law which is implemented in Dutch law. This results in a formal (and slow) process of adaptation. PROs can take any organisational form but currently are either an executive agency (Wecycle), social enterprise (WEEE NL) or non-profit organisation (RTA; PV Cycle; Zonne-energie Recycling Nederland). According to Wecycle, the organisational form affects the agency of PROs: WEEE NL is incentivised to make a profit. WEEE NL goes against this and states that the system of representation has more influence on agency than the form of organisation.

EOL products and their materials change owners many times through the chain. The collective nature of the scheme ensures that PROs gain ownership over EOL products and producers do not. In Wecycle's case, WEEE is property of the PRO from the moment it is placed in a designated bin until the moment of weighing at a processor. Even though the WEEE is legally Wecycle's possession, all physical handling is done by subcontractors of Wecycle.

Transaction costs of regaining EOL products are relatively high for individual producers. PROs are established to lower the costs per producer. Competition between PROs incentivises the pursuit of low transaction costs. However, in a country the size of the Netherlands, it is unclear whether the scale of the waste streams is large enough to facilitate more than one PRO efficiently.

Various forms of responsibility are exchanged in the EPR scheme. Producers have a physical responsibility to set up systems for the recovery of WEEE collected separately. Target percentages for collection, recycling and recovery depend on the product category. Municipalities are required to realise a location for separate collection and distributors and large selling points are obligated to accept returned EOL products.

Producers' physical responsibilities are exchanged with PROs. Producers are allowed to join PROs who carry out their physical responsibilities in exchange for a disposal fee. These disposal fees are a representation of transaction costs. There used to be an ADF on large appliances, following the BBWB. The revenues were used for setting up Wecycle (in 1999) and stopped by 2013 when the fund reached around 300 million euros.

A producer who brings a new type of electric or electronic appliance on the market has one year to provide information (free of charge) about reuse and processing the appliance. The information has to contain instructions on storing the product, processing its various parts and materials, and where hazardous materials are found. Furthermore, Stichting Nationaal (W)EEE Register in Zoetermeer is responsible for administration and reporting to the Ministry of I&W, following the Directive (Nationaal (W)EEE Register, 2020). Producers and processors are required to report yearly quantities to the register. PROs inform and educate consumers on the disposal of WEEE, for example via lessons on schools.

Cooperation through the whole chain would greatly benefit efficiency and circular ambitions. Interestingly, it seems that the interests are often already aligned. However, parties either do not want to be the only party to bear costs or do not find like-minded peers that have similar ambitions.

The institutional analysis of the EPR scheme for WEEE is summarised in Table 12.

Table 12, summary of institutional features of EPR scheme for WEEE.

Institutional feature	Description
Institutions	• The EPR scheme is based in European law which is implemented in Dutch law. • PROs can take any organisational form.
Property Rights	• EOL products change owners many times through the process. PROs gain ownership and producers do not. • PROs are owner from the moment WEEE is deposited in designated bins until it is weighed at the processor.
Transaction Costs	• Costs of regaining EOL products are (relatively) high for individual producers. Therefore, PROs are set up. • Competition between incentivises the pursuit for low transaction costs.
Responsibilities	• Producers obtain physical responsibility for collecting and recycling WEEE. • Municipalities have physical responsibility to realise a location for separate collection. • Distributors and large selling points have physical responsibility to accept returned EOL products. • Producers are allowed to join PROs in order to exchange physical for financial responsibility. • Producers have the responsibility to provide information on reuse and processing of their new product types. • Stichting Nationaal (W)EEE Register is responsible for administration and reporting on the scheme. • Producers have informational responsibility to report yearly results to the register. • PROs inform and educate consumers on the proper disposal of WEEE.
Agency	• Interests of stakeholders are often aligned, but parties do not want to be bear costs. • There is a discussion between the PROs on whether the institutional base of a PRO has more influence on its agency or its system of representation.

6.2. EPR scheme for Packaging

The current Dutch EPR scheme for Packaging has a long history. It is formed both by covenants between government and packaging producers and by European legislation. The first covenant was forged in 1991 and contained agreements on deposits on reusable and one-way bottles [Mendeley reference Spasova 2019]. EU Directive 94/62/EC on Packaging was 'the first EU legislation to place responsibility on member states to address the recovery and recycling of product-associated wastes' (Cahill, Grimes, & Wilson, 2011, p. 456) or, in other words, the first European Directive on EPR.

Influenced by subsequent covenants and Directives, the EPR system changed through the last three decades. Since the 2013 Framework agreement Packaging (Staatssecretaris van Infrastructuur en Milieu, FNLI CBL RND Fiar Vlehan en BVNL, & VNG, 2013), a central role in the scheme is reserved for Afvalfonds Verpakkingen (AV), a PRO that represents Dutch packaging producers. Figure 12 visualises the scheme in its current form. It shows material (full arrows) and

non-material (dotted arrows) flows through the scheme. Two executive organisations under the AV, NederlandSchoon and VPKT, are left out. Their role, along with the roles of other parties in the scheme, will be discussed in section 6.2.4.

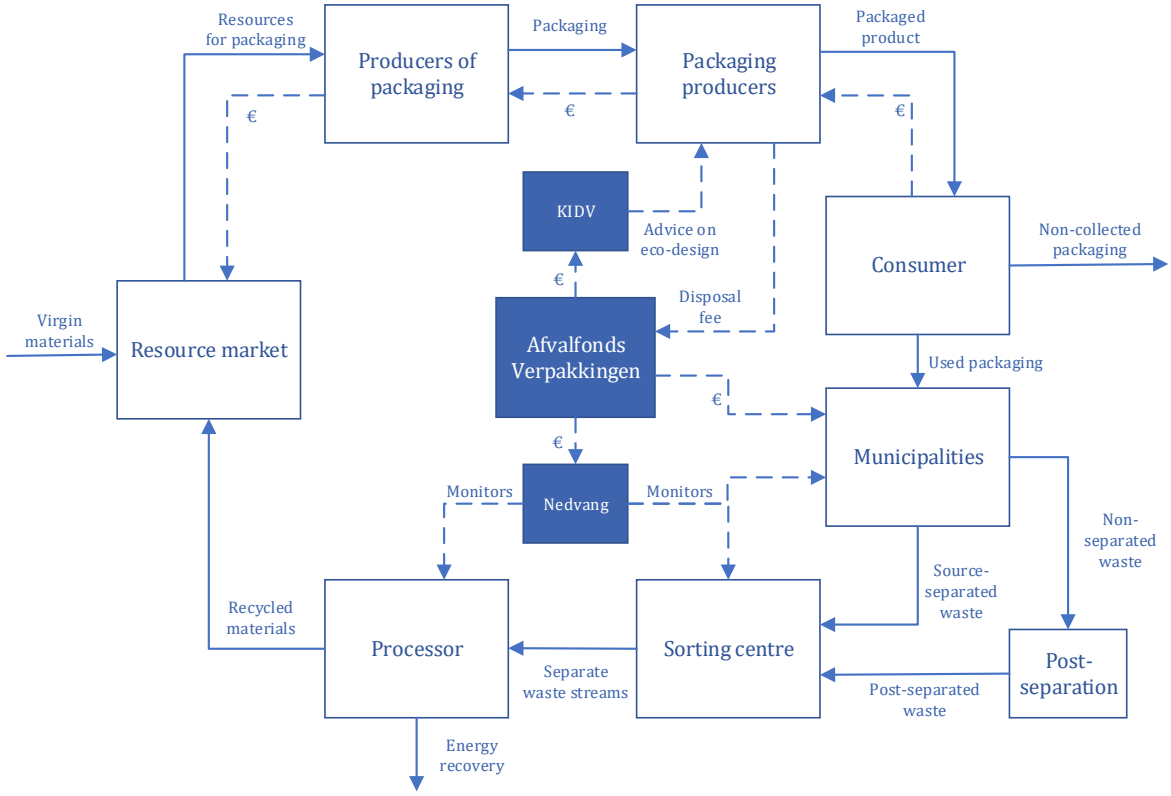

Figure 12, visualisation of Dutch EPR scheme for Packaging.

The EPR scheme specifically assigns responsibility to packaging producers and not producers of packaging. The latter are producers whose output are packaging. Packaging producers use packages for their products. Only producers who use packaging for their products are assigned an extended responsibility.

6.2.1. EPR Instruments

The Dutch scheme for Packaging is a non-competitive collective product take-back scheme, combined with DRS for several types of drink packaging. Packaging producers are obliged to pay eco-modulated disposal fees to AV. Section 6.2.3.1 describes the method of eco-modulation for plastics. The product take-back requirements and DRS are coupled with prohibitions of hazardous materials and several information-based instruments such as reporting requirements for producers and educational campaigns.

A non-competitive collective product take-back scheme could, according to the analysis in chapter 5, theoretically lead to Recycling (R8) and Recovery (R9). However, the implemented eco-modulation, DRS and prohibitions of hazardous materials should incentivise R-strategies up to Rethink (R1). Information-based instruments do not directly lead to a specific R-strategy.

6.2.2. Legislation

The laws and regulations around packaging are recorded in European and Dutch legislation. The base for the EPR scheme was established in the first EU Directive on Packaging 94/62/EC (European Parliament and Council, 1994), updated in 2018 with the European Directive (EU) 2018/852 (European Parliament and Council, 2018). Directive (EU) 2018/852 determines minimum recycling targets to which member states should comply and describes essential

requirements. The essential requirements are minimum requirements for the design of packaging, e.g. limitations of weight and hazardous materials.

The European Directives were integrated in Dutch legislation through various laws and covenants. The most relevant are the Environmental Managemant Act [Wet Milieubeheer] (Minister van Volksgezondheid en Milieuhygiëne, 2020), Decision Management of Packaging [Besluit Beheer Verpakkingen] (Staatssecretaris van Infrastructuur en Milieu, 2020a), and the Framework Agreement Packaging [Raamovereenkomst Verpakkingen] (Staatssecretaris van Infrastructuur en Milieu et al., 2013).

The Environmental Management Act lays down rules for environmental hygiene. It prescribes what tools the government can use for protection of the environment. Relevant for the EPR scheme are its rules on waste streams, disposal fees and DRS.

Directive (EU) 2018/852 is implemented in Dutch law and harmonised with the Environmental Management Act through the Decision Management of Packaging. It describes how producers are assigned responsibilities in the EPR scheme. Additionally, the Decision addresses the definition, requirements and prevention of packaging, reporting requirements and recycling targets in the Netherlands.

The Framework Agreement describes a series of agreements between the ministry of I&W, Dutch municipalities and packaging producers. These agreements further shape how these actors comply with the rules and targets in the Decision Management of Packaging.

6.2.3. Product system

Packaging is defined in the Environmental Management Act as all products, manufactured of any material, that can be used for embedding, protecting, loading, delivering and offering of other products, from resources to finished products, over the whole chain from producer to user or consumer, single-use items used fort this goal included, whereby packaging exclusively includes the sale or primary packaging, collection or secondary packaging and transport of tertiary packaging.

The majority of packaging is used for food and drinks. These kinds of packaging are submitted to many rules concerning health and safety in order to protect consumers. Reuse of packaging is often difficult because of these rules. The EU encourages reusable packaging where possible (Publications Office of European Parliament, 2018).

The EU Directives and Dutch implementation divides packaging into different materials that have their own targets. The European directives state targets for each year up to 2030. The Dutch implementation has heightened these percentages to show their ambitions. Table 13 shows a list with different categories, results in the Netherlands in 2017 and 2018, and recycling targets of the EU and the Netherlands. Metals under the EU targets show double numbers as aluminium and ferrous metals are combined in Dutch targets. The table makes clear that the targets set by the Dutch government are far more ambitious than the EU's. The EU targets for 2025 have already been attained in 2017.

Table 13, overview of categories, targets and results of the EPR scheme for Packaging.

Material type	Result in 2017 (NL)	Result in 2018 (NL)	EU target 2019	NL target 2019	EU target 2025	EU target 2030
Glass	85%	86%	60%	90%	70%	75%
Paper and cardboard	87%	88%	60%	75%	75%	85%
Plastics	51%	52%	22.5%	48%	50%	55%
Metals	95%	95%	50%	85%	70%/50%	80%/60%
Wood	73%	77%	15%	37%	25%	30%
In total	78%	79%	55%	70%	65%	70%

Most Dutch municipalities collect Plastics, Metals and Drinking packages (PMD) separately. Other municipalities apply post-separation to separate these waste streams. According to interviewees, introducing separated PMD collection has had downsides: collecting rates went up, backed by subsidies, but recycling stayed behind. As it was unclear for households how waste should be separated, PMD's quality was often too poor for recycling and mostly ended up in the incinerator. In the meantime, households have become familiar with PMD separation with higher quality as a consequence. This illustrates the importance of informational instruments aimed at consumers.

6.2.3.1. Eco-modulation

The EPR scheme for Packaging features a tariff differentiation based on the recyclability of producers packaging. This form of eco-modulation is implemented by the AV and overseen by the Netherlands Institute for Sustainable Packaging [Kennisinstituut Duurzaam Verpakken] (KIDV). The KIDV produced a recycle check to assist producers in producing sustainable packaging that is easier to recycle. The AV utilised the recycle check for eco-modulation. Packaging producers receive a reduction on the disposal fee when their packaging complies to the recycle check. The KIDV checks packaging and helps producers to comply.

The eco-modulation forms a financial risk for the AV. Discounts result in lower revenues from disposal fees. Therefore, it is important for the AV that packaging that complies with the recycling check are cheaper to process than non-complying packaging. The incentive for the AV is financial and not necessarily circular.

6.2.4. Actors in the Packaging scheme

Table 14 shows an overview of the most important parties in the Dutch EPR scheme for Packaging. The table describes actors that are actively involved in the scheme and leaves out parties that are affected but do not play an active role. For example, consumers and primary producers are not described in the table.

Table 14, overview of stakeholders in EPR scheme for Packaging.

Actor	Description and role
Packaging producers	Producers that use packaging for the products they bring onto the market. Producers are required to pay contributions when they bring more than 50.000 kg of packaging on the Dutch market. This group is largely made up of supermarkets and food companies.
Producers of packaging	These are the parties that provide packaging for products to packaging producers. Producers of packaging are not required to pay contributions as long as they are not the ones who bring packaged products on the market.
Afvalfonds Verpakkingen (AV)	Central PRO in the Dutch EPR scheme for Packaging. The AV is a non-profit organisation that represents producers of packaging. Their main assignment is achieving the recycling goals for packaging. The AV collects disposal fees from producers, provides fees for waste to municipalities, and reports to the Dutch government on their activities and achieved targets. The AV is supported by four executive organisations, the KIDV, Nedvang, NederlandSchoon and VPKT.
KIDV	An executive organisation, funded by the AV. The KIDV advises packaging producers on making their packaging more sustainable, based on scientific and practical knowledge.
Nedvang	Nedvang monitors the amount of packaging put on the market, collected and recycled. The collected numbers are used by the AV to report to the government.
NederlandSchoon	The executive organisation NederlandSchoon's task is to prevent and tackle litter. They use informational instruments aimed at consumers and research behavioural changes.
VPKT	The Verpakkingsketen BV (VPKT) was established in 2018 with the goal to streamline the processing of plastic packaging. VPKT engages in contracts with post-separators, sorting centres, recyclers and logistic partners.
Municipalities	Municipalities are tasked with the collection of household waste. They can choose for a system with source-separation or post-separation.
Processors	Pay for bales of packaging waste and recycles these.
Ministry of I&W	Legislator and in that role responsible for implementing and enforcement of EPR legislation including instrumental linking to other legislation. Initiates explorations to new EPR schemes or improvements to existing schemes.
Rijkswaterstaat	Monitors EPR schemes and uses this knowledge in setting up new EPR schemes. Assesses reports on EPR and reports the ministry of I&W on them.

6.2.5. Upcoming changes

The Dutch EPR scheme is subject to changes. This section describes two forthcoming changes to the scheme, both originating in circular ambitions of the Dutch government.

6.2.5.1. DRS for small PET bottles

DRS for plastic bottles has been a debated topic for a long time among stakeholders in the EPR scheme for packaging. Producers, united in the AV, oppose DRS as they see it as costly and

complex. Eventually, the government agreed to this (NOS, 2012). That is why the Framework Agreement of 2013 contains several commitments concerning DRS (Staatssecretaris van Infrastructuur en Milieu et al., 2013). An example is the concession that the legal obligation for a DRS for large PET bottles would be abolished when performance indicators concerning recycling rates and litter were achieved (Staatssecretaris van Infrastructuur en Milieu, 2014).

The years that followed did not show the promised improvements, which led to an ultimatum by the responsible minister of I&W in 2018 (NOS, 2018). If the sector could not improve recycling and litter rates before 2020, DRS for smaller PET bottles would be implemented. As these improvements have not been achieved, deposits on smaller PET bottles become mandatory in 2021 (Staatssecretaris van Infrastructuur en Waterstaat, 2020).

6.2.5.2. Offensive on packaging waste

The ministry of I&W has announced *a new offensive against packaging waste* in July 2020 (Rijksoverheid, 2020b). Together with producers, the ministry wants to decrease the use of packaging, stimulate reuse, and improve the quality of collecting and recycling. The offensive is based in European rules of the Directive (EU) 2018/852. The Dutch stakeholders have agreed to heighten the objectives of the EU. The EU's overall goal for recycling 2030 (70%, see Table 13) is set in the Netherlands for 2021. For 2025, the ambitions are higher and set on 74%.

The Dutch ministry and producers have added reuse to the objectives in order to incentivise circular strategies. Reuse will count toward recycling targets which incentivises initiatives to reuse. An example is the voluntary Dutch DRS for beer bottles (Rijksoverheid, 2020b). In recent years an increasing amount of beer bottles without deposit appeared on the market. By adding reuse to recycling targets, there is an incentive for producers to use the beer bottle DRS as these bottles are included when calculating recycling achievements.

6.2.6. Institutional analysis

The complex embedding in legislation combined with a basis in European law results in a difficult route to change of the scheme. However, the Framework Agreement has managed to overcome these difficulties and is a voluntary covenant between packaging producers, the ministry of I&W, and municipalities. The Agreement resulted in the AV and its executive organisations, non-profits that are governed by packaging producers.

Property rights of packaging waste go from municipalities to sorters and recyclers. Technically, the AV does not own the waste in the process. Municipalities are incentivised to realise high-quality packaging waste as they are the owner of packaging waste after the consumer and receive the revenues of selling the bales of packaging waste.

The costs of the whole operation of the AV can be seen as transaction costs. These are divided over all packaging producers. As DRS are seen as costly and complicated, transaction costs are often brought up as an argument against DRS.

The physical responsibility of packaging producers is exchanged with the AV for financial responsibility. Therefore, the AV has the physical responsibility for collecting and recycling packaging waste. The Framework Agreement gives other physical responsibilities to producers via the AV, for example operating DRS. Eco-modulation adjusts the financial responsibilities of producers on the basis of the recyclability of the used packaging.

Informative responsibilities are distributed among the executive organisations of the AV. Nedvang monitors and reports the amount of packaging put on the market, collected and recycled. NederlandSchoon informs consumers in order to prevent and tackle litter. VPKT engages in contracts with post-separators, sorting centres, recyclers and logistic partners.

The AV represents all packaging producers. The ministry of I&W and municipalities used to have a seat at the board, but the board currently consists of producer representatives. This puts the AV at risk of becoming a lobbying organisation for packaging producers. Chain cooperation

could be stimulated by diversifying the representation in the board of the AV. Representatives of other steps in the product value chain could bring new perspectives.

Table 15 shows a summary of the institutional analysis of the EPR scheme for Packaging.

Table 15, summary of institutional features of EPR scheme for Packaging.

Institutional feature	Description
Institutions	• Complex embedding in legislation combined with a basis in European law. • The Framework Agreement is a voluntary covenant between packaging producers, ministry of I&W and municipalities. • AV and its executive organisations are non-profits that are governed by packaging producers.
Property Rights	• Ownership of waste goes from municipalities to sorters and recyclers. The AV does not own the waste in the process. • As municipalities are the owner of packaging waste after the consumer and receive the revenues of selling the bales of packaging waste, they are incentivised to realise high qualities.
Transaction Costs	• Transaction costs are the costs of the whole operation of AV; these are divided among all packaging producers. • Transaction costs for DRS are brought up as an argument against it.
Responsibilities	• Physical responsibilities of producers for collecting and recycling are exchanged with the AV for financial responsibilities. • The Framework Agreement assigns physical responsibilities to producers via the AV, for example operating DRS. • The financial responsibility of producers is adjusted with eco-modulation. • Nedvang has the informational responsibility to monitor and report the amount of packaging put on the market, collected and recycled. • NederlandSchoon informs consumers in order to prevent and tackle litter. • VPKT has an informational responsibility to streamline the processing of plastic packaging by engaging in contracts with post-separators, sorting centres, recyclers and logistic partners.
Agency	• The AV directly represents the packaging producers. • Chain cooperation could be stimulated by diversifying the representatives on the board of the AV.

6.3. EPR for Textiles

The current system of producing in the textiles industry essentially operates in a linear fashion (Ecopreneur.eu, 2019). There is a comprehensive system for collecting, reusing and recycling of textiles in place in the Netherlands. However, less than one per cent of the material used for clothing is recycled. Apart from its environmental impact, the sector faces several social challenges such as 'poor working conditions, poverty, exploitation, abuse and gender inequality' (Ecopreneur.eu, 2019, p. 9).

The current system is shaped by producers that collect EOL clothing in their stores and large-scale collectors that make revenues by selling reusable clothing on foreign markets. An interviewee from a non-profit collector explained that they enter into contracts with Dutch municipalities for the right to place collecting bins there. In 2012, 56% of the collected textile waste was reusable and thus profitable for collectors. 37% proved recyclable. 7% was non-recyclable and incinerated (FFact, 2020). These numbers are more or less consistent with Sympany's current results. However, 140 million kgs of EOL textiles are being thrown away in residual waste. Collectors anticipate plans to process these extra kgs, but as the quality is probably lower, they cannot bear the extra costs. They see an EPR scheme as a possible financing structure.

The Dutch government and the sector aspire a transition towards a more circular and social industry (INretail, Modint, & VGT, 2019b; Staatssecretaris van Infrastructuur en Waterstaat, 2019). Their plans aim for 100% use of circular materials in 2050, and one of the tools to achieve this goal is an EPR scheme. An example is found in France, where an EPR scheme has been in place for over ten years. As the French model essentially only provides financial support for better collection of textile waste, the Dutch plans seem more ambitious.

6.3.1. Plans for EPR

The Dutch government plans implementation of an EPR scheme for textiles (Staatssecretaris van Infrastructuur en Waterstaat, 2019). Branch organisations Modint and INretail are working out a potential EPR scheme on behalf of the Dutch textiles industry (INretail et al., 2019b). Their preference goes out to an initially voluntary product take-back scheme that becomes mandatory following an AVV. This form would give producers the possibility to individually collect EOL clothing and achieve take-back and recycling targets independent of municipalities.

Parallel to the development by Modint and INretail, the ministry of I&W researches realistic targets for prevention, reuse and recycling, disposal fees and possible eco-modulation, and possible phases for the scheme (Staatssecretaris van Infrastructuur en Waterstaat, 2019). The outcomes could assist in further detailing of the scheme proposed by the sector organisations. It could also serve as a basis for a mandatory EPR, in case the voluntary EPR takes too long or is considered insufficient. A textile covenant, comparable to the Framework Agreement Packaging, is anticipated before the end of 2020. A definitive proposal for an EPR scheme will be made by the ministry of I&W in spring 2021.

6.3.2. Product system

The greater part of textile products that are put on the Dutch market is produced outside of the Netherlands and in particular in Asia (INretail, Modint, & VGT, 2019a). The global nature of the textile chain has a significant influence on the possibilities of a circularity-boosting EPR scheme. The Netherlands is dependent on other countries' production capacities for circular textiles.

Not only the production chain is international, but the chain for reuse and recycling is also mainly external to the Netherlands as well. Reusable clothing is currently mostly sold on markets in Eastern Europe and several countries in Africa. The industry for recycling textiles is primarily located in India.

The state of recycling lags behind compared to other sectors. Recycling within the textile industry is comparable to the glass industry of 20 years ago (Ecopreneur.eu, 2019). The widespread use of blends with biodegradable and synthetic fibres (60-70 per cent of all textiles groups) enable optimal end-use properties but makes recycling a complicated process.

6.3.3. Actors

Table 16 shows an overview of the parties in the textiles sector that are relevant to a potential EPR scheme. The table describes actors that are actively involved but leaves out parties that are affected but do not play an active role, for example consumers and primary producers.

Table 16, overview of stakeholders in textile sector.

Actor	Description and role
Producers	Producers are parties that bring textile products on the Dutch markets. The aim of the ministry of I&W is to make them responsible for the whole life cycle of their products. Some producers have started collection networks for their clothing.
Sector organisations	Modint (clothing and textile branch) and INretail (retailers) represent the producers of textiles as defined above. They are responsible for proposing an EPR scheme.
Municipalities	Municipalities have started to tender the responsibility for collection of textiles in the past, as several parties were willing to pay for the right to collect textiles. Apart from this, they play an important role as they are responsible for residual waste, where most textile waste ends up.
Collectors	A diverse set of companies that collect textile waste in order to reuse and recycle it. Collectors range from charities and non-profits to for-profit companies. Some collectors sort the textiles themselves; others sell their collected textile waste to sorters.
Sorters	Organisations specialised in sorting textiles in streams varying from reusable products to non-recyclable textile.
Processors	Processors for most recycled products are located in Asia, except for a number of relatively small-scale processors that are based in Europe.
Ministry of I&W	Legislator and in that role responsible for implementing and enforcement of EPR legislation including instrumental linking to other legislation. Initiates explorations to new EPR schemes or improvements to existing schemes.
Rijkswaterstaat	Monitors EPR schemes and uses this knowledge in setting up new EPR schemes. Assesses reports on EPR and reports the ministry of I&W on them.

6.3.4. Institutional analysis

As there is no EPR scheme in place (yet), this section shortly analyses the institutional context in which the plans for an EPR scheme are made.

The sector aims for a covenant between producers and the government, similar to the Framework Agreement in the Packaging scheme. When the sector fails to implement a (voluntary) EPR scheme or their plan is deemed insufficient, the Ministry of I&W will impose a (mandatory) scheme.

Currently, collectors own the collected textiles before selling the sorted fractions. The revenues of selling reusable products are their business case. Some retailers collect textiles in order to reuse and recycle their own clothing.

Collectors pay municipalities for the right to collect. These costs are part of the transaction costs associated with gaining property rights over EOL textiles. Logistical costs are higher because of the international recycling market.

Table 17 shows a summary of the institutional analysis of the potential EPR scheme for textiles.

Table 17, summary of institutional features of potential EPR scheme for Textiles.

Institutional feature	Description
Institutions	• The sector aims for a covenant between producers and the government. • The Ministry of I&W will impose a mandatory EPR scheme if the sector's plan is deemed insufficient.
Property Rights	• Collectors own the collected textiles. • Several retailers collect their textiles.
Transaction Costs	• Collectors pay municipalities for the right to collect. • High logistical costs due to the international industry.

6.4. Conclusion on case studies

This section concludes the chapter and provides an answer to the sub-question '*what is the institutional environment of EPR schemes in the Netherlands?*'. The answer is provided by generalising the findings of three case studies. Two on the existing Dutch EPR schemes for WEEE and Packaging; one on the to-be-implemented scheme for Textiles.

This chapter affirms the notion that every EPR scheme is unique. While the analysed schemes have comparable elements, they are essentially different due to the possibilities of product processing and the agent situation.

The legislation of EPR schemes proved to be complex as they are embedded in a multitude of (European and national) laws and regulations. This complex embedding makes adjustments to the schemes difficult.

The analysed schemes are (or are planned to be) collectively organised (i.e. CPR). This makes large-scale collecting and recycling possible with relatively low transaction costs. However, the collective nature of the schemes makes higher R-strategies than R8 and R9 difficult. There are plans in Packaging scheme to aim for more reuse. As the Packaging scheme has implemented eco-modulation, it influences producers' designs.

Informational responsibility proves an important factor in the schemes. Many actors have a solely informational task such as informing consumers or reporting on the results of the scheme.

Alignment of interests is done in small steps. It proves difficult to organise chain cooperation. Not because interests are far apart, but because stakeholders are not represented well or do not find each other.

Dutch EPR schemes and their stakeholders prove to be in constant motion. Various changes are initiated in order to heighten the level of circularity of the EPR schemes. Examples are implementations of DRS, stimulating reuse of EOL products and the implementation of an EPR scheme for textiles.

The analysed schemes seem to confirm the findings in chapter 5. Due to the collective nature of the schemes, higher R-strategies than recycling are not attained, apart from incentives to eco-design via eco-modulation. However, the schemes positively influence the costs of collection and recycling. This beneficial influence is one of the reasons to implement EPR for textiles.

7. Barriers and opportunities for a CE

This chapter answers the fourth sub-question 'What are opportunities and barriers for EPR schemes in the transition to a circular economy from an institutional perspective?'. Barriers refer to aspects of EPR systems that hinder circularity. Opportunities concern possibilities to overcome these barriers or heighten the level of circularity in EPR systems in another way.

More concrete, barriers are structures, identified in chapters 4, 5 and 6, that prevent EPR instruments or schemes from attaining higher R-strategies. Opportunities are defined as ways that could theoretically improve the circularity of EPR schemes, confirmed by a practical perspective. The identified opportunities are (a part of) EPR instruments or schemes that showed circular promises in theory that are not utilised in practice.

The barriers and opportunities are identified by comparing the outcomes of (the institutional analyses in) chapters 4, 5 and 6. Institutional structures, identified in one of these chapters, were consequently checked and compared with the other chapters. For example, the first barrier, *current EPR schemes do not incentivise higher R-strategies*, was identified through studying EPR instruments' circularity (chapter 5). The institutional analyses in chapter 6 confirmed the identified structures and could further help to explain them. In this sense, the barriers and opportunities are the outcomes of combining the theoretical assessment of EPR instruments' circularity in chapters 4 and 5 (sub-question 1 and 2) with the practical perspective from three case studies in chapter 6 (sub-question 3).

The next section will describe three barriers, followed by a section on five opportunities to overcome these barriers. The conclusion will provide an answer to sub-question 4.

7.1. Barriers that hinder circularity in EPR schemes

This section describes three barriers that hinder circularity in EPR schemes. The first barrier is the step towards higher processing methods than recycling, and incentivising eco-design is the second barrier. The third barrier, costs associated with EPR schemes, is related to the first two barriers.

7.1.1. Current EPR schemes do not incentivise higher R-strategies

EPR schemes promote circularity by maintaining materials in the system and closing loops through mandating or financing collection and recycling of products. However, improving to higher R-strategies such as refurbishment or reuse proves to be difficult. The collective nature of EPR schemes and an emphasis on recycling hinder initiatives for refurbishment or reuse. The step in the waste hierarchy from recycling (R8) in the direction of reuse (R3) forms the first barrier.

This barrier was identified by the analysis of EPR instruments' circularity in chapter 5. An often utilised instrument, collective product take-back requirements, was assessed as not incentivising high R-strategies. The case studies proved that this instrument is indeed often utilised in the Netherlands, and the assessment was confirmed.

Higher R-strategies are challenging in collective schemes. Refurbishing or repairing a product is not possible without a certain level of expertise and the right components. EPR schemes are often set up collectively in PROs, resulting in large streams of EOL products from different producers. A PRO would need personnel with an astonishing degree of expertise and a stockpile of components to be able to refurbish or repair all incoming end-of-life (EOL) products. The extent to which collective schemes face this problem depends on the product system. Complex products as electric and electronic equipment (EEE) require a higher level of expertise than less complex products as textiles or packaging.

The general emphasis on recycling can hinder higher processing methods as well. This hindrance is seen in the case studies on WEEE and Packaging. In both EPR schemes, ambitious collection and recycling targets challenge PROs to make most of the available recycling techniques. Higher R-strategies, for example reuse (R3), are not taken into account in the recycling target. Therefore, even if reusing products would be easy, PROs are incentivised to recycle products in order to attain recycling targets. Incidentally, there are developments in both the WEEE and Packaging schemes to count reuse as 100% recycling. Doing this would eradicate the incentive to choose recycling over higher R-strategies.

7.1.2. EPR often cannot incentivise eco-design

The second barrier is related to the goal of eco-design. Even though EPR is often said to promote eco-design, whether and to what extent this is achieved has been subject to a long ongoing debate (Kaffine & O'Reilly, 2015). The OECD states that the 'overall impact has been less than originally hoped for' (OECD, 2016, p. 51). This barrier was, therefore, suggested by theory and subsequently confirmed by the analyses and case studies chapters 4 through 6.

Similar to higher processing methods, the lack of stimulus to eco-design can largely be attributed to the collective nature of EPR schemes. Costs for processing EOL products are shared among members of PROs, which diminishes incentives to design products that are processed more efficiently or with more maintained value.

Incentives for eco-design in EPR schemes generally relate to the degree of IPR. This relationship follows naturally from Atasu and Subramanian's (2012) statement that producers in schemes with IPR can reap full benefits of design changes. Accordingly, EPR schemes without IPR do not directly incentivise eco-design, as individual producers do not benefit from environmentally friendly design changes. The obvious route to overcoming this barrier is, therefore, implementing a higher degree of IPR.

7.1.3. Costs of EPR schemes hinder circularity

The costs of EPR schemes are the third and last barrier. This barrier is a cause for the collective nature of EPR schemes, which leads to the other two barriers. It can therefore be seen as an overarching aspect of EPR that can easily be missed when zooming in on specific instruments and schemes. The institutional analyses in chapters 4, 5 and 6, for example, do not identify this barrier. However, the analyses have this barrier in common and often express the consequences of it.

Implementing EPR schemes means that producers become increasingly responsible for their products' life cycle. This increased responsibility is always associated with extra costs for de individual producer. Establishing a system in which products and materials are collected and recycled burdens producers, often financially. Producers will choose the most affordable option, for example a collective system, which complicates higher R-strategies.

The case studies showed that many stakeholders in EPR schemes are in a prisoner's dilemma regarding the costs of circular initiatives. There are initiatives for increased circularity in EPR schemes, but stakeholders do not want to bear the costs for these activities alone. However, increased circularity could greatly benefit society as a whole (Wijkman et al., 2016).

7.2. Opportunities for higher circularity in EPR schemes

This section proposes five opportunities for higher circularity in EPR schemes. Circularity in EPR schemes can be boosted by:

- returning property rights of EOL products to producers
- stimulating chain cooperation
- mandating product standards or methods of processing
- implementing eco-modulation

- taxing materials

Figure 13 visualises the opportunities in a basic production chain. The green text and arrows visualise opportunities to reach higher R-strategies and promote eco-design. Full green arrows represent physical opportunities, and dotted arrows refer to financial opportunities. The production chain is visualised in blue. The following sections will describe the depicted opportunities.

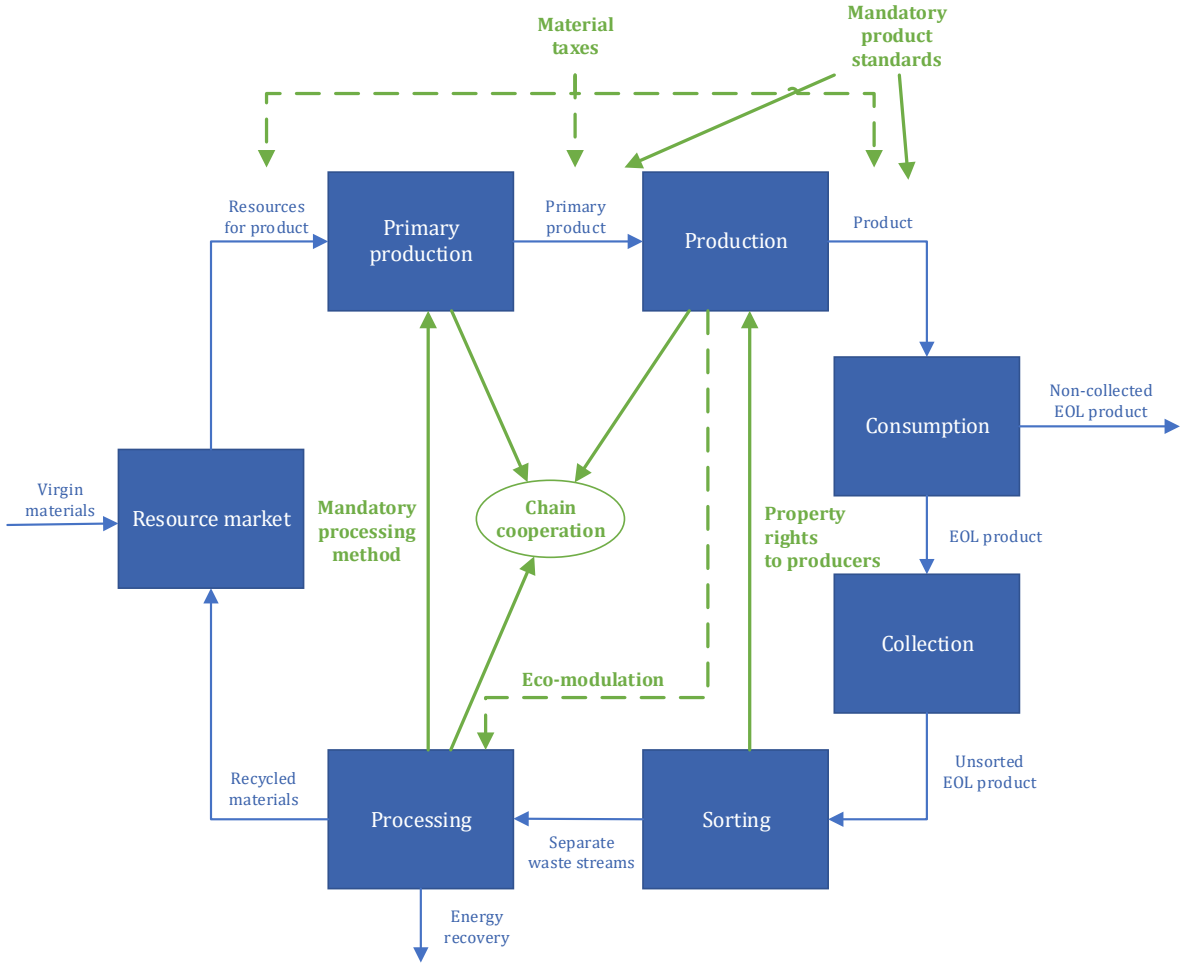

Figure 13, schematic visualisation of opportunities for heightening circularity in EPR.

7.2.1. Property rights back to producers

A measure that can incentivise higher R-strategies and promote eco-design is returning property rights over EOL products to the original producer. This could take many forms but does not mean that EOL products physically return to producers. Merely transferring the rights on their EOL products would incentivise producers to choose the highest attainable R-strategy as it maintains the most material value. Producers harvest the benefits of higher R-strategies as they are the owner.

For example, producers in a collective product take-back scheme could be assigned the possibility to obtain their EOL products in order to process the products themselves. Producers choosing to process their own products would be awarded a discount on paid disposal fees, depending on the costs of regular processing.

Moreover, transferring property rights back to producers would likely result in achieving higher R-strategies than many EPR instruments (such as ADF and CPR). These instruments feature

a third party that collects and processes EOL products without the proper product knowledge nor the agency to reuse or refurbish products.

This measure could also stimulate eco-design. When producers can obtain ownership over products after the consumer phase, they are incentivised to adjust product designs that are easier to recycle/refurbish/repair. In other words, producers are incentivised to design products in a way that product or material value can be preserved better. Examples of systems where producers gain ownership over their own EOL product, are DRS or physical IPR.

This opportunity could be implemented top-down, when designing the EPR scheme, by governments in case of mandatory schemes or sectors when schemes are voluntary. The opportunity could be implemented bottom-up as well when producers in EPR schemes demand the right to take back their own EOL products.

It stands to reason that implementation depends on the type of product, EPR instrument and scheme, and the parties involved.

7.2.2. Chain cooperation

EPR assigns responsibility specifically to producers. Most interviewees, however, stated that circular steps forward require input from different actors throughout the whole value chain. Eco-design, for example, requires not only the producer's knowledge of product design but also knowledge of processing methods and techniques. The latter is the expertise of waste processors. On their turn, processors can benefit from producers' product information and how to process them in the most valuable way.

Possible enhancements can be found throughout the whole chain, between sorters and producers, municipalities and PROs, and almost every other combination of actors. Informational responsibilities assigned to actors through the chain could enhance its level of circularity. In this light, extended producer responsibility could be rebranded to extended chain responsibility.

Implementation of this opportunity could be done formally or informally. When implemented formally, parties are brought together by mandatory meetings, obligated as part of the EPR scheme. Informal implementation depends on parties finding each other because they see added value in cooperation. Either way, the parties involved are themselves responsible for whether chain cooperation creates this added value.

7.2.3. Mandated product standards or methods of processing

Where other non-binding EPR instruments do not work, simply mandating certain product specifics or processing methods could overcome barriers for circularity. Mandated product standards or prohibition of specific materials of products can be used to affect product design strongly. Setting targets could do the same for a preferred R-strategy.

An additional benefit of mandating product designs with recycled content is the effect on the demand for recycled materials. Low demand for the products of recycling is often a problem in EPR schemes. All three case studies showed this. Mandating producers to use recycled materials in their products affects the revenue of processing EOL products positively, lowering disposal fees over the long term.

As mandatory standards or processes are unlikely to be implemented by individual producers, the responsibility lies with sector-wide organisations or governments. As implementation is expected to be unpopular, consideration on the best method is required.

There are downsides to these strong instruments. Most importantly, it strongly interferes with producers' business operations. It could prove costly or even impossible to adjust product designs or processing. These extra costs could drive producers out of business.

7.2.4. Eco-modulation

A strategy to stimulate eco-design is through modulation of fees. This strategy is possible in systems where producers pay a form of disposal fee, e.g. ADF, collective take-back systems, or UCTS. As described in section B.2.4, eco-modulation can incentivise environmentally friendly design of products through providing a discount of fees to producers who produce products that have a lower environmental impact.

An apparent disadvantage of environmental impact assessment is the (high) associated costs as scoring a product's circularity is difficult. However, methods range from simple (assessing circularity on weight) to complex (grade a product on a circularity indicator). Section B.2.4 elaborates on various forms of eco-modulation. A version with a circularity-based grade seems practically impossible, as circularity indicators are problematic when there are 114 definitions of CE alone (Kirchherr et al., 2017).

However, a version in between the simple and complex method could work, proven by the KIDV's recycle check. The recycle check is an example of a straightforward way of assessing a product's circularity. Moreover, it is cost-effective as it leads to easier-to-recycle products. Section 6.2.3.1 describes the recycle check. Similar to the tactic for assessing EPR schemes in this thesis, the recycle check assesses whether a product has circular characteristics.

The example by the KIDV shows that responsibility for eco-modulation could lie with a PRO. It could be implemented more top-down as well when it is a demand of a government that implements an EPR scheme.

7.2.5. Material taxes

An instrument that could incentivise both eco-design and higher R-strategies is a tax on (virgin) material use. Applying a tax to environmentally unfriendly materials has three benefits. First of all, it directly incentivises the design of products that use fewer virgin materials. When a tax is applied to virgin materials, recycled materials become economically more attractive in comparison. The second benefit is that material taxes could incentivise circular activities. As materials become more valuable because of the tax, strategies that maintain more material value (i.e. higher R-strategies) are becoming increasingly attractive for owners of EOL products. Finally, material taxes tackle a more significant barrier for circular initiatives. As circular activities are usually (human) labour intensive, a shift from tax on human labour to tax on materials could prove a catalyst for circularity (Groothuis, 2018).

However, it is not clear at what spot in the value chain material taxes should be applied in order for them to be effective. From an administrative perspective, one would want a material tax early in the production process where primary materials are used. However, this incentivises geographical relocation of production to a part of the world where there is no material tax. Another option is applying a material tax to products actually put on the market. This circumvents incentives for relocation of production but is accompanied by an administrative burden of keeping track of the materials in products. Therefore, the best place for implementation depends on many factors such as product, materials and whether product chains are entirely domestic or international.

A bottom-up implementation of material taxes seems unlikely, as individual producers or other parties in an EPR scheme do not have the ability to force taxes on others. Therefore, the responsibility of implementation lies with governments, or even higher with international collaboration organisations such as the EU.

7.3. Conclusion

This chapter answered sub-question 4 by stating three barriers for circularity in EPR schemes and five opportunities to heighten EPR schemes' circular level. The circularity of EPR schemes is often

hindered by an inability to incentivise eco-design and higher R-strategies than recycling. The cause for these inabilities is found in the collective nature of most EPR schemes and the emphasis on recycling. Costs of EPR schemes form the third barrier.

Opportunities for heightening the level of circularity in EPR schemes could facilitate overcoming the described barriers. By returning property rights of EOL products to producers, they are incentivised to maintain more value from the products (higher R-strategies) and design products that are easier to recycle/refurbish/repair. Promoting chain cooperation could incentivise circularity throughout the whole chain. Mandated product standards and methods of processing are strong instruments, but could additionally benefit circularity by raising the demand for recycled materials. Eco-modulation is an unfulfilled promise of EPR but could work when based on a straightforward assessment of circular characteristics. The last described opportunity are material taxes, which have three benefits. A virgin material tax incentivises designs of products with fewer virgin materials. As material taxes increase the value of materials, they incentivise higher R-strategies. As a third benefit, a shift of taxes from human labour to materials could prove a catalyst for circularity.

Apart from the answer to sub-question 4, barriers and opportunities described in this chapter are an important element in the recommendations in chapter 10.

III. Conclusion and recommendations

8. Conclusion

This chapter offers a conclusion to the research question of this thesis.

8.1. Answering the main question

The main research question is answered by combining the theory and the answers to the four sub-questions. The research question is: *'how can Extended Producer Responsibility, from an institutional perspective, facilitate a transition to a Circular Economy?'*

The policy principle of EPR aims to promote environmental improvements by extending the responsibilities of the producer. The EPR policy principle is expressed in EPR schemes and EPR instruments that show a considerable variety.

An assessment of the level of circularity of EPR instruments and their institutional features distinguished three ways in which EPR instruments incentivise circularity. The most effective way of incentivising circularity is through mandating producers to take back ownership over their EOL products. Another way that EPR instruments incentivise circularity is by beneficially adjusting the costs and revenues of processing EOL products. The third method is through influencing product design.

The case studies for sub-question 3 showed that EPR schemes prove more complicated in practice because of the divergent interests of stakeholders and comprehensive legislation in which schemes are embedded. However, the three methods in which EPR instruments incentivise circularity were confirmed. The collective nature of the analysed schemes helps to attain high collecting rates with low transaction costs but hinders all R-strategies higher than recycling. As EOL products are collected collectively, individual producers cannot use their knowledge for circular activities and are not always incentivised to improve their product design.

However, Dutch EPR schemes and their stakeholders are in constant motion. Various changes are initiated in order to heighten the level of circularity of the EPR schemes. Examples are implementations of Deposit-Refund systems (packaging), plans to attain higher collection rates (WEEE) and the implementation of a new EPR scheme for textiles that would enable higher collection and recycling rates.

EPR is often presumed to have an important role in the transition to a CE. This premise is justified when looking at the often high collection and recycling rates of EPR schemes. Collection and recycling of end-of-life products are vital for a CE. This thesis, however, shows that EPR's role in facilitating a transition could be more significant if it could overcome its high costs and inabilities to incentivise eco-design and realise higher R-strategies than recycling.

In other words, EPR is not synonymous with the CE. It can be used as a tool in the transition towards a CE. This thesis has shown, however, that the manner of implementation can greatly affect EPR's circularity. By circumventing identified barriers and seizing opportunities, EPR can take a significant role in the transition to a CE.

8.2. Answering the sub-questions

Sections on the four sub-questions precede an answer to the main research question. Together, the answers to the sub-questions formed the answer to the main research question.

8.2.1. What is the institutional working of EPR instruments?

Answering this sub-question required describing EPR instruments and analysing them from an institutional perspective. This was vital for understanding the working of EPR instruments and

subsequent analyses of their circularity. The answer provided insight into commonly used EPR instruments and how institutional aspects manifest within EPR.

Product take-back requirements are the most used EPR instrument. This instrument assigns a physical responsibility to producers to collect a target of property rights over EOL products in order to process them. The targeted processing methods are often recycling and recovery. Product take-back instruments come in many forms. The variations trade individual physical responsibilities for financial responsibilities (IPR vs CPR), keep transaction costs low by enabling or blocking competition between PROs, or avoid PA problems when set up voluntarily. The context, particularly the type, volume and value of the product, determines what variation could achieve the best results in terms of low costs, circularity, or other indicators.

DRS is the only instrument in the category of economic and market-based instruments that involves the collection of EOL products and the associated property rights. DRS and all other instruments in this category assign financial responsibility to producers in the form of a tax. This tax is often used to finance the collection and recycling of EOL products, i.e. transaction costs.

Regulatory approaches such as product standards and prohibition of materials and products are straightforward and assign physical and informative responsibilities to producers. The process of standardisation can have an additional effect on the agency of the parties involved.

Information-based instruments and voluntary approaches are two broad categories that include a diversity of instruments. Their main institutional feature is an effect on agency. Both categories align interests of parties, either via institutional foundations (voluntary pacts between producers) or an exchange of information (between producers, consumers and recyclers).

Table 35 (on page 97) shows an overview of the institutional concepts and theories that were used to analyse the instruments.

8.2.2. How do different EPR instruments and their institutional features incentivise circularity?

How EPR instruments and their institutional features theoretically incentivise circularity is described in chapter 5. The sub-question was answered by analysing to which R-strategies different EPR instruments lead or may lead, followed by an analysis of the effect of separate institutional features on the instrument's circularity. The answer to this sub-question provided an overview of R-strategies that are incentivised by different EPR instruments and a summary of how institutional features affect circularity. This overview supported the identification of barriers and opportunities.

Three methods are distinguished in which EPR instruments could theoretically incentivise circularity: 1) mandating producers to take back ownership over EOL products, 2) adjusting costs and revenues of processing EOL products beneficially, and 3) promoting product design.

The first and arguably most effective method in which EPR instruments incentivise circularity is by mandating producers to take back ownership of EOL products. Ownership is taken back in product take-back instruments and DRS. Producers in these instruments are incentivised to choose an R-strategy that extends the life span of their products, i.e. repurpose (R7) up to re-use (R3). In instruments where the producer is individually responsible for processing the EOL products, producers are incentivised to adjust their product design to these strategies as well (R2 and R1). When systems are set up to process products collectively, most incentives for redesigning products are removed from the scheme as producers do not directly experience the benefits of their design changes.

A second method in which EPR instruments incentivise R-strategies is by adjusting the costs and revenues of processing EOL products. R-strategies are incentivised by subsidising the preferred form of processing. Material taxes incentivise R-strategies in a similar but indirect manner. Taxing virgin materials makes them more costly for producers resulting in more

expensive products. As recycled materials are not taxed, demand for recycled materials or reused products will probably rise, which heightens the incentive to apply R-strategies.

Promoting product design is the third way in which EPR instruments incentivise circularity. Product design is directly influenced by minimum product standards and prohibition of materials and products. Other instruments influence product design indirectly. Incentivising adjustments in product design can, in some cases, result in product redesign for a specific R-strategy. Material taxes could influence product design as well. When virgin materials are more expensive through taxes, producers are incentivised to use less or other (for example recycled) materials, which boosts circularity.

The conclusions of chapter 5 and appendix B feature a more extensive description of the influence of institutional features on circularity. Table 51 on page 110 offers an overview of EPR instruments' circularity.

8.2.3. What is the institutional environment of EPR schemes in the Netherlands?

Chapter 6 provided an answer to the third sub-question by generalising the findings of three case studies. Two on the existing Dutch EPR schemes for WEEE and Packaging; one on the future scheme for Textiles. The case studies offered a perspective on the practical nature of EPR with more complexity through the differing interests of stakeholders. This perspective is important for a valid answer to the main research question as the transition to a CE happens in reality and not in theory.

The chapter affirms the notion that every EPR scheme is unique. While the analysed schemes have comparable elements, they are essentially different due to the possibilities of product processing and the agent situation. The legislation of EPR schemes proved to be complex as they are embedded in a multitude of (European and national) laws and regulations. This complexity makes it difficult to adjust the schemes.

The analysed schemes were (or were planning to be) collectively organised. This makes large-scale collection and recycling possible against relatively low transaction costs. However, the collective nature of the schemes makes higher R-strategies, such as reuse, difficult. There are plans to aim for more reuse in the Packaging scheme.

Informational responsibility proves to be an important factor in the schemes. Many actors only have an informational task, such as informing consumers or reporting on the results of the scheme. Alignment of interests is done in small steps. It proves difficult to organise chain cooperation. Not because interests are far apart, but because stakeholders are not represented well or do not find each other.

Dutch EPR schemes and their stakeholders are in constant motion. Various changes are initiated in order to heighten the level of circularity of the EPR schemes. Examples are implementations of DRS (packaging), plans to attain higher collection rates (WEEE) and the implementation of a new EPR scheme for textiles that would enable higher collection and recycling rates.

The analysed schemes seem to confirm the findings in Chapter 5. Due to the collective nature of the schemes, higher R-strategies than recycling are not attained, apart from incentives to eco-design via eco-modulation. However, the schemes positively influence the costs of collection and recycling. This beneficial influence is one of the reasons to implement EPR for textiles.

8.2.4. What are opportunities and barriers for EPR schemes in the transition to a circular economy from an institutional perspective?

Chapter 7 presented three main barriers for circularity of EPR schemes followed by five opportunities to heighten the level of circularity. These opportunities and barriers designate (the difference between) the current and potential role of EPR in the transition to a CE.

The circularity of EPR schemes is often hindered by an inability to incentivise eco-design and attain higher R-strategies than recycling. The cause for these inabilities is found in the collective nature of most EPR schemes and the inherent focus on recycling (rates). Costs of EPR schemes form the third barrier for circularity.

Opportunities for heightening the level of circularity in EPR schemes could facilitate overcoming the described barriers. The following opportunities are identified:

1. **Returning property rights of EOL products to producers** could incentivise maintaining more value from the products (higher R-strategies) and designing products for easier recycle/refurbish/repair.
2. **Promoting chain cooperation** could incentivise circularity throughout the whole chain by promoting the exchange of knowledge and services.
3. **Mandated product standards and methods of processing** are strong instruments but could benefit circularity by raising the demand for recycled materials.
4. **Eco-modulation** is an unfulfilled promise of EPR but could work when based on a straightforward assessment of circular characteristics.
5. **Material taxes** have three benefits. A virgin material tax incentivises designs of products with fewer virgin materials. As material taxes increase the value of materials, they incentivise higher R-strategies. Thirdly, a shift of taxes from human labour to materials could prove a catalyst for circularity.

9. Discussion

The conclusion in chapter 8 provided answers to the research questions of this thesis. These answers are the result of extensive research. In this chapter, the results are interpreted. The process and limitations of the conducted research are discussed in order to put findings in perspective.

The main research question was answered by stating that the presumed important role for EPR is justified when looking at the high collection and recycling rates of EOL products. However, EPR could play a more significant role in the transition to a CE by overcoming three barriers; EPR's costs, and the inabilities to incentivise eco-design and realise higher R-strategies. Five opportunities have been designated that could increase EPR's significance in the transition to a CE.

The research questions were answered by utilising a literature review and case studies. The following sections will indicate the limitations of the conducted research and how these limitations affect findings.

9.1. Methodological limitations

The adopted qualitative multiple case study approach combined with a literature review provided sufficient freedom for combining theoretical analysis with an examination of stakeholders' perspectives. The approach proved to allow the required degree of generalisation.

However, the choice for a qualitative research approach resulted in limitations as well. It is challenging to verify the results as they are not statistically representative. By utilising an iterative process of a literature review and case studies, findings with one method could be verified using the other method or by asking other interviewees. In practice, however, it proved difficult to investigate findings or statements in literature or with other interviewees.

One of the causes for the lack of statistical representativeness (apart from a small sample size) is a positive selection bias. It can be assumed that the respondents who were willing to do an interview have a higher general interest in EPR and circularity. This mechanism excluded negative perspectives on the subject.

Nonetheless, taking these methodological limitations into account, the scientific validity of the study stands firm. The study is reproducible, and it is probable that reproducing the study would lead to similar results.

9.2. Utilisation of the institutional framework

This thesis utilised an institutional framework to analyse EPR instruments and schemes. While not being the first academic study on the role of institutions in EPR, it was the first occasion that EPR was analysed using an institutional framework, as far as known to the author.

In that sense, the study was explorative in nature. It explored the scientific usefulness of an institutional framework in the context of EPR. The exploration required an interesting balance between structure and creativity. Structure in order to keep the eyes on the objectives and creativity to resolve or circumvent difficulties. Future researchers who plan on doing a similar study need both characteristics. Without it, they might lose their heads in the bulk of information and get stuck. The author was helped in this process with a pair of supervisors with extensive knowledge of institutional economics and the other pair of supervisors who guided in the subjects of EPR and CE. It is strongly recommended that future researchers possess similar expertise or arrange this type of guidance.

The pioneering role brought difficulties as there were no 'example frameworks' to choose from. Theories and concepts were chosen at the beginning of the research process without precisely knowing what elements they had to help analyse. Time constraints combined with an overload of available institutional concepts and theories prevent an iterative process in which the best fitting framework is the outcome. As a consequence, it occasionally required some practice and skill to 'fit' observations in the chosen framework. If relevant aspects of EPR schemes fell outside of the framework, there were two options: either force the aspect into the framework or remark it in another way.

Using an institutional framework is coupled with the possibility of a positive bias. It increases the chance of finding solutions that are linked to the used concepts and theories. This mechanism was described in section 3.1.3 on transaction cost theory, but it is relevant to all used concepts and theories. For example, this thesis had a focus on property rights. As a result, one of the proposed opportunities is based on property rights. This example does not imply that the proposed opportunity is faulty. However, it could be that other, potentially better, opportunities were not considered because they were outside of the framework's scope.

Difficulties aside, the institutional framework proved an effective tool for analysing EPR schemes and for structuring findings. All used concepts proved to be useful. However, in order to 'fit' more relevant elements, the theories of agency and transaction costs were expanded to a point at which they became somewhat opaque. Using theories to explain observation requires a balance between adapting the theory to the observation and vice versa. In this research, the theories in the framework were somewhat adapted to the observations, which reduced their explanatory capacity.

9.3. Number and nature of interviews

As every research, this study had practical limits. The primary constraint of this research was time. Qualitative research is time-consuming, and therefore, the amount of interviews is limited. Seven interviews were conducted in real-time via video or phone calls, and three interviews were conducted via e-mail.

More interviews would have benefitted the research. The conducted interviews provided interesting perspectives but not all the EPR schemes' stakeholders were interviewed. It would have been especially interesting to consult more (primary and secondary) producers and analyse their perspective.

The interviews by e-mail proved to provide lesser information than real-time interviews. Even though the respondents were relatively open and answered the provided questions, the lack of a possibility to ask in-depth questions directly resulted in an inferior understanding of their perspective.

The choice to interview stakeholders in three different schemes had a positive effect - the possibility to compare different schemes seemed to provide more insight than a more in-depth focus on one scheme.

9.4. Effect of limitations on findings

The methodological limitations and practical difficulties do not refute the findings in this thesis. As the findings stemmed from either literature or interviews with stakeholders, they portray an accurate image.

Generalising findings in the case studies to other cases is problematic, however, due to the varying contexts of different EPR schemes. The working of the analysed schemes cannot easily be transferred to other EPR schemes. The smaller and less complex an analysed structure or

incentive mechanism is, the more transferrable to other cases it is. EPR schemes, however, are complex in practice due to a multitude of parties and interests.

To be able to generalise the findings in this thesis, confirmation by further studies is needed. Both a broader quantitative approach into different EPR schemes as more detailed analyses of specific cases can provide interesting insights. Quantitative research is needed to calculate the costs of heightened circularity. However, in order to approach EPR quantitatively, more data is needed on the internal working of EPR schemes.

Hopefully, this thesis can contribute to the discussion on EPR and act as a starting point for further research.

10. Recommendations

This chapter describes recommendations following the conclusion and discussion. The first section describes recommendations for EPR in general. The following section provides recommendations that are specific to the analysed schemes. Recommendations for future research are made in the last section.

10.1. Recommendations for EPR in general

As stated in the introduction, EPR is often seen as a driver towards circularity. This assumed connection is partly justified by high collection and recycling rates resulting from EPR schemes. However, this thesis shows that EPR can only achieve high levels of circularity when schemes are specifically designed to attain higher R-strategies. Therefore, the main recommendation from this thesis is to choose a high level of circularity as the primary goal when implementing EPR. This choice will lead to schemes that incentivise circularity to the greatest extent.

The opportunities described in chapter 7 provide more concrete recommendations on heightening circularity in EPR schemes. However, what form of implementation of these recommendations is most desirable depends on the specific product, stakeholders, legislation and other aspects of the institutional context.

The next section describes scheme-specific recommendations.

10.2. Recommendations for the analysed schemes

The following recommendations are specific to the schemes that were analysed in chapter 6.

10.2.1. Recommendations for the Dutch EPR scheme for WEEE

The product chain of EEE is complex and international. Products sold in the Netherlands are imported from all over the world. Therefore, the precise effects of an adjustment to the WEEE scheme in the Netherlands might work out differently than planned. On a more positive note, adjustments to the WEEE scheme might stretch further than the Dutch market because of its international nature.

The WEEE scheme is focused on collection, recycling and recovery. This focus might hinder higher R-strategies. There are several strategies to overcome this barrier. Mandating reuse is the most direct method. Starting with a small percentage, reuse of products or components could gradually rise. A small percentage would stimulate producers and Producer Responsibility Organisations (PROs) to explore adjustments to the chain to make reuse possible.

The possibility for producers to regain property rights over their own products would incentivise higher R-strategies that are not possible at this moment. These property rights would not require physical ownership by producers, but should at least offer producers the opportunity to take back their products. Placing this possibility during or after sorting seems the most cost-effective. Financial incentives can be built in to stimulate taking back products. However, this might create perverse incentives. For instance, it would incentivise taking back products and dumping them. This measure would only be interesting for producers based in the Netherlands (or, to a lesser extent, in Europe). Retailers, importers or distributors would have less incentive to take back products when they do not have the knowledge needed for higher R-strategies.

The following recommendation regards the establishment of Stichting OPEN and their request for an Algemeen Verbindend Verklaring (AVV). In the light of collaboration in the chain, the choice to exclude a growing PRO that verifiably contributes to the EPR scheme seems illogical. However, their reasoning against competition in an EPR scheme is understandable. The example of the Dutch EPR system of packaging seems to be a driver for change, but copying only part of it

(monopoly for one central PRO) without other elements (e.g. agreement with the government, KIDV) seems unwise. An ideal scheme would have the effectiveness of a system with one PRO with the shared expertise and performance of a competition-based scheme.

Applying eco-modulation following a circularity-score would directly incentivise eco-design. However, setting up a system to assess products for their circularity could prove costly. The recycle-check of the KIDV provides an excellent example for a straightforward way of assessing a product's circularity and connecting it to a discount in disposal fees. A link between processors and producers would ideally be part of this system, encouraging chain cooperation.

10.2.2. Recommendations for the Dutch EPR scheme for Packaging

Compared to the chain of EEE, production of packaging is more local. Most packaging is produced in the Netherlands or Germany, and the producers using packaging are often located in Europe as well. Food health and safety regulations often prohibit the reuse of packaging that has been in contact with food. This hinders higher R-strategies.

The Afvalfonds Verpakkingen (AV) is a representation of all packaging producers in the Netherlands. On the one hand, this makes AV directly accountable for achieving imposed targets. On the other hand, AV is incentivised to follow strategies that protect their producers' interests. As the only PRO, they have a powerful position versus other stakeholders.

The most significant opportunities for circularity in the scheme for Packaging seem to lie in broader chain cooperation. Producers of packaging and processors can provide valuable circular insights to packaging producers. At this moment, transfer of knowledge takes place through the KIDV. The KIDV seems to do a great job in transferring knowledge, but this can be strengthened by giving stakeholders (other than packaging producers) a place within the AV. It could be a step towards more cooperation through the whole chain.

10.2.3. Recommendations for a Dutch EPR scheme for Textiles

Textiles are relatively simple products, but the product chain is global, not only in production but also in recycling. A comprehensive infrastructure is already in place for reuse and recycling of textiles. The barrier for attaining higher targets is financing.

A future EPR scheme could take many forms. A simple ADF could provide financing for higher collection and recycling rates. However, a more elaborate scheme with eco-modulation, mandated recycled content, and cooperation between producers, collectors and processors should be able to attain a higher level of circularity. Implementing such an elaborate scheme should be done in steps, as setting up product take-back targets and accompanying PROs – in other words changing the institutional context – strongly interferes with activities of stakeholders in the current system.

An important aspect for a future EPR scheme for textiles would be the possibility for exceptions. When producers can prove that they have set up an individual system for collection, reuse and recycling of clothes, this should be encouraged.

10.3. Future research

As stated in section 9.4, further research into the findings of this thesis is recommended. Studies into the effects of the proposed opportunities could provide a more robust understanding of their preferred working and the effects of their implementation. Furthermore, a more in-depth study on which of the five proposed opportunities could prove beneficial in which EPR scheme could prove useful. Such a study would firstly require an extended institutional analysis of EPR schemes in order to understand the working and context of the scheme. Secondly, the proposed study would benefit from a quantitative approach in order to support the costs and benefits of implementing a proposed measure.

In order to extend the research of this thesis, other EPR schemes in the Netherlands or abroad could be studied using (an updated version of) the institutional framework utilised in this thesis. This research could validate (or falsify) the use of the institutional framework and should help investigate what findings in this thesis can be generalised (and what findings cannot).

A quantitative approach could provide indications of the costs associated with heightened circularity of EPR schemes. Such a study would prove a welcome addition to this thesis.

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IV. Appendices

A. Institutional analysis of EPR instruments

In literature, EPR schemes and corresponding policy instruments are categorised in various ways. In this appendix, various forms of EPR instruments are analysed and categorised according to the institutional framework in chapter 3. The analysis and categorisation should provide an answer to the first sub-question: '*what is the institutional working of EPR instruments?*'. These instruments should be covered by the definition of EPR in section 2.1.1 and described in literature on EPR.

Several references are used in order to make sure that all EPR policy instruments are taken into account in this study. The starting point is the categorisation in Table 18, which shows the instruments referred to by three influential authors. An X indicates that the instrument is mentioned in the source.

Table 18, overview of categories and examples of EPR instruments, copy of Table 4.

Category	Instrument	OECD (2016)	Widmer et al. (2005)	Gupt & Sahay (2015)
Product take-back requirements	Mandatory take-back	X	X	X
	Voluntary take-back	X	X	X
	Reuse and recycling targets			X
	Recovery obligation			X
Economic instruments	Deposit refund	X	X	X
	Advanced disposal/recycling fees	X	X	X
	Material taxes	X	X	X
	Upstream combination tax/subsidy	X		X
	Fees on disposal		X	
	Subsidies			X
Regulations and performance standards	Minimum product standard	X	X	X
	Combination standard with tax	X		
	Prohibition of hazardous materials/products		X	
	Disposal ban		X	
	Mandated recycling		X	
	Emission limits			X
Information-based instruments	Reporting requirements	X		X
	Labelling of products/components	X	X	X
	Communication to consumers	X		
	Informing recyclers	X		X
	Consultation with authorities			X
Voluntary practices	Public/private partnerships		X	
	Leasing and "servicizing"		X	
	Social contracts			X
	Gentlemen's agreement			X

A clear conclusion is that the set of instruments listed as 'EPR instruments' varies. Most (academic and non-academic) literature on EPR refers to the work by the OECD, most notably their 2001 guidance manual and the updated version from 2016. This manual has been

instrumental in designing EPR systems in many countries (Gupt & Sahay, 2015). Therefore, the categorisation from the 2016 OECD manual is regarded as leading. Other influential sources such as Widmer et al. (2005) and Gupt & Sahay (2015) complement the OECD manual. Occasionally, these sources offer clearer distinctions between EPR instruments than the OECD.

The set of instruments that are studied in this analysis is shown by Table 19. The categorisation and instruments follow from the list in Table 18. Instruments were chosen to analyse when either the OECD or other mentioned influential sources mention them. A second prerequisite is that the instrument is described extensively enough to analyse it further. When no clear description by the mentioned sources was found, the instrument is not included in the analysis in this thesis.

Table 19, analysed instruments.

Category	Instrument
Product take-back requirements	General take-back requirements
	Collective Producer Responsibility
	Competition between PRO's
	Individual Producer Responsibility
	Voluntary take-back requirements
Economic and market-based instruments	Deposit-Refund Systems
	Advance Disposal Fee
	Material taxes
	Upstream Combination Tax/Subsidy
Regulatory approaches	Minimum product standards
	Prohibition of materials
Information-based instruments	
Voluntary approaches	

The instruments are analysed by utilising the institutional framework in section 3.1. Table 20, a copy of the table in chapter 3, shows the concepts and theories in the institutional framework. The table further summarises the focus of analysis of the institutional framework and shows how the EPR instruments in this thesis are analysed.

Table 20, institutional concepts' and theories' main focus of analysis, copy of Table 3.

Concept or theory	Main focus of analysis
Institution	Analysed by describing the institutional foundation of EPR schemes. This is (often national) legislation, and therefore other institutional foundations are remarkable. Other relevant features are the distinction between voluntary and mandatory systems and the legislative base of stakeholders, e.g. non-profit organisations vs for-profit firms. Most other relevant manifestations of institutions are described by the other concepts and theories.
Transaction costs	Describes the costs of establishment or exchange of property rights and costs of processing the products when the scheme or a contract requires this. In EPR schemes, establishing property rights often refers to collection of End-of-Life (EOL) products.
Property rights	Analysed by describing distributions of property rights that follow from legislation, contracts or covenants between parties in the scheme. Where possible, distinctions are made between different bundles of property rights.
Responsibilities	Describes the responsibilities that are obtained by stakeholders through legislation, contracts or covenants. Three types of responsibilities are distinguished. • Informative responsibilities are expressed in obligations to provide (any form of) information about products. • Physical responsibilities in EPR often refer to an obtained burden to collect and/or process EOL products, or requirements in designs of products. • Financial responsibilities occur through legislation, contracts or covenants that burden stakeholders with covering expenses, for example of collection or processing of EOL products.
Agency theory	Describes a wide arrange of phenomena following from relationships between stakeholders in EPR, such as (dis)alignment interests, potential PA problems, willingness to cooperate and the availability of information with different parties in a scheme. All features of EPR schemes or instruments that influence the capacity of an actor to act could be analysed under the denominator 'agency theory'.

Questions can be derived from the foci of analysis in Table 20. The following questions are examples to make the table more concrete:

- In what type of institution is the instrument based (other than legislative)?
- Are property rights exchanged in the instrument (and how)?
- Can transaction costs be distinguished in the instrument?
- What responsibilities are assigned or exchanged in the instrument?
- What is the likelihood of the instrument influencing the agency of involved parties (e.g. through a mismatch or alignment of interests)?

An answer is provided for instruments where the institutional concept in question forms a relevant feature of the instrument. The concept is deemed relevant when a change of the feature could affect the outcome of the instrument or scheme. However, the choice of whether an institutional concept is relevant remains somewhat arbitrary.

A.1. Product take-back requirements

The first instrument described in this chapter is product take-back requirements. The various forms of product take-back requirements are often 'regarded as the purest form of EPR' (OECD, 2001, p. 41). As a category, it is the most common policy instrument used under EPR, as 72% of all EPR schemes globally were a form of product take-back requirements in 2015 (Kaffine & O'Reilly, 2015).

Product take-back requirements involve the assignment of responsibility to producers for the End-Of-Life (EOL) management of products. Commonly, product take-back requirements are put into practice by setting collection and recycling targets (OECD, 2016).

The collection and recycling targets generally work as follows. Every party – which depending on the type of product can refer to producers, importers, or sometimes retailers or other parties – that puts products on the national market is obligated to collect a specific amount of EOL products in the same product category. Targets are related to the number of products (or kilograms) that are put on the market by the party. For the collected products, a recycling target is set that indicates what minimum percentage of the total collected kilogrammes should be recycled. For example, under the WEEE Directive (European Parliament and Council, 2012), of the weight of all-electric and electronic equipment put on the market by producers, a target 65% should minimally be collected. For the collected electric and electronic equipment, recycling targets between 55% and 80% (depending on the type of appliance) exist.

In these boxes, institutional analyses of the (variations of) EPR instruments are presented, followed by a table that summarises the analysis.

Institutional analysis of product take-back requirements

Product take-back requirement instruments assign responsibility for the EOL management of products to producers. In practice, this entails obtaining property rights over EOL products in order to recycle them. The costs involved in obtaining property rights, for example setting up collection locations, informing people that where these locations are and the logistics involved, are transaction costs. These often are higher than the value of the EOL products.

A product take-back target administers physical and administrative responsibilities to the producer. The physical responsibility is to collect and recycle its EOL products. The informative responsibility is to track and declare the amount and type of products put on the market, collected, and recycled, often towards the government or a governmental agency.

Table 21 shows a summary of the institutional analysis of take-back requirements in general.

Table 21, summary of institutional analysis of take-back requirements in general.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*
Property rights	Product take-back requirement instruments assign responsibility to collect property rights over EOL products to producers.
Transaction costs	The costs involved in gaining property rights over EOL products are transaction costs.
Responsibilities	• A producer receives a physical responsibility to collect and recycle its EOL products. • A producer receives an informative responsibility to track and declare the amount and type of products put on the market, collected, and recycled.

Agency	Not deemed as a relevant feature

Even though the premise is often the same, instruments under the broad category of take-back requirements come in many different forms. The main difference is between mandatory and voluntary targets. Mandatory targets obligate producers to take back EOL products and set specific recycling targets accompanied by penalties for not attaining the targets. Industries often set up voluntary schemes and therefore lack penalties for not meeting the targets.

A second difference is between individual and collective schemes. In individual schemes, every producer is individually responsible for collection and recycling of EOL products in proportion to what that producer has put on the market. In a collective scheme, producers are allowed to bundle their responsibility in a Producer Responsibility Organisation (PRO) that executes collection and recycling collectively. Collective schemes differentiate between schemes with one PRO and schemes with multiple competing PROs. The visualisation in Figure 14 shows what different types of schemes arise from these differences.

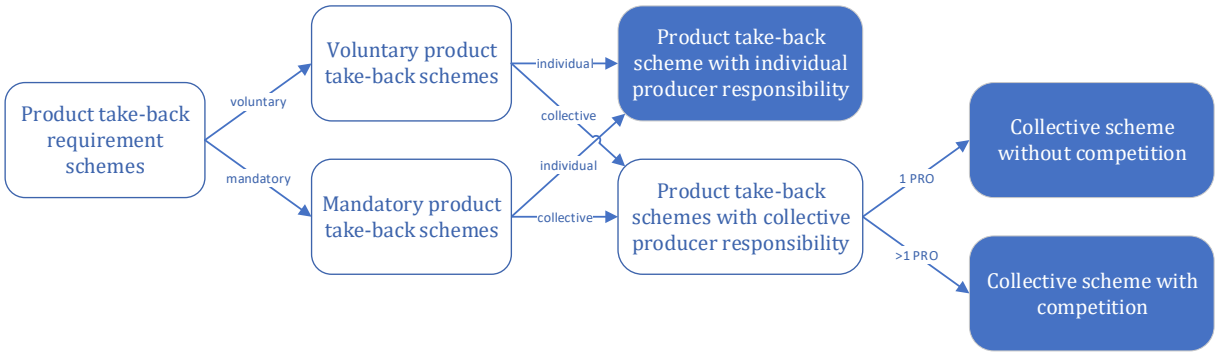

Figure 14, different types of product take-back requirement schemes.

The different types of product take-back schemes will be discussed in the following sections, starting with collective producer responsibility and followed by a section on competition in take-back schemes. Afterwards, individual producer responsibility is discussed and finally voluntary take-back schemes.

A.1.1. Product take-back scheme with collective producer responsibility

With Collective Producer Responsibility (CPR), producers are jointly responsibly for collection and recycling of a mix of products of all producers (Atasu & Subramanian, 2012). In the case of product take-back schemes, this means that producers are allowed to set up a PRO to arrange the collecting and recycling on behalf of the industry (Nahman, 2010). PROs are often seen as the simplest and most cost-effective way to achieve take-back and recycling targets (Atasu & Subramanian, 2012), as PROs can use economies of scale by collecting EOL products of several producers. Figure 15 shows a visualisation of a highly abstracted take-back requirement scheme with a PRO.

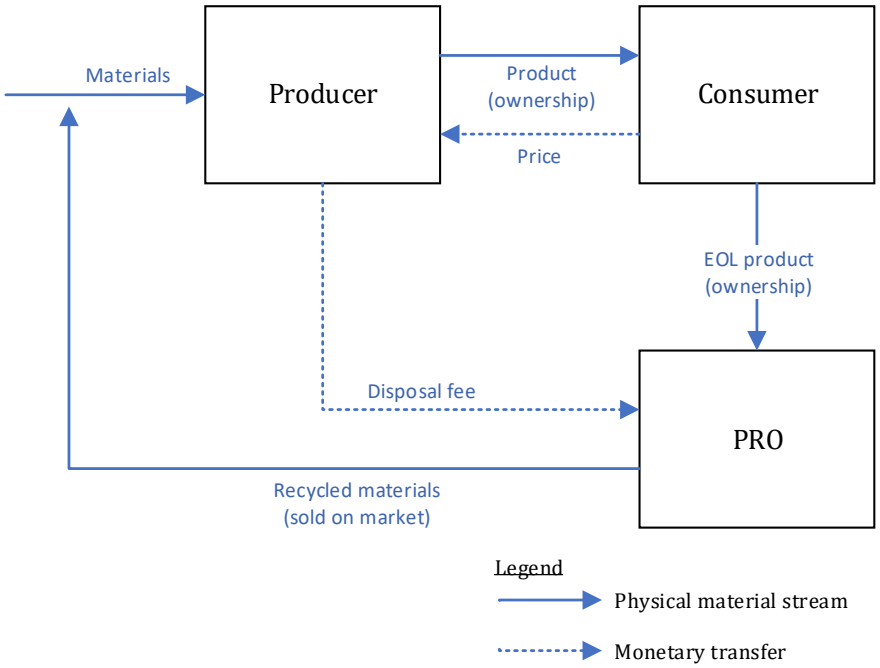

Figure 15, abstract visualisation of take-back requirements with collective producer responsibility.

The visualisation in Figure 15 shows that EOL products are collected by a PRO, after which recycled materials are fed back into the market. Producers pay a disposal fee to the PRO to cover for the processing costs. Note that the figure is highly abstracted and in practice, PROs are often purely administrative parties that leave collection to municipalities and processing to waste processors. This is illustrated in the case studies in chapter 6.

The legal form of PROs varies. According to the OECD (2016), they come as non-profit organisations (typically), for-profit firms (occasionally), government agencies (rarely) and quasi-government organisations (occasionally).

Institutional analysis of CPR

In order to obtain economies of scale in regaining property rights over EOL products, PROs are set up. This explanation is essentially similar to Coase's *The Nature of the Firm*, in which he describes that individuals choose to form partnerships and companies rather than working in two-sided relationships (Coase, 1937). PROs come in varying legal forms, most often as non-profit organisations.

Apart from the value of EOL products, there are many costs in gaining property rights over them – transaction costs. Because producers would have to make these costs individually, it is economically beneficial to set up a PRO that incurs the costs for all producers. In this way, transaction costs are reflected in disposal fees paid by producers.

As PROs act as intermediaries between producers and consumers, it is not the producer that obtain property rights over its EOL product, but the PRO. As the property rights are in the hands of the PRO, the producer has no physical responsibility. The physical and part of the informative responsibilities of a producer in a take-back scheme are transferred to PROs by paying a disposal fee. The producer effectively trades its physical responsibilities for financial responsibility.

Interests of PROs and producers are never entirely aligned. For example, producers aim to keep disposal fees low, while PROs need sufficient funds to achieve targets which can result in the desire to raise disposal fees. This misalignment of interests could lead to PA problems. The

principle (in this case: the producer) has different interests than the agent (in this case: the PRO).

Table 22 shows a summary of the institutional analysis of producer take-back with CPR.

Table 22, summary of institutional analysis of collective producer responsibility.

Subject	Remarks
Institutions	PROs are typically non-profit organisations but exist as for-profit firms, government agencies and quasi-government organisations.
Property rights	PROs gain property rights over collected EOL products, and therefore producers do not gain property rights individually.
Transaction costs	The costs in gaining property rights over EOL products are reflected in disposal fees.
Responsibilities	In a system with CPR, the physical and part of the informative responsibility of individual producers are transferred to the PRO, effectively converting the producer's responsibilities to financial responsibility by paying a disposal fee.
Agency	As interests are never entirely aligned, PA problems can occur between PRO and producers.

A.1.1.1. Competition between PROs

Within product take-back schemes with CPR, there is a distinction between monopolistic (one PRO) and competitive (more than one PRO with the same scope) schemes (Toyasaki, Boyacî, & Verter, 2011). EPR schemes with several non-competing PROs (e.g. they cover different product categories) are part of the monopolistic category.

Competition is a controversial issue in EPR implementation policies, and its (positive and negative) effects are debated (Rubio, Ramos, Leitão, & Barbosa-Povoa, 2019). An argument in support of monopolistic systems can fully exploit economies of scale under a single nationwide scheme, which is important in countries where volumes are not high enough to create a viable market for multiple competitive PROs (Savage, 2006).

An argument in favour of competitive schemes is the belief in the laws of competition (Rubio et al., 2019), which dictate that competition leads to innovativeness and efficiency. Kunz et al. (2014) provide an example of competition between PROs in Germany and how it helped to bring down waste management costs and improve the recycling services. They recommend national authorities to open up EPR markets to competition.

There is no clear indication whether competition is preferable when looking at the efficiency of existing schemes. A 2014 report on the development of guidance on EPR by BIO by Deloitte states that after analysing 36 EPR schemes in the EU, 'there is no evidence that a centralised organisation is preferable to the introduction of competition among PROs and vice-versa' (BIO by Deloitte, 2014, p. 102).

Institutional analysis of competition

There are two contrasting arguments on transaction costs with competition:

- The total amount of EOL products is limited. Without competition, one PRO can use economies of scale to collect the required amount of EOL products with relatively low transaction costs. With competition, PROs have to spend more (relative to the amount of EOL products) to gain property rights on EOL products as they are more scarce than

without competition. Total transaction costs are therefore higher with than without competition.

- In a scheme with competition, producers are inclined to choose the PRO with the lowest disposal fees, which are directly connected to transaction costs. PROs are therefore incentivised to be efficient and innovative to keep transaction costs as low as possible.

Table 23 shows a summary of the two arguments.

Table 23, summary of institutional analysis of competition between PROs.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*
Property rights	*Not deemed as a relevant institutional feature.*
Transaction costs	Two arguments on transaction costs with and without competition: • Without competition, the only PRO can use economies of scale to reach the set targets for collection and recycling. Therefore total transaction costs are lower than with competition. • With competition, PROs are incentivised to be efficient and innovative to keep transaction costs low. This will lead to lower transaction costs than without competition.
Responsibilities	*Not deemed as a relevant institutional feature.*
Agency	*Not deemed as a relevant institutional feature.*

A.1.2. Product take-back scheme with individual producer responsibility

Individual Producer Responsibility (IPR) is the counter-part of CPR. Toffel (2003) states that with IRP, 'manufacturers are held responsible only for their own EOL products' (p. 107), as opposed to CPR where responsibility is imposed on all participating companies.

The rationale behind IPR is described by Atasu and Subramanian (2012), who state that producers in schemes with IPR can reap full benefits of design changes that boost product recovery. IPR incentivises producers into taking responsibility for the entire lifecycle of its product, one of the main goals of EPR.

Going from full IPR to full CPR, one comes across several mixes of IPR and CPR. When intersecting physical and financial with collective and individual responsibility, as done by Favot (2014), four different forms of take-back schemes arise. Table 24, an adaptation of Favot (2014), shows the result. The outcomes are named option A to D. The darker the colour, the more the option is brought into practice.

Table 24, intersection physical vs financial responsibility and individual vs collective responsibility.

	Individual financial responsibility (IF)	Collective financial responsibility (CF)
Individual physical responsibility (IPh)	Option A: **IPh** & **IF**	Option B: **IPh** & **CF**
Collective physical responsibility (CPh)	Option C: **CPh** & **IF**	Option D: **CPh** & **CF**

Option A is what could be seen as 'pure IPR', as individual producers are financially and physically responsible for collecting and processing their own EOL products. In reality, there are systems designed in this way where the product market is concentrated and viable for individual producers to operate a take-back system (OECD, 2016). An example is take-back of EOL vehicles

by German car producers (BIO by Deloitte, 2014). However, most producers have established collective systems with PROs, and pure IPR is seldom brought into practice (OECD, 2016).

The upper right cell, option B, has no implementation in reality because it is costly and ineffective to individually collect and process EOL products, and then charge producers on a collective basis (Favot, 2014). In option C, the physical collection is done collectively but with a system to charge the producers individually. Option C is arguably the most interesting option as it combines the efficiency of a collective system with the incentives to producers of IPR. Option D refers to pure collective systems or CPR. It is unclear whether most take-back systems in practice resemble option C or option D. Therefore, their colour in Table 24 is the same.

Combining collective physical responsibility with individual financial responsibility brings its own challenges. An example is described by Gui et al. (2016). The authors' main question is how the costs of large collective collection and recycling networks should be allocated to individual producers to maximise cost efficiency, without imposing higher costs on certain producer groups than they can achieve individually. The risk of the latter is that producers break away from the collective systems, resulting in fragmentation which leads to relatively higher total costs. Gui et al. propose cost allocation mechanisms as a solution. These mechanisms weigh and base return shares on processing costs and capacity contributions to collective systems are rewarded (2016).

Allocation of costs is often executed by via disposal fees. When these fees are not equal for all producers, it is named tariff differentiation. Disposal fees are sometimes differentiated to reward producers for design changes that increase the effectivity of recycling. Modulated fees that incentivise these forms eco-design, branded eco-modulation, increase the degree of IPR in product take-back schemes, as producers reap benefits of design changes. Section B.2.4 elaborates on eco-modulation and its effect on circularity.

This section will not go further into allocation systems, but the examples show that IPR vs CPR is indeed a scale. The degree of a system in this scale can shift by changing the allocation of costs, and thus responsibilities. When a scheme promotes benefits to individual producers for design changes, either in physical or financial responsibility, it moves on the scale towards IPR (Atasu & Subramanian, 2012).

Institutional analysis of IPR

In systems with full IPR, manufacturers are held responsible for their EOL products. In other words, producers are obligated to regain property rights on products they have put on the market in order to recycle these. As producers will have to incur costs to gain the property rights individually, transaction costs will probably be higher than with CPR.

The degree of IPR in a system with take-back is to a great extent determined by the allocation of physical and financial responsibilities. In a system where collective physical responsibility is combined with individual financial responsibility (option C in Favot's analysis (2014)), the mechanism for allocating costs (i.e. allocating financial responsibility to individual producers) is an important determinant for the degree of IPR in the system. Rewarding physical capacity contributions by producers boosts IPR further.

Table 25 shows a summary of the institutional analysis of IPR.

Table 25, summary of institutional analysis of individual producer responsibility.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*
Property rights	Producers are obligated to regain the property rights they have put on the market.
Transaction costs	Will probably be higher with IPR in comparison to CPR.

Responsibilities	In a system where collective physical responsibility is combined with individual financial responsibility, the mechanism for allocating financial responsibility is an important determinant for the degree of IPR in the system.
Agency	*Not deemed as a relevant institutional feature.*

A.1.3. Voluntary product take-back schemes

A take-back scheme is purely voluntary in case of firms agree to impose a take-back system for their EOL products and set a recycling goal (Walls, 2006), without governmental penalties for not achieving goals. Voluntary take-back schemes are not implemented to adhere to governmental law legislation but are the result of an industry initiative. These schemes, though voluntary, can have an inbuilt penalty or reward system.

There is little systematic, quantitative information on voluntary schemes. The available evidence suggests that voluntary programmes are mostly set up for a few, specific product categories (OECD, 2016). These are often categories where producers have a direct incentive to take back products because of its profitability, most commonly durable commercial products and EOL products that have value (positive prices). A long-cited example is photocopiers (OECD, 2016). Producers that want to prevent acquisition, refurbishment and resale of their products by third-parties may also pursue voluntary take-back (Ferguson & Toktay, 2006).

As with other categories of EPR, the fact that a scheme is voluntary does not change the system in itself. It is likely, however, that a voluntary scheme has different targets from a mandatory scheme. Moreover, voluntary schemes start with collaboration between like-minded producers in the same industry. Mandatory targets imposed by a government force producers into collaboration, but not seldom unwanted.

Institutional analysis of voluntary take-back schemes

The difference between voluntary and mandatory take-back schemes is reflected in the institutional foundation. Mandatory systems will find their base in legislative obligations, while voluntary systems are often found with industry-wide pacts or agreements between producers (OECD, 2016). Voluntary systems can later be included in legislation.

With mandatory systems, there is a difference in interests between government (principal) and producers (agent), which can lead to efficiency problems. A government forces a system upon producers that can differ from producer interests. Voluntary schemes are bound to have less discrepancy in interests, and therefore less chance on inefficiencies due to a PA problem.

Table 26 shows a summary of the institutional analysis of voluntary take-back schemes.

Table 26, summary of institutional analysis of voluntary take-back schemes.

Subject	Remarks
Institutions	• Mandatory schemes are often based in governmental legislation. • Voluntary schemes are often based in industry-wide pacts or agreements.
Property rights	*Not deemed as a relevant institutional feature.*
Transaction costs	*Not deemed as a relevant institutional feature.*
Responsibilities	*Not deemed as a relevant institutional feature.*
Agency	Mandatory systems have a higher potential of leading to PA problems than voluntary systems.

A.2. Economic and market-based EPR instruments

Economic and market-based instruments are based on financial incentives to comply with EPR (OECD, 2016). As take-back requirement instruments are based in a physical responsibility, they differ from this category. The different forms of economic and market-based instruments share many similarities but are discussed separately in the following sections.

A.2.1. Deposit-refund systems

In Deposit-Refund Systems (DRS), an initial deposit is made at purchase of a product. When returned to a specific location, this deposit is fully or partially refunded (OECD, 2016). The best-known example in the Netherlands is probably the system for standardised beer and soft drink bottles, which can be returned empty at most supermarkets. Initially, most DRS were adapted to battle litter problems, but the approach has now been applied in a much wider scope (Walls, 2011). For example, DRS can be set up in a scheme with product take-back requirements in order to achieve collection targets.

The working of DRS is illustrated by Walls (2011), who compares it to a Pigouvian tax as both control pollution similarly (Bohm, 1981; Fullerton & Wolverton, 2000). A Pigouvian tax is a tariff on market activities that generate negative externalities – costs that are not included in the market price. The Pigouvian tax is intended to correct market failure by being set equal to the external marginal cost of negative externalities. DRS impose an up-front fee on production or consumption, and the revenue can be used to rebate green inputs and mitigation activities, similar to a Pigouvian tax (Walls, 2011). However, DRS have an important advantage over a Pigouvian tax as they avoid the problem of dumping that is often associated with the latter (Walls, 2011). Especially when legal disposal is taxed, households and firms might seek alternative disposal options, e.g. burning and illegal dumping. When rebates are offered for EOL products – as with DRS – this problem is circumvented. Non-recovered deposits may be used to finance the DRS and waste collection and disposal facilities.

Institutional analysis of DRS

In DRS, property rights of the product switch from producer to consumer (in exchange for a deposit) and back (in exchange for the refund). The exchanged property rights do not relate to full ownership. For example, labels of refundable beer bottles state 'this bottle is property of the brewery'. The legal status is, however, unclear.

Similar to take-back instruments, transaction costs in DRS are the costs of running the system to collect EOL products. When the refund is higher than the value of the EOL product, transaction costs of DRS are lower because not all deposits are recovered and can therefore be used to finance the system. This mechanism raises the question of whether it is in the producer's interest to aim for 100% recovery. The last part of this section (on agency) expands on this question.

In a DRS, producers have a financial responsibility towards owners of EOL products to reimburse them, a physical responsibility for setting up locations where the products can be brought, and an informative responsibility to the consumer.

DRS negate the problem of dumping, by creating agency with the owner of the EOL products to bring it to the designated location.

When the refund combined with marginal costs of the collecting system is higher than the value of the EOL product, producers have no agency to collect all product. As non-recovered deposits can be used to finance the DRS, it might not be in the interest of the producer who runs the DRS to aim for 100% recovery. In the situation that all deposits are refunded, the costs of logistics are higher, and no deposits can be used to finance the system. This mechanism is an

example of a PA problem as the interests of a government (principal) are different from the producer (agent). The problem is circumvented when the refund is lower than the value of the EOL product combined with the marginal costs of the collecting system.

Table 27 shows a summary of the institutional analysis of DRS.

Table 27, summary of institutional analysis of DRS.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*
Property rights	Property rights are exchanged twice between producer and consumer, while the deposit and refund are exchanged the opposite way.
Transaction costs	The transaction costs of (running the) DRS can (partly) be financed by non-refunded deposits.
Responsibilities	• Financial responsibility is assigned to producers to reimburse owners of EOL products. • Physical responsibility is assigned to producers to set up locations to bring products. • Informative responsibility is assigned to producers to inform consumer.
Agency	• Creates agency with consumer to return the EOL product. • It could be not in the interest of the producer who runs the DRS to aim for 100% recovery, as this heightens the costs of logistics and lowers the amount of non-refunded deposits.

A.2.2. Advance disposal fee

Some governments limit the involvement of producers in EPR schemes to the payment of an Advance Disposal Fee (ADF), sometimes referred to as advance recycling fees. ADF is a tax that is paid – either by producers or consumers – at the purchase of a waste-generating product (OECD, 2016). Public or private entities may collect the fee and use them to finance the post-consumer treatment of the designated products. ADF is a form of a Pigouvian tax, and would therefore ideally be set at the level of the marginal cost of treatment.

ADF and DRS (and material taxes) are often deemed very similar, which makes the distinction between them ambiguous. ADF essentially is a simpler version of other instruments. It is similar to a deposit without refund, and in case material taxes are used for financing of post-consumer treatment of products, they technically are an ADF as well. Moreover, product take-back requirements are sometimes combined with ADF (OECD, 2016).

After product take-back schemes, ADF was the most used EPR instrument in 2015, as 16% of global EPR schemes featured ADF as main EPR instrument in 2015 (Kaffine & O'Reilly, 2015).

Institutional analysis of ADF

An ADF provides a purely financial responsibility to producers. Producers only pay the ADF, which is often incorporated in the price paid by the consumer.

An ADF enables governments to finance the transaction costs involved in collecting and recycling EOL products.

Table 28 shows a summary of the institutional analysis of ADF.

Table 28, summary of institutional analysis of ADF.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*

Property rights	*Not deemed as a relevant institutional feature.*
Transaction costs	The revenues of the ADF are often used for collection and recycling.
Responsibilities	An ADF provides a purely financial responsibility to the producer.
Agency	*Not deemed as a relevant institutional feature.*

A.2.3. Material taxes

Material taxes can come in two forms. The first is a special tax imposed on the use of materials that are potentially harmful and difficult to recycle (OECD, 2016). Such a tax encourages producers to use less harmful materials. The second is a tax on the use of virgin material that incentivises the use of secondary (recycled) materials. Ideally, both taxes are set at a level where the marginal cost of the tax equals the marginal cost of treatment (Gupt & Sahay, 2015).

Both forms of material taxes are essentially a Pigouvian tax, as they put a price on externalities involved in material choice. The intention of material taxes in EPR schemes is to earmark the tax and use the revenue for collection, sorting, and treatment of EOL products (OECD, 2016). This would make this instrument similar to an ADF based on material choice and weight.

Looking broader than EPR, material tax fits in a movement that aims to prioritise tax on material over tax on human labour. An example is Ex'tax, a Dutch thinktank advocating this movement (Groothuis, 2018).

Institutional analysis of material taxes

Material taxes differ from most EPR schemes in requiring institutional assurance in tax policy and legislation and thus demand a much broader institutional embedding.

Revenues of material taxes are often earmarked to incentivise collection and recycling of EOL products, which would lower transaction costs for producers.

Both forms of material taxes assign financial responsibility to producers that is preceded by an informational responsibility. In order to tax materials, producers must know and report the materials they use.

Table 29 shows a summary of the institutional analysis of material taxes.

Table 29, summary of institutional analysis of material taxes.

Subject	Remarks
Institutions	Requires broad institutional embedding in tax policy and legislation.
Property rights	Not deemed as a relevant institutional feature.
Transaction costs	The intention is to earmark the revenues of material taxes for collection and recycling of EOL products.
Responsibilities	• Material taxes assign financial responsibility to the producer. • Material taxes assign informational responsibility to producers to track and report used materials.
Agency	Not deemed as a relevant institutional feature.

A.2.4. Upstream Combination Tax/Subsidy

With Upstream Combination Tax/Subsidy (UCTS), producers pay a tax that is used to subsidise waste treatment (OECD, 2016). UCTS provides producers with incentives to alter material input and design of products while providing a financing mechanism to support treatment and recycling. UCTS is similar to DRS, but rather than placing the tax at the purchase of a product, the charge and refund are placed upstream in the production process (Kaffine & O'Reilly, 2015). For example, a tax by weight on aluminium blocks in combination with a subsidy by weight to collectors of aluminium cans would constitute a UCTS (Kaffine & O'Reilly, 2015).

UCTS can be seen as an ADF combined with a recycling subsidy. However, the type of ADF and what is done with the revenues highly influence the incentive effects (Walls, 2006). With UCTS, the ADF is assigned to producers of intermediate products (e.g. aluminium blocks). The revenues are used to subsidise 'back-end' recycling – a subsidy per pound of material recycled or per unit of the product recycled. The outcome is a policy with different incentives to producers than when ADF revenues are solely used to cover the costs of managing waste.

Institutional analysis of UCTS

Subsidies for collectors of EOL products lower transaction costs.

The financial responsibility in UCTS instruments is not assigned to producers of end-products (as with ADF) but intermediate producers.

Similar to DRS, UCTS creates agency with collectors to recycle certain materials because the subsidy provides a financial incentive. Creating agency negates PA problems and collateral inefficiencies.

Table 30 shows a summary of the institutional analysis of UCTS.

Table 30, summary of institutional analysis of UCTS.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*
Property rights	*Not deemed as a relevant institutional feature.*
Transaction costs	Transaction costs are lowered by subsidies.
Responsibilities	UCTS assign financial responsibility to intermediate producers.
Agency	UCTS creates agency with collectors to recycle materials, negating PA problems.

A.3. Regulatory approaches

Regulatory approaches are instruments that regulate product designs, disposal or emissions. This is a broad category. Therefore, only product standards and prohibitions that are discussed in the literature on EPR will be analysed in this section. Other instruments that are listed but not discussed in the literature, e.g. disposal bans and emission limits, are excluded from analysis.

A.3.1. Minimum product standards

Minimum product standards obligate producers to design products that conform to specific product standards. These standards can apply to different parts of the design or even the method of the design itself. However, in the light of EPR, product standards often address a minimum recycled content that products should contain (OECD, 2016). When minimum product standards are used in combination with a tax – which is lower in case of compliance to the standard – standards incentivise the redesign of products additionally.

Standards can be mandatory but are often applied as voluntary industry initiatives. An example of the latter is the use of the standardised beer bottle in the Dutch DRS. The DRS is mandatory, whilst the industry voluntarily used a minimum product standard. This system resulted in the wide use of one type of beer bottle in the Netherlands.

Institutional analysis of minimum product standards

Minimum product standards assign a physical responsibility to producers to conform to a certain standard, and often an informative responsibility to consumers or others to make sure they know a product does indeed comply with the standard. When product standards are combined with a tax, physical responsibility is coupled to financial responsibility.

Product standards are often applied by industries voluntarily. In this process of voluntary standardisation, interests of producers are compared and aligned.

Table 31 shows a summary of the institutional analysis of minimum product standards.

Table 31, summary of institutional analysis of minimum product standards.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*
Property rights	*Not deemed as a relevant institutional feature.*
Transaction costs	*Not deemed as a relevant institutional feature.*
Responsibilities	• Physical responsibility to conform to the standard is assigned to producers. • Informative responsibility for producers to inform consumers that products comply with standards. • Addition of a tax adds financial responsibility for producers when not complying to the product standard.
Agency	When standardisation is done voluntarily, interests of producers are often aligned.

A.3.2. Prohibition of materials or products

Standards obligate producers to use certain materials or processes, and this instrument does the opposite: it prohibits the use of certain hazardous materials or products. Prohibitions can be mandated from a government or voluntary as an industry initiative. In EPR schemes, prohibitions are often used in case of materials or products that are not recycled easily.

Institutional analysis of prohibition of materials or products

Similarly to product standards, this instrument assigns a physical responsibility to producers. In this case, however, it is a responsibility not to use certain materials or products. This responsibility is often combined with an informative responsibility to consumers or others that they conform to the rules.

Table 32 shows a summary of the institutional analysis of prohibition of materials and products.

Table 32, summary of institutional analysis of prohibition of materials and products.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*
Property rights	*Not deemed as a relevant institutional feature.*
Transaction costs	*Not deemed as a relevant institutional feature.*
Responsibilities	Physical responsibility for producers to not use materials or products. Informative responsibility assigned to producers to inform consumers that products comply with prohibition.
Agency	Not deemed as a relevant institutional feature.

A.3.3. Other regulatory instruments

Widmer et al. (2005) and Gupt and Sahay (2015) list several other regulatory instruments in their categorisation. These are disposal bans, mandated recycling, recovery obligations, and emission limits. However, neither article explains how these instruments are used in EPR systems,

nor does the 2016 OECD guidance manual on EPR or other EPR literature. Therefore, the instruments are not included in the analysis in this chapter.

A.4. Information-based instruments

The set of instruments listed under information-based instruments is diverse, but these instruments have one thing in common: producers have the responsibility to provide information about their products or work processes. These instruments intend to indirectly support EPR by raising public awareness or providing recyclers with knowledge of products and used materials (OECD, 2016). The following list provides several examples of how this is implemented into EPR schemes:

- Reporting requirements for producers
- Labelling of products and components
- Communicating to consumers about waste separation
- Informing recyclers about the materials used in products
- Consultation to authorities about collection network

Institutional analysis of information-based instruments

Unsurprisingly, information-based instruments assign an informative responsibility to producers. With most of the provided examples, the informative responsibility is preceded by an administrative responsibility. After all, it is difficult to report on used materials or consult about collection network, when there is no information to provide. Producers have the responsibility to track their production and sales.

Information-based instruments can affect the agency of different parties in a scheme. For example, when producers provide information to consumers via labels on products, this might affect not only the consumer in their actions but also the producers in product design choices.

Table 33 shows a summary of the institutional analysis of information-based instruments.

Table 33, summary of institutional analysis of information-based instruments.

Subject	Remarks
Institutions	*Not deemed as a relevant institutional feature.*
Property rights	*Not deemed as a relevant institutional feature.*
Transaction costs	*Not deemed as a relevant institutional feature.*
Responsibilities	Assigns informative responsibility to producers, which is often preceded by an administrative responsibility.
Agency	Provision of information can affect agency of the recipient, but also of the party that provides the information.

A.5. Voluntary practices

The category of voluntary practices is a common denominator for a wide range of instruments that can be part of EPR schemes. This category is very diverse and has unclear demarcations. Therefore, only some general remarks will be made on the subject.

Technically, all voluntary initiatives in which producers extend their responsibility to additional parts of the life cycle of their products would belong to this category. Examples from EPR literature are public/private partnerships, leasing and servicing, social contracts, and gentlemen's agreements. These examples have in common that the producer's interests are aligned either with another party (partnerships/social contracts/gentlemen's agreements) or an alternative business model (leasing and servicing).

Davis and Wilt (1997) analysed factors that encourage voluntary adoption of EPR in 1997. Though dated, it offers a view on incentives for producers to start voluntary practices. Davis and Wilt identified the following six factors (not necessarily in order of importance):

- **Cost savings**: even if not created with savings as a goal, many practices are maintained because they save costs.
- **Environmental stewardship**: all companies analysed by Davis and Wilt had environmental stewardship adopted as corporate ethic, and EPR initiatives demonstrate their commitment to it.
- **Product innovation**: companies found that extending product responsibility to additional stages of the life cycle resulted in product innovation that cut costs through more efficient manufacturing or material use.
- **Consumer satisfaction and loyalty**: producers taking care of EOL stages are more likely to breed better consumer loyalty.
- **Green marketing**: voluntary practices boost the green or environmentally friendly image of a company.
- **Avoiding mandatory take-back programs**: Davis and Wilt detected that industry sectors set up voluntary practices to avoid mandatory programmes that differ from state to state (US) or by country (EU). This calls into question what 'voluntary' actually means in the context of these initiatives.

Institutional analysis of voluntary practices

The essence of voluntary practices is that they are not based on legislation. These practices can take the form of formal pacts, extraordinary business models, informal collaboration, and everything in between. This makes them too diverse to identify institutional characteristics, apart from agency.

When voluntary EPR initiatives are set up, either the interests of involved parties are already aligned, or the initiative aligns interests. Davis and Wilt's observation that voluntary practices are sometimes set up to avoid mandatory EPR schemes confirms the latter (1997). Their observation could indicate that voluntary initiatives are started to prevent a situation where the enforcing government (principal) has other interests than the producers (agents) and the PA problems that can occur in these situations.

Table 34 shows a summary of the institutional analysis of voluntary practices.

Table 34, summary of institutional analysis of voluntary practices.

Subject	Remarks
Institutions	Based in non-legislative institutions.
Property rights	*Not deemed as a relevant institutional feature.*
Transaction costs	*Not deemed as a relevant institutional feature.*
Responsibilities	*Not deemed as a relevant institutional feature.*
Agency	Voluntary practices are either set up to align the interest or because the interests of the parties involved are already aligned with each other. When a voluntary practice is set up to avoid mandatory EPR, it is done to prevent a PA problem.

A.6. Conclusion

In this appendix, standard EPR instruments are described and analysed from an institutional perspective. Table 35 (on page 97) shows an overview of the institutional features of the analysed

instruments. This section summarises the chapter in order to answer the sub-question '*what is the institutional working of EPR instruments?*'.

By far the most used EPR instrument is product take-back requirements. Producers are assigned the physical responsibility to collect a target of property rights over EOL products in order to process them. The required processing method is most often recycling. A variety of product take-back instruments exists. They are implemented with the aim to achieve targets efficiently and keep associated transaction costs low. The variations trade individual physical responsibilities for financial responsibilities (resulting in a shift from IPR to CPR) and keep transaction costs low by enabling or blocking competition between PROs, or avoid PA problems when set up voluntarily. The context, particularly the type, volume and value of the product, determines what variation achieves the best results.

Of the described economic and market-based instruments in this chapter, only DRS involves the collection of EOL products and the associated property rights. DRS and all other instruments in this category assign financial responsibility to producers in the form of a tax. This tax is often used to finance the collection and recycling of EOL products, i.e. transaction costs.

Regulatory approaches such as product standards and prohibition of materials and products are straightforward and assign physical and informative responsibilities to producers. Additionally, the process of standardisation can affect the agency of the parties involved.

Information-based instruments and voluntary approaches are broad categories under which various instruments are categorised. Their main institutional feature is an effect on agency. Both categories align interests of parties, either via institutional foundations (voluntary pacts between producers) or an exchange of information (between producers, consumers and recyclers).

Table 35, overview of institutional concept/theory used for analysis per instrument.

Category	Instrument	Institutions	Property rights	Transaction costs	Physical resp.	Financial resp.	Informative resp.	Agency
Product take-back requirements	General take-back		**X**	**X**	**X**		**X**	
	CPR	**X**	**X**	**X**	**X**	**X**	**X**	**X**
	Competition			**X**				
	IPR		**X**	**X**	**X**	**X**		
	Voluntary	**X**						**X**
Economic and market-based	DRS		**X**	**X**	**X**	**X**	**X**	**X**
	ADF			**X**		**X**		
	Material taxes	**X**		**X**		**X**	**X**	
	UCTS			**X**		**X**		**X**
Regulatory approaches	Minimum product standards				**X**	**X**	**X**	**X**
	Prohibition of materials				**X**		**X**	
Information-based instruments							**X**	**X**
Voluntary approaches		**X**						**X**

B. Analysis of EPR instruments' circularity

Appendix A described and analysed various EPR instruments and their institutional features. This appendix answers the sub-question *'do different types of EPR instruments and their institutional features incentivise circularity?'* Input for answering the sub-question is the descriptions and institutional analyses from appendix A combined with the theory on CE in chapter 3.

B.1. Determining circularity

This chapter will analyse to which R-strategy EPR instruments can lead and whether and how its institutional features affect the level of circularity of the instrument. For every instrument, the following questions are answered:

- To which R-strategy does/can the instrument lead?
- What effect do the institutional features have on the level of circularity of the instrument?

The working of the instrument is evaluated in order to answer these questions.

Table 36 comes from chapter 3 and describes the steps in the 9R model. The 9R model facilitates analysis of EPR instrument or scheme's level of circularity by examining the R-strategy that is incentivised by the instrument or scheme. Every step in the model is a circularity strategy or R-strategy that decreases the consumption of virgin materials in a product chain. In the described order, the effect of Refuse (R0) is generally the highest and the effect of Recover (R9) the least. Therefore, R-strategies with *lower* numbers are referred to as *higher* R-strategies. R0 is the highest R-strategy and R9 the lowest.

Strategies Refuse (R0) and Rethink (R1) do not necessarily involve an increase of reusing products or components. They do, however, decrease consumption of natural resources and materials and are therefore circularity strategies.

Table 36, the ten steps of the 9R model, adaptation of Potting et al., 2017, copy of Table 6.

Smarter product use and manufacturing	R0 – Refuse	Make product redundant by abandoning the function or coming up with a radically different product
	R1 – Rethink	Intensify product use (e.g. by sharing products or using multifunctional products)
	R2 – Reduce	Fabricate more efficiently by using less resources and materials for the product or in using it
Extend lifespan of product and its parts	R3 – Reuse	Reuse disposed products that are still useful in their original function, but by another user
	R4 – Repair	Reparation and maintenance of broken products for usage in its original function
	R5 – Refurbish	Renew or modernise an older product
	R6 – Remanufacture	Use parts of a disposed product in a new product with the same function
	R7 – Repurpose	Use whole or parts of a disposed product in a new product with different function
Utilise materials efficiently	R8 – Recycle	Process the materials of a disposed product to the same (high grade) or lesser (low grade) quality
	R9 – Recover	Recover energy in materials by incineration

Figure 16, copy of Figure 8 from chapter 3, is an adaptation of figures by the EMF (2015) and Potting et al. (2017) and visualises the steps of the 9R model in a product chain. It shows how

higher R-strategies create tighter circles than low R-strategies. The figure does not visualise R0, as it removes or shrinks the flows in the product chain altogether.

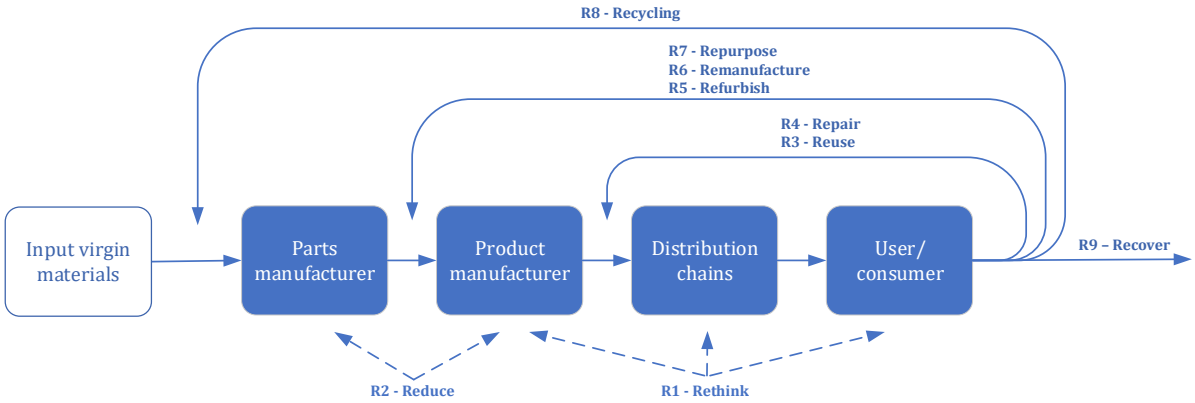

Figure 16, visualisation of 9R model in the product chain, copy of Figure 8.

Each section in this appendix describes which R-strategies (R0 down to R9) are possible or incentivised by the EPR instrument in question. The boxes describe the logical or probable effect of the institutional features (following the analysis done in chapter 4) on the level of circularity. These effects can be deemed positive (+), negative (-), both negative and positive (±), no effect (0) or unclear (?).

B.1.1. Remarks on analyses

There are two important remarks on the analyses in this chapter. The first is that the product or product group could significantly influence the outcome for all instruments and their institutional features. For some products, high R-strategies are not possible. For example, packaging for food is often bound to health and safety rules that prohibit reuse. Moreover, when an instrument incentivises a certain R-strategy, it depends on several factors such as the technical possibilities of the product processing and associated costs whether it leads to that strategy.

The second remark is about the interconnectedness of institutional features. Because of it, the precise effect of an individual feature can be somewhat ambiguous. Features often have a direct and indirect effect. For example, the institutional base of a PRO could affect agency (see section A.1.1), while agency affects the level of circularity of an instrument. This analysis aims to distinguish and describe the direct effects.

B.2. Product take-back requirements

General product take-back requirements enable R-strategies up to **re-use (R3)** through assigning the physical responsibility to producers to collect their products. As producers have to collect an amount of EOL products relative to the products on the market, they can execute an R-strategy on these products. The type of mandated processing determines whether these instruments will mainly lead to **re-use (R3), recover (R9), or a strategy in between**.

Most take-back instruments and schemes have a recycling target. Where this is the case, take-back instruments can disincentivise higher R-strategies when these higher strategies do not count towards the target. For example, an implemented product take-back scheme might mandate a producer to recycle 50% of collected products. Not counting the reuse of products towards this target disincentivises the producer to use a higher R-strategy than recycling.

Effect of institutional features on circularity

Property rights: the requirement to collect property rights over EOL products is the main reason for this instrument's circular possibilities. R-strategies that require physical possession of EOL products, for example recycling or refurbishing, are difficult without property rights, specifically the right to alter a product.

Transaction costs: the transaction costs do not *directly* affect the instrument's circularity or possible R-strategies. However, there is a strong relationship between transaction costs and circularity. Higher R-strategies are, depending on the product system, often more expensive due to a higher human labour component. Therefore, transaction increase when a higher level of circularity is pursued.

Physical responsibility: the responsibility to collect and process products is physical and proportional to products put on the market by every individual producer. It has a direct effect on materials kept in the economy and therefore affects circularity positively.

As described in the general description of this instrument, in some cases, the physical responsibility to recycle a percentage of the collected products can hinder higher R-strategies. In these cases, the physical responsibility in product take-back schemes negatively affects the level of circularity.

Informative responsibility: the informative responsibility in this instrument force producers to track the amount and type of products they put on the market. This strengthens oversight of used, collected and recycled products and will therefore probably affect circularity positively.

Table 37 shows an overview of the effects of the institutional features of product take-back requirements on circularity.

Table 37, overview effects of inst. features of product take-back requirements on circularity.

Institutional feature	Effect	Explanation
Property rights	+	Producers are required to collect property rights. This requirement makes R-strategies possible.
Transaction costs	0	Transaction costs seem to affect circularity indirectly and are dependent on the product system.
Physical responsibility	±	Positive as it the physical responsibility has a direct effect on materials kept in the economy. Negative when it blocks higher R-strategies.
Administrative responsibility	+	Strengthens oversight of used, collected and recycled products

B.2.1. Collective Producer Responsibility

CPR enables producers to use economies of scale in order to attain high collection and recycling rates efficiently. A consequence of this is that PROs collect EOL products instead of individual producers. Unless producers can collect their products from the PRO, this disables R-strategies which require the producer's knowledge of the product. In theory, CPR could lead to **all R-strategies up to re-use (R3)**. The possibility for producers to collect their products from PROs seldom exists – because this would bring down the efficiency that was the reason to implement CPR in the first place – and therefore CPR often leads to **recycling (R8) and recovery (R9).**

Effect of institutional features on circularity

Institutions: the institutional form of PROs (public/private and non-profit/for-profit) does not seem to have a direct effect on the circularity of the instrument. It can, however, have an effect on agency in the system which consequently can directly affect circularity.

Property rights: with CPR, individual producers do not gain property rights over collected EOL products. CPR disables individual producer's possibilities to use knowledge of their products for strategies R3 up to R5, and R6 and R7 to a lesser extent.

Transaction costs: transaction costs in CPR are reflected in disposal fees. These do not affect the circularity of the instrument. The other way around, the chosen R-strategy can affect transaction costs. There is a relation between transaction costs and circularity, however, as higher disposal fees enable higher R-strategies and a higher level of circularity.

Physical responsibility: with CPR, physical responsibility is exchanged for financial responsibility by paying a disposal fee. This exchange removes the incentive for producers to expand the lifespan of their product by using R-strategies R3 to R7.

Financial responsibility: financial responsibilities that producers acquire in exchange for physical responsibilities can incentivise circularity when applied correctly. Modulation of fees – linked to the ecological impact of the producer's products – can incentivise producers to design more environmentally friendly products. Eco-modulation will be described more extensively in the paragraph on IPR.

Informative responsibility: responsibilities for producers to track and declare the amount of used, collected and recycled products could incentivise circularity. This mechanism is described with product take-back requirements in general. With CPR, this responsibility is partly transferred to PROs. Whether responsibilities are assigned to producers or PROs does not seem to affect the level of circularity of the instrument.

Agency: the interests of PRO and producers are never entirely aligned. It is unclear, however, whether a mismatch in interests would disincentivise circular activities or do the opposite. For producers who have no further ambition than to meet mandated targets, ambitious PROs could bring the level of circularity higher than individual producers would. Conversely: an ambitious producer can get stuck with a PRO that chooses to comply with targets as cheaply as possible with no aim for high circularity.

Table 38 shows an overview of the effects of the institutional features of CPR requirements on circularity.

Table 38, overview effects of inst. features of CPR on circularity.

Institutional feature	Effect	Explanation
Institutions	0	The institutional form of PROs has no direct effect on circularity.
Property rights	-	Individual producers do not gain property rights over their EOL products, which disables higher R-strategies.
Transaction costs	0	Do not affect circularity. Circularity affects transaction costs.
Physical responsibility	-	By exchanging physical for financial responsibility, the incentive to extend the life span of products is removed.
Financial responsibility	+	With eco-modulation, financial responsibility could be applied in a way that incentivises circularity.
Informative responsibility	0	Makes no difference whether the informative responsibility lies with producer or PRO.

Agency	±	Interests of PRO and producer will not be aligned. The outcome of this could be positive or negative for the level of circularity.

B.2.2. Competition

Competition incentivises efficiency and innovativeness in attaining high collection and recycling rates. When seen from this perspective, it promotes innovation in recycling. Competition in itself does not, however, directly lead to a distinctive R-strategy. It might influence the efficiency of a strategy when implemented, which could have an indirect effect on circularity via transaction costs (see below). For the discussion on whether the influence is positive or negative, see the section on competition in chapter 4.

Effect of institutional features on circularity

Transaction costs: circularity could be affected by transaction costs positively when competition boosts innovativeness and efficiency of the chosen R-strategy. It could, however, influence circularity negatively when economies of scale cannot be achieved because of competition.

Table 39 shows an overview of the effects of the institutional features of competition on circularity.

Table 39, overview effects of inst. features of competition on circularity.

Institutional feature	Effect	Explanation
Transaction costs	±	Could affect circularity positively by boosting innovativeness and efficiency. Could affect circularity negatively when economies of scale cannot be achieved.

B.2.3. Individual Producer Responsibility

A distinction can be made between pure IPR and schemes with a lesser degree of IPR. In pure IPR, producers are mandated to regain property rights over their EOL products. Higher circularity strategies generally maintain more value from EOL products. Producers in a scheme with pure IPR are therefore incentivised to use higher circularity strategies, as more value is maintained and they are the owner. These are **all R-strategies up to re-use (R3)**. As individual producers in pure IPR schemes reap benefits from design changes that boost product recovery (Atasu & Subramanian, 2012), they are incentivised to rethink product designs via R-strategies **rethink (R1) and reduce (R2)**.

In schemes with a lesser degree IPR, the incentives to design environmentally friendly products are lower. Allocation of physical and financial responsibilities determines the degree of CPR and IPR in a system. Modulation of disposal fees paid by producers can, therefore, add a degree of IPR and circularity to collective systems. Fees that are modulated to decrease environmental impact are called eco-modulation. The next section will elaborate on eco-modulation

Effect of institutional features on circularity

Property rights: in pure IPR, producers gain ownership over EOL products. In many schemes with a lesser degree of IPR, however, producers do not gain property rights. The degree of IPR in a scheme determines whether property rights are exchanged in a way that (possibly)

improves the level of circularity. Therefore, the effect of property rights in IPR is deemed both positive and negative.

Physical responsibility: similar to property rights, the degree of IPR determines the specific effect of physical responsibility. What is clear is that in pure IPR, the physical responsibility for individual producers has a strong positive effect on circularity. It is difficult, however, to pinpoint at what degree of IPR the positive effect turns negative.

Financial responsibility: allocation of financial responsibilities that implement a degree of IPR in collective schemes can positively influence circularity via modulation of fees. See the section on eco-modulation.

Table 40 shows an overview of the effects of the institutional features of IPR on circularity.

Table 40, overview effects of inst. features of IPR on circularity.

Institutional feature	Effect	Explanation
Property rights	±	Only in pure IPR schemes, property rights seem to have a positive effect on circularity. In schemes with a lesser degree of IPR, property rights' effects are negative.
Physical responsibility	±	In pure IPR schemes, the physical responsibility for individual producers has a strong positive effect on circularity. At which degree of IPR this turns negative is unclear.
Financial responsibility	+	Via modulation of fees (eco-modulation), financial responsibility can affect circularity positively.

B.2.4. Eco-modulation

With eco-modulation, producers of environmentally unfriendly products are forced to pay higher fees, while products with less environmental impact result in lower fees. The main idea of eco-modulation is to provide a financial incentive to producers to redesign products to reduce their impacts. There are different eco-design aspects which can be incentivised via fees. Most common are weight, recyclability, presence of hazardous components, durability (lifetime) of products, prevention of consumption, reparability of products, and recycled content (Dubois, Graaf, & Thieren, 2016). It seems clear that these aspects aim to incentivise a different R-strategy. Table 41 connects the forms of eco-modulation mentioned by Dubois et al. (2016) to R-strategies (as mentioned by Potting (2017)).

Table 41, forms of eco-modulation and incentivised R-strategies.

Form of eco-modulation	Incentivised R-strategy
Prevention of consumption	Refuse (R0) and Reduce (R2)
Durability of products	Rethink (R1) and Reduce (R2)
Presence of hazardous components	Rethink (R1)
Weight	Reduce (R2)
Reparability of products	Repair (R4)
Recyclability	Recycle (R8)
Recycled content	Recycle (R8)

Environmental improvements in product design can be incentivised by eco-modulation. However, added complexity adds costs to eco-modulation. Whatever the modulation of fees is based on has to be measured or assessed. A fee could be based on a *circularity score,* but assessing

a product on circularity can lead to methodological and practical difficulties. Methodological difficulties arise from the multitude of definitions of circularity (Kirchherr et al., 2017). Practical obstacles are appointing an objective authority that assesses products and associated costs. Therefore, Dubois et al. (2016) conclude that 'modulated fees should only be imposed where the environmental benefits outperform the negative effects of fragmented fees' (p. 24).

As eco-modulation is a method to implement IPR and not a distinct EPR instrument, it has not been analysed using the institutional framework.

B.2.5. Voluntary product take-back

As voluntary product take-back can take various forms, it is impossible to identify to what R-strategies these instruments lead or can lead. However, something can be said about the institutional features of voluntary product take-back instruments.

Effect of institutional features on circularity

Institutions: voluntary take-back schemes are, contrary to mandated schemes, often based in industry-wide pacts or agreements between producers. This affects agency of actors in these schemes. It is unclear, however, whether the institutional basis itself has a direct effect on the level of circularity.

Agency: voluntary take-back schemes start with aligned interests or align interest in the process of implementation. The alignment of interests eliminates possible PA problems and associated inefficiencies that occur in mandatory systems. As product take-back schemes have a circular goal (often recycling), taking away inefficiencies could affect circularity positively.

Table 42 shows an overview of the effects of the institutional features of voluntary product take-back on circularity.

Table 42, overview effects of inst. features of voluntary product take-back on circularity.

Institutional feature	Effect	Explanation
Institutions	?	The institutional base affects agency, but it is unclear whether the institutional base itself directly affects circularity.
Agency	+	By aligning interests and thus taking away inefficiencies, circularity is affected positively.

B.3. Economic and market-based instruments

Economic and market-based instruments are based on financial incentives to comply with EPR (OECD, 2016). Producers in these instruments are assigned financial responsibilities that affect their behaviour. Therefore, the circularity of these instruments is based on financial incentives. The instruments in this category work differently, however, and therefore their level of circularity varies as well.

B.3.1. Deposit-refund

DRS provide producers with the obligation to take back their products and rebate the consumer. This as two strong circular incentives. First, producers become the owner of their EOL products, which means they can use all R-strategies from **recover (R9)** up to **re-use (R3)** on these products. Second, producers are incentivised to design products that are easy to re-use/recycle/etc., because they know that they will become the owner of the EOL product. In other words, they are stimulated to **rethink (R1)** their products.

Effect of institutional features on circularity

Property rights: similar to take-back systems, the requirement to collect property rights over EOL products is the main reason for a DRS's circular possibilities. Without property rights over EOL products, many R-strategies are impossible or at least more difficult.

Transaction costs: transaction costs of DRS could disincentivise operators of the system to aim for the highest collection grade possible, as non-returned/collected products mean unreturned refunds. This situation can occur when transaction costs are high.

Physical responsibility: the physical responsibility to set up locations has a positive influence on circularity, as there is a clear location for consumers to bring EOL products.

Financial responsibility: financial responsibilities for producers to reimburse consumers for EOL products provides a positive incentive to those consumers to bring the products to a collection location.

Informative responsibility: informative responsibilities to inform consumers about refunds and where these can be collected will probably have a positive effect on the amount of EOL thrown away by consumers.

Agency: agency created with consumers to return EOL products has a positive effect on the circularity of this instrument. Producers might be incentivised to aim for a collection rate lower than 100% when the refund combined with marginal costs of the collecting system is higher than the value of the collected product. This mechanism could harm the circularity of the instrument.

Table 43 shows an overview of the effects of the institutional features of DRS on circularity.

Table 43, overview effects of inst. features of DRS on circularity.

Institutional feature	Effect	Explanation
Property rights	+	The requirement to collect property rights over EOL products is the main driver for DRS' circular possibilities.
Transaction costs	-	Might disincentivise operator to aim for 100% collection.
Physical responsibility	+	Responsibility to set up locations for collection affects circularity positively.
Financial responsibility	+	A positive incentive for consumers to bring products to a collection location.
Informative responsibility	+	Probably positive for circularity as consumers will not trash EOL products.
Agency	±	Positive effect on circularity with consumers. Possible negative effect with producers.

B.3.2. Advance disposal fee

ADF systems are similar to DRS but miss the main circularity-promoting feature of DRS as ADF lacks a way to regain property rights over EOL products. Even though ADF provides a budget that can be used for various R-strategies, the instrument itself does not lead to a particular R-strategy. In conclusion, this instrument does not lead to an R-strategy, but its institutional features do have a positive effect on circularity.

Effect of institutional features on circularity

Transaction costs: as the revenues of ADF are often used to finance the post-consumer collection and treatment of products and thus provide for the transaction costs of these activities, the effect on circularity is positive.

Financial responsibility: when the revenues of ADF are indeed used for circularity strategies, producers take financial responsibility for it. This affects circularity positively.

Table 44 shows an overview of the effects of the institutional features of ADF on circularity.

Table 44, overview effects of inst. features of ADF on circularity.

Institutional feature	Effect	Explanation
Transaction costs	+	Revenues of ADF are often used to finance transaction costs of circular strategies.
Financial responsibility	+	Producers carry the financial responsibility of circular activities.

B.3.3. Material taxes

There are two ways in which material taxes incentivises circularity strategies. The first is through an increase in the value of materials. Taxing virgin materials makes them more costly for producers resulting in more expensive products. As recycled materials are not taxed, demand for recycled materials or re-used products will probably rise, which heightens the incentive to apply R-strategies. R-strategies that retain more value are stimulated as a result of a higher demand for recycled materials and higher material values.

Secondly, R-strategies are generally (human) labour-intensive. By shifting tax from human labour to natural resources, circular strategies are stimulated. In the two ways described above, all R-strategies ranging from **recovery (R9) up to rethink (R1)** are incentivised. When material taxes are passed on to consumers, they could even lead to **refusing (R0)** products.

Material taxes fit in the circular movement that aims to shift tax from human labour to natural resources and pollution or, in short, to materials (Groothuis, 2018).

Effect of institutional features on circularity

Institutions: institutional **e**mbedding of material taxes in tax legislation and policy arguably requires more effort than the implementation of other EPR instruments. However, embedding in taxation could affect circularity in a broader fashion than more standard EPR instruments as these are solely aimed at producers of a specific product. Material taxes could, depending on its form, address all producers that use a material.

Transaction costs: earmarking revenues of material taxes for collecting and recycling (or other R-strategies) would lower transaction costs for producers. Collecting and recycling are then incentivised, which would have a positive effect on circularity.

Financial responsibility: material taxes use financial responsibility to promote circularity. Through internalising costs for resources in the price, the responsibility is initially placed with producers and not society. Because producers carry the financial responsibilities of their material choice, they will be incentivised to make more circular choices. In the end, the choice to buy products is made by consumers, but with material taxes this choice is based on prices with internalised material costs.

Informational responsibility: the informative responsibility forces producers to track and declare the amount and type of materials they use for their products. This responsibility strengthens oversight of used materials and will therefore probably affect circularity positively.

Table 45 shows an overview of the effects of the institutional features of material taxes on circularity.

Table 45, overview effects of inst. features of material taxes on circularity.

Institutional feature	Effect	Explanation
Institutions	+	Institutional embedding in tax legislation would address all producers that use a material.
Transaction costs	+	Earmarking revenues could incentivise collecting and recycling.
Financial responsibility	+	Producers are incentivised to make circular choices.
Informational responsibility	+	Responsibility for producers to track and declare their used materials will probably affect circularity positively.

B.3.4. Upstream combination tax/subsidy

Where ADF systems provided revenue but no specification on how the money should be used, UCTS directly incentivises collectors to execute R-strategies by offering subsidies. For example, a tax paid by primary producers of PET is used for collecting and recycling of PET packaging. The subsidised strategy is often recycling, but the subsidy can be used to incentivise every R-strategy that process the product, from **recovery (R9) to re-use (R3)**.

Effect of institutional features on circularity

Transaction costs: through subsidies on collection and recycling of EOL products, transaction costs are lowered. Lowered transaction costs incentivise producers (or collectors) to collect and recycle more products, which heightens this instrument's level of circularity.

Financial responsibility: upstream producers are assigned a financial responsibility from which the subsidies are paid. The financial responsibility, therefore, has a positive effect on circularity.

Agency: UCTS creates agency with collectors to carry out circular strategies by offering subsidies. This agency directly heightens circularity.

Table 46 shows an overview of the effects of the institutional features of UCTS on circularity.

Table 46, overview effects of inst. features of UCTS on circularity.

Institutional feature	Effect	Explanation
Transaction costs	+	Collecting and recycling of EOL products are incentivised.
Financial responsibility	+	Upstream producers are assigned the financial responsibility for subsidies on circular processes.
Agency	+	Creates agency with collectors to carry out circular strategies.

B.4. Regulatory approaches

Regulatory approaches are instruments that regulate product designs and can therefore directly influence circularity. Their effect, however, is dependent on the specific content of standards or

prohibitions. This section describes whether regulatory approaches could theoretically incentivise circularity. It does not analyse whether all implementations in practice affect circularity positively.

B.4.1. Minimum product standards

With minimum product standards producers are stimulated (when voluntary) or obligated (when mandated) to redesign their products more environmentally friendly, following R-strategies **rethink (R1) and reduce (R2)**. In the same manner, product standards can stimulate products that are easier to recycle, repair, re-use or another R-strategy that lengthens the life span or retains the value of a product (**R3 – R9**). The addition of a tax, based on the use of the prescribed product standard, boosts incentives stemming from standards. It does not, however, change the strategy to which the instrument leads.

Effect of institutional features on circularity

Physical responsibility: this is the primary institutional feature of standards. If a standard has no physical effect on the product, there is little effect on the circularity. Therefore, this institutional feature has the most significant positive effect on the level of circularity of standards.

Informative responsibility: the responsibility to inform consumers on the fact that a producer's products conform to a standard could have a positive effect on circularity. It can be seen as a quality mark, which could contribute to circular consumer behaviour.

Financial responsibility: a tax could be added to this instrument, charging producers who do not follow the product standards. The addition of this financial responsibility would probably strengthen the circular incentives of standards.

Agency: in voluntary standardisation processes, interests of producers are (often) aligned or at least come closer together. Whether this leads to more circular products, is unclear and probably depends on specific producers, their products and ambitions.

Table 47 shows an overview of the effects of the institutional features of competition on circularity.

Table 47, overview effects of inst. features of minimum product standards on circularity.

Institutional feature	Effect	Explanation
Physical responsibility	+	The physical responsibility to redesign products is the main driver for circularity of this instrument.
Informative responsibility	+	Could contribute positively to circular consumer behaviour.
Financial responsibility	+	Addition of a tax could strengthen circular incentives.
Agency	?	Unclear whether the alignment of interests in voluntary standardisation processes leads to more circular products.

B.4.2. Prohibition of materials or products

Prohibition of materials and products works similar to standards: it provides rules for product design and stimulates producers into **rethinking (R1) and reducing (R2)** material and product use. This instrument often applies to materials or products that hinder R-strategies. When prohibitions lead to waste streams with less of these materials or products, prohibition could promote all R-strategies ranging from **recovery (R9) up to re-use (R3)**.

Effect of institutional features on circularity

Physical responsibility: similar to product standards, the responsibility to physically change products is the main circular driver of this instrument.

Informative responsibility: similar to the working of informative responsibility with standards, the responsibility to inform consumers could incentivise circular choices of materials and products. It is questionable, however, how significant this effect is.

Table 48 shows an overview of the effects of the institutional features of prohibition of materials and products on circularity.

Table 48, overview effects of inst. features of prohibition of materials/products on circularity.

Institutional feature	Effect	Explanation
Physical responsibility	+	The responsibility to physically change a product positively influences circularity.
Informative responsibility	+	Could incentivise circular choices of materials and products.

B.5. Information-based instruments

As the transition from a linear to a circular economy can be seen as a paradigm change, the importance of informational responsibility should not be overlooked as it can help consumers (and producers) in changing paradigms. The wide variety of instruments make it unclear, however, whether information-based instruments lead to a particular R-strategy.

Effect of institutional features on circularity

Informative responsibility: with a wide array of information-based instruments, it cannot be said whether the provision of information contributes to the instruments' circularity. This depends on the specific instrument. However, the responsibility to keep track of used materials and manufactured products that is part of informative responsibility probably does contribute to circularity. To what extent it leads to circular behaviour or specific R-strategies in the end, depends on what is done with the information.

Agency: provision of information can affect agency in a system. Whether this affects circularity is unclear and probably depends on the type, place and time of the information.

Table 49 shows an overview of the effects of the institutional features of information-based instruments on circularity.

Table 49, overview effects of inst. features of information-based instruments on circularity.

Institutional feature	Effect	Explanation
Informative responsibility	+	Responsibility to keep track of used materials and manufactured products will probably contribute to circularity.
Agency	?	In what way the provision of information affects agency in a way that promotes circularity depends on type, place and time of information.

B.6. Voluntary approaches

Given the broad collection of instruments that under the denominator of voluntary approaches, ranging from public/private partnerships to leasing and servicing, it is not possible to assess to

what R-strategies voluntary approaches lead or can lead. However, the effect of this category's institutional features can be distinguished.

Effect of institutional features on circularity
Institutions: the fact that a practice is not based on standard legislative institutions does not have a direct effect on circularity. It could, however, affect agency.
Agency: as interests are often better aligned in voluntary than mandatory EPR practices, less inefficiency from PA problems can be expected. This alignment of interests should have a positive effect on circularity in these systems.

Table 50 shows an overview of the effects of the institutional features of voluntary approaches on circularity.

Table 50, overview effects of inst. features of voluntary approaches on circularity.

Institutional feature	Effect	Explanation
Institutions	0	No direct effect on circularity.
Agency	+	Interests are often better aligned with voluntary practices, which boosts efficiency.

B.7. Conclusion

In this conclusion, the chapter will be summarised and generalised in order to answer the sub-question *'how can different types of EPR instruments and their institutional features incentivise circularity?'*. The sub-question was answered by analysing to which R-strategies different EPR instruments lead or may lead, followed by an analysis of the effect of separate institutional features on the instrument's circularity.

The analysis shows that EPR instruments can theoretically incentivise R-strategies in varied ways. The results are joined with the effect of the instruments' institutional features on circularity in Table 51.

Table 51, overview effects of EPR instruments' institutional features on circularity.

Instrument	Leads to R-strategy	In	PR	TC	PhR	FR	IR	Ag
General take-back requirements	R3 - R9		+	0	±		+	
CPR	R8 - R9	0	-	0	-	+	0	±
Competition	-			±				
IPR	R3 – R8 & R1 – R2		±		±	+		
Voluntary take-back	-	?						+
DRS	R3 – R8 & R1		+	-	+	+	+	±
ADF	-			+		+		
Material Taxes	R0 – R8	+		+		+	+	
UCTS	R3 – R9			+		+		+
Standards	R1 – R2 & R3 – R9				+	+	+	?
Prohibition of materials	R1 – R2 & R3 – R9				+		+	
Information-based instruments	-						+	?
Voluntary approaches	-	0						+

Three main workings of EPR strategies were found. The first and arguably most effective method in which EPR instruments incentivise circularity is by mandating producers to take back

ownership over EOL products, e.g. with product take-back requirements and DRS. In these instruments, ownership of EOL products incentivises producers to apply processes that retain the highest value of the product. Not only are producers in these instruments incentivised to choose an R-strategy that extends the life span of their products, i.e. repurpose (R7) up to re-use (R3). Producers are incentivised to adjust their product design to these strategies as well (R2 and R1). However, these incentives are in only in place when the producer is individually responsible for processing the EOL products. When systems are set up to process products collectively, most incentives for redesigning products are removed from the scheme as producers do not directly experience the benefits of their design changes.

A second method by which EPR instruments incentivise R-strategies is by adjusting the costs and revenues of processing EOL products beneficially, often by implementing a subsidy for the preferred form of processing. ADF and UCTS, for example, tax (upstream) producers and use the revenue to subsidise processers of EOL products. Material taxes incentivise R-strategies in the same manner but more subtly. Taxing virgin materials makes them more costly for producers resulting in more expensive products. As recycled materials are not taxed, demand for recycled materials or re-used products will probably rise, which heightens the incentive to apply R-strategies.

Promoting product design is the third way in which EPR instruments incentivise circularity. Minimum product standards and prohibition of materials and products directly influence product design. When done correctly, this will incentivise circularity. Other instruments could influence product design indirectly. The first of two examples is described above: when producers are required to regain ownership over products, they can be incentivised to adjust product design in such a way that more value can be retained after the consumer phase. The second example is material taxes. When virgin materials are more expensive through taxes, producers are incentivised to use less or other (for example recycled) materials, which boosts circularity.

In summary, there are three methods in which EPR instruments could theoretically incentivise circularity: 1) mandating producers to take back ownership over EOL products, 2) adjusting costs and revenues of processing EOL products beneficially, and 3) promoting product design. The case studies in the following chapter show whether EPR schemes in practice follow these methods of incentivising circularity.

The following sections generally describe the effects of institutional components in EPR instruments.

B.7.1. Institutions

The formal institutional base of EPR instruments is only relevant to CPR, voluntary take-back, material taxes and voluntary practices. In what matter institutional base influences circularity is somewhat unclear, but it seems that there is no direct effect between the two. Indirect effects probably can occur, as the institutional foundation of schemes or organisations within a scheme can influence agency with involved parties.

B.7.2. Property rights

In the four instruments where property rights were distinguished as an institutional feature, a pivotal role in their possible circularity was played by those property rights. When producers are required to gain ownership over EOL products, instruments offer direct possibilities to carry out all R-strategies up to R3. With instruments that lack the requirement to regain property rights, incentives for R-strategies from R9 up to R3 are indirect. For example, regulation-based instruments offer incentives for strategies R3 – R9 trough a physical responsibility. However, because there is no obligation to gain ownership over EOL products, the incentives are indirect. The instrument does not offer possibilities to bring R-strategies into action.

B.7.3. Transaction costs

Transaction costs are a significant institutional component of product take-back schemes and DRS. However, they relate more to the efficiency of the system than circularity. Efficiency is vital for EPR, yet it seems that transaction costs do not have an important role in the circularity of a system or instrument. The only exception is transaction costs in DRS. With DRS, producers (or operators of the system) are disincentivised to aim for 100% collection.

B.7.4. Responsibilities

Arguably not surprising, but physical responsibility seems to be an important factor in the circularity of instruments, especially when it concerns an individual responsibility. This can be deemed unsurprising because higher circularity is a logical consequence of assigning individual producers with the responsibility to physically redesign products, collect EOL products and/or act out R-strategies.

Maybe more surprising is the observation that financial responsibilities affected circularity positively in all analysed instruments. All the various forms of assigned financial responsibilities incentivise producers to carry out R-strategies. It could have been expected that some instruments showed financial incentives against circularity, but none were found.

Informative responsibilities in described instruments were all deemed to affect circularity positively. Information-based instruments were deemed too broad to analyse the effects of the provided information. However, administrative responsibility linked to providing information provided circular incentives in these instruments. This observation tells us that tracking the use of materials and products, followed by spreading information about products to either consumers or other parties in EPR schemes generally has a positive influence on circularity.

B.7.5. Agency

The effects of agency in EPR instruments show varied results. With some instruments, the effect on circularity is positive. With others, they are positive as well as negative. The effects were unclear in the third group of instruments. In general, EPR instruments change agency for involved parties because interests are either aligned or contrasted, often both simultaneously. The outcome depends on the specific application of the instruments and the parties involved.

C. Interview guideline

This interview guideline is part of a master's thesis research by Jurriaan Vink, studying Engineering and Policy Analysis at the Delft University of Technology. The main subject of the research is Extended Producer Responsibility (EPR) and whether it can facilitate the transition to a Circular Economy (CE). The research is done from an institutional perspective, focusing on the legal and social rules in the EPR schemes. As part of this research, interviews are performed with involved parties.

As the interview is semi-structured, the following questions are a guideline which means they can be deepened or deviated from. As the same guideline is used for various organisations, some questions might be asked differently to better connect to the organisation.

The interview will be recorded for methodological reasons. In order to ensure there are no confidentiality infringements, several steps are taken. The interview guideline will be sent in advance. After the interview, a worked-out interview report will be sent to the interviewee to check for any infringements or mistakes. Only information from the approved document will be used in the research.

Introduction

- Before starting this interview, do you have any questions to me concerning my research subject, methodology, or anything else?
- What organisation are you part of?
- What is your role at this organisation?
- What activities do you carry out on a weekly basis, that are connected to EPR?
    - And specific activities concerning circularity?

The EPR scheme

- What EPR scheme is your organisation involved in?
- Was your organisation involved in setting up the scheme?
    - What were the goals (of your organisation) when setting up the scheme?
- Can you describe the role of your organisation in this scheme?
    - Is your organisation a part in the (physical) stream of materials? If so, are you the owner of the material?
    - Where are the costs and benefits of the EPR scheme for your organisation?

Circular economy (CE)

- Does your organisation have a strategy concerning CE?
    - If so, what is it (or where can it be found)?
    - Is EPR a part of this strategy?
- Can you describe what part(s) or mechanism(s) of EPR facilitate a CE?
- Can you describe what part(s) or mechanism(s) of EPR hinder a CE?
- Do you think eco-design could be applied more to the products in the EPR scheme, and if so, how?

The product(-system)

- What products fall under the EPR scheme?
    - What products are handled by your organisation?
- What are the main characteristics of the products?
    - Materials needed to produce the products.
    - Knowledge needed to produce the products.
    - Scrap value of the products?

- What part of the product is useful for recycling?
- Can the products be reused?
    - What are barriers to reuse?
- Are products designed differently because of the EPR scheme?

Interaction with other organisations

- What organisations in the EPR scheme are you in direct contact with?
- Per relationship: is your relationship formally bound in a document/contract?
    - What rights or responsibilities follow from the document?
    - Is the document strictly followed?
    - Are there responsibilities in the relationship that are not formally bound in a document/contract?
- Are there materials exchanged with other organisations?
- Is there information exchanged with other organisations?
- Is there another form of interaction with other organisations where no materials or information is exchanged?

Other

- Are there people/organisations that you think should be contacted and/or interviewed for my research?
- Do you have anything to add?

D. Interview reports

The interview reports are anonymised in order to comply with privacy regulation. The order of appearance is chronological.

D.1. Interview report Wecycle

The interview was conducted on the 8th of May, 2020 via a video call on GoToMeeting.

The interviewee is Director of Operations at Wecycle. Wecycle is a Producer Responsibility Organisation (PRO). They are aimed at Waste of Electronic and Electric Equipment (WEEE) and are the largest PRO in the Dutch EPR scheme for WEEE.

Wecycle, NVMP and product organisations

Wecyle is a non-profit foundation. It is an executive organisation for the NVMP, which represents six product organisations. These product organisations are established to represent interests for producers of products in the six categories of the EPR scheme. Wecycle monitors the costs for collecting and processing, and redirect them on to the products organisations which determine the disposal fees for individual producers. In this system, producers are represented in Wecycle through a couple of steps. As Wecycle is an organisation with only executive tasks, they cannot be held responsible for unmet targets. Wecycle 'does his best' to achieve the highest possible grades, but is no direct representative of producers. When a national target is not met, it is unclear who bears the responsibility.

Changes are coming. The plan is to restructure and streamline the system of collecting and recycling of WEEE during the course of 2020. The new foundation Organisation Producer responsibility E-waste Nederland (OPEN) or Stichting OPEN takes responsibility for the recycling of e-waste throughout the Netherlands and is the representative for all producers toward the government. Stichting OPEN will take over the role of among others Wecycle as manager of achieving targets most effectively and efficiently. By applying for a collective agreement binding [Algemeen Verbindend Verklaring] (AVV), all producers are obligated and to join and pay a disposal fee to Stichting OPEN, which would create a level playing field. Moreover, the establishment of Stichting OPEN opens the possibility to designate an accountable organisation when targets are not met. The initiative for the new structure is made by producers (and product organisations).

EPR scheme

Wecycle is the overseer in the EPR scheme. The organisation does not execute physical tasks, but outsources these tasks and monitors the administration (and reports to the National (W)EEE Register). In this sense, Wecycle is a central player and supervises the steps in the chain. Materials in the EPR scheme are followed and successively pass the following parties:

- **Producers** are parties who bring products on the market. Therefore, the term producer could refer to importers as well. In some cases, products pass a wholesaler before reaching the consumer. When producers are a member of product organisations, they are connected to Wecycle through a couple of steps. Of course, not all producers in the Netherlands are connected to Wecycle. In case they are connected, producers report the amount of products they have brought onto the market, and their disposal fees are calculated on these amounts.

- **Consumers** are only approached by Wecycle with information that tries to encourage them to turn in unused appliances and lamps at collection points. There are three options: partners of Wecycle (mostly retailers but also petting zoos), waste locations of municipalities, or hand e-waste over to deliverers of 'premium partners' of Wecycle.
- **Retailers** (and other collecting partners of Wecycle) have WEEE-bins where consumers can deposit their e-waste. Retailers receive compensation based on the amount of kgs of appliances (and lamps) that are collected. When e-waste is placed in the bins, it is the property and responsibility of Wecycle.
- **Municipalities** are required to operate waste locations where WEEE can be deposited. Wecycle has agreements with the larger part (75%) of the municipalities in the Netherlands to take on further processing. Municipalities are compensated per kg e-waste, similar to retailers but in higher orders of magnitude: tonnes instead of kgs. Wecycle is the owner and responsible for the e-waste when it is placed in the associated collecting bin or container.
- **Wecycle Service Centers** are the next step in the chain. From retailers and municipalities, WEEE is transported (by contracted logistic partners) to sites where sorting and disassembly take place. These service centres carry Wecycle's name but are run by contracted sorters. As the name Wecycle Service Centres suggests, a service is carried out here and therefore the materials are still Wecycle's property and responsibility. The different material streams are separated and prioritised as materials vary in value. Due to the stepwise representation and the indirect influence of producers, it is impossible for producers to pick products out of the stream at this point in the process (apart from practical problems).
- **Waste processors** are the next step in the chain after the Wecycle Service Centers. Materials are transported to contracted WEEELABEX-certified processors. They are the owner from the moment of weighing, with some conditions. Processors have an administrative responsibility. They have to report achieved recycling and recovery percentages to Wecycle. The processors put the recycled materials on the market themselves, but Wecycle receives a part of the revenues (pre-defined in a contract).

The intended new situation with Stichting OPEN will not differ much from an organisational perspective.

Circularity

Wecycle is increasingly working on consciously heighten circularity in their process. An example is the reuse of products. Until recently, products that are reused (or refurbished) were not counted towards recycling targets. With high recycling targets (and not long ago no and currently low reuse targets) it was incentivised to recycle products. Despite an unclear definition of de relation between recycling and reuse in European directives (and therefore in Dutch regulation as well), Wecycle has chosen to include reuse in recycling targets. By counting reuse as 100% recycling, the incentive towards reuse is much larger.

Other subjects

- Eco-modulation/tariff differentiation could certainly stimulate producers to deliver 'circular' products, and it is definitely possible with electric and electronic equipment. However, the interviewee attributed two difficult issues to eco-modulation. Firstly, products have to be assessed on eco-design (how do you score such design?), and the question is how this assessment is done best. Secondly, eco-modulation leads to an extra administrative burden for producer and Wecycle.

- According to the interviewee, competition with other PROs mainly has negative consequences for Wecycle and the system. Of course, competition ensures PROs working more efficiently. However, in most cases, the competition will revolve around the easiest-to-recycle materials. When there is competition, it is illogical to focus on difficult (and therefore more costly) materials. This happens with competitors of Wecycle as they are private companies and not non-profit foundations such as Wecycle. The interviewee wants to emphasise that competitors of Wecycle are not directly guilty of only aiming for 'easy' materials. A system with competition, however, does incentivise this behaviour. Wecycle aims for the positive effects of competition between processors. For example, trough competition between their processors, the required efficiency is achieved.
- De facto, it is true that producers buy off their responsibility by paying tariffs. This does not have to be a problem, however, as long as targets are met.

D.2. Interview report BSH Group

The interview took place on the 4th of June, 11:20 – 12:15, via a video call on Skype.

After an introduction to the research and thesis of Jurriaan, the interviewee explained the perspective of BSH Group. BSH Group produces several appliance brands, of which the biggest are Bosch and Siemens, and is owned by Bosch Group. The interviewee fulfils the role of Head of Field service at BSH. In this role, he researches possibilities for BSH Group to put used products (repaired or refurbished) of BSH's top brands in the market. Even though he is not directly involved with EPR, the interviewee could provide a clear picture of BSH's view of the circular economy (CE) and the difficulties with it from a producer's perspective. This was reinforced by the interviewee's background in the marketing of BSH, as he could explain the focus points of different brands of BSH and their effect on

BSH's view on the CE

In Figure 18, BSH's strategy on circularity is visualised. In every step of producing their appliances, BSH has different strategies and systems in place to strengthen circularity. BSH has a strong focus on long lifetimes of products with a high level of service, which fits within a circular paradigm. They have also experimented with new owning structures via BlueMovement and WeWash. The 'recycling' arrow is where EPR comes into view. BSH is connected to Wecycle, and they take care of the processing of end-of-life appliances.

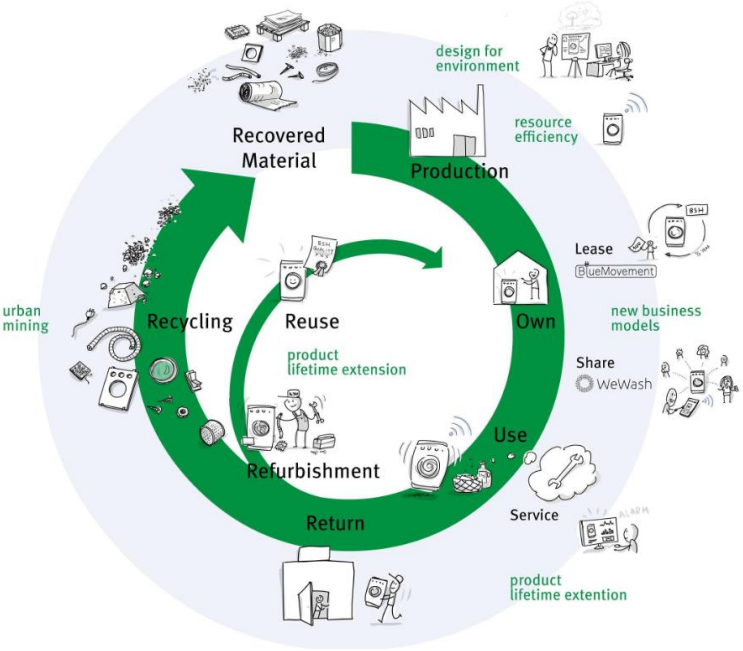

Figure 17, visualisation of BSH's strategy on circularity.

Project around return, reuse and refurbishment

The interviewee is lead of a project that investigates possibilities of reusing and refurbishing appliances that have been returned after use. This is outside of BSH's current scope. At this moment, BSH is set up to produce and sell new appliances (the interviewee defined these as category A). However, some appliances are returned before use, for instance because of damage during transport. These are returned to the BSH logistic centre in Tiel and technically checked before they are sold with a discount via the official BSH site (defined as category B). In this category are 'second-chance' appliances as well. These are appliances that are shown in showrooms or on fairs before they were taken back, checked, and sold with a discount.

There are two other categories designated by the interviewee. Under category C fall all appliances that are used up to two years. Return policies that are offered as an extra service ('you can return your appliance within 30 days when unhappy') lead to higher quantities in this category than might be expected. These are machines that are used and therefore cannot be sold as new machines, but often still function very well (possibly after a small repair). Category D contains the appliances used between two and eight years. Appliances in both categories would normally be sold second-hand, or go to a waste processor and be recycled as part of the EPR scheme. In fact, according to the interviewee, with many producers a month's old appliance with a defect would probably be discarded and replaced with a new one. The simple reason is that the costs of repairing (accompanied by the needed logistics and a designated repair centre) are higher than producing a new product.

As mentioned, the interviewee is investigating whether there are different ways to put C- and D-category appliances in the market. Machines in the C-category can be put on the market with an approach similar to the B-category. Several steps in the process make this difficult. First of all, the machines have to be collected from retailers that are obligated to accept them. BSH has agreements with some retailers about taking over appliances of their brands. Not with all retailers, so collecting appliances from these companies is a challenge. Secondly, the appliances have to be checked and if needed, repaired. This can be done at the BSH logistics and repair centre in Tiel, but unsurprisingly brings costs with it as it is manual labour. The third step is bringing the appliances on the market. Providing quality is an important aspect for the brands of BSH, and putting 'not-perfect' appliances on the market might damage the public view on BSH's brands.

For D-category appliances, the interviewee is developing a different strategy that involves thrift shops. At this moment, thrift shops collect, repair, and sell old appliances. This means that when you walk into a thrift shop, you will probably find older Bosch washing machines waiting for a new owner. The state of these appliances is often low as they have not been repaired to the standards of official Bosch service but do carry the Bosch logo. This is neither ideal for BSH nor the thrift shops.

Therefore, the planned strategy of the interviewee is to set up a system where used appliances from the D-category are offered to thrift shops, combined with service to get these (and other appliances from the brands of BSH that the thrift shops collect themselves) to a state that BSH want their brands to represent. BSH Belgium has already experimented with a system similar to this.

The costs of the described systems for C- and particularly D-category appliances are higher than the returns. BSH is willing to pay for the effects on sustainability, social welfare, and upholding the brands. With the described plans, they gain a triple dividend on these themes.

BSH's role in the greater picture

There are challenges with plans as described above. BSH's core business is producing appliances, as goes for all producers. They are not some sort of bank that lends out products and maintains

them. Therefore, projects as the interviewee is working on are complex, and barriers have to be eliminated to come to a working system.

As BSH is the largest producer of household appliances in Europe, they have the means to set up new systems and eliminate regulatory barriers. As they are such a big player, they are not only keeping track of legislation and regulation; they influence it as well. When EU legislation on the subject is implemented or updated, BSH will usually be invited to contribute their thoughts and reflections on the matter.

A last note by the interviewee: if a project described would have come up three years ago, it would probably be shot down directly ("why would you want to do that?"). Now, three years later, everybody is way more convinced with the idea that there are opportunities on the subject of circularity here.

D.3. Interview report WEEE Nederland

The interview took place on the 10th of June, via a phone call.

Note: in order to avoid confusion, waste of electric and electronic equipment is referred to as e-waste in this interview report, instead of WEEE.

WEEE Nederland (WEEE NL) is a PRO organised as a collective of producers. It is a non-hierarchical social enterprise with 11 employees. Indirectly 200 people work for WEEE NL in sorting centres, logistics, etc. As it is a social enterprise, profit is not WEEE NL's primary driver. Adding value to society, either social or physical, is WEEE NL's main goal. The interviewee has a background in waste processing and is project director for WEEE NL.

Six years ago WEEE NL was founded as a reaction to a demand in the market. Wecycle was the only available PRO at the time, which sparked dissatisfaction for different reasons. First of all, producers were unsure whether they were paying too high disposal fees. Some wanted more in return, for example, advice on product design or the recycling process. Another source of dissatisfaction was, the central processing of e-waste. Municipalities wanted more regional circular activities, but Wecycle was not willing to cooperate.

WEEE NL has direct connections to producers and is able to respond quickly to internal or external initiatives. According to the interviewee, this follows from their non-hierarchical structure and values as a social enterprise and producer collective. WEEE NL is not accountable to a board in a way that executive and public organisations are.

Working of WEEE NL

WEEE NL works as other PROs, in the sense that they take over the physical responsibility of collecting and processing e-waste for producers but do not physically process waste themselves. Instead of utilising tendering processes, WEEE NL specifically aims for long-term cooperation with partners. These partnerships provide more value and knowledge than short-term contracts, according to WEEE NL.

The interviewee provided many examples of how WEEE NL was able to react to problems or opportunities because of these partnerships. Examples are:

- An unburdening service for - and in collaboration with – home-delivering retailers that manage collection of returned appliances and directly bring the e-waste to sorting centres.
- A service that collects Styrofoam that is used for safeguarding appliances during their delivery. The service has grown to a separate company (EPS Nederland), closely

connected to WEEE NL, that collects and recycles Styrofoam. Before EPS Nederland, most Styrofoam was used for energy recovery (i.e. incineration).

- In cooperation with several schools throughout the Netherlands, E-waste races are organised where schools battle each other in a competition who can collect the most e-waste.
- A project with PostNL in which deliverers accept (small) e-waste when delivering parcels. This project was cancelled due to high costs.

Urgenda measure 43

Another example of WEEE NL's circular initiatives is their proposal for a DRS on refrigerators. This proposal is included in Urgenda's 54 point plan for reducing Dutch CO2 emissions with 25 per cent and partly accepted by the Dutch government. WEEE NL's plan involves a 40 euro disposal fee when purchasing a refrigerator, of which 20 euros is refunded when an older version is returned. This incentivises consumers to process their fridges through official channels instead of dumping them with scrap dealer. The revenues of the disposal fees should be used to stimulate circular initiatives. The responsible ministry has reacted positively but had not followed up on it.

Involvement with legislation

According to the interviewee, WEEE NL is only little involved with changes in policy and legislation by the government. An example is the process around the Arrangement for EPR [Regeling voor Uitgebreide Productentenverantwoordelijkheid]. VPN, the Dutch union of PROs, has reacted on the arrangement with their perspective on the plan that specifically addresses producers and PROs. However, there has not been a conversation with the government on the arrangement. The arrangement increases the responsibilities of producers and PROs but offers no means to fulfil these tasks. There are no resources offered for extra supervision or enforcement. WEEE NL does not want to assert that the ball is the government's court, but dialogue is a necessary prerequisite to stimulate ideas from both sides. At this moment, there is no dialogue.

Response to Stichting OPEN

The website of WEEE NL features an extensive response to the plans of Stichting OPEN/Wecycle. WEEE NL is strongly opposed to the AVV requested by OPEN, which would in practice mean WEEE NL is out of business and a monopoly position for OPEN. Apart from appealing to competition laws, WEEE NL argues that the AVV would not only cancel out competition between PROs but hinder competition between sorters and processors as well. If OPEN is the only PRO, only the processor that wins OPEN's tender remains competitive in the e-waste market. Additionally, WEEE NL argues that many initiatives of Wecycle are done in reaction to examples by WEEE NL such as the e-waste race, social impact in the job market and the local processing of e-waste. Cancelling competition means cancelling incentives for such initiatives.

Additional note (29th of September)

After the ministry has made the preliminary decision to grant the AVV to Stichting OPEN, WEEE NL has reacted in correspondence that this will not mean the end of WEEE NL's activities as a PRO. WEEE NL reckons they can apply for an exemption which would keep them in business.

D.4. Interview Report KIDV

The interview was conducted on the 10th of June, 2020, via a video call on Microsoft Teams.

Netherlands Institute for Sustainable Packaging

The interviewee is an expert on sustainable packaging at the Netherlands Institute for Sustainable Packaging [Kennisinstituut Duurzaam Verpakken] (KIDV).

Beginning, goals and governance of KIDV

The KIDV was established in 2013 to comply with one of the conditions of the Framework Agreement on Packaging [Raamovereenkomst Verpakkingen]. The KIDV is an independent agency, financed by the Afvalfonds Verpakkingen (AV).

The goal of the KIDV is to accelerate the process of making packaging more sustainable in the Netherlands. They pursue this goal by using existing research, doing research and translating existing research to courses of action for the whole chain. Instead of making a producer read a 500-page booklet, the KIDV gives producers clear and concise indications where packaging can become more environmentally friendly. Most studies are executed by external agencies. The KIDV's responsibility is focussing the research question and guiding projects.

During its beginnings, the KIDV was mostly aimed at studies stemming from the Framework Agreement, e.g. possible abolishment of deposit-refund systems and a tax on carrier bags. Its tasks have gradually grown to a broader perspective. There were three parties in the KIDV's board at the start, but following a statutory change in 2017 the government and municipalities left and only the AV remained as a member of the supervisory board. As a result, the KIDV's focus shifted from chain cooperation towards guiding packaging producers. The KIDV has grown from approximately 10 people to 20 permanent staff members in the last six years.

The Netherlands is the only country with a special institute for packaging. In that sense, the Netherlands is a frontrunner. Remarkable about the system is that the KIDV offers their services 'for free' (up to a certain point). The KIDV is financed by the AV but is not strictly monitored in their work. The KIDV's funding comes from the EPR scheme for packaging and is fixed for the duration of the framework agreement (until 2022). This means that packaging producers pay for the KIDV's services indirectly.

Activities and influence of the KIDV

The KIDV cannot make binding rules for producers. However, the Framework Agreement states that plans should be made on sector level. These sector plans (with highest attainable goals) are checked by the KIDV's College of independent experts, who can indicate where the plan has to be better or more ambitious. This makes the KIDV's influence on one hand very large, as they review sector plans and are in contact with big players in these sectors. On the other hand, smaller players are more difficult to reach.

The KIDV is involved with legislation in another way. The government often comes to the KIDV with questions, probably because they used to have a role in the board. Examples are Netherlands Circular 2050, where sub-groups were led by the KIDV. The KIDV has a pretty good and relatively objective view on what is going on in the system. Other parties might see something from their perspective and interests. The KIDV does not have these interests and is presented with questions from both sides, which makes it possible to compare perspectives.

Examples of demand-driven activities by the KIDV are the development of a sorting standard for PET trays and setting up a working group that investigates the washability of adhesives used for labels. The first was done as a reaction to Nedvang's need for a new standard. Nedvang is using DKR standards, copied from Gruener Punkt Germany, to assess the quality of bales of sorted packaging waste in order to compensate municipalities accordingly. There was a need for a standard for PET trays, and the KIDV's impartiality made them a suitable party. The other example is the washability of adhesives for labels. The KIDV receives many questions on their recyclability (sortability), which they could not answer properly due to a lack of available research, and decided to start a working group on the subject.

EPR scheme

The interviewee has no opinion on EPR. It is a system that makes the system financially viable. It has pros and cons. EPR can slow things down. Take the standard for PET trays: it can take five years before a solution is found. This is partly due to the high quantity of parties involved, but the EPR system only increases this. On the other hand, EPR makes things clear. It is clear to all parties who has what responsibility.

The only difficulty in this sense are municipalities, who are an important part of the current system. They are only responsible for collection, after which the waste goes to sorters. Initially, the chain management (effectively controlling the sales of sorted bales of waste) was with packaging producers. This was transferred to municipalities because they wanted the responsibility themselves. Municipalities have come back on this decision, and therefore VPKT was established as part of the AV. The role and responsibilities of municipalities have therefore changed many times, ending with transferring the responsibilities back to the AV.

Working of eco-modulation and eco-design

The interviewee does not think the KIDV is the cause for eco-design, but rather a catalyst. Questions originate in the market, and the KIDV has the expertise to answer these questions. This was the reason for the KIDV to investigate a tax on plastic carrier bags and adding drinking cartons to PMD: both initiatives originated elsewhere and the KIDV was asked to research them. The KIDV is originated as an executive organisation but is nowadays proactive as well.

The KIDV recycle check for packaging is another example of their proactive executive role. The KIDV produced a recycle check to assist producers in producing sustainable packaging. The AV has then used the recycle check for tariff differentiation. Packaging producers receive a reduction on the disposal fee when their packaging complies to the recycle check. The KIDV does the check and helps producers to comply.

The reduction in disposal fees is an example of eco-modulation in the EPR scheme. The AV takes a risk by installing the tariff differentiation because these reductions may result in lower revenues from disposal fees. Therefore, it is important for the AV that packaging that complies with the recycling check are cheaper to process than non-complying packaging. The incentive for the AV is financial and not necessarily circular (though the circular profit is a welcome extra of course).

At an earlier stage, there was differentiation for compostable packaging, following the EN13432 standard. This differentiation has been removed because the packages that complied to the standard disturbed recycling of PMD. Apart from the discussion about whether compostable packaging contributes to a CE, the choice was made for practical reasons. Producers of packaging who had invested in compostable packaging, however, suffered the losses for this.

D.5. Interview report Sympany

SYMPANY
Stof tot grondstof

The interview was conducted on the 12th of June 2020, via a video call on Microsoft Teams.

The interviewee is program manager at Sympany, a non-profit company that is one of the largest textile collectors of the Netherlands.

Sympany is actively involved with getting a seat at the table with the development of a Dutch EPR scheme for textiles. They believe EPR is a prerequisite for a circular textiles chain.

Sympany's work

Sympany collected 24 million kg of textiles last year. Of those 24 million kgs, 70% is reusable. Sympany tries to get back these clothes back on the market, often in Eastern Europe and three countries in Africa. This part is profitable and has to cover the operational cost. 30% is not reusable and Sympany attempts to get this part recycled. At this moment, 12% is not textile and not recyclable and is 'pure waste'. The other 1% is recycled. Most in Europe and about 3 to 5% is shipped to India where textiles are recycled. In Sympany's revenue model, the 70% reusable textiles pay for the 30% non-reusable.

Some brands collect textiles, e.g. H&M. These brands are not very open about the amounts they collect. The interviewee could not find information on how they process the collected textile. Sympany reckons that it is about 2,5 millions of kg in Europe. As the collecting rates are meagre compared to the total amount of textiles waste, collection by clothing retailers and brands seems a marketing tool for now. Furthermore, there are several smaller recycling projects. The interviewee does not want to denigrate, but these projects do not impact the bigger picture of the circular textile value chain, as they are negligible compared to Sympany's 24 million kg.

In its current system, Sympany collects clothing for municipalities. Allocation of the right to collect in municipalities works via tender systems. Sympany bids against other collectors to be able to collect in a specific municipality for a certain time (3 or 4 years). A result of this system is that municipalities make a profit of textile collection and extract money from the textiles chain.

Dutch legislation dictates that residual household waste should be textile-free by 2030. As a consequence, the Netherlands would get an extra 140 million kgs textile waste to process. Part of these textiles will be reusable but the larger fraction probably will not. This means there should be more funds available for recycling and supporting legislation to be developed.

Sympany has a system in place for large-scale collecting, reusing and recycling of textiles. However, with more (probably non-reusable) textiles on the horizon, Sympany looks for strategies for financing these activities. EPR promises this.

A seat at the table for EPR

An EPR scheme is being implemented in the Netherlands, form still unknown, and therefore Sympany wants a seat at the table. In that way, Sympany can influence whether collectors get a role and a fair share to compensate for the costs of collecting (and recycling). Producers (or indirectly consumers) have to contribute to the collecting and recycling costs to complete the textile value chain.

For Sympany, the scheme would ideally tax producers for textiles brought on the market. The revenues should be stored in a fund, managed by producers, and used to compensate collectors such as Sympany. Another prerequisite for an EPR scheme would be ensuring circularity in the sense that textiles are upcycled to qualitative textiles in good social and environmental circumstances.

Sympany organised a meeting with stakeholders (producers/government and others) in January 2020. The attending representatives of the responsible ministry (IenW) stated that an EPR scheme will be implemented either way. The question is whether it will be voluntary or mandatory. The industry has had three years to come up with ideas, but this has not led to much action so far.

The fact that municipalities make a profit from clothing collection was a reason for producers during the meeting in January to stall implementation of EPR. According to the interviewee, producers indicated that the first step should be that municipalities stop asking for money. The VNG, the association for Dutch municipalities, had cancelled for the meeting. The NVRD, an association for municipal waste organisations, could not make it. Therefore, there was little rebuttal on the claims of producers.

Environmental ambitions

Stientje van Veldhoven has set a target of 25% post-consumer textiles in imported clothing by 2025. That is high, considering it currently stands around 1%. Every brand has one type of jeans that consists out of 20% recycled textiles or one dress that consists of 100% recycled polyester.

The blame is often put on fast fashion. Fast-changing fashion makes for several clothing collections per season, put in stores for low prices. The interviewee nuances the role of fast fashion by stating that many consumers are forced to choose low priced clothing due to financial reasons. Fast fashion has a limited effect on this. This type of garment is often not suitable for re-wearing but can be used for recycling.

According to the interviewee, circular incentives are possible. The first suggestion is more transparency on recyclability and social impact of clothing. People care for the impact of their clothing but are mostly unaware of it as well. Another circular incentive could be implemented by finding a way to make producers buy yarn of post-consumer textiles. The only possible approach seems to mandate a percentage of recycled textiles in clothing. For example, 50% of a producer's products have to be made of post-consumer recycled materials. This could result in producers making two products, of which one has a rate of 100% and the other 0%. The interviewee's third advice is making sure that the whole chain is up to date with the plans. Not only management should be working on circular plans; procurement should be involved as well.

Social component

Apart from environmental ambitions, Sympany aims for social requirements for producers in an EPR scheme. Compared to packaging, for example, the social impact of textiles is far more significant.

Sympany has carried out projects that investigated its own chain. From the Netherlands to the Baltics, from there to Panipat, India (the largest textiles recycling hub in the world), where textiles are processed. Sympany wants the chain to be socially responsible (e.g. child labour-free, no forced labour, living wage) in the horizontal sense (following materials along the chain), but also a vertical sense (all organisations in the chain). Only then, Sympany can state that their textiles are not only environmentally but also socially-friendly.

Producers in the driver's seat

Even though producers seem not full of action in negotiating the immediate implementation of EPR, the interviewee states that it is essential that producers take the initiative. If the government sets up a governmental fund that pays for collection and processing, it will result in a constant stream of critique aimed at the fund. The implementation process of EPR should engage producers to ensure they are in the driver's seat and monitor and support the outcome. The interviewee states that Sympany's seat on the table is important, if only for cost calculations.

Even though Sympany reckons that a scenario where producers are responsible for implementing an EPR scheme is most preferred, they observe that this will take too long to achieve circular ambitions. Therefore, Sympany prefers a scenario with the implementation of a 'simple' disposal fee as fast as possible as this would cover their expenses. If a better scheme is ready at a later stage, it should be implemented hereafter.

D.6. Interview report Coolrec

The interview took place on the 30th of June, 16:10-16:50, via a video call using Teams.

The interviewee started at van Gansewinkel, one of the companies that fused into Renewi, as manager metal processing. Coolrec, where the interviewee ended up, is part of Renewi. Coolrec started with recycling refrigerators – hence the name. In the last 30 years, Coolrec has extended their expertise into the many facets of recycling of WEEE.

Coolrec's process

Consumers can return their WEEE at retailers or municipality. Apart from a secondary market with scrap dealers, most WEEE arrives with Coolrec via Wecycle.

The process of every product is different, but when refrigerators are taken as an example: the first step is removing hazardous materials or components (e.g. condensers and batteries). Afterwards, fridges go into a mechanical process. After a couple of steps, the equipment is shredded. The shredded materials are sieved and sorted into fractions such as steel, aluminium, plastics etc. Coolrec has an own processor for plastics; the other fractions are sold to other secondary processors.

All these steps are part of a contract with Wecycle. Wecycle takes care of collecting and can collect small quantities that combine to very large volumes. Coolrec is responsible for processing the WEEE. The materials are Wecycle's property.

Coolrec is WEEELABEX certified, which means that they are legally permitted to process WEEE. Duties for WEEELABEX certified processors are 1) having the right equipment, 2) prove that the materials that come out at the end of the process match with the reported materials, and 3) being able to declare where the materials go to after processing. According to Coolrec, there are plenty of small companies that can evade WEEELABEX rules. Bigger players on the market, however, have no incentive to evade rules because it does not follow their proposition as a reliable waste processor.

Chain cooperation

Even though Coolrec has several examples of projects with producers, chain cooperation is achieved only sparsely. Examples are a vacuum cleaner made for 36% of recycled content, drip trays for a coffee machine made of recycled materials. Another example is reusable cast iron weights for a washing machine producer. Coolrec separates washing machines with these weights and sends them to the producer who can reuse the components.

The given examples are small-scale, but they have given Coolrec experience in setting up projects with chain cooperation. Projects must involve employees from different compartments of the company. Not only sustainability managers, but purchase and supply chain managers should get a seat on the table.

The same goes for projects on a larger scale. You can only achieve circularity when parties through the whole chain take their responsibility. Costs and certain interests for profit are involved in every step of the chain. This makes for constant stacking of goods and a lack of a holistic approach. It is impossible to get every party on board when some make profits while others only bear costs. The government has an important role in this: only raising recycling targets will not lead to cooperation between parties.

Circular step forward

At this moment, producers who are affiliated with producers have no interest in usable materials at the end of the recycling process: they will buy new materials anyway. When Coolrec collects WEEE secondarily, which means outside of the Wecycle system, they can accommodate to particular wishes of producers. These producers might only have half a container a month available, but Coolrec can process this WEEE more freely. When it concerns high-quality materials,

mainly in ICT (e.g. servers, computers, etc.), it is worthwhile to process these products at a higher grade. This is often not because of a circular mindset, but because of the value of the materials.

Coolrec expects a changing composition of materials in the future. Products will probably become more complex, which strengthens the demand for smart solutions for WEEE.

D.7. Interview Report Renewi

The interview was conducted on the 3rd of July 2020

The interviewee has his roots in glass, a product where control on the supply chain is very important. When Maltha, Shanks and van Gansewinkel merged into Renewi, the interviewee was asked to apply his expertise to plastics.

History and chances of EPR system for packaging

Households had too many plastics coming, minor recycling, and as consequence producers were told: you are responsible. This started via taxes. Following the framework agreement [Raamovereenkomst], the system was changed. In the current system, a small part of the price that is paid for a product in the supermarket goes to the treasury of Afvalfonds Verpakkingen (AV). Municipalities are paid from this treasury.

An element of the agreement was municipal collection of plastics, metals and drinking packages (PMD). This had a downside: collecting rates went up, backed by subsidies, but recycling stayed still behind. As it was unclear for households how waste should be separated, PMD's quality was often too poor for recycling and mostly ended up in the incinerator.

The interviewee reckons the system is working well on paper, but it has a couple of 'loose ends'. An example is made clear by the current Corona crisis: recycled plastic cannot be placed on the market competitively, because virgin plastics are very cheap following the low oil prices. Another example is the compensation received by municipalities. This has dropped from 900 euro/ton in the beginning to 270 currently. This makes it very difficult for municipalities to keep the collection up to par.

These loose ends can be solved by stricter rules by the government. The ban on single-use plastics is an example of this. Even though such a ban does not solve everything and is not perfect – replacing a plastic single-use stirrer for a wooden one would not change it going into the incinerator – but it is a step in the right direction: fewer plastics.

Another solution put forward by the interviewee is steering policy towards the reuse of packaging. Used packaging would go back to producers in such a system. At this moment, the only contribution of most producers is a couple of cents per package. A day before the interview, the ministry of IenW indicated to aim for more reuse in packaging (Rijksoverheid, 2020c). The interviewee applauds this. When packaging has to return as packaging, the system works effectively.

At this moment, however, it has proved unfeasible to collect packaging for specific producers and recycle only these products, especially for the same producer. There have been initiatives, for example using delivery trucks of food product wholesalers to collect packaging simultaneous to delivery. However, there were too many problems with food health and safety regulations, as fresh food products are not allowed to store in the same space with used/contaminated food packaging.

PMD proposition aimed at businesses

In the future, mandatory PMD separation will be introduced for businesses. Businesses that can prove their separation efforts will be compensated by the AV, which will oversee the rollout.

Renewi anticipated this change in legislation and introduced PMD Business [PMD Zakelijk], in order to have their service ready when it becomes mandatory.

Setting up PMD Business has a long backstory and is an example of chain cooperation. Renewi noticed that something was missing in the system. Processing PMD could only develop in collaboration with other parties in the chain. After exploratory talks with different packaging producers, Renewi concluded two things: 1) knowledge sharing and transparency were vital, and 2) there had to be a party that would collect packaging with businesses. These conclusions were supported by large companies and the government, which gave Renewi the confidence to 'go for it' and start PMD Business.

Instead of the standard procedure of starting with recruiting clients, Renewi started with searching and finding a sorter that could process PMD. When visiting the found sorter in Germany, Renewi invited several companies in the chain to join. This got the ball rolling fast; Renewi was overwhelmed by the demand of clients and orders coming in.

Renewi changed their system. The old system was limited to collecting plastics from businesses. Transforming from plastic collection to the much broader PMD ensures more collection and less residual waste for clients. Renewi has six locations in the Netherlands where PMD is brought to, with a license for export. Trucks drive through the country, equipped with PMD livery that ensures they really collect PMD. Per October 1st the old plastic collection stopped and was upgraded to PMD Business. As collecting PMD will be compensated from 2023, Renewi reckons they made a big score with their new proposition.

Renewi is able to process PMD to several granulates, that can be used for producing several products, e.g. paint containers, furniture, platforms, fences, etc. The fact that new products are made from PMD delights packaging producers. It provides a purpose for packaging waste, but in the end, the producers want to go to food to food. An intermediate step is chemical recycling, where packaging is processed into a resource for new packaging.

When setting up PMD Business, rigidities of the Dutch scheme for packaging became clear to the interviewee. As the AV is solely responsible for households, sorting centres are built that are subsidised for household fractions by the AV. These sorting centres have no interest in the business market, as there is no additional financial compensation. Therefore, Renewi had to divert to Germany to find a sorter who was willing to process their PMD for an acceptable price.

Representation and chain collaboration

The AV is represented by packaging producers, government and municipalities. As the sorting and waste processing sector is not involved in AV, policy is developed by people who do not understand how processing works. The result is complex protocols that are impossible to comply with by e.g. Renewi. This is a clear missed opportunity when no processor wants to sign the AV's contract.

According to the interviewee, the AV has accomplished its mission but has to evolve with the market. The current board consists mainly of the representatives of the supermarket branch. It would be an idea to bring more diversity in the representation of the AV.

The interviewee has many connections with multiple parties in the chain through his background in the sector. This enables quick switching in case of new policies or other news. PMD Business is an example of this.

Another example is Renewi's collaboration with Unilever in the Field Lab Circular Plastics (FLCP). The FLCP is the result of several companies that signed for the Plastic Pact – an agreement between packaging producers to use less plastic and recycle more – but were dissatisfied with the results in practice. The interviewee was at a 2019 meeting that had the simple question: who wants to join (on the condition that you add something to the lab)? For the interviewee, it was

clear that Renewi had to join. At the FLCP, parties from the whole chain have a seat on the table. Together, they investigate packaging and question how they end up in the incinerator.

The FLCP was initially set up independently from the AV. However, the AV both shares the dissatisfaction on the Plastic Pact and recognises the results and work rate of the FLCP. Therefore, the FLCP and the AV actively work together, which results in benefits for both parties. The FLCP can use the AV's influence to find collaborators. Results of the FLCP can be used by producers, united in the AV.

According to the interviewee, companies only come into action when 'something' happens (e.g. legislation or policy change, price change, public outcry). However, you cannot put all producers in a box. Companies are genuinely touched by the public judgement of waste originating from their company. However, this is certainly helped by a government that assigns them the responsibility for their own waste. It looks like this will happen in 2023: producers will be made responsible for collecting all the packaging materials they have put on the market.

E. Correspondence reports

The interview reports are anonymised in order to comply with privacy regulation. The order of appearance is chronological.

E.1. Correspondence Report Afvalfonds Verpakkingen

This report is based on correspondence in April 2020 via e-mail.

Introduction

It is important to realise that EPR is not new in the Netherlands. Even though it was implemented for packaging in 2006, the concept exists since 1991 (in Germany) and 1994 (European Packaging Directive).

According to the correspondent, EPR could strictly be categorised as compliance. There is legislation to which companies have to comply directly (national legislation) or indirectly (EU Directives on which the national legislation is based).

The correspondent reckons that the judicial basis for the European Packaging Directive is grounded in the proper functioning of the internal market of the EU. Therefore, the Directive is, strictly speaking, not environmental legislation. However, the most concrete rules aim for a positive effect on the environment, without hindering the internal market.

In the case of packaging, the mentioned rules encompass roughly two things: requirements for the design of packaging (essential requirements as in annexe 1 of the EU Directive for Packaging) and an obligation for collecting and recycling (with minimum targets). An important difference between these two requirements is that producers are often individually able to comply with requirements concerning packaging design, but not with those concerning the obligation to collect and recycle packaging waste. This inability resulted in the implementation of collective systems. These systems provide for the required collection and recycling. Collective systems are principally not able to carry the responsibility for the design of packaging of individual producers in a free market. Executive organisations for EPR as the Afvalfonds Verpakkingen (AV) are no governmental agencies and therefore do not have the required authority.

Cornerstones for the AV

The introduction should clarify that the AV mainly focuses on (collectively) imposed requirements for collection and recycling but with the mentality to mean as much as possible for the environment. The AV can (apart from stimulating the right choices via the KIDV) do nothing more than inform and advise producers. Cornerstones are:

- The internal market and the legislation in EU member states concerning the design of packaging (including use of logos): producers should not be forced to differentiate packaging per country (which could incidentally result in a larger environmental impact).
- When designing, the combination of product and packaging should be seen as a whole, and the functionality of the packaging should be optimal. Simply removing layers in packaging for meat could lead to a larger environmental impact through product decay than recyclability of the packaging might compensate.

The latter aims for minimal total product usage and not only of packaging. This approach is often misunderstood when the focus is on packaging, resulting in a disturbed relation to the product.

An example is packaging for foodstuffs. Minimising virgin material content as a stand-alone target is possible. However, this could potentially facilitate product decay or loss when the packaging loses part of its protecting function. Replacing virgin for recycled materials is often (excluding glass and metals) not an option. Legislation on 'food contact' prohibits the application of recycled materials unless there is complete certainty that it comes from a collection process where less than 5% of the total waste weight is originating from other applications than food.

Targets, quality and costs

In waste management, the AV aims for the highest possible result, higher than minimum targets require. Moreover, the AV is for the larger part only financially responsible and does not have a large influence on operations (except for plastics/PMD between 2010 - 2014 and from 1st of April, 2020, where the AV monitors contracts for sorting and selling materials). To a certain extent, it is questionable whether it is possible to measure the effect of EPR. EPR is a part of a larger set of instruments such as responsibilities assigned to the government. Nonetheless, the correspondent could indicate what the AV does.

In operational terms, the AV can set quality requirements for packaging waste that is sent to recyclers. The correspondent mentioned plastics, where specifications for various have been set. Sorting is done automated, and the size of waste particles determines whether a type of plastic can be sorted in the right specification. Small and thin waste, in particular, run the risk of not being sorted in the right specification. As a consequence, a category of mixed plastics has emerged that is inevitable and incidentally can be recycled as well, despite the critiques. There would be less recycling of plastic in case the AV would have chosen another configuration. According to the correspondent, this choice shows that the AV aims for optimal environmental effects.

However, in the collecting process, the AV sees that the responsible parties in the public domain (the municipalities) are actively committed to reducing residual waste. They assume that everything apart from residual waste is automatically recycled and thus circular. The AV has noticed that initiatives such as 'reversed collection' (especially in combination with differentiated tariffs, collection non-transparent collection tools such as mini-containers, and less frequent pick-ups) have led to an increase in pollution of primarily PMD. Add in that the AV has always campaigned actively for separate collection (via Plastic Hero), but since municipalities took over this responsibility in 2015, communication to consumers has watered down. All this has amounted to more work for the same quality, and this is one of the reasons why the AV is more actively involved since this year.

AV's work has to be funded. Packaging producers pay for the costs of collection and recycling (plus a part of the overhead expenses) per kg per material that they put on the market as packaging. Every material finances its own waste collection in addition to the overhead costs, which are equal for every material. The AV actively stimulates producers to design recyclable (plastic) packaging. Generally, this goes fairly decent, given the recycling percentages. As the recycling percentage of plastics is lower than that of other materials, a strong stimulus is needed. Therefore, the AV grants discounts (26 cents per kg) on disposal fees of producers who can demonstrate that (a part of) their packaging is recyclable and has a positive market value upon delivery with recyclers.

Monitoring and reporting

In weighing and reporting on packaging and packaging waste, all organisations in the AV's waste management structure (the AV, Nedvang and VPKT) apply an active verification- and control program. In principle, producers of packaged products, municipalities and waste companies independently monitor and report on their operations, and these data are copied. The data is numerically analysed and checked for notable and non-plausible developments (on which they

follow up). Furthermore, every year a representative sample is taken from the companies/organisations that provide data in order to verify in detail whether the numbers are complete and reliable. Findings are covered in the reported results in research's year, and in the data system in which companies/organisations report their data. In the end, data that are used for reporting to the government are audited by accountants who subsequently give assurance.

E.2. Correspondence report Rijkswaterstaat

This report is based on correspondence in May 2020 via e-mail.

Rijkswaterstaat

Rijkswaterstaat (RWS) is the executive agency of the Ministry of Infrastructure and Water Management (I&W). Therefore, RWS is responsible for the execution of governmental tasks concerning infrastructure, water management and the environment.

RWS plays an important role in the implementation (and assessment) of AVVs and associated exemptions. Additionally, RWS monitors the achievement of environmental targets by existing EPR schemes. Their knowledge and experience are used in the implementation of new EPR schemes. EPR schemes must report on achieved results. These reports are sent to and assessed by RWS. RWS reports and advises the Ministry of I&W on the EPR schemes. RWS is engaged with the stakeholders in the schemes, both formal and informal.

Current EPR schemes

Legislative EPR applies to the following EPR systems (based on a general administrative measure and/or a ministerial decision), sometimes also based on an AVV:

- Electric and electronic equipment (EEE)
    - Lighting
- Batteries and accumulators
- End-of-life vehicles
- Car tyres
- Packaging
- Paper and cardboard *
- Flat glass *

* Voluntary EPR scheme that has received a legislative status following an AVV, without mandatory EPR. AVV is a form that occurs when a group of producers or a product organisation has taken the initiative for waste management of their product. In order to uphold the scheme, they have chosen to apply for an AVV for their disposal fee. When approved, all producers (including importers) of the product are obligated to pay a disposal fee relative to the amount of products put on the Dutch market.

Following the above, there are three forms of EPR: 1) mandatory EPR without an AVV, 2) mandatory EPR with an AVV, and 3) voluntary EPR with an AVV.

Goals of EPR

EPR is seen as one of the instruments to achieve the Dutch government's circular ambitions.

Goals of implemented EPR systems are determined by legislation and potentially complemented in an AVV. Goals of voluntary schemes are only listed in an AVV and the associated agreement. When determining and assessing these goals, policy objectives as listed in the national waste management plan play an important role. Moreover, European and/or national legislation can include concrete (quantitative) objectives, for example a recycling target.

E.3. Correspondence report Ministry of I&W

This report is based on correspondence in June 2020 via e-mail.

Ministerie van Infrastructuur en Waterstaat

Role of I&W

The Ministry of Infrastructure and Water Management [Infrastructuur en Waterstaat] (I&W) is responsible for the implementation of legislation for waste management. I&W determines conditions for implementing EPR schemes, their legislative link to the EU Waste Framework Directive and EU product decisions (e.g. WEEE, vehicles), and their instrumental connection to the national waste management plan (LAP3). The role of I&W further consists of ensuring that producers comply with responsibilities in waste management (targets, systems, communications). In addition, I&W initiates explorations to new EPR schemes and execute motions by the Dutch parliament. I&W is involved with all EPR schemes, new and old, as there are constant developments.

Implementation of EPR

Several factors influence whether a sector shape an EPR scheme or the government implements it. EU Directives are binding, and negotiations mainly take place in Brussels. National decisions are possible, see for example textiles and matrasses. These national processes often follow similar steps: increasing societal and political interests, an desire from parliament to explore EPR as an instrumental option, the preference of this government for non-EU schemes is to implement voluntary schemes, whether or not with an AVV. A final option is a regulation by I&W when the voluntary process fails and where there is environmental importance.

EU Directives determine the goals for their resulting schemes. Specific national targets are often determined in consultation with EPR stakeholders based on an assessment. It is vital that goals are supported in terms of feasibility, time window and costs. Progressive targets or norms can also be on the agenda.

There are no protocols for the decision-making process involving EPR schemes. Knowledge is often available within the ministry, and gaps are filled with explorations into the state of the market and relevant stakeholders. Currently, such an exploration is initiated into carpet floors, following a motion.

Engagement with stakeholders at an official level is often informal. The Netherlands is small and networks with stakeholders are often known. On a ministerial level, consultation processes are often more formal and based on preparations by officials.

Sometimes, there is confidential business information involved in the preliminary process of EPR implementation. Even though executed explorations become public, communication can take place in a climate of confidence. However, FOI requests can enforce public access to detailed reports, data and notes.

EPR is linked to circularity by the Implementation Programme CE. EPR is one of the described instruments to implement circularity.