Universiteit Utrecht

Terminology in Translation

Study of the IATE Term Database for Term Translation in the Domain of Life Cycle Assessment Applied to Waste Management

Rianne van Eldik | 3673901 | Master's thesis
Translation Studies | Faculty of Humanities | Utrecht University
Supervisor: Dr. Gys-Walt van Egdom
Second supervisor: Prof. Dr. Joost Buysschaert

English (US)

Preface: This study was carried out as part of the master's program of Translation for the university of Utrecht. For me, this thesis is the last part of my master's program. In January I conducted a small research regarding consistency in terminology translation within EUR-Lex. However, for that research I only studied one term. Motivated by my supervisor, I decided to write my master's thesis about terminology as well. The subject was selected with ease as terminology on Circular Economy is of interest to the European Commission, and I have been interested in the subject for years. This research offered me the chance to gain in-depth knowledge from a specific subdomain. In addition, I have learned a great amount about terminology, automatic term extraction and term annotation. Furthermore, I have gained experience with TermoStat, IATE, EUR-Lex, SketchEngine, Memsource & term fiches. This sounds like a lot, and in retrospect, it was. However, there is a perfectly clear explanation: I am enthusiastic, and I don't know when to stop. This, in combination with my ambitious supervisor, has led to a thesis containing a research as well as an annotated translation.

It was challenging to keep track of all interrelated methods and components included in this study. However, the subject on which my thesis was conducted has been smooth sailing from the start and for this I would like to express my deep gratitude to Professor Dr. Joost Buysschaert. He has provided me with the terminology starter-pack: term fiche templates, examples, access to Zephyr, literature on my topic, and valuable advice concerning the source-text selection.

Finally, I would like to thank Dr. Gys-Walt van Egdom, who has been a great source of inspiration during the last year. I have always been ambitious and enthusiastic, but he has managed to bring out the best in me (or the worst, according to the dimensions of this research). He has made a tremendous effort over the last year. Illustrating this is his willingness to supervise my internship and thesis over the summer holidays for which I am extremely grateful.

Abstract: Circular economy (CE) has been of great interest in recent years and Life Cycle Assessment (LCA) is frequently used to analyze the product life cycle from cradle-to-grave. Additionally, LCA can be applied to Waste Management, as waste poses a growing problem. The European Union produces a variety of texts on this subject which are translated to languages used within the EU. However, as these domains were developed recently, relevant terminology may not be included in the European Union's term database: IATE. The main objective of this study is to investigate to which extent IATE is suitable for the translation of terminology used in English source texts to Dutch within the domain of Life Cycle Assessment applied to Waste Management. The source text that will be discussed in this study is part of *Sustainable Solid Waste Collection and Management* by Pires, Martinho, Rodrigues, & Gomes (2018b).

In this study, the automatic term extraction tool TermoStat by Drouin (2003) is used. Subsequently, the output will be evaluated using the annotation scheme developed by Rigouts Terryn (2017). The resulting list of terms will be cross-referenced with the IATE database.

The source text contains 185 terms of which 102 are included in the IATE database. However, 83 terms are not (or not sufficiently) represented. Thus, when translating texts from these domains, translators cannot depend on the IATE database, meaning that the translation process is slowed down, because Dutch term equivalents must be obtained from other resources. Term fiches are proposed for 21 terms that are not represented in IATE.

Though the interest in CE and LCA has increased considerably, the IATE database is not adapted for the translation of texts which fall under these domains. Consequently, the database should be expanded to include terms so academic and institutional knowledge on these topics can be made available for a larger audience using translation.

Keywords: Translation; Terminology; Life Cycle Assessment; Waste Management; IATE.

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1. Introduction

The sustainable concept of Circular Economy (CE) has been gaining more interest from academics, companies, and policy and business advocacy groups (Geissdoerfer, Savaget, Bocken, & Hultink, 2017; Korhonen, Nuur, Feldmann, & Birkie, 2018) CE's main focus is closing the material flow within the product cycle which is further elaborated on by Geissdoerfer et al. (2017): "*a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling."* (p. 759). Different models can be used to study and analyze the physical flows of materials and energy, such as Life Cycle Assessment (LCA), eco-efficiency, and carbon footprints (Korhonen et al., 2018). One of the main benefits of Life Cycle Approaches such as LCA is that the total product life cycle is covered, and roles and responsibilities are ascribed to all parties involved ("Benefits of Life Cycle Approaches - Life Cycle Initiative," n.d.).

Furthermore, LCA has a unique focus on products from a life cycle perspective and is used as a tool "to assess the environmental impacts and resources used throughout a product's life cycle, i.e., from raw material acquisition, via production and use phases, to waste management." (Finnveden et al., 2009, p. 1). According to Finnveden et al. (2009), LCA is particularly useful to avoid problem-shifting, because all phases in a product's life cycle are addressed (p. 1). Among the environmental impacts that can be ascribed to the life cycle of a product are "climate change, stratospheric ozone depletion, tropospheric ozone (smog) creation, eutrophication, acidification, toxicological stress on human health and ecosystems, the depletion of resources, water use, land use, and noise" (Rebitzer et al., 2004, p. 702).

From the 1990s onwards there has been a rapid growth in the interest in LCA as well as in the acceptance of the tool for product-oriented environmental management and the concept

has strongly developed and standardized since (Guinée et al., 1993, p. 3; Finnveden et al., 2009). In addition, the domains in which LCA was used were also expanded (Guinée et al., 2011). One of the domains to which LCA was expanded is Waste Management. This domain has gained relevance in the past few years due to the growing awareness of the dangers of mismanagement of waste for the environment and human health (Singh, Saxena, Bharti, & Singh, 2018). To rid of these dangers, the past accumulations of waste should be dealt with in addition to establishing new guidelines for future waste management (Singh et al., 2018). The area of Waste Management is labelled as enormous as it "includes all kinds of wastes, including those produced by household, agriculture, and industry and special waste produced by hospitals" (Nehrenheim, 2014, p.1). Not only are there many different producers, but there are various types of waste as well, such as solid waste, hazardous waste, and municipal waste. The European Union Waste Framework Directive (2018) formulated a waste management hierarchy of the favored priority of addressing waste. This hierarchy is represented in figure 1 by Nehrenheim (2014).

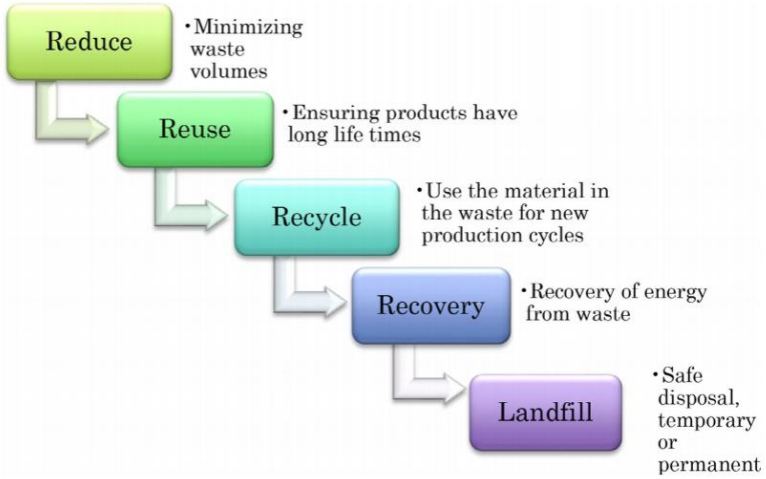


Figure 1. Priority of waste management by Directive 2008/98/EC of the European Union (Nehrenheim, 2014, p.2)

Circular Economy and Waste Management have been of particular interest to the Dutch government due to its goal to be 100% circular by 2050 and they have recently made means available to contribute to the circular economy in 2019 and 2020 ("€ 80 miljoen extra voor circulaire economie," 2019; *Nederland circulair in 2050. In het kort.*, 2016). The management of waste plays an important role for CE, as its objective is to have an economy without waste ("€ 80 miljoen extra voor circulaire economie," 2019). Within the European Union waste management is of great importance as well (*Being wise with waste: the EU's approach to waste management*, 2010) and as the EU forms a larger body of knowledge, the Dutch government could benefit from the EU's knowledge. The European Parliament's language policy is multilingual, meaning that all documents are available in all official languages of the EU (Hériard, 2019). To make all documents available, they are translated by the Directorate-General for Translation ("Translation | European Commission," n.d.). Since most texts within the EU are domain-specific, e.g. law, industry or environment, the phenomenon of terminology occurs, and these terms must be translated appropriately. The next section first introduces the field of terminology and in addition discusses how terminology is translated within EU texts.

According to Pearson (1998), the field of terminology originates from the early 1900s, when there was a sudden need for new labels and corresponding standardized equivalents in several languages, due to swift technological developments and a globalization of the market that resulted in new concepts. Pearson (1998) describes how the rapid development of terms led to the risk of confusion and communicative problems when a single concept was referred to by multiple terms. The opposite phenomenon possibly led to the same risks; referring to multiple concepts with a single term. Hence, the need for term standardization grew, and from the 1930s onwards symposiums addressing standardization and the conceptual structure of terms were organized, though these were mainly aimed at scientists and engineers from specialized knowledge domains (Montero Martinez & Faber, 2009). In 1951 the International

Organization for Standardization (ISO) was founded, including a committee specifically focused on terminology.

According to Pearson (1998), *terminology* is used to refer to multiple aspects: the process of collecting and documenting terms, the theory regarding the difference between terms and words, and the vocabulary of a special subject field. Terms can be single words, but in most cases are made up out of multiple words (Bowker & Pearson, 2002, p. 198). According to Pearson (1998), Thelen (2002) and Rigouts Terryn (2017), it is difficult to distinguish between words and terms. Pearson (1998) states that this is caused by the similarity of words and terms, as they not only look alike, but in some contexts, terms can also function as words. Both Pearson (1998) and Bononno (2000) state that terms assign labels to concepts, the mental constructs of things that occur in the real, physical world, so that these concepts can be represented in language. However, common words are used to denote concepts as well, as described in the theory of language by the Swiss linguist Saussure which will be further discussed in chapter 2. Additionally, means by which terms and words can be distinguished are offered in chapter 2 as well.

As described, terminology was initially mainly of importance to scientists and domain experts, however, the awareness of the importance of terminology for the field of translation grew. Terminology in translations is a linguistic translation problem according to the categorization made by Nord (2005), as it is often claimed that terms operate in standardized equivalents within a specific language pair. Academics have pointed out the importance of terminology with regards to translation education and translation quality as well. Montero Martinez & Faber (2009) consider terminology as an "indispensable instrument in any process of specialized language communication" within "the context of translator training" (p. 91). According to Thelen (2002), "It is a generally held belief among specialized translators … that Terminology is one the most important areas of specialized translation" and "the formulation

of an 'appropriate' target text is to a large extent dependent on a good knowledge and the proper use of the terminology relevant to the subject field of the source text." (p. 21). What Thelen (2002) means by appropriate is that "the particular target text complies with the requirements of the translation job at hand and that the meaning (i.e. referential meaning, organisational meaning and situational meaning) of the source text has been kept as constant as possible …" (p. 21). Thelen used "appropriate" as a more neutral label to refer to the quality of a translation without giving a value judgement such as "good" or "bad", which is widely criticized in Translation Studies. Chesterman (2016) adopted the use of "appropriate" as well.

Although the focus in translation education lies strongly on a thorough source text analysis including terminology analysis, in the professional field of translation systematic terminology management is not feasible, because the task is time consuming and the translator has to comply with deadlines and competitive rates (Montero Martinez & Faber, 2009). There are several solutions for dealing with the translation of terms in specialized texts, However, most translators rely on multilingual term databases for the definition and appropriate equivalents of terms in the target language (Kerremans, 2019). The main goals of term management are to ensure consistency and that the effort put into the definition and translation of a specific term does not have to be repeated. In 1999, the initiative for the IATE database was taken with those same goals in mind: the improvement of interinstitutional term translation consistency and the minimization of effort (Johnson & MacPhail, 2000; Kerremans, 2019). IATE, initially used to abbreviated "Inter-Agency Terminology Exchange", is the central term database for all bodies of the European Union (Johnson & MacPhail, 2000). IATE is maintained by translators and terminologists who work for the language services of the EU institutions ("IATE - FAQ," n.d.). New terms are added on a weekly basis, which is necessary as the database should keep up with new terminology and terminology from new domains, such as Waste Management. The IATE database is not only accessible for employees of bodies in the

European Union, but for the general public as well (Ball, 2003). In chapter 2, the IATE database will be further elaborated on. In the next paragraph, terminology, term management and the IATE database will be connected to the translation service of the EU.

The translation of EU texts is an example of the specialized translation for which Thelen (2002) claims that terminology is one of the most important areas. As stated, most of the EU texts' content is specific to a certain domain and the terminology in these texts is derived from these domains as well. Because of the large volume of texts that needs to be translated within the EU, the Directorate-General for Translation used CAT tools with Machine Translation. CAT stands for Computer Assisted Translation and a CAT tool is a digital environment in which texts are automatically divided into segments for translation. There are various options within these CAT tools, such as Machine Translations by which texts are automatically translated or term bases in which terms can be managed. The EU uses Machine Translations based on Translation Memories constructed from texts previously translated by the EU. Terminology, then, is managed in the IATE database, which is connected to the CAT tool. Thus, when coming across a term that is represented by an entry in the IATE database, the term translation will pop up in the CAT tool.

The relevance of the domain of terminology regarding translation, the IATE database and terminology in the domains of CE and Waste Management is reflected by recent academic research on these topics. Abraham-Barna (2016) describes the relation between translation quality and terminology. Different approaches of Translation Quality Assessment were compared to find which factor plays a large and continuous role in the quality of translations. This comparison showed that the accurate and consistent use of terminology greatly influences the translation quality and that "using official resources for terminology is a very important factor for the translation quality, assurance and assessment, which increases the accuracy of

translations" (Abraham-Barna, 2016, p. 31). According to Abraham-Barna (2016), IATE and EUR-Lex are among the most reliable official resources for terminology in the European Union.

Kaniklidou & Peclaris (2017) state that the importance of terminology is growing for translation education in the European Union as well, as the translation industry is rapidly expanding. Kaniklidou & Peclaris (2017) claimed that to improve student employability, students should gain experience in dealing with terminology, e.g. by participating in the IATE project, in which students are assigned terms for decoding by TermCoord, the organization responsible for managing the IATE database. Decoding terms refers to term collection, and the retrieval of equivalents in the target language along with related data such as a definition and contextual references (Kaniklidou & Peclaris, 2017). The IATE project investigates terms from a top-down perspective, as students are assigned terms identified and marked as relevant by TermCoord (Kaniklidou & Peclaris, 2017). Kaniklidou & Peclaris (2017) describe that in 2017 the IATE project assigned students with 18 terms from the domain of Waste Management. In the IATE database, Waste Management is one of the subdomains of Environmental policy within the domain of Environment ("Browse by EuroVoc - EUR-Lex," n.d.).

Cossu & Williams (2015) state that there is no universal agreement on terminology within waste and resource management, as different stakeholders have different attitudes towards environmental and social issues regarding resource recovery from waste, and these attitudes influence the terms they use. However, according to Cossu & Williams (2015), agreement on terminology is crucial to establish consensus on resource recovery strategies. Ervasti, Miranda, & Kauranen (2016) affirm the need for universal terms and term definitions for the subdomain of paper recycling. They claim that variation in term use and term definition can have negative consequences, e.g. problems in communication may lead to misunderstandings and constraints on information resources found through search queries. In their analysis, Ervasti et al. (2016) found that terms are used interchangeable in some research

articles, whereas the same terms were used for different concepts in other articles, and in some studies, terms were not defined at all, leaving room for ambiguity in interpretation. Thus, according to Ervasti et al. (2016), "Every field of science needs to build a systematic terminology with generally accepted, uniform definitions for terms." (p. 65).

However, according to Kerremans (2019), translators in fact use term translations beyond standardized equivalents, thus, beyond the terms and equivalents mentioned on term fiches within the IATE database, because of contextual factors, such as. the communicative goal of a text, that influence which term translation is appropriate within a specific target text. In addition, Kerremans (2019) claims that concepts referred to with terms are rarely delimited in meaning, and thus the objective of univocity does not apply. However, Kerremans (2019) also describes that there is tension between the preciseness necessary for in-domain term use and the dynamic use of terminology influenced by contextual factors. According to Kerremans (2019), differently structured term databases, which are aimed at representing a plurality of terms and a (visual) representation of the interrelatedness of terms, should be the subject of research addressing the dynamic purpose of terms and their translation. Kerremans (2019) proposes a visual and dynamic representation of interrelated terms in a network, such as a term cloud. Figure 2 contains the result for *waste management* in the Ecolexicon that Kerremans (2019) refers to which was developed by the LexiCon Research Group at the University of Granada.

To summarize, the interest in terminology within CE and the domain of Waste Management has been on the rise, and the use of standardized terminology in various languages regarding these domains is stated to be of importance to prevent communication errors. Claims have been made that translation quality is highly dependent on accurate and consistent use of terminology, however, there are also academics who claim that translators use terms beyond

Figure 2. Visual network of *waste management* in Ecolexicon

(Screenshot retrieved May 22, 2019, from http://ecolexicon.ugr.es/visual/index_en.html)

the standardized equivalents and that suggest other visual representations of terms may have to be adopted. Thus far, no research has been conducted from a bottom-up perspective, to study whether standardized equivalents in the IATE database are suited for the translator's task of appropriately translating domain-relevant terminology. In this study this knowledge gap will be investigated by researching the practical use of IATE during the translation of a source text concerning LCA applied to Waste Management. The practical use of IATE will be tested on multiple components. First, an assessment will be made of whether source-text terms are represented by entries in IATE from a bottom-up perspective. Terms will not be supplied by for instance TermCoord but will be extracted from the domain-specific text. Second, the

usefulness of entries' contents will be evaluated, as term translations will be put to practical use in the translation phase of this study. However, prior to using IATE, the problems arising from identifying terms, an acknowledged difficult task, will be addressed based on a case study regarding the same source text. This results in the following research question:

To which extent is IATE suitable for the translation of terminology in English source texts to Dutch within the domain of Life Cycle Assessment applied to Waste Management?

The next chapter will focus on the theoretical background, in which this study's three main pillars of terminology, the IATE database, and LCA in general and applied to Waste Management, will be discussed further. In chapter 3, the source text, on which the evaluation of IATE is based, will be elaborated on, including publication data, the selected fragment and the use of terminology within the text. Chapter 4 will address the method of this study. In chapter 5 and 6 the results are discussed, and chapter 7 consists of the English source text and the translated Dutch target text including annotations concerning translation problems that are not specific to terminology. In Chapter 8, this study's discussion and conclusion will be provided.

2. Theoretical Background

In this chapter, some of the concepts introduced in the previous chapter will be further elaborated upon. First, terminology will be discussed with respect to the relationship between concept and label, and subsequently the possibilities considering the distinction between words and terms will be discussed. Second, the IATE database will be considered in more detail (mostly regarding its structure), and lastly, an introduction into the different phases within LCA will be provided in addition to the application of LCA to Waste Management.

2.1 Terminology

In chapter one the Swiss linguist Saussure's theory of language was mentioned in relation to how both terms and words can function as labels for concepts. First the theory of language will be further elaborated upon and subsequently the difference between words and terms will be discussed into more detail.

As described in chapter one, Pearson (1998) and Bononno (2000) state that terms assign labels to concepts. However, more than a century ago, Saussure developed a theory about words functioning as labels for concepts. According to Saussure, language is a system of signs that includes the notion of *signifier* and *signified* that together construct the *sign* (Hall, 2013). The signifier consists of the form while the signified is the mental idea or concept triggered by the signifier (Hall, 2013, p. 16). Saussure states that the relationship between most signifiers and signifieds is arbitrary, i.e. they are only related to each other because of cultural and linguistic codes as their link is not natural or inevitable (Hall, 2013). Saussure adds to this the notion of difference that describes that signs "are members of a system and are defined in relation to other members of that system" (Hall, 2013, p. 16). The notion of signs being defined in relation to each other can be related to Kerremans' (2019) view on the structure of term databases. As stated in this study's introduction, Kerremans (2019) proposes a dynamic structure for term databases in which the interrelatedness of terms is (visually) represented as in the Ecolexicon.

If terms are represented in a dynamic database, the relation, and therefore also the differences between terms, may be easier to interpret.

Since the use of linguistic labels ascribed to concepts is not an exclusive aspect of terminology, whereas it is also used in Saussure's theory of language regarding words, it is not an appropriate tool to distinguish terms from words. This section will cover the distinction between words and terms. According to several sources, it is the translator's task to distinguish between terms and words during the translation process, though this has repeatedly been described as a difficult task (Pearson, 1998; A. Rigouts Terryn, 2017; Thelen, 2002). The difficulty lies in the fact that they look alike and that terms can also function as words (Pearson, 1998). According to both Pearson (1998) and Thelen (2002), there is no suitable definition of what a term is that can subsequently be used for the differentiation of words and terms. Instead, they claim that there is a tendency for terms to be used within specific communicative settings. This will be the focus of the next paragraph.

Pearson (1998) defined four different communicative settings: expert-expert communication, expert to initiates, relative expert to the uninitiated, and teacher-pupil communication. According to Pearson (1998), expert-expert communication often includes highly specialized jargon containing words or phrases to which domain-specific meaning is ascribed beforehand. Pearson (1998) continues that within this specific communicative setting speakers use the terminology as it is defined and only give an explanation when terms are used beyond their standardized meaning or in case of neologisms. Examples of this type of communication include journals, academic books and research reports (Pearson, 1998, p. 36). According to Pearson (1998), this communicative setting yields the highest amount of terms. The second communicative setting mentioned by Pearson (1998), is that of expert to initiates. The initiates are people with less knowledge than the experts, because they are students or because they have a different educational background (Pearson, 1998). In this communicative

setting, terms are also likely to occur. However, they are less frequent and are more likely to be explained. The communicative setting that Pearson (1998) labels as the relative expert to the uninitiated has a much lower frequency of terms than the two previous settings. The main objective for communication in this setting is that the audience comprehends the general meaning of the text, not that they have the same level of understanding as the author (Pearson, 1998). The last communicative setting is teacher-pupil communication and according to Pearson (1998), the pupil has no prior knowledge regarding the specific domain. Terms are used, but merely to reflect important concepts in the domain and terms are explained in general of simplified language (Pearson, 1998). The main feature of this setting is that there is a teacher who is trying to convey knowledge (Pearson, 1998). In this study, these communicative settings may be used to predict the likeliness of terms to occur.

After predicting if terms are likely to occur, terms must be differentiated from words. To guide this decision-making process, Rigouts Terryn (2017) developed an annotation scheme. The main goals of this annotation scheme were to provide an easy way to annotate terms and to improve agreement amongst annotators (A. Rigouts Terryn, Hoste, & Lefever, 2018). In addition, Rigouts Terryn et al. (2018) wanted to implement parameters by which terms could be analyzed in more detail. In this section, the annotation scheme will be introduced based on which lexical units can be divided into four categories; *Out-of-Domain Terms, Specific Terms, Common Terms* and *Not Terms* (see figure 3 by Rigouts Terryn et al. 2018).

The main parameters that were implemented are lexicon-specificity, i.e. "the degree to which a term belongs to either the general language or to the lexicon of specialists" and domain-specificity, i.e. "how relevant the term is to the subject" (Rigouts Terryn et al., 2018, p. 1804). The labels for terms are ascribed depending on whether a term is lexicon-specific, but not domain-specific (*Out-of-Domain Terms*), both lexicon and domain-specific (*Specific Terms),*

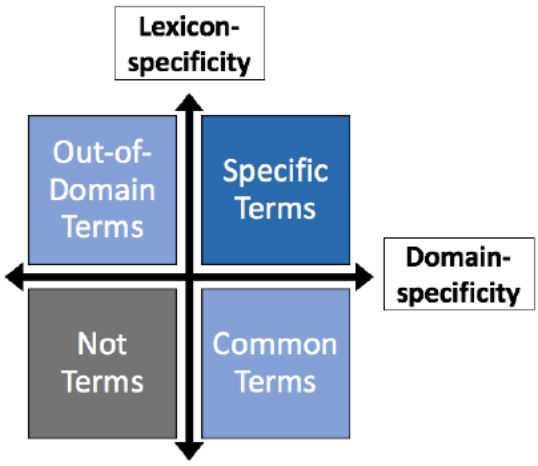


Figure 3: Annotation scheme by Rigouts Terryn, Hoste & Lefever (2018, p. 1804).

or domain-specific but not lexicon-specific (*Common Terms*). Lexical units that do not belong to the lexicon of specialists nor to a specialist domain are labeled *Not Terms.* Within the domain of Waste Management, *significance* is be an example of an *Out-of-Domain Term,* since this is not specific to the domain of waste, but it is part of the scientific specific lexicon. A *Common Term* is specific to the domain, but is also part of the general vocabulary, e.g. *waste. Specific Terms* are the most strict terms (A. Rigouts Terryn et al., 2018), for the domain of LCA an example would be *avoided burden approach.* In a recent pilot study, Rigouts Terryn, Hoste, & Lefever (2019) found that the implementation of this annotation scheme may lead to higher inter-annotator agreement.

Consistency in distinguishing between terms and words is not the only coherence-related factor of importance with respect to terminology. It is the translator's goal to produce a coherent translation as "companies and organisations have an growing need for a coherent language use in their external and internal communication" but "it is far from evident to continuously use the correct and appropriate terminology." ("Terminology Extraction for Semantic Interoperability and Standardization," n.d.). Coherence in terminology translation can exist between texts or in the case of a single text being translated internally. Not only should a single term be translated consequently, there should be text-internal coherence between terms

as well. When there is partial overlap between different terms, e.g. between *waste management* and *integrated waste management systems,* terms should be managed in relation to each other, and whenever possible, should be translated using the same target-language equivalents (Rigouts Terryn, 2017). However, as stated earlier, in a regular translation process, the translator does not extensively research terminology in advance as terminology serves only a practical purpose, and thus, the relation between terms might not be reflected properly and may negatively influence text's internal coherence. As stated in the previous chapter, translators use multilingual term databases to retrieve term equivalents in the target language and using databases can support consistency in terminology (Kerremans, 2019). In the next section the database used within this study, IATE, will be elaborated on further.

2.2 IATE

In this section, aspects of the IATE database will be addressed, such as how the database and entries are constructed, and how search queries can be performed.

As of now, two decades have passed since the founding of the IATE database. Prior to the IATE database being set up, different institutions of the European Union had different terminology databases varying from on-line terminology databases to card files, and some bodies within the European Union had no systematic terminology arrangements at all (Johnson & MacPhail, 2000, p. 2). Nowadays the online database holds over one million entries and is working towards eight million terms defined in those entries ("IATE Search," n.d.). As is reflected by these numbers, an entry can contain multiple terms, and entries are concept-based rather than term-based. Entries are ascribed to one or more of the 21 domains and 127 subdomains, e.g. Waste Management is one of the 52 subdomains of the main domain Environment within the IATE database ("Browse by EuroVoc - EUR-Lex," n.d.). A total of 25 languages is represented in the database ("IATE - About IATE," n.d.). In this research, the

online version of IATE, released on November 7, 2018, is used ("IATE - About IATE," n.d.).

Search queries in IATE can be performed based on a term, its source language and the preferred target language, but queries can also be specified further based on "Matching", "Search in term types (source)", "Search in fields (source)" and "Domains". In this research, the matching is set for "all words", IATE is searched for all term types and terms are only searched for in the field "Term". The preferred domain for this research is that of Environment, however, queries are also performed without selecting a domain to check the entire database for specific terms, as some terms may be used beyond the domain of Environment or may be placed in a different domain due to error.

Entries in IATE are constructed out of term fiches that consist of multiple elements, see figure 4 and 5 for the IATE entry for the concept of CE. At the top of the term fiche, the awarded IATE ID-number is provided, followed by the entry's domain and subdomain. The IATE database consists of loose entries in various domains. ISO 12620 (2009) states that every terminological entry should address only one concept, which is also documented in the IATE Handbook (2018) under: "One concept, one entry" in which is it stated that "each entry corresponds to one concept […] and each concept should ideally be covered only in one entry" (*IATE Handbook - Europa EU*, 2018, p. 4). An entry contains terms and translations of a specific concept in all available languages that are made visible according to the user's settings of the source and target language, and a single entry can contain multiple terms and translations regarding a specific concept. If multiple terms are available to refer to a single concept within a language, the codes "preferred", "admitted", "deprecated" and "obsolete" can be ascribed to the terms within an entry to reflect their status ("IATE - Data fields explained," n.d.). According to IATE, the code "preferred" is used to describe that a term is "intrinsically better than other terms" or that the term should be used "simply to ensure consistency in EU texts" ("IATE - Data fields explained," n.d.). Stating that one term is preferred over another term and describing

that some terms are "intrinsically better", attributes to IATE's prescriptive character. According to Bononno (2000), prescriptive terminology may lead to better communication and is possibly safer and more efficient. The prescriptive use of terminology can also be related to term standardization, in which the use of specific terms is preferred over the use of other terms (Pearson, 1998). In addition, it may refer to the normative character of term fiches in term databases and the prescriptive perspective on the translation of terminology, in which a source language term is 'simply' substituted with a target-language standardized equivalent (Kerremans, 2019, p. 66). In ISO guideline 860 (2007), the ambiguity of labels for concepts is addressed: "differences between concepts and misleading similarities at the designation level create barriers in communication" and may lead to mistakes. ISO 860 (2007) advises harmonization, i.e. reducing or eliminating minor differences between closely related terms, which is perceived as an integral part of standardization and is aimed at improving communication.

Whereas IATE is constructed out of single concepts, different related concepts are linked together, as is represented in the section "Cross-references". Links between entries can be subdivided into categories such as "broader" and "narrower", depicting hypernymy and hyponymy, "related" and "antonym". This is the only reflection of the underlying ontological structure of terms in which terms are related to each other in a hierarchy.

After information regarding cross-references, first, the term definition in the set source language is provided, followed by the definition's reference and the owner of the entry. Then the term is provided, together with the term reference, its reliability, part of speech, gender, number, context, context reference and owner. The reliability of terms in IATE is scored on a scale from 1 to 4, where 1 stands for "reliability not verified", 2 stands for "minimum reliability", 3 stands "reliable" and 4 represents "very reliable" ("IATE - Fields explained," n.d.) However, IATE's website states that code 3 was "automatically assigned to many entries,

regardless of their previous validation status, following the merger of existing databases to create IATE. Therefore some entries marked as *reliable* are not necessarily so." ("IATE - Fields explained," n.d.).

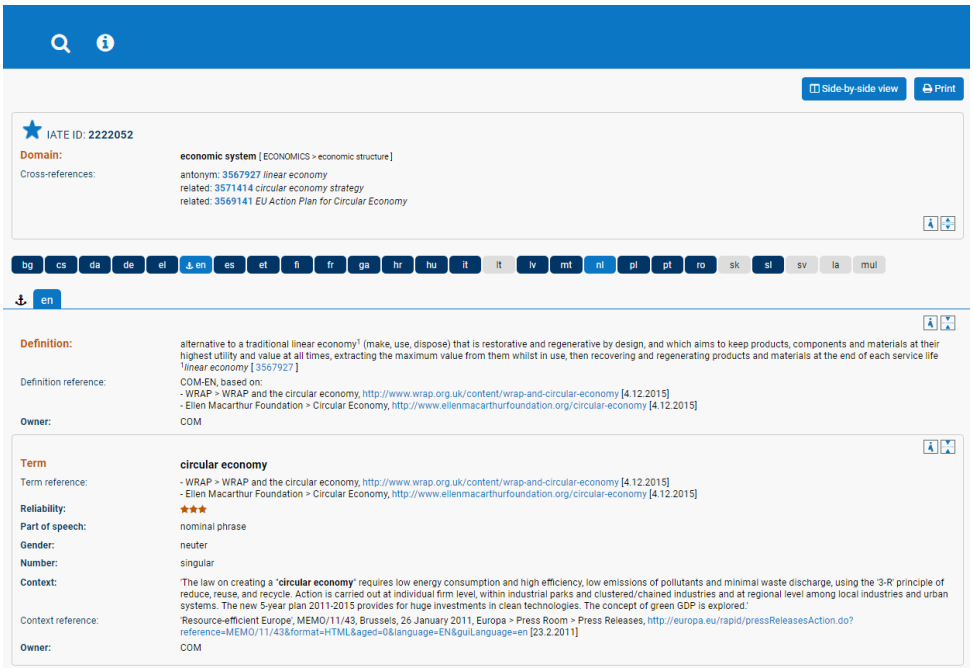


Figure 4. IATE entry for Circular Economy (Part 1) ("IATE - Entry ID 2222052," n.d.)

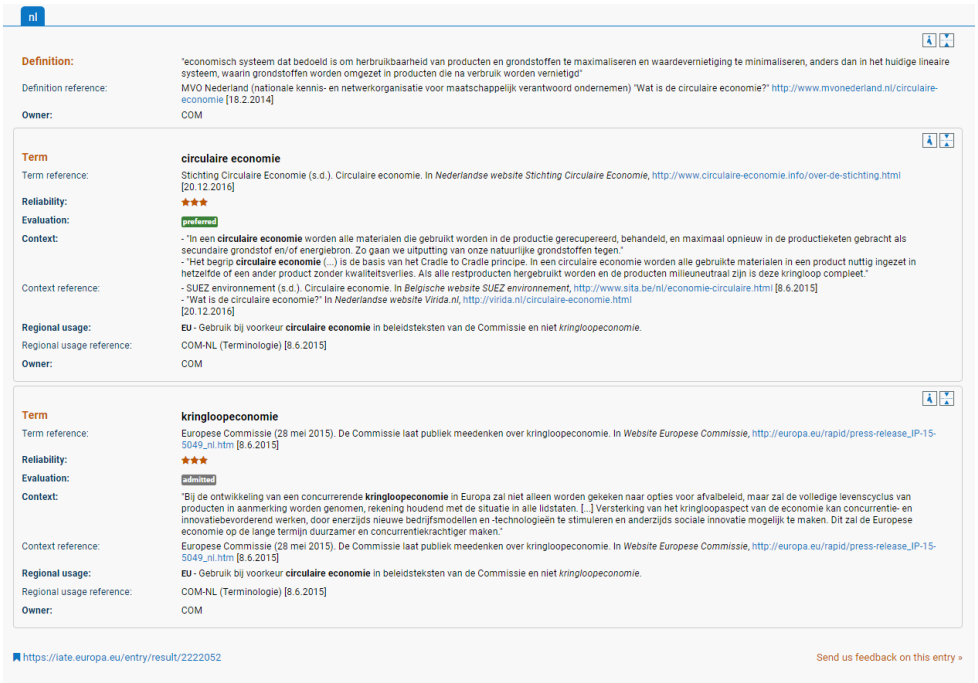


Figure 5. IATE entry for Circular Economy (Part 2) ("IATE - Entry ID 2222052," n.d.)

2.3 LCA

In this section, the four phases of LCA will be introduced and the relevance of LCA for waste management will be discussed based on the application of LCA in literature.

An LCA study consists of the following four phases: Goal and Scope Definition, Life Cycle Inventory Analysis (LCI), Life Cycle Impact Assessment (LCIA), and Interpretation (Finnveden et al., 2009, p. 2). The first phase "provides a description of the product system in terms of the system boundaries and a functional unit" in which "alternative goods, or services [such as packaging materials] [can] be compared or analysed" (Rebitzer et al., 2004, p. 704). In the second phase, Life Cycle Inventory Analysis, input, i.e. the consumption of resources and output, i.e. the waste flows and emissions, are estimated and related to the functional unit from the first phase (Finnveden et al., 2009; Rebitzer et al., 2004). During Life Cycle Impact Assessment, the degree and implications of potential environmental impacts, e.g. climate change and land use, are addressed (Finnveden et al., 2009; Rebitzer et al., 2004). Interpretation can occur during the second or third phase or at the end of both phases to evaluate results in relation to the Goal and Scope Definition (Finnveden et al., 2009; Rebitzer et al., 2004). Based on this evaluation conclusions and recommendations can be made (Rebitzer et al., 2004).

The broad application of LCA in the domain of Waste Management has been covered in various recent studies and a selection of these studies will be briefly mentioned in order to provide insight into the applicability of LCA for waste management purposes. Morrissey & Browne (2004) reviewed different models used in municipal waste management including models based on LCA. McDougall, White, Franke, & Hindle (2007) proposed using the LCI phase of LCA for Integrated Waste Management (IWM) to contrast alternative waste management options or to enhance current options. Cherubini, Bargigli, & Ulgiati (2009) performed LCA to evaluate the sustainability of four waste management strategies applied to the waste amount and composition of Rome. In a comparable study, Iriarte, Gabarrell, &

Rieradevall (2009) used LCA to compare the potential environmental impact of three selective waste collection systems designed for densely-populated urban areas. Khoo, Lim, & Tan (2010) investigated the environmental performance of four food waste conversion scenarios using LCA with the purpose of finding a suitable management solution for the huge volumes of food waste Singapore is challenged with. LCA is not only used regarding the disposal of waste, but also for the use of waste materials in, for example, the Hong Kong cement industry, as researched by Hossain, Poon, Lo, & Cheng (2017).

As discussed, LCA has already been implemented in waste management. However, the importance of this type of analysis may be established further from a more general point of view. In the next chapter, the text that will function as source text in this study will be introduced. In this source text, general information of the applicability of LCA on waste management is provided.

3. Source-text analysis

In the first section of this chapter the publisher, authors and target audience of the source text will be discussed. The second section will address the source-text fragment selected for translation and the third section will focus on terminology in relation to the source text.

3.1 Publisher, authors and target audience

The selected source text is *Sustainable Solid Waste Collection and Management*. This text is focused on multidisciplinary aspects regarding waste, such as the collection of waste, waste streams, economic models and behavioral studies ("Sustainable Solid Waste Collection and Management | Ana Pires | Springer," n.d.). Springer published the book in 2008. From a historic perspective Springer Publishing Company is mainly focused on health-related sciences. However, their portfolio now also consists of works on the subject of Environmental Sciences and its subdomain Pollution and Remediation within which this book was published ("Pollution and Remediation | Springer," n.d.) In this subdomain 55 journals are issued and over a thousand books have been published.

The source text is written by Ana Pires, Graça Martinho, Susana Rodrigues and Maria Isabel Gomes ("Sustainable Solid Waste Collection and Management - Ana Pires - Springer," n.d.). Both Ana Pires and Susana Rodrigues have a Ph.D. in Environmental Engineering from the New University of Lisbon and are affiliated with the Center for Marine and Environmental Sciences. Pires specializes in life cycle assessment and Rodrigues is an expert on waste collection systems. Graça Martinho is an associate professor in the Department of Sciences and Environmental Engineering at the New University of Lisbon, specializes in Solid Waste Management and Life Cycle Assessment and has over 50 publications ("Graça Martinho," n.d.). Maria Isabel Gomes is an associate professor at the Centre for Mathematics and its Applications (CMA) at the New University of Lisbon ("Maria Isabel Gomes," n.d.). Gomes has an academic

background in Operations Research and Engineering Systems and in Engineering and Management, has published 91 research items and was cited over a thousand times ("Maria Isabel Gomes," n.d.).

In the preface of the book, the authors define their target audience and their main goal. The authors state that the book "intends to provide those who work in the scientific field of waste management and who are practitioners the backgrounds of waste collection and its incredible role in the success of an entire waste management system. Bringing the most recent developments on the subject to people who are not keen in searching for scientific articles to obtain knowledge and apply it to its professional life is the challenge of this book. [The authors] do not intend to define the best technology to implement waste collection. [They] want to give readers the tools to improve waste collection by integrating their work within the entire waste management system." (Pires, Martinho, Rodrigues, & Gomes, 2018, vi). Furthermore, they state that as "a particular interest for graduate students: this book shows the recent technology tendencies in the field, which will help students finding new directions their study and graduation at waste collection systems. This book will allow students to understand the applicability of system analysis through case studies." (Pires, Martinho, Rodrigues, & Gomes, 2018, vi).

In the next section the selected fragment used in this study will be discussed.

3.2 Source-text fragment

Sustainable Solid Waste Collection and Management is a text within the sustainable and scientific domain. It has been written by experts for (future) experts and the authors intend to give an overview of recent developments on the subject (Pires, Martinho, Rodrigues, & Gomes, 2018, vi). The selected fragment for this study is part of chapter 11 titled "Assessment and Improvement" and consists of the first five subsections of the first paragraph (see: appendix V).

This fragment was chosen, because it addresses LCA applied to waste management. As stated earlier, LCA conducts an analysis of the total life cycle of a product. It is a useful tool for the establishment of guidelines for future waste management, as recently, focus has shifted towards the environmental and human health threats posed by current and future waste streams. In the abstract of chapter 11, the authors state that the purpose of chapter 11 is "to discuss the assessment and improvement of the waste collection system by using life cycle thinking, with a sustainable perspective. Several methodologies such as life cycle assessment, carbon footprint, life cycle costing, and social life cycle assessment will be presented and discussed concerning its application to waste collection systems and contribution to the integrated waste management system." (Pires et al., 2018, p. 183). The paragraphs included in the selected fragment are:

11.1 Life Cycle Assessment and Carbon Footprint

- 11.1.1 Goal and Scope Definition
- 11.1.2 Life Cycle Inventory
- 11.1.3 Life Cycle Impact Assessment
- 11.1.4 Interpretation
- 11.1.5 LCA Software

In the introduction to paragraph 11.1 it is shortly stated what LCA is and which phases it includes. Furthermore, the relevance of LCA for solid waste collection systems is defined. Paragraphs 11.1.1 to 11.1.4 cover the four different phases in LCA. The description of the Goal and Scope Definition phase is entirely directed at the waste collection system, though the other phases are mostly explained in general. Paragraph 11.1.5 is titled *LCA Software* and in this paragraph first various types of software to conduct LCA's are mentioned. Some types of software are exclusively directed at waste management and other LCA software tools are fit for general use. In addition, some focus points for practitioners are described, such as the influence

of the production of capital goods on environmental impacts.

The domain-specificity of LCA and the target audience of (future) experts accounts for the register of the text. This relatively high as scientific language is used. However, the level of academic language and quality of English are not consistent throughout the source-text fragment. This will not be elaborated on further, as terminology is this study's main objective. These aspects and the following translational implications and choices will be mentioned in footnotes in the source and target text in chapter 7. The next section will discuss the difficulty of distinguishing terms from words and the probability of terms in the source text.

3.3 Source-text terminology

As discussed in the previous chapter, Pearson (1998) defined four different communicative settings: expert-expert communication, expert to initiates, relative expert to the uninitiated, and teacher-pupil communication. This categorization will now be applied to the source text to determine the likelihood of terms in the source text. The authors of *Sustainable Waste Collection and Management* are experts in the domain of waste collection and the domain of LCA, proven by their academic careers in the domain as described in section 3.1. The target audience of the source text consists out of experts, i.e. "those who work in the scientific field of waste management" and initiates, i.e. "practitioners in the backgrounds of waste collection" and "graduate students" (Pires, Martinho, Rodrigues, & Gomes, 2018, vi). Thus, the communicative setting of the source text overlaps with two communicative settings described by Pearson (1998): expert-expert communication, and expert to initiates. According to Pearson (1998), these are the two communicative settings in which terms are most likely to occur. Thus, in this source text the occurrence of terms can be expected, and the translator should be aware of this and manage term definition and translation appropriately.

As stated earlier, the translator is held responsible for identifying terms in the source

text. However, according to Bononno (2000) and Thelen (2002), this is usually not performed in a systematic manner, but more ad hoc, because the translator only investigates terms to the extent necessary in service of the translation process. Translators can be troubled by irregular use of terms or by the use of non-standardized terms, because in consequence terms can be harder to recognize and for that reason specialized knowledge is required to determine differences between the contextual and the standardized meaning (Thelen, 2002, p. 22). Regardless of these challenges, the translator first has to identify a term, and subsequently the standardized equivalent in the target language (if available) should be provided in order to produce an appropriate translation (Thelen, 2002, p. 22).

In section 3.5 this study's translation strategy will be discussed, in which will be elaborated further on the strategy regarding terminology. In the next section, however, first the translation brief will be addressed.

3.4 Translation Brief

The selected source-text fragment will be translated within this study to determine the practical use of the IATE database for texts within the domain of LCA within Waste Management. For this purpose, a hypothetical translation brief is composed.

The text fragment described in section 3.2 will be translated from the English source language into Dutch and will be published commissioned by the Dutch government. On the website of the RIVM, the importance and of LCA and the multifunctionality of this tool is highlighted ("Wat is LCA?," 2018). However, LCA has not been employed for managing waste by the Dutch government, despite goals set for a Circular Economy by 2050, for which waste plays a crucial role (*Nederland circulair in 2050. In het kort.*, 2016). Thus, it is of high importance to ensure scientific texts on the subject are available to the Dutch market. In 2015 *Afvalbeheer* by Anthony de Proft was published by a Belgian publishing house, and in this book

waste management was also discussed. However, in Proft (2015) the management of waste is not mediated by LCA and only concerns waste management as part of facility management within organizations. Thus, current literature available in Dutch is not sufficient. Pires et al. (2018) describe the application of LCA in waste management, and address waste management on a scale beyond single organizations. Addressing this problem on a wide scale is necessary for the switch from a linear to a circular economy within the Netherlands.

For this study only the selected sections of chapter 11 of Pires et al. (2018) will be translated, as this part addresses the application of LCA in waste management. However, the complete work may be of interest for Dutch policymakers, as the management of waste continues to be placed higher on the Dutch political agenda. This is reflected in agreements with organizations as well, e.g. the Plastic Pact NL between the Dutch Ministry of Infrastructure and Water Management and 75 Dutch companies, aimed at closing the loop of fast moving consumer goods made of plastic ("Bijlage 1 Plastic Pact NL Koplopers gaan voor méér met minder plactic in de circulaire economie | Brief | Rijksoverheid," 2019). Consequently, in the future, the Dutch government may commission the translation of larger parts of Pires et al. (2018).

The Dutch target text is aimed at Dutch policy makers within and outside governmental institutions. However, possibly other audiences may be interested in the translation as well, e.g. companies, scientists, academics, and students.

3.5 Translation strategy

First, Nord's objective concerning target texts is addressed. Subsequently, this is related to the target-text audience and translation strategies.

According to Nord (2006), in traditional translation approaches, the source text was usually regarded as the most important, as target texts where merely seen as a reproduction of

a source text in another language. Nord (2006) describes that in modern approaches the starting point for a translation is more dynamic, as the intended audience and target-language culture are taken into consideration as well. Nord suggests a prospective view of translation in which translations are focused on a specific communicative goal. The target audience should be the focal point according to Nord (2006), as their needs and expectations should be met to achieve a particular communicative purpose. The translator acts as the connection between the senders of the source text and the receivers of the target text, as they belong to different cultural groups caused by the difference in language (Nord, 2006). However, the work of the translator can be mediated through the intention of the party that initiated the translation (Christiane Nord, 2006)

As stated in section 3.4 the intended Dutch target audience are Dutch policymakers within and outside the Dutch government. Thus, there is no significant difference between the target-text audience and the source-text audience, whereas the source text is aimed at experts, "those who work in the scientific field of waste management" and initiates, i.e. "practitioners in the backgrounds of waste collection" and "graduate students" (Pires, Martinho, Rodrigues, & Gomes, 2018, vi). The Dutch policy makers that the target text is aimed at are practitioners working in the domain of waste collection and, in an integrated way, in the entire domain of waste management. As a result, no changes need to be made based on the target audience.

The similarity in source-text audience and target-text audience also accounts for the translational strategy regarding the register of the source-text. The register of the source text does not need to be altered, whereas the target-text audience is similar to the source-text audience. In addition, the communicative purpose is similar as well: to introduce relevant information within a scientific context.

As stated, Nord (2006) refers to the mediation of the translation by the party that intended the translation. In this study, the Dutch government commissions the translation as it is inclined to inform their employees of the advantages of LCA for waste management. For

their communicative goals it is of importance to produce a clear, unambiguous target text. Thus, the source text will not be translated word-for-word as the overall importance of producing a clear target text is valued higher than producing a truthful reflection of the source text.

Considering that the two communicative settings of expert-to-expert and expert-to-initiates as described by Pearson (1998) still apply to the target text, the use of terminology should be preserved. To maintain the use of terminology in the target text, the source-text terms should be identified and researched regarding definitions and target-language equivalents. As stated earlier, translators often manage terminology ad hoc. However, for this study, terminology will be studied in a systematic manner to thoroughly check if the IATE database is suited as terminology resource for texts from the domain of LCA and Waste Management.

In the next chapter this study's method is discussed.

4. Method

This chapter will address the methodology used in this research and consists of three sections. The first section focusses on source-text terminology and is discussed in section 4.1. This section will cover both a discussion of automatic term extraction and the selection of a term extraction tool. Next, this section will introduce an annotation scheme by Rigouts Terryn, Hoste and Lefever (2018) that will be used to differentiate between words and terms. Furthermore, this section discusses the decision-making process regarding the adding of terms from beyond the term extraction tool and addresses cross-referencing source-text terms with the IATE database. The second section of this method concentrates on selecting a sample of the terms not (sufficiently) represented in the IATE database for which term fiches will be constructed. To draw a sample from all terms not represented in IATE a domain-relevant corpus will be constructed to cross-reference these terms with, and for terms occurring on both lists (that thus prove to be of relevance to multiple texts from the two domains) term fiches will be made. The third and last section focusses on the source-text translation and discusses the CAT-tool selection and Term Base construction.

4.1 Source-text terminology: extraction, tool selection, labelling, adding, and IATE check

The practice of terminology extraction, also known as terminology mining, is relatively new. A sudden demand for automatic term extraction emerged in the late 80's, and in the following decade the first steps were taken in the development of relevant computer programs and digital corpora (Cabré i Castellví, Estopà, & Vivaldi Palatresi, 2001). Since then, the development of software tools fit for automatic term extraction from a single source text or from corpora has been the focus of research (Inkpen, Faez, Amjadian, Paribakht, & Amjadian, 2016). These tools extract terms based on a system that is linguistical, statistical, or a hybrid of both (Cabré i Castellví et al., 2001). According to Bowker and Pearson (2002), possible pitfalls

of linguistic term extraction tools are caused by the focus on a single language and by the design in which specific lexical patterns are seen as more likely to be a term, which may exclude other patterns. They continue to discuss statistical tools, which use parallel corpora to compare word frequency, however, this may lead to the extraction of single words and multi-word groups that do not qualify as terms but are merely frequently repeated (Bowker & Pearson, 2002). Words that are unjustifiably extracted from a text or corpus by a tool are labelled *noise* (Bowker & Pearson, 2002). The opposite occurs as well: terms are overlooked by statistical extraction tools because of their low frequency, this is labelled *silence* (Bowker & Pearson, 2002). By using a hybrid extraction tool, the pitfalls associated with linguistic and statistical tools can be avoided. Hence, for this study, a hybrid term extraction tool should be chosen. In addition to this criterium of a hybrid tool, the selected tool should be freely accessible, since this will positively affect practicality.

TermoStat was chosen to extract candidate terms from the source text. This free-access online software uses a mixed method of statistical and linguistic analysis to calculate the relative frequency of words or word combinations in comparison with parallel corpora (Drouin, 2003). Drouin constructed this tool and used a threshold of +3.09 for specificity, "which means that the probability of finding the observed frequency is less than 1/1 000." (Drouin, 2003, p. 102). TermoStat's output consists of a list of candidate terms alongside additional information about their frequency, specificity, the variants occurring in the source text and word type (Drouin, 2003). The entirety of the selected source-text fragment formed the input for this study, i.e. chapter 11 from the title up to and including paragraph 11.1.5 and including text from figures and tables.

The output of a term extraction tool merely consists of candidate terms. Subsequently, each item on the candidate term list "must be verified by a human terminologist or translator" (Bowker & Delsey, 2016, p. 80). Hence, the process is guided by computer as well as by human,

which means that what is labelled as automatic term extraction is in fact semi-automatic or computer-aided (Bowker & Delsey, 2016, p. 80).

The distinction between terms and common words in TermoStat's output will be made according to the annotation scheme by Rigouts Terryn (2017) introduced in chapter 2. Based on the two parameters of lexicon-specificity and domain-specificity linguistic units are divided into four categories: Out-of-Domain Terms, Specific Terms, Common Terms and Not Terms. For this study the distinction between the three term labels and the *Not Terms* label is the most important. Candidate terms will only be divided into *Term* or *No Term,* as a general assessment is made to which extent IATE is suited to translate texts, including terminology, from the domain of LCA and Waste Management.

All candidate terms extracted with TermoStat will be assessed on whether they are a term by scoring the candidates on the parameters of lexicon and domain. When a candidate term is either lexicon or domain-specific, or both, it is labeled *Term,* if the candidate term does not score on one of the two parameters it is labeled *No Term*. Rigouts Terryn (2017) agrees with Bowker & Pearson (2002) that terms can consist of one or multiple words and adds to this that if part of the multi-word term is a shorter term on its own, that should be annotated as a term as well.

The candidate terms labelled *No Term* constitute the *noise* in the term extraction. After the labelling phase the *precision* of the term extraction tool can be calculated, i.e. the amount of terms in proportion to all retrieved candidate terms (H. Chen, Fuller, Friedman, & Hersh, 2005).

After using the annotation scheme to remove candidate terms from the term list, a test will be performed to determine whether source-text terms were ignored by the extraction tool. During this process, multiple sources will be used assess if terms beyond the extracted candidate terms should be added to construct a complete list of all source-text terms. Reference works

such as glossaries related to LCA, terminology databases as IATE, and other scientific books or articles about LCA and/or waste can be used to both instigate the addition of a term or to assess whether a word or multi-word combination from the source text is used more often in this domain and may actually be a term. After adding relevant terms, the *recall*, i.e. the amount of terms that were retrieved in proportion to all terms that occur within the source text (H. Chen et al., 2005), of the term extraction tool will be calculated.

In the following phase the total list of terms will be cross-referenced with the IATE database. The goal is to obtain a translation for each identified English term in the target language. All entries for source-text terms will be analyzed, and a record will be kept of the relevant Dutch equivalent terms retrieved from IATE. This record will include data on IATE ID-numbers, domains and the reason for selecting that specific entry. Lastly, an example will be used to reflect decision-making factors for single entries that include multiple Dutch terms referring to the same concept.

4.2 Selection for term fiches: term fiches, corpus tool selection and corpus construction

If in the results from the previous phases terms are encountered that are not, or insufficiently, represented in IATE, term fiches will be constructed to propose new entries in IATE. In this section, the term fiche form is discussed that will be used. If the number of terms that need to be added to IATE is beyond the scope of this research, only a single sample will be discussed, and this sample will be drawn through cross-referencing to a term extraction list from a parallel corpus. Thus, in this section, a combined corpus and term extraction tool will be introduced as well, and these will be used to create a parallel corpus of academic texts from same domain of the source text.

A term fiche is a form based on which different types of information about a concept and terms referring to this concept can be collected and subsequently stored in a systematic

manner. In this study, the template supplied by Ghent University is used, (see: appendix A). This term fiche is constructed out of three different levels. The first level is language independent, it covers the domain specification and cross-references to other IATE entries, and this level is only used once in every entry. In the cross-reference section the relationship between terms is stated first, contributing to a more ontological structure in which relations between terms are reflected, and then the IATE ID is provided followed by the entry name in italics. For proposed entries that are related to terms that are not included in IATE (yet) or that are included in IATE but not within the domain of Environment leading to differences in meaning, ###### will be used instead of an IATE ID number. The second level of the term fiche is language specific and its main focus is defining a term in a specific language. The third level provides information about a single term (in a specific language) which includes reliability, a term reference from a European Union text and contextual references.

In order to draw a sample from the terms that are not (sufficiently) represented by IATE, a corpus will be used to cross-reference them with. Sketch Engine will be used, because this tool is freely accessible online (with a 30-day trial), and can be used to construct a corpus as well as extract candidate terms from that corpus with the incorporated statistical extractor ("Sketch Engine | language corpus management and query system," n.d.). In addition, the software is user friendly, as it is possible to upload articles in pdf format, from which the tool obtains the text.

With the online version of Sketch Engine, a new corpus will be constructed containing 20 academic texts on LCA and waste, amounting to a total of over 170.000 words. The corpus will include the following texts (in alphabetical order): Abduli, Naghib, Yonesi, & Akbari, 2011; Bartolozzi, Baldereschi, Daddi, & Iraldo, 2018; Bernstad & La Cour Jansen, 2012; Blengini, Busto, Fantoni, & Fino, 2012; Bovea, Ibáñez-Forés, Gallardo, & Colomer-Mendoza, 2010; Buttol et al., 2007; Cherubini et al., 2009; Clavreul, Guyonnet, & Christensen, 2012;

Cleary, 2009; den Boer, den Boer, & Jager, 2007; Erses Yay, 2015; Haupt, Kägi, & Hellweg, 2018; Heijungs & Guinée, 2007; Laurent et al., 2014; Liamsanguan & Gheewala, 2008; Parkes, Lettieri, & Bogle, 2015; Reich, 2005; Ripa, Fiorentino, Vacca, & Ulgiati, 2017; Rives, Rieradevall, & Gabarrell, 2010; Yadav & Samadder, 2018. The texts are obtained through Google Scholar queries with the search entries "LCA" + "waste", while logged in at the Utrecht University, and through links to article suggestions on the same topic.

After constructing the corpus, Sketch Engine will be used for term extraction and single-words and multi-word candidate term lists were generated, i.e. extractions containing only one or multiple words. The extracted data will represent the frequency of the word or word combination within the constructed corpus in relation to the frequency within the reference corpus from Sketch Engine. The terms that are not (sufficiently) represented in IATE will then be cross-referenced with this list and term fiches will only be made for terms that appear on both lists, as these terms are of importance for LCA within Waste Management. If there is a need for newly proposed IATE entries, these will be discussed in chapter 6.

4.3 Source-text translation: CAT-tool selection and Term Base construction

The translation of the selected source-text fragment will be performed in a CAT tool. CAT tools are Computer Aided Translation tools that support professional translators by speeding up the translation process and thus making it possible to translate larger texts within a specific time frame (Zaretskaya, 2016). Translators can choose from a wide selection of available CAT tools, as well as a wide selection of features that can be used within the interface of the selected tools, such as machine translations, translation memories and term bases.

For this study, the web browser version of Memsource will be used, as it is user-friendly, all important features are included, and an account could be obtained through the

Universiteit Utrecht (Zaretskaya, 2016). Memsource has a horizontal layout in which source-text sentences are displayed on the left, and for each source-text sentence an empty bar is displayed on the right side of the page in which the translated target-language sentence can be entered. The source text will be translated by a human translator, as this study's focus is to investigate the usefulness of the IATE database, and not that of machine translations or translation memories. Within the European Union, texts are translated in CAT tools with activated translation machines. The IATE database is connected to the interface and term translations automatically appear when source-texts terms are represented by entries in IATE. Within this study there was no access to this system, thus, the source text was translated by a human translator with the use of the IATE database through its web version.

One of the features of CAT tools is the possibility to construct or insert a termbase. During the translation process, a bilingual termbase will be constructed consisting of domain-specific English source-text terms and their corresponding Dutch target-language equivalent, with the aim of ensuring consistency in term translation (Melby, 2012). All terms will be added to this termbase, terms that are already represented in IATE and terms that are not. The termbase will be included in the external appendix *Termbase Memsource*.

5. Results

This chapter addresses the results of the term extraction and the evaluation of the candidate terms. The first section discusses the automatic term extraction by TermoStat and in the second section candidate terms are labelled *Term* or *No Term* using the annotation scheme of Rigouts Terryn et al. (2018). In the third section, source-text terms not included in TermoStat's output will be added, and section 4 cross-references source-text terms with entries in IATE. The last section discusses the assessment of entries containing multiple target-language translations with respect to appropriateness and text internal coherence.

5.1 Extracted terms

The external appendix *TermoStat Extraction* provides TermoStat's output containing 392 candidate terms and additional information about these terms, such as word type and frequency. Figure 6 offers a visual representation of the candidate terms in the source text through a word cloud extracted from TermoStat. A word cloud is a statistical tool that represents the relative frequency of words within a text by font size (Heimerl, Lohmann, Lange, & Ertl, 2014). According to Heimerl et al. (2014), visual representations of words related to their frequency in word clouds "are used to give an intuitive and visually overview of a text", e.g. to give a text summarization (p. 1833). The word cloud in figure 6 does not represent the frequency of all words within the source text, but the frequency of all candidate terms identified by TermoStat. However, it can be used to provide an overview of the source text's terminology.

As stated earlier, the TermoStat extraction tool only identifies candidate terms. Whether the candidate terms are actual terms should be evaluated by human intervention. In the next section the term extraction output will be evaluated according to the annotation scheme by Rigouts Terryn et al. (2018).

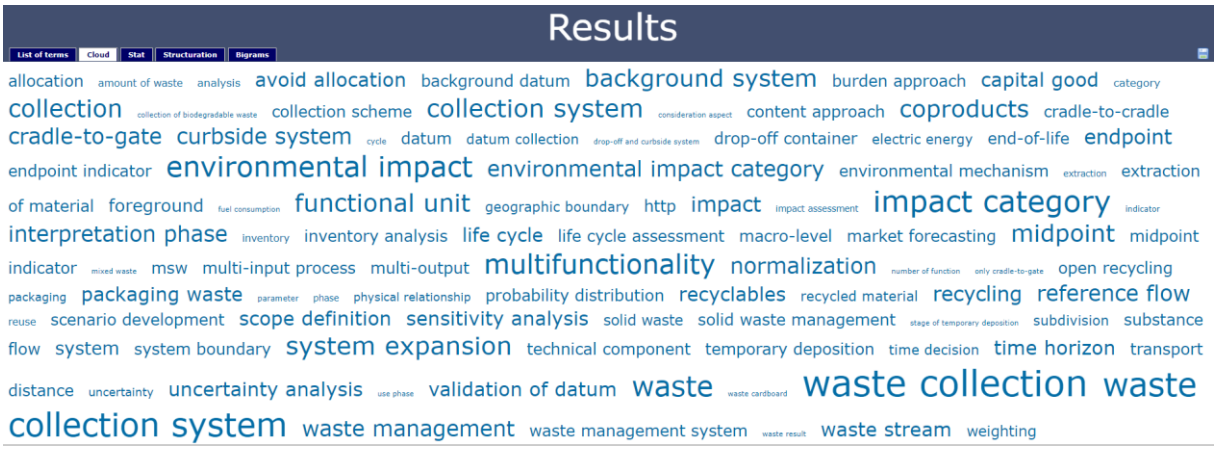


Figure 6. Word cloud of candidate terms extracted with TermoStat, with size reflecting frequency

5.2 Term labelling

The 392 candidate terms were reviewed by a human translator and the decision-making process was guided by the annotation scheme developed by Rigouts Terryn et al. (2018). Candidate terms that were not terms, i.e. that did not score on one of the two parameters of lexicon-specificity and domain-specificity, were labelled *No Term.* These candidate terms were subsequently removed from the definitive term list and excluded from further analysis. Candidate terms that scored on one of the parameters or on both, were labeled *Term.* Examples are provided in table 1 for a small sample of candidate terms, i.e. the first candidate term for every letter of the alphabet.

142 candidate terms were labelled *Term,* (see: external appendix *Labelling Annotation Scheme*). 250 of the 392 candidate terms were labelled *No Term* at this stage, including single words as *background*, *destination*, *europa* and *referent*, and multi-word combinations such as *abstract today*, *approach attributional datum*, *approach physical perspective socioeconomic perspective*, *only cradle-to-gate* and *understanding of nature*. Nonwords such as *nrel* and parts of URLs as *http* were also labelled *No Term*.

Table 1

Sample of labelling candidate terms

Candidate term	Parameters		Labels	
	Lexicon-specific	Domain-specific	Term	No Term
abstract today				×
background				×
capital good		×	×	
damage				×
e.g. engine				×
final disposal		×	×	
gate-togate*				×
heterogeneous waste stream				×
impact		×	×	
jrc				×
large number of time				×
macro-level	×		×	
national and international plan				×
only cradle-to-gate				×
packaging		×	×	
quality of material source				×
raw material		×	×	
scenario	×		×	
technical component				×
uncertain parameter				×
validation of datum				×
waste		×	×	

*labelled no term due to spelling error ("gate-to-gate" was added, see section 5.3)

The 250 candidate terms labelled *No Term* constitute the *noise* in the term extraction. The precision of the tool can be calculated by dividing the amount of relevant retrieved items, i.e. the terms, by the total amount of retrieved items, i.e. all candidate terms (H. Chen et al., 2005). The precision of TermoStat for the source-text fragment in this study is 0.36 (or 36.2%).

5.3 Added terms

This section discusses the source-text terms that TermoStat did not include in the extraction and that should be added to this study. For the addition of terms, it is important to identify terms recursively. Rigouts Terryn (2017) describes that terms may overlap, and that

both the larger and smaller term should be identified. For this, all candidate terms from TermoStat are used. However, for all additions it is recorded whether they are based on a term or merely on a candidate term.

The first category of added terms is based on multi-word terms that were checked for reduced variants. In agreement with TermoStat's extraction, reduced variants that only occur in the source text as part of a larger term will also be added. For example, the term *waste recycling system* led to the shorter term of *waste recycling*, and the candidate term *level of source separation,* that was labelled *No Term,* led to the term *source separation.* Other reduced terms based on other (candidate) terms are represented in table 2.

Table 2

Added reduced terms derived from multiword (candidate) terms

	Terms	Added reduced terms
1	integrated waste management system	integrated waste management
2	resource overexploitation	overexploitation
3	selective collection service	selective collection
4	upstream environmental impact	upstream
5	waste compaction rate	waste compaction
6	waste recycling system	waste recycling
	Candidate terms	Reduced derived terms
7	type of decision-making process	decision-making process
8	heterogeneous waste stream	heterogeneous waste
9	level at source separation	source separation
10	micro-level decision	micro-level
11	product life cycle phase	product life cycle
12	quantification of material	quantification
13	theoretical recovery	recovery
14	useful life of device	useful life
15	validation of datum	validation
16	waste fraction distribution	waste fraction

The second category of added terms are expanded variants. Most of these two-or-more word combination terms were obtained by examination of the direct context of candidate terms in the source text. For example, the candidate term *burden approach* only occurs in the source text preceded by *avoided*. Whereas the candidate term *burden approach* was labelled *No Term,* the expanded term *avoided burden approach* is a term used in the relevant domain. The term

life cycle led to multiple expanded variants.

Table 3

Added expanded terms based on (candidate) terms

	Terms	Added expanded terms
1	life cycle	life cycle costing
2	life cycle	life cycle impact assessment
3	life cycle	life cycle inventory (LCI)
4	container	waste container
	Candidate terms	Added expanded terms
5	burden approach	avoided burden approach
6	burden assumption	zero burden assumption

Furthermore, terms were added based on candidate terms including spelling errors (see: table 4). Technically, these terms were merely corrected. The spelling errors are not caused by the extraction but originate from the source text. Included in this category is *mixed collection,* which in the source text was referred to as *mix collection.* However, *mix collection* is not the standardized term as *mixed collection* is used in other academic texts from the same domain (Baltes, Draghici, Manea, Ceausescu, & Tierean, 2009; Janz, Günther, & Bilitewski, 2011). In addition, *mixed collection* is used in chapter 16 of the same book of which the source-text fragment was derived from (Pires et al., 2018, pp. 313-314).

Table 4

Terms added due to spelling errors in candidate terms

	Candidate terms	Added terms
1	coproduct	co-product*
2	cutoff approach	cut-off approach
3	cutoff method	cut-off method
4	gate-togate	gate-to-gate
5	mix collection	mixed collection

*****Yields over 4 million results in Google, whereas *coproduct* yields below 350.000 results.

The TermoStat software renders candidate terms in the singular form. However, some terms are only used in plural, such as *goods* and *data* of which no singular exists. Other addition in this category are provided in table 5.

Table 5

Terms added due to non-existing singular candidate term

	Candidate term	Added plural variant
1	consumption of resource	consumption of resources
2	good	goods
3	primary datum	primary data
4	secondary datum	secondary data

The last category of added terms consists of source-text terms identified through association (see: table 6). Most additions in this category were based on multiple (candidate) terms. *Landfill* is related to *temporary deposition of waste,* as waste can be temporarily stored in a *landfill,* waste can also be stored in a landfill indefinitely, referred to by *final disposal,* and a less land-consuming method of disposal is *incineration* (Jones, Geysen, Rossy, & Bienge, 2010).

Table 6

Added terms related to candidate terms

	Terms	Added associated terms
1	biogas; solid waste; mixed waste	biodegradable waste
2	cradle-to-cradle; cradle-to-gate	cradle-to-grave
3	solid waste; mixed waste	organic waste
4	temporary deposition of waste; final disposal; incineration	landfill
5	secondary metal	primary metal
6	uncertainty analysis	uncertainty propagation*
7	uncertainty analysis	Monte Carlo simulation
8	waste cardboard	waste paper
	Candidate terms	Added associated terms
9	attributional type	attributional LCA
10	collection scheme; collection system	collection service
11	consequential analysis; consequential type	consequential LCA
12	logistic case	reverse logistics

*****Source text contained *propagation.* However, *uncertainty propagation* is standardized term.

In this section, 43 terms (see: external appendix *Added Terms*) were added to the terms extracted with TermoStat. Thus, the source text contains a total of 185 terms. The 43 added terms constitute the *silence,* i.e. the terms that the term extraction tool did not extract, though there were included in the source text (Chen et al., 2005). By calculating the proportion of the

retrieved terms in relation to all source-text terms, the *recall* of the term extraction tool can be calculated (Chen et al., 2005). The *recall* for TermoStat in this study is 0.77 (or 76.8%). This illustrates that it is insufficient to rely solely on the candidate terms that are automatically extracted by TermoStat.

The total list of terms is provided in the table in the external appendix *ST Terms Total*. As of now, this study will focus entirely on the applicability of IATE for the source-text terms, since it is this study's main objective to assess the suitability of IATE for target-language term equivalents of terms from the domains of LCA and Waste Management. The next section discusses whether the source-text terms are represented by entries in IATE. In addition, the implications of multiple entries on the same concept or multiple terms within entries will be addressed.

5.4 Cross-referencing terms with IATE

In this section, the 185 source-text terms are cross-referenced with the IATE database. As described in this study's method, search queries are performed based on the English source language and Dutch target language. Dutch term equivalents are only recorded for use in the translation phase if the term in the entry is similar to the source-text term. Expanded or reduced variants are not accepted as such, e.g. *theoretical recovery of head* is not accepted for *theoretical recovery* nor is *allocation* for *economic allocation*, as these differences may lead to differences in definition and applicability.

Search queries are performed in all domains of the database, as to increase the chance of retrieving a relevant entry. For most terms, the domain of Environment and its subdomains are favored, as various terms are derived from this subject field. However, if entries from other domains provide more relevant term definitions, they are used instead. For *impact assessment*, entry 929089 from the domains of Politics and European Law is used, since entry 47082 from

the domain of Environment contains six less relevant Dutch translations (see table 7 below)(“IATE - Entry ID 47082,” n.d.; “IATE - Entry ID 929089,” n.d.). Some terms are derived from the general domain of science, such as *uncertainty* and *weighting*. These terms are often represented by entries in (sub)domains used by multiple scientific disciplines, such as Statistics.

Table 7

Entries for impact assessment in IATE

IATE ID	Domain	Dutch translation
47082	Environment	de evaluatie van het effect van; de evaluatie van de uitwerking van; het inschatten van het effect van; het inschatten van de uitwerking van; de evaluatie van de weerslag van; het inschatten van het effect van iets
929089	Politics; European Union Law	effectbeoordeling

For most terms, several entries were available on the same concept. This conflicts with IATE’s statements concerning *one concept in one entry* and *one entry about one concept* (*IATE Handbook - Europa EU*, 2018). In external appendix *Term Translations IATE*, arguments for using specific entries are provided. Frequently used reasons are domain relevancy and definition relevancy. When the chosen entry included more than one term, the most relevant term within that entry had to be chosen as well. The decision-making process concerning multiple terms within one entry will be discussed in the next paragraph.

For 60 source-text terms there was a relevant entry in IATE containing one target-language term equivalent. For 42 source-text terms there were relevant entries as well, though these entries included more than one Dutch term translation. If a single entry contains multiple term translations, the translator must choose the most appropriate translation. The arguments regarding the selection of a specific term equivalent are provided in the external appendix *Term Translation IATE*. The three most frequently used reasons will now be illustrated using

examples.

For entries including multiple source-language and target-language terms, the word order and contents of the source-text term are compared with target-language terms. For instance, for the query regarding *waste recycling* entry 830978 was chosen ("IATE - Entry ID 830978," n.d.). This entry includes three terms in the English term level and three in the Dutch term level (see figure 7). The English term *recycling* can be matched to the Dutch term equivalent of *recycling,* because both contain a single noun. To *waste recycling* the Dutch *afvalrecycling* is matched, because the English term contains two nouns that are reflected in the Dutch compound. The third term included in this entry illustrates the importance of word order. The contents of *recycling of waste* are similar to *waste recycling,* though due to word there is a stronger equivalence between *waste recycling* and *afvalrecycling* than between *waste recycling* and *recycling of afvalstoffen.* It should be highlighted that both *afval* and *afvalstoffen* are used as equivalent for *waste.* This is discussed further in the next example regarding text internal coherence.

As stated earlier, consistency regarding terms is of high importance. Source-text terms are consistently translated with the same target-language term equivalent. However, consistency between terms containing the same component must be considered as well. *Waste* is frequently used in multi-word source-text terms. To ensure text internal coherence, this component should be translated consistently in all multi-word source-text term translations.

18 source-text terms containing *waste* are represented by entries (see table 8). A*fval, afvalstoffen, vuil* and *vuilnis* are most frequently included in the Dutch term levels of these entries. In the source text there is less variation, as only *waste* is used and not *refuse* or *garbage* (Pires, Martinho, Rodrigues, & Gomes, 2018a) To preserve the text internal coherence regarding terminology, *waste* should be translated consistently in the various terms. Subsequently, it was assessed which Dutch term equivalent was the most appropriate.

Figure 7. IATE entry 830978 containing multiple English and Dutch term levels ("IATE - Entry ID 830978," n.d.)

The entry for *biodegradable waste* is the only entry containing *waste* that solely holds the translation *afvalstoffen*, all other entries include *afval* or both *afval* and *afvalstoffen* ("IATE - Entry ID 919405," n.d.). In addition, most Dutch term translations including *afval* yield more results in Google than similar terms including *afvalstoffen*, e.g. *biologisch afbreekbare afvalstoffen* yields 1.200 results in Google and *biologisch afbreekbaar afval* 7.280. Thus, it was determined that *waste* will be translated with *afval.* The use of *afval* is also extended to the entry for *waste compaction*. Though *afval* is not included in the Dutch term equivalents within this entry, the use of *afval* is appropriate as it supports text internal coherence and *afvalverdichting* is also used in *ZEVENDE JAARVERSLAG over de STRUCTUURFONDSEN* (CELEX:51996DC0502). The only exception to this cluster is *waste collection vehicle* which must be translated with *vuilniswagen* as this is the most idiomatic in the target language. *Vuilniswagen* also yields the most results in Google and Google Scholar in comparison with the Dutch term equivalents provided in entry 1427362 (see: table 9) ("IATE - Entry ID 1427362," n.d.).

As there is no official guideline regarding the use of *afval* versus *afvalstoffen*, the IATE database should include both in all terms containing *waste* to represent the dynamic translation Kerremans (2019) describes. However, for the target text the main objective is text internal coherence and as a result dynamic translation of *waste* or other terms will not be applied.

Table 8

Cluster of terms containing waste

	IATE ID	Terms in entry*	Dutch Translations
1	919405	biodegradable waste	biologisch afbreekbare afvalstoffen
2	1427097	mixed waste	gemengd afval
3	48005	organic waste	organisch afval
4	48055	packaging waste	verpakkingsafval
5	1427137	solid waste	vast afval; vaste afvalstoffen
6	1390591	solid waste management	beheer van vast afval; beheer van vaste afvalstoffen
7	3535256	waste	afval; afvalstoffen
8	1108181	rubbish bin; **waste bin**	vuilnisemmer; vuilnisvat; afvalbak; afvalemmer
9	49643	waste collection	afvalinzameling
10	1427362	refuse collection vehicle; collection vehicle; **waste collection vehicle**; garbage truck	vuilnisauto; vuilniskar; vuilnisophaalauto
11	1108203	**waste compaction**; compaction of waste	vuilverdichting; verdichting van het afval; vuil verdichten
12	49646	waste composition	samenstelling van het afval
13	1427046	waste container	afvalcontainer; vuilniscontainer; vuilcontainer
14	919490	fraction of waste; **waste fraction**	afvalfractie
15	1427050	waste management	afvalbeheer; afvalstoffenbeheer
16	134311	waste paper	oud papier; papierafval
17	830978	recycling; waste recycling; recycling of waste	recycling; afvalrecycling; recycling van afvalstoffen
18	872353	waste stream; waste flow	afvalstroom

*Source-text term in bold in case of multiple source language terms in entry

Table 9

Frequencies of translations of "waste collection vehicle"

	Google	Google Scholar
vuilnisauto	85.600	60
vuilniskar*	27.800	56
vuilnisophaalauto	47	1
vuilniswagen	430.000	252

*****Used in region of Flanders

For the third category the most appropriate Dutch term equivalent had to be verified using external sources. The entry for *anaerobic digestion* includes multiple English and Dutch terms (see figure 8) ("IATE - Entry ID 1493573," n.d.). In the decision-making process regarding this terms and similar cases, EUR-Lex was used. In EUR-Lex, e.g. Directive (EU) 2018/2001 (CELEX:32018L2001), *anaerobe vergisting* is used as Dutch term translation for *anaerobic digestion.* Based on this, *anaerobe vergisting* will be used in the target text.

IATE contains relevant entries including a relevant Dutch term equivalent for 102 source-text terms (see: external appendix *Term Translations IATE)*. The Dutch term equivalents obtained from these entries will be used in the source-text translation and will be included in the termbase in Memsource. 7 terms yielded entries in IATE, but they were not sufficiently represented as will be argued in the next paragraph.

For 7 terms represented in IATE, the entries were assessed insufficient (see: table 11) The entries for *electricity grid* and *waste management system* do not provide relevant Dutch terms, as there is no equivalence between the English and the Dutch term. For *electricity grid* the entry provides *geïntegreerd distributiesysteem* as translation, though this is a broader concept than *electricity grid* and thus, there is no standardized equivalence between the two terms ("IATE - Entry ID 1681070," n.d.). The two terms do not necessarily refer to the same concept as *geïntegreerd distributiesysteem* is not solely used to with respect to electrical energy. The translation provided possibly originates from a direct translation of the contextual

Figure 8. IATE entry 1493574 containing multiple English and Dutch term levels ("IATE - Entry ID 1493574," n.d.)

reference: "An **electrical grid** is an interconnected network for delivering electricity…", consisting of "…distribution lines that connect individual customers." ("IATE - Entry ID 1681070," n.d.). In the entry for *waste management system* in the domain of Environment, the translation of *afvalvergaring* is provided ("IATE - Entry ID 293104," n.d.). The English term denotes a system in which waste is managed, whereas the Dutch translation neglects to incorporate these aspects. Furthermore, the English term is the hypernym of the Dutch *afvalvergaring*, since the collection of waste is only a part of the waste management system. The Dutch translation of *inzameling* is preferred over *vergaring*, due to idiomaticness and higher amounts of results yielded in Google.

Table 11

IATE entries for source-text terms valued as insufficient

	Term	IATE ID	Domain	Translation
1	electricity grid	1681070	Electronics and electrical engineering	geïntegreerd distributiesysteem
2	cut-off method	1119809	Earth sciences	cut-offmethode
		1568814	Statistics; Science	verkorte methode
3	endpoint	930980*	Pharmaceutical industry	eindpunt
		951260**	Chemistry	omslagpunt; eindpunt van de titratie; equivalentiepunt
		3570056***	Medical science	eindpunt
		3535202****	Chemistry	eindpunt
4	impact	50323	Pharmaceutical industry; Environment	invloed
5	uncertainty propagation	1609441*****	Electronics and electrical engineering	propagatie-onzekerheid
6	unit process	1397307	Chemical compound	unit process
7	waste management system	293104	Environment	afvalvergaring

*****definition: "a stage used in a clinical trial to mark the withdrawal of the entity from the trial"
** definition: "the point in the titration once the equivalence point has been reached, indicated by some form of indicator which varies depending on the type of titration being done"
******* definition: "physical or chemical outcome that can be assessed by a test"
**** definition: "An observable or measurable inherent property of a chemical substance. It can for example refer to a physical-chemical property like vapour pressure or to degradability or a biological effect that a given substance has on human health or the environment, e.g. carcinogenicity, irritation, aquatic toxicity."
***** concept is for *propagation uncertainty*, not for *uncertainty propagation*

In contrast to the two previous terms, the translation included in the entry for *unit process* does not seem to be a translation at all. In the Dutch term *process* still ends with -ss, though the Dutch word *proces* is spelled differently ("IATE - Entry ID 1397307," n.d.). In addition, the used word ending is not commonly used in Dutch and seems to be transferred directly from the English term.

The Dutch translation included in the entry for *cutoff method* is adapted further to the Dutch target language than the translation for *unit process*, but it still not useful ("IATE - Entry ID 1119809," n.d.). Whereas *method* is altered to its Dutch equivalent of *methode*, the entry is

located in the domain of Earth Sciences and contains no definition or contextual references. In addition, the term reference mentioned cannot be found to check the term's context. IATE also contains an entry for *cut-off method*. However, this entry is insufficient as well, since no definition is included and the entry is located in domains that are most likely irrelevant to the source-text term ("IATE - Entry ID 1568814," n.d.). Within the domain of Economics *cut-off method,* and its Dutch equivalent *verkorte methode,* refers to a different concept (Traas, 2000)

The entries for the term *endpoint* provided (see: table 11) are insufficient because of contextual differences. In the source text, *endpoint* refers to the highest level of aggregation of environmental impacts scored on three indicators: "damage to human health", "damage to ecosystems" and "damage to resource availability" ("LCIA: the ReCiPe model | RIVM," 2011). The current entries cannot be used, since the definitions of these terms refers to other concepts.

For *impact* there are currently seven different entries in IATE. Table 11 contains the most relevant entry (due to its inclusion in domain of Environment). However, *impact assessment* should be translated to Dutch with *effectbeoordeling* ("IATE - Entry ID 929089," n.d.) Consequently, entry 50323 in IATE is valued as insufficient, because only *invloed* is provided as translation for *impact* which makes text internal consistency regarding the translation of *impact* impossible.

For *impact* there are currently seven different entries in IATE. Table 11 contains the most relevant entry (due to its inclusion in domain of Environment). In entry 50323 only *invloed* is included as Dutch equivalent for *impact.* However, *impact assessment* should referred to in Dutch with *effectbeoordeling* ("IATE - Entry ID 929089," n.d.). Consequently, entry 50323 in IATE is valued as insufficient, as this would influence text internal consistency regarding the translation of *impact.* Other entries containing impact provide both *effect* and *invloed* are provided as Dutch term equivalents for *impact* ("IATE - Entry ID 795327," n.d.). In addition, no definitions or contextual references are included in entry 50323.

Entry 1609441 contains *propagation uncertainty* and the Dutch term equivalent *propagatie-onzekerheid* ("IATE - Entry ID 1609441," n.d.). Though *propagation uncertainty* may refer to the same phenomenon as *uncertainty propagation,* (the occurrence of uncertainty in a system caused by parameter uncertainty), the terms refer to different concepts as *uncertainty propagation* is a method to calculate the system's uncertainty (Clavreul et al., 2012).

To summarize, 7 term entries were excluded as they were insufficient with respect to the source-text terms. 76 source-text terms are not represented by an entry in IATE at all. Thus, for 83 source-text terms no Dutch term equivalents could be obtained in IATE. For most terms, new entries must be proposed. However, for a few terms, current entries must be altered to include the identified terms and/or Dutch term equivalents. For these term, new entries must not be made as this is in violation of the *one concept, one entry* objective of the database. Proposed additions and alterations to the IATE database will be discussed in the next chapter.

6. Proposals for IATE entries

For 83 source-text terms, IATE provides no (sufficient) entry. This chapter proposed entries to be recorded or altered in IATE. However, because of time and spatial limits only a selection will be addressed. In the first section of this chapter the selection procedure will be discussed, as a random sample will be selected based on a domain-relevant parallel corpus. In the following sections the selected terms are addressed. For each term the amount of results in four search engines will be presented: Google, Google Scholar (GS), Google Books (GB) and EUR-Lex. In all search queries terms are placed between double quotation marks to ensure only results for that exact query are generated, and when specifications are added, those are placed between quotation marks as well. For English terms the language is set to English, and for Dutch terms the language is set to Dutch to ensure that only language specific results are generated. For most terms, multiple variants of English and Dutch terms are taken into consideration. For each term, a term fiche is constructed (see: appendices B-T). Various aspects of terms, as described in section 2.2, are included in entries in IATE and thus, will be included in the term fiches. The template for the term fiches was supplied by Ghent University.

6.1 Selection of terms

As described in this study's method, a parallel corpus is constructed containing academic texts within the domain of LCA and Waste Management. From this corpus a single-word and multi-word term list is extracted. Both the corpus construction and the term extraction are performed with Sketch Engine. The 83 terms that are not or insufficiently represented in IATE are cross-referenced with the extracted lists. Of those 83 terms, 21 occurred in the term extractions. Thus 62 of the terms not represented in IATE did not occur in the corpus (or were not extracted by Sketch Engine). For this research it is not of importance why those terms did not occur in the constructed corpus, since the corpus was merely constructed to draw a sample.

However, for all source-text terms not included in IATE, a Dutch term equivalent should be obtained for the translation. How these equivalents were obtained for terms for which no term fiche will be made, will be discussed in section 6.20.

Table 12 contains a list of terms for which term fiches will be proposed. In addition, their frequency in the parallel corpus is provided. Terms will be addressed in order of this frequency list, except for clusters of terms containing *impact* and subsequently *waste management* for which terms will be discussed in successive sections. Three sections address two terms each. Arguments will be provided that within the source-text domain *impact category* and *environmental impact category* refer to the same concept, *uncertainty analysis* and *uncertainty propagation* will be argued to refer to the same concept as well, and *background system* and *foreground system* are discussed within one section because they complement each other, though different entries are proposed. Appendices B – T contain the corresponding term fiches.

Table 12

Terms not represented in IATE and cross-referenced with term extraction by Sketch Engine from LCA+Waste corpus and frequency within that corpus

	Term	Frequency
1	impact	893
2	waste management system	90
3	integrated waste management	48
4	impact category	43
5	source separation	25
6	uncertainty propagation	22
7	inventory analysis	18
8	system expansion	17
9	treatment process	14
10	midpoint	13
11	uncertainty analysis	13
12	unit process	10
13	waste cardboard	10
14	background system	9
15	foreground system	9
16	environmental burden	7
17	mixed collection	7
18	integrated waste management system	6

19	economic allocation	5
20	environmental impact category	4
21	raw material extraction	3

6.2 Impact

For *impact,* alterations to the current entry in IATE with ID-number 50323 are proposed, as it does not contain the most relevant Dutch term equivalent and no definitions nor contextual references (see: appendix B) ("IATE - Entry ID 50323," n.d.).

IATE entry 50323 contains *impact* within the domain of Environment and Pharmaceutical Industry, which is a subdomain of Health within Social Questions ("Browse by EuroVoc - EUR-Lex," n.d.). Within Pharmaceutical Industry, *impact* refers to influence of pharmaceuticals on the environment, e.g. Kasprzyk-Hordern, Dinsdale, & Guwy (2009) researched treatment of wastewater containing various pharmaceuticals. Within the domain of Environment, *impact* is used to denote human influence on the environment, e.g. emissions due to waste treatment (Tabasová, Kropáč, Kermes, Nemet, & Stehlík, 2012), and deforestation caused by war migration (Certini, Scalenghe, & Woods, 2013). Thus, in both domains *impact* is used to refer to a change to the environment caused by human interaction.

6.2.1 English

In the English language *impact* is used in multiple domains. In general language, *impact* functions as a word, e.g. it is both a noun and a verb. However, in specific domains *impact* functions as a term related to specific concepts. As stated, *impact* refers to human influence on nature within the domains of Environment and Pharmaceutical Industry. By the amount of results yielded by different search queries, it is reflected that *impact* is used beyond these domains. For *impact,* over 2 billion were yielded in Google, almost 6 million in Google Scholar, 121 million in Google Books and over 73.000 in EUR-Lex. I*mpact + environment* resulted in 600 million hits in Google, over 5 million in Google Scholar, over 30 million in Google Books

and almost 40.000 in EUR-Lex, and *impact + LCA* resulted in almost 9 million hits in Google, 225.000 results in Google Scholar, 159.000 in Google Books and 172 in EUR-Lex.

Table 13

Frequencies of "impact" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
impact	2.090.000.000	5.910.000	121.000.000	73.927
impact + environment	600.000.000	5.010.000	30.300.000	39.396
impact + LCA	8.910.000	225.000	159.000	172

The definition proposed reflects the causal relation between human activity and the environment, referring to the influence humankind has on nature ("Common glossary - ILCA," n.d.).

impact	changes to nature and the environment directly caused by human influence

The proposed definition for *impact* cannot be generalized over all domains, as the concepts it refers to may differ. For example, in the domain of Traffic Safety, *impact* refers to traffic accidents, e.g. the place were a vehicle comes into connect without another object (Kramlich, Langwieder, Lang, & Hell, 2002).

6.2.2 Dutch

In Dutch, both *effect* and *invloed* are used as equivalents for *impact.* However, in texts within EUR-Lex *impact* is translated with *effect* rather than *invloed*, whereas *affect* is used as equivalent for *invloed*, as in *DIRECTIVE 2011/92/EU* (CELEX:32011L0092). In EUR-Lex, *impact* is used as Dutch translation for the English word *effect*, e.g. *REGULATION (EU) 2019/1021* (CELEX:32019R1021), but also as equivalent of *impact* in English, such as in *DIRECTIVE (EU) 2015/2193* (CELEX:32015L2193). In table 14 frequencies of both *effect* and *impact* are included. For *effect*, more results are generated than for *impact* in all sources, though

for both entries the frequencies are distributed the same across the different search engines. For *effect* and *impact* most results are generated, followed by search queries including *milieu.* The lowest amounts of results are generated by *effect* and *impact* combined with *LCA.*

I*mpact* is also included in table 14. In *REGULATION (EU) No 1380/2013* (CELEX:32013R1380) about the Common Fisheries Policy, *impact* is translated in various ways, depending on context. When *impact* included in the multi-word term *environmental impact* this is translated with *milieueffect and* when *impact* refers to the English term, it is translated with *impact. Impact assessment* is translated with *effectbeoordeling,* and in other contexts *gevolg* is used as Dutch translation.

As both *effect* and *impact* are used in EUR-Lex and in other sources, as is represented by the frequency of these terms in combination with *milieu* and *LCA,* they are both included in the Dutch term level for the altered term fiche regarding *impact.* To ensure future consistency, domain experts could be consulted aimed at of labelling one as preferred.

Table 14

Frequencies of Dutch terms for "impact" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
effect	77.400.000	91.300	363.000	45.680
effect + milieu	5.080.000	33.700	18.800	16.847
effect + LCA	33.900	1.160	805	63
impact	31.000.000	57.400*	110.000	14.986
impact + milieu	4.370.000	23.400	8.210	7.081
impact + LCA	62.900	839*	538	42

* English texts or fragments are included in this number despite language being set to Dutch

The definition for the Dutch term equivalents is based on the English term definition.

effect; impact	verandering aan de natuur en het milieu direct veroorzaakt door menselijke invloed

6.3 Impact category & environmental impact category

In this section, the terms *impact category* and *environmental impact category* are discussed, as these terms are in practice interchangeable terms referring to the same concept within the domain of Environment. Both terms, in addition to *EF impact category*, are used for the same concept in academic literature, e.g. Pelletier, Allacker, Pant, & Manfredi (2014), as well as in texts within bodies of the European Union, e.g. *2013/179/EU: Commission Recommendation* (CELEX:32013H0179). This document of the European Union addresses the interchangeable use of *impact category* and *EF impact category* by stating that *impact category* is preferred according to ISO 14044 (2006), but that in the specific document *EF impact category* will be used. However, in *2013/179/EU: Commission Recommendation* (CELEX:32013H0179) both variants used to refer to the same concept. To meet the requirements of one entry for one concept in IATE, all three terms were included in one term fiche (see: appendix C). If *impact category* would be added in a domain other than Environment, *environmental impact category* and *EF impact category* should not be included automatically, whereas in other domains *impact category* refers to categories beyond environmental factors.

6.3.1 English

The frequencies of the English terms regarding this concept vary. *Impact category* yields 181.000 results in Google, over 23.000 in Google Scholar, over 34.000 in Google Books and 35 in EUR-LEX, *environmental impact category* yields 88.400 results in Google, over 2.300 in Google Scholar, over 8.7000 in Google Books, and 7 in EUR-Lex. *EF Impact Category* yields the lowest amount of results with 4.410 hits in Google, 15 in Google Scholar, 114 in Google Books and 1 in EUR-Lex. All terms will be included in the term fiche for this concept, though domain experts should be consulted to determine whether a specific term is more appropriate.

Table 15

Frequencies of term variants for "impact category" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
impact category	181.000	23.100	34.200	35
environmental impact category	88.400	2.370	8.770	7
EF impact category	4.410	15	114	1

The definition for the concept that these three terms refer to is based on Brentrup, Küsters, Kuhlmann, & Lammel (2004) and Kim, Tae, & Chae (2016).

impact category; environmental impact category; EF impact category	collection of several negative interrelated impacts on the environment

6.3.2 Dutch

The distribution of frequencies of the Dutch terms is roughly similar to the distribution of frequencies of the English terms. However, the absolute amounts of results are significantly lower. *Effectcategorie* yields the most results in all search engines: 1.560 in Google, 34 in Google Scholar, 1 in Google Books, and 7 in EUR-Lex, followed by *milieueffectcategorie* with 193 results in Google, 17 in Google Scholar, 1 in Google Books and 2 results for the plural of *milieueffectcategorieën* in EUR-Lex. *EF-effectcategorie* yields the lowest amount of results of the three terms: 190 in Google, zero in Google Scholar and Google Books, and 1 in EUR-Lex.

Due to frequency use of *effectcategorie* and *milieueffectcategorie* could be preferred over the use of *EF-effectcategorie.* However, domain experts should be consulted before labels as *preferred* or *deprecated* or *obsolete* are ascribed to these terms ("IATE - Data fields explained," n.d.).

Table 16

Frequencies of Dutch terms for "impact category" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
effectcategorie	1.560	34	1	7
milieueffectcategorie	193	17	1	2*
EF-effectcategorie	190	0	0	1

*****results for plural

For each English term a slightly different Dutch translation is available. However, all terms refer to the same concept for which a definition is constructed based on the English concept definition, as no Dutch source provides a definition of the concept.

effectcategorie; milieueffectcategorie; EF-effectcategorie	verzameling van onderling verbonden aspecten die een negatieve invloed op het milieu uitoefenen

6.4 Waste management system

The following three sections will discuss *waste management system, integrated waste management* and *integrated waste management system*. These terms strongly related in meaning and show great similarity in word form. All terms refer to waste management and differ only in whether that is performed in an integrated manner and/or within a system. For Dutch term equivalents, it is important to consider the relation between these terms as well, to ensure consistency in the term translation.

This section addresses *waste management system*. This term refers to the procedure used to collect, transport, recover and dispose of waste ("waste management system," n.d.). There is an entry for this concept in IATE ("IATE - Entry ID 293104," n.d.). However, this entry is considered insufficient, as discussed in section 5.4. The low quality of this entry is reflected in its reliability as well, as it is only awarded 1 star ("IATE - Entry ID 293104," n.d.).

6.4.1 English

Additions and alterations for the entry, except for the English term, are proposed in the term fiche for *waste management system* (see: appendix D) ("IATE - Entry ID 293104," n.d.). The English term *waste management system* is preserved as it yields 11 million results in Google, over 50.000 results in Google Scholar, 202.000 results in Google Books and 163 results in EUR-Lex.

Table 17

Frequencies of "waste management system" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
waste management system	11.000.000	50.100	202.000	163

The proposed term definition is based on the definition in the General Multilingual Environmental Thesaurus ("waste management system," n.d.).

waste management system	procedure for the total waste chain, from collection and transport to recovery and disposal of waste and maintenance of disposal sites

6.4.2 Dutch

The Dutch term is altered based on the translation of *waste management system* used in *Directive (EU) 2019/883* (CELEX:32019L0883): *afvalbeheersysteem.* The newly proposed Dutch term yields more results than *afvalvergaring,* which is currently included in entry 293104 ("IATE - Entry ID 293104," n.d.). In Google, *afvalvergaring* yields nine results and in the other search engines zero, whereas *afvalbeheersysteem* only yields zero results in Google Books, and 3.190 results in Google, 6 in Google Scholar, and 47 in EUR-Lex. *Afvalstoffenbeheer* yields significantly lower amounts of results than *afvalbeheersysteem,* due to which the use of *afvalbeheersysteem* is included in the term fiche for this concept.

Table 18

Frequencies of Dutch equivalents for "waste management system" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
afvalvergaring	9	0	0	0
afvalbeheersysteem	3.190	6	0	47
afvalstoffenbeheersysteem	50	0	0	1

Frequencies of the Dutch term are low, especially compared to frequencies of the English term. As a result, no reliable definitions could be obtained from academic literature. Thus, a Dutch definition is proposed based on the English definition for *waste management system.*

afvalbeheersysteem	werkwijze voor de uitvoering van afvalbeleid van a tot z, i.e. van inzameling en transport tot verwerking, inclusief beheer van stortplaatsen

6.5 Integrated waste management

This section addresses *integrated waste management,* which refers to the management of waste in an integrated way, i.e. all relevant aspects are addressed, such as collection and disposal of different types of waste (Quattrociocchi, Mercuri, & Pasqualino, 2014).

6.5.1 English

Integrated waste management is frequently used, as reflected by the frequency in which it occurs in Google, Google Scholar, Google Books and EUR-Lex. The abbreviation for *integrated waste management* is *IWM*. However, in the regular Google search engine and in Google Books, the query *IWM* results in a great amount of out-of-domain hits, mostly as a reference to the five Imperial War Museums ("Imperial War Museums," n.d.). In Google Scholar, in the first 15 pages with results *IWM* solely refers to the initials of authors, not to in-text abbreviations of *integrated waste management*. Most of the hits for *IWM* in EUR-Lex results from falsely labelled scanned documents, such as *RECOMMENDATION FOR A COUNCIL REGULATION (EEC)* (CELEX:51979PC0782). When *waste* is included in the

regular Google query, results refer to integrated waste management, but to other domain-relevant terms as well, e.g. *instant waste management*, and *international waste management*. Thus, the abbreviation will not be included in the term fiche as it is not solely related to *integrated waste management.*

Table 19

Frequencies of "integrated waste management" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
integrated waste management	687.000	16.500	85.400	91
IWM	8.460.000	61.900	638.000	14
IWM + waste	779.000	7.670	6.890	5

The proposed definition for the English term is based on Quattrociocchi et al. (2014).

integrated waste management	method regarding the handling of waste that involves multiple parties, waste streams and waste treatment processes and connects those different aspects

6.5.2 Dutch

Both *afval* and *afvalstoffen* were included in the search queries, as both are included in several entries including *waste*, as discussed in section 5.4. To ensure consistency with other terms including *waste,* terms including *afval* instead of *afvalstoffen* are favored. Only *geïntegreerd afvalbeheer* will be included in the Dutch term level due to frequency, whereas this term yields 377 results in Google, two in Google Scholar and 19 in EUR-Lex. Other search queries only yield results in Google, except for *geïntegreerd beheer van afval* that has one result in EUR-Lex. The abbreviation for the English term generates results in Dutch as well, though in lower frequencies. Most results also do not abbreviate *integrated waste management*, but for example *Intercommunale Watermaatschappij* ("home," n.d.). There is no specific Dutch abbreviation for the Dutch term *geïntegreerd afvalbeheer*. Thus, no abbreviations will be included in the Dutch term level.

Table 20

Frequencies of Dutch terms for "integrated waste management" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
geïntegreerd afvalbeheer	377	2	0	19
geïntegreerd afvalstoffenbeheer	9	0	0	0
geïntegreerd beheer van afval	16	0	0	1
geïntegreerd beheer van afvalstoffen	1	0	0	0
IWM	47.300	291	3.360	15
IWM + afval	2.720	11	270*	3

***** Most results are irrelevant despite inclusion of *afval*

The definition for *geïntegreerd afvalbeheer* is based on a progress note of the Ministry for Development Cooperation titled *Internationaal Natuur- en Milieubeleid; Notitie "Milieu en Armoedebestrijding,"* (2001).

geïntegreerd afvalbeheer	aanpak van afval waarbij alle partijen, afvalstromen en manieren om afval te verwerken worden betrokken en aan elkaar worden verbonden

6.6 Integrated waste management system

The term *integrated waste management system* is strongly related to *integrated waste management*, discussed in section 6.5, whereas the only difference is that the management of waste is handled within the framework of a system.

6.6.1 English

The term *integrated waste management system* was derived from the source text by Pires et al. (2018b). However, it is frequently used beyond this text as well, as is reflected by the frequency of *integrated waste management system* in the consulted search engines, see table 21.

In English academic literature about integrated waste management systems, this term is frequently abbreviated with *IWMS*, e.g. in Herva, Neto, & Roca (2014). However, when using

IWMS as a Google search query, most of the results do not refer to an integrated waste management system, similar to the results for *IWM* discussed in the previous section. Results in the regular Google search engine, as well as results from Google Scholar and Google Books, address other terms as *integrated workplace management systems* and *internal working models.* The amount of results that refer to the domain of waste management is significantly higher when *waste* is included in the search query, however, *IWMS* is also used to refer to *informal waste management system* and *infectious waste management system* when *waste* is included in the query. In EUR-Lex the abbreviation yields zero results. The abbreviation of *IWMS* was not used in the term fiche, as it is ambiguous.

Table 21

Frequencies of "integrated waste management system" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
integrated waste management system	139.000	2.470	6.020	27
IWMS	917.000	3.810	10.600	0
IWMS + waste	33.700	483	1.660	0

The term *integrated waste management system* refers to a framework in which waste is handled in an integrated manner, i.e. it included all actors, types of waste, and waste strategies (Marchi et al., 2017). The English definition is based on Marchi et al. (2017)

integrated waste management system	framework in which various parties, waste streams, and strategies (e.g. prevention, collection, recycling, disposal) are handled in an interrelated way

6.6.2 Dutch

For the Dutch term for *integrated waste management system* four Dutch translations are taken into consideration, one of which does not comply with rules of the Dutch language regarding word contractions, though it is the only translation yielding a result in Google Scholar and thus included in frequency table 22. All considered Dutch variants yielded low amounts of results in all search engine; the frequency varied from zero to 17. For the term fiche

geïntegreerd afvalbeheersysteem is advised, promoting the use of idiomatic Dutch, in addition to yielding the most results in the regular Google search engine, and this term being the only variant used in EUR-Lex. Furthermore, *geïntegreerd afvalbeheersysteem* is a combination of the Dutch term equivalents for *waste management system* and *integrated waste management,* supporting consistency between the Dutch term equivalents for these terms.

The English term abbreviation was also used as query for the target language. In Dutch most results also refer to *Integrated Workplace Management System*, even when *afval* is included in the query. Thus, the abbreviation will also be excluded from the Dutch term level.

Table 22

Frequencies of Dutch terms for "integrated waste management system" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
geïntegreerd afvalbeheersysteem	14	0	0	1
geïntegreerd afvalbeheer systeem	7	1	0	0
geïntegreerd beheersysteem van afval	0	0	0	0
geïntegreerd systeem voor het beheer van afval	0	0	0	0
IWMS	18.900	3	77	0
IWMS + afval	7.490	1	4*	0

***** Results irrelevant despite inclusion of *afval*

No definition could be obtained from Dutch sources, because of the low amount of results for *geïntegreerd afvalbeheersysteem* in all search engines. The Dutch term definition is based on the English definition for *integrated waste management* proposed in the previous section.

geïntegreerd afvalbeheersysteem	kader waarbinnen verschillende partijen, afvalstromen en strategieën (e.g. ter preventie van afvalproductie, voor afvalinzameling, recycling of verwerking) worden beschouwd als één geheel

6.7 Source separation

S*ource separation* refers to sorting of waste into different streams, to ensure that every stream contains only one type of waste, e.g. organic waste or plastics. Source separation is

performed at the point where waste is generated, e.g. in households, public spaces and in companies (*Source Separation of Waste - Position Statement*, 2014). There is no exact match for this term in IATE, though there is an entry within the domain of Environment for *separation at source.* This term is part of the same concept depicting the separation of waste implemented at the point of generation ("IATE - Entry ID 48916," n.d.). In addition, there is a second entry within the domain of Environment containing three English terms defined as "the sorting of waste and other residues at the place of origin" ("IATE - Entry ID 1408024," n.d.). These terms will be included in the search queries for this concept as well.

6.7.1 English

For the search queries five English term variants are considered. *Separation at source* was derived from the IATE entry with ID-number 48916 ("IATE - Entry ID 48916," n.d.), *pre-separation at source, source segregation* and *at-source segregation* were derived from entry 1408024 ("IATE - Entry ID 1408024," n.d.), and *source separation* was derived from the source text by Pires et al. (2018b).

Separation at source, source separation and *source segregation* yielded the highest amounts of results in all search engines. Subsequently, *waste* was added to these three queries to determine domain-relevancy.

Source separation yields the highest amount of results in all search engines. *Source separation + waste* yields 226.000 results in Google, 13.400 in Google Scholar, over 35.000 in Google Books and 36 in EUR-Lex. S*eparation at source + waste* yields almost 44.000 results in Google, almost 2000 in Google Scholar and Google Books and 19 in EUR-Lex. *Source segregation + waste* yields almost 50.000 results in Google, 1.750 in Google Scholar, over 2.100 in Google Books and 6 in EUR-Lex. Academic literature often only uses *source segregation* or *source separation*, e.g. Di Maria, Micale, & Morettini (2016) only describe

source segregation. It is important to reflect the plurality of terms used in academic texts in IATE, whereas academics and translators rely on the database for term equivalents. Thus, term levels were made for *separation at source, source separation* and *source segregation* in the term fiche with proposed alterations for entry 48916 (see: appendix G).

Use of *pre-separation at source* is not recommended as the term seems to be a pleonasm. Separation at the source is effectively pre-separation, as the separation is performed before waste collection. In addition, *pre-separation at source* yields low results in all search engines. Compared to the three terms included in the term fiche, *at-source segregation* also yields low amounts of results, and thus, will not be included.

Whereas relevant terms from entry 1408024 were included in the proposed alterations for entry 48916, entry 1408024 has become redundant ("IATE - Entry ID 1408024," n.d.; "IATE - Entry ID 48916," n.d.). Furthermore, both entries refer to one concept, and according to the regulations of IATE, one concept should only be reflected by one entry (*IATE Handbook - Europa EU,* 2018). It is proposed that the IATE entry with ID-number 1408024 is removed from the IATE database.

Table 23

Frequencies of variants for "separation at source" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
separation at source	50.700	2.010	2.120	19
separation at source	43.900	1.970	1.930	19
source separation	881.000	145.000	119.000	36
source separation + waste	226.000	13.400	35.200	36
pre-separation at source	269	12	9	0
source segregation	66.000	3.610	3.080	6
source segregation + waste	49.900	1.750	2.130	6
at-source segregation	11.600	94	5	0

In the current entry for *separation at source* the concept is defined as "1. Segregating various wastes at the point of generation (e.g. separation of paper, metal and glass from other wastes to make recycling simpler and more efficient." ("IATE - Entry ID 48916," n.d.). In entry

1408024 the concept was defined as "the sorting of waste and other residues at the place of origin" ("IATE - Entry ID 1408024," n.d.). These definitions are merged and specified by adding that *point of generation* refers to the moment that the waste is produced and that the separation is performed "at home, in the office, on building sites and in public places" as stated by the Government of Western Australia (*Source Separation of Waste - Position Statement*, 2014, p. 1).

source separation; separation at source; source segregation	sorting of waste into different containers to form same-waste streams at the moment the waste is produced (e.g. in households and offices) to make recycling simpler and more efficient

6.7.2 Dutch

For Dutch term equivalents three main variants were considered: *scheiding bij de bron, bronscheiding* and *sorteren bij de bron.* The first and third variant were also considered including the preposition *aan* instead of *bij*. For Dutch, terms including *sorteren* are not advised, as *scheiden* and *scheiding* are more frequently used. In addition, *scheiden* is also used by the Dutch government, e.g. on websites about *afvalscheiding* ("Afvalscheidingswijzer - Milieu Centraal," n.d.). Both *bronscheiding* and *scheiding aan de bron* were included in term levels, and *scheiding bij de bron* was mentioned under *LookUpForms* in the term level for *scheiding aan de bron.*

Table 24

Frequencies of variants of Dutch terms for "separation at source" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
scheiding bij de bron	10.800	8	2	1
scheiding aan de bron	11.700	41	52	21
bronscheiding	10.200	81	9	2
sorteren bij de bron	779	0	0	0
sorteren aan de bron*	1.100	3	1	0

*Used in region of Flanders

There was no Dutch definition included in the current entry and as no complete Dutch definition was available in academic literature, one is proposed based on the English term definition.

bronscheiding; sorteren aan de bron	apart verzamelen van verschillende soorten afval, e.g. papier, glas, en plastic, op het moment dat het afval geproduceerd wordt, e.g. in huishoudens of op kantoren

6.8 Inventory analysis

In this section, the term inventory analysis will be discussed. This term refers to the second phase within LCA in which energy and material flows from input, e.g. raw materials, to output, e.g. emissions released to the environment are quantified (Islam & Kumar, 2019).

6.8.1 English

Inventory analysis is not only used within LCA, as represented by the differences in frequencies from *inventory analysis* or *inventory analysis + LCA*. When *LCA* is included, less results are yielded in Google and Google Books. The difference between the amount of results yielded by *inventory analysis* and *inventory analysis + LCA* is smaller in Google Scholar and Eur-Lex, which can be explained by the fact that these sources offer more specialized texts. Thus, in the future, other entries may be proposed to be included in the IATE database regarding *inventory analysis* referring to other concepts. For example, the balance between product stock and product demand for products within Economics ("Inventory Analysis - AccountingTools," n.d.). However, within the domain of Environment *inventory analysis* is used to refer to one concept, the phase in LCA in which materials and energy flows are quantified.

Table 25

Frequencies of variants of English terms for "inventory analysis" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
inventory analysis	525.000	33.600	67.500	6
inventory analysis + LCA	77.300	19.400	6.940	2

The proposed definition for this term is based on Islam & Kumar (2019).

inventory analysis	second phase within Life Cycle Assessment in which all energy, material flows and emissions (from input to output) within the system are quantified

6.8.2 Dutch

EUR-Lex contains two documents providing Dutch translations for *inventory analysis*. In *2013/179/EU: Commission Recommendation* (CELEX:32013H0179) *Life Cycle Inventory Analysis* is translated with *Levenscyclusinventarisanalyse*, and in *Proposal for a Council Regulation (EC) on a revised Community eco-label award scheme* (CELEX:51996PC0603) *inventory analysis* is translated with *inventarisanalyse*. Thus, *inventarisanalyse* is included as a query in table 26. However, *inventarisanalyse* yields low results in other search engines; 70 in Google, 1 in Google Scholar and zero in Google Books.

Valk et al. (2016) describe the different phases of LCA. In this document, published by the Dutch National Institute for Public Health and the Environment, the second phase in LCA is labelled *inventarisatie*. This term was included as search queries in combination with *LCA*, as *inventarisatie* is used beyond the concept it refers to in this context.

In *2013/179/EU: Commission Recommendation* (CELEX:32013H0179) *inventarisatie* is used to refer to the process of quantifying input and output, within *levenscyclusinventarisatie*, *inventarisatie-methode* and *inventarisatieproces*. However, it is not used directly in combination with *analyse*. *Inventarisatie* yields higher amounts of results than the combination of *inventarisatie* and *analyse*. *Inventarisatie + LCA* yields 17.700 results in Google, 522 in Google Scholar, 574 in Google Books and 11 in EUR-Lex.

Due to frequency and occurrence in governmental documents, such as Valk et al. (2016), *inventarisatie* is included in the term fiche. In the definition *analysis* is be referred to, as analysis is executed within this phase within LCA. Other variations represented by search queries are included under *LookUpForms*.

Table 26

Frequencies of variants of Dutch terms for "inventarisanalyse" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
inventarisanalyse	70	1	0	2
inventarisatie + LCA	17.700	522	574	11
inventarisatieanalyse	155	2	1	0
inventarisatie analyse	5.030	127	253	5

De definition for *inventarisatie* is based on Valk et al. (2016).

inventarisatie	tweede fase in levenscyclusanalyse waarin gegevens over de energie, materialen en uitstoot in het productsysteem (van invoer tot uitvoer) worden verzameld en gekwantificeerd ten behoeve van analyse

6.9 System expansion

When system expansion is applied to LCA, environmental impacts and benefits of co-products of the product system that is analyzed are included to avoid allocation (Samuel-Fitwi, Schroeder, & Schulz, 2013). In allocation the system boundaries are defined from a normative perspective, rather than based on practice (Samuel-Fitwi et al., 2013). Environmental impacts refer to resource use and emissions from co-products that are included in the main products system (Soethoudt & Timmermans, 2013). When the production of a certain produce is increased, the co-product's production increases as well. This may lead to replacement of product from other product systems by co-products. Co-products of the beer production system can be used to feed livestock, replacing (part of) the food produced solely to feed livestock (Soethoudt & Timmermans, 2013). This is a benefit of system expansion. In other domains *system expansion* refers to increasing the capacity of hardware and software, so that it can process more data ("Integrator/CP User Guide | System Expansion - Arm Developer," n.d.; "System Expansion Overview | Pivotal Greenplum Database Docs," n.d.). In the next two sections, English and Dutch terms referring to the source-text concept will be researched.

6.9.1 English

S*ystem expansion* is used beyond LCA, as is represented by the difference in frequency of results in the search engines dependent on whether *waste* or *LCA* is included. *System expansion* yields over 850.000 results in Google, almost 15.000 in Google Scholar, over 100.000 in Google Books and 36 in EUR-Lex. When *waste* is included in the search query, over 160.000 results are yielded in Google, over 8.600 in Google Scholar, almost 6.900 in Google Books and 27 in EUR-Lex. *System expansion* combined with *LCA* yields the lowest amount of results: 26.100 in Google, 4.140 in Google Scholar, 1.340 in Google Books and 2 in EUR-Lex.

Table 27

Frequencies of "system expansion" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
system expansion	854.000	14.900	102.000	36
system expansion + waste	161.000	8.630	6.880	27
system expansion + LCA	26.100	4.140	1.340	2

The proposed definition is based on Samuel-Fitwi et al. (2013).

system expansion	inclusion of environmental impacts and benefits of coproducts to the product system that is analyzed

6.9.2 Dutch

The Dutch equivalent for *system expansion, systeemuitbreiding,* was obtained through *2013/179/EU: Commission Recommendation* (CELEX:32013H0179). However, in Dutch literature on the subject of LCA *uitbreiding van het systeem* is used as well (*Milieueffectrapport Landelijk Afvalbeheersplan, Achtergronddocument A2; LCA; methodiek en uitwerking in MER-LAP*, 2002). *Uitbreiding van het systeem* yields more results than *systeemuitbreiding* in all search engines, though not when *LCA* is included. *Systeemuitbreiding + LCA* yields 177 results in Google, 15 in Google Scholar, zero in Google Books and 1 in EUR-Lex. *Uitbreiding van het*

systeem + LCA results in 17 hits in Google, 3 in Google Scholar and zero in Google Books and EUR-Lex. Thus, *systeemuitbreiding* is included in the Dutch term level. *Uitbreiding van het systeem* is mentioned under *LookUpForms*.

Table 28

Frequencies of Dutch terms for "system expansion" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
systeemuitbreiding	21.800	27	40	3
systeemuitbreiding + LCA	177	15	0	1
uitbreiding van het systeem	582.000	170	6.490	149
uitbreiding van het systeem + LCA	17	3	0	0

The definition for *systeemuitbreiding* is based on Kleijn, Huppes, Wrisberg, & Hermans (2000)

systeemuitbreiding	toevoeging van milieudruk en -voordelen van bijproducten aan het productsysteem dat wordt onderzocht

6.10 Treatment process

Within the domain of Waste Management *treatment process* refers to the procedure to break down waste (Lagerkvist & Dahlén, 2019). Which procedure is used depends on the type of waste, however, different processes can be applied to specific waste streams, e.g. "paper can be recycled in a paper mill, incinerated in a power plant, or decomposed by biological treatment" (Lagerkvist & Dahlén, 2019, p. 9).

6.10.1 English

Treatment process is not only used with respect to waste, as reflected by the difference in frequencies of *treatment process* and *treatment process + waste*. *Treatment process* yields over 11 million entries in Google, more than one million in Google Scholar and Google Books, and 328 in EUR-Lex. *Treatment process* yields results from beyond the domain Environment, e.g. related to treating mental disorders in the domain Psychology as in Levy & Ablon (2008).

When *waste* is included in the search query, over 4.8 million results are yielded in Google, 427.000 in Google Scholar, 363.000 in Google Books and 275 in EUR-Lex. Frequencies of *waste treatment process* are also determined: 330.000 in Google, 10.500 in Google Scholar, 47.000 in Google Books and 18 in EUR-Lex.

Table 29

Frequencies of "treatment process" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
treatment process	10.700.000	1.120.000	1.250.000	328
treatment process + waste	4.870.000	427.000	363.000	275
waste treatment process	330.000	10.500	47.000	18

Academic literature is mostly focused on a specific type of waste that is broken down by a specific kind of treatment process, e.g. anaerobic treatment of waste water (Bolzonella, Pavan, Battistoni, & Cecchi, 2005), anaerobic treatment of industrial and municipal waste (Malina, Pohland, Eckenfelder, & Patterson, 2017), processes for treatment of hazardous wastes (Prakash & Gowtham, 2018), and hydrometallurgical treatment of electronic waste (Iannicelli-Zubiani et al., 2017). This poses problems for the definition of *treatment process* to be included in the term fiche, as reliable sources only depict specific treatment processes. As a result, no general definition could be found in literature, and one was constructed for use in the term fiche. Additional information in the term fiche is based on Lagerkvist & Dahlén (2019) and addresses different processes used for treating different types of waste (see: appendix J).

treatment process	procedure aimed towards breaking down waste

6.10.2 Dutch

The Dutch term *behandelingsproces* is obtained from *Regulation (EC) No 1013/2006* (CELEX:32006R1013). However, this term yields high amounts of unrelated results in the Google search engines, e.g. results related to the health sector where patients are treated for

mental disorders as in Sproet (2003). Thus, *afval* was included to ensure for domain-relevant hits in the search engines. *Behandelingsproces + afval* yielded 5.420 results in Google, 29 in Google Scholar, 10 in Google Books and 129 in EUR-Lex. When *afval* was included into the search query, as in *afvalbehandelingsproces,* this results in significantly lower amounts of results. 30 results are yielded in Google, one in Google Scholar and zero in Google Books and EUR-Lex. Thus, *behandelingsproces* will be included in the term fiche. The term fiche will be included in the domain of Waste Management, to ensure that it refers to the relevant concept.

Table 30

Frequencies of Dutch terms for "treatment process" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
behandelingsproces	27.400	516	818	158
behandelproces	43.700	1.040	1.230	8
behandelingsproces + afval	5.420	29	10	129
behandelproces + afval	1.480	10	29*	0
afvalbehandelingsproces	30	1	0	0
afvalbehandelproces	0	0	0	0

***** Most results are irrelevant despite inclusion of *afval*

For the Dutch term it was also difficult to obtain a general definition. However, for the Dutch term this was partially caused by a lower number of reliable academic sources represented by the results in Google Scholar. Thus, a definition is suggested based on the English term definition. In the Dutch term level, information concerning different processes and different types of waste is included based on the English language level.

behandelingsproces	procedure om afval te bewerken ter bevordering van de afbraak

6.11 Midpoint

Midpoint refers to the aggregation level of environmental impacts within Life Cycle assessment. This level is located between the start and the endpoint ("LCIA: the ReCiPe model | RIVM," 2011). At midpoint, environmental impacts are converted into impact categories.

When combined, these impact categories can lead to environmental impact at the endpoint level, in which damage is caused to human health, ecosystems, or resource availability (see: figure 9) ("LCIA: the ReCiPe model | RIVM," 2011).

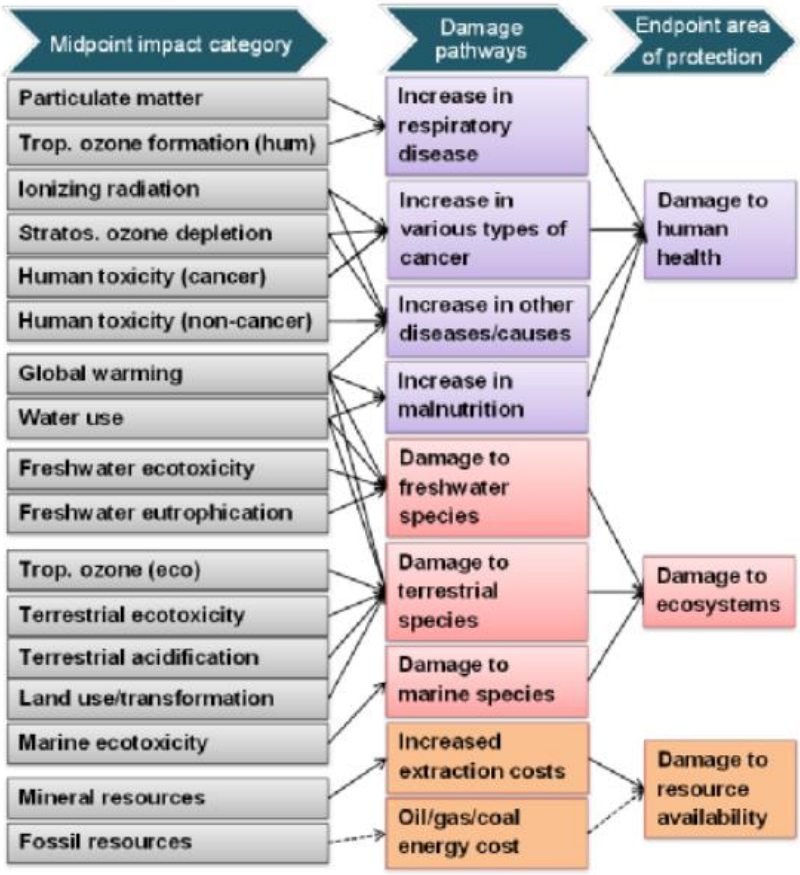


Figure 9: Environmental impact on midpoint and endpoint level guided by impact categories (Source: "LCIA: the ReCiPe model | RIVM," 2011)

6.11.1 English

Both *midpoint* and *midpoint level* are used to refer to the level of aggregation for environmental impact categories. However, both terms are also used in other domains, as is reflected by the lower amount of results yielded when *LCA* is included in the queries. There are also differences in the amounts of results yielded by *midpoint + LCA* and *midpoint level + LCA.* The highest amounts of results are generated by *midpoint + LCA:* 89.600 in Google, 12.100 in

Google Scholar, 2.590 in Google Books and 7 in EUR-Lex. *Midpoint level + LCA* yields 9.870 results in Google, 1.500 in Google Scholar, 804 in Google Books and zero in EUR-Lex.

Midpoint in the domain Environment refers to the level of aggregation, and thus, it is not necessary to include *level* in the term. *Midpoint level* is mentioned under *LookUpForms* in the term level.

Table 31

Frequencies of "midpoint" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
midpoint	19.600.000	564.000	3.950.000	238
midpoint + LCA	89.600	12.100	2.590	7
midpoint level	21.200	2.360	2.080	0
midpoint level + LCA	9.870	1.500	804	0

The definition refers to the fact that *midpoint* is an aggregation level concerning environmental impact ("LCIA: the ReCiPe model | RIVM," 2011).

midpoint	aggregation level of environmental impact containing impact categories that is located between the start and the endpoint

6.11.2 Dutch

In the Dutch translation of *2013/179/EU: Commission Recommendation* (CELEX:32013H0179), *middelpunt, klassenmidden* and the untranslated *midpoint* are all used as equivalents for *midpoint.* Both *middelpunt* and *klassenmidden* is included in the search queries for this concept. *Midpunt* is also added to the queries, based on its use in Floru (2016). In addition, search queries are performed that include *level* or *niveau.*

Based on the frequencies of all search queries for the four search engines, *middelpunt* will be added to the Dutch term level (see: table 32). For *middelpunt + LCA* 4.860 results were yielded in Google, 55 in Google Scholar, 307 in Google Books and 3 in EUR-Lex. *Midpunt + LCA* and *klassenmidden + LCA* did not yield enough results to be considered reliable Dutch term equivalents for *midpoint.* However, *midpunt* and *klassenmidden* are included under

LookUpForms in the Dutch term level.

As *middelpunt* yields large amounts of irrelevant results, the term fiche for this concept should be placed in the domain Environment. This entry cannot be expanded over other domains, as it is used to refer to other concepts within other domains.

Table 32

Frequencies of Dutch terms for "midpoint" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
middelpunt	3.150.000	19.100	167.000	1405
middelpunt + LCA	4.860	55	307	3
middelpunt + levenscyclusanalyse	1.020	10	38*	4
midpunt	3.300	26	1.420	0
midpunt + LCA	7	2	0	0
midpunt + levenscyclusanalyse	9	1	0	0
klassenmidden	2.190	29	64	1
klassenmidden + LCA	2	0	0	1
klassenmidden + levenscyclusanalyse	2	0	0	1
midpunt niveau	1	0	0	0
midpunt level	0	0	0	0
middelpunt niveau	40	0	1	0
middelpuntniveau	120	0	0	0
middelpunt level	0	0	0	0

***** Most results irrelevant despite inclusion of *levenscyclusanalyse*

The definition for the Dutch term equivalent is based on the definition for the English term.

middelpunt	niveau van aggregatie van milieueffecten onderverdeeld in effectcategorieën dat zich bevindt tussen het begin- en eindpunt

6.12 Uncertainty analysis & uncertainty propagation

Uncertainty analysis is a tool to calculate the overall uncertainty of results in a study by quantifying the uncertainty of all parameters in the system (Cacuci, 2003). There is no entry for the English term in IATE, but its Dutch term equivalent *onzekerheidsanalyse* is part of the entry for *sensitivity-uncertainty analysis* ("IATE - Entry ID 1110129," n.d.). However, *onzekerheidsanalyse* is not the Dutch standardized equivalent of *sensitivity-uncertainty analysis*, whereas the aspect of *sensitivity* is not included in the Dutch term and section 6.12.2

will argue that *onzekerheidsanalyse* is the Dutch standardized equivalent for *uncertainty analysis*. The entry concerning *sensitivity-uncertainty analysis* should be altered to include the appropriate Dutch equivalent of *gevoeligheids- en onzekerheidsanalyse* (Dahm, Elffrink, & Burgers, 2011), and a new entry for *uncertainty analysis* is proposed (see appendix L). The term *uncertainty propagation* refers to the same concept and is added to a term level in this fiche as well.

6.12.1 English

Uncertainty analysis and *uncertainty propagation* are not solely used in the domain of Waste Management or LCA, as is reflected in the frequencies of the different search queries (see: table 33). *Uncertainty analysis* yields more results when *waste* and *LCA* are not included. The lowest amount of results is yielded by *uncertainty analysis + LCA.* The frequencies of search queries including *uncertainty propagation* show the same frequency distribution. Most results are yielded for *uncertainty propagation,* though frequencies are ten times smaller than for *uncertainty analysis.* Whereas *uncertainty analysis* and *uncertainty propagation* yield results beyond the domain of Waste Management and Environment, the term fiche containing these terms should be added to other domains as well in the IATE database, such as Economics, as the concept denotes a statistical tool to calculate the uncertainty of a system. As *uncertainty analysis* yields more results in all sources than *uncertainty propagation,* this term will be added in the first term level.

Table 33

Frequencies of "uncertainty analysis" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
uncertainty analysis	1.490.000	440.000	196.000	33
uncertainty analysis + waste	381.000	35.000	23.500	28
uncertainty analysis + LCA	148.000	6.430	2.040	3
uncertainty propagation	296.000	34.200	15.300	0
uncertainty propagation + waste	83.500	3.860	1.190	0

uncertainty propagation + LCA	46.900	671	150	0

The definition for the English term is based on Cacuci (2003) and reflects *uncertainty analysis* within a general scientific domain rather than within the domain of Waste Management or LCA. As the term fiche is proposed to be included in the domain of Economics as well, the contextual references chosen do not solely depict *uncertainty analysis* within Waste Management or LCA.

uncertainty analysis; uncertainty propagation	method to determine the uncertainty in a system by calculating parameter uncertainty and their effects on the total system

6.12.2 Dutch

Onderzekerheidsanalyse is included, because this is used in Rötter, van Grinsven, Boers, Beusen, & Oenema (2001). However, due to low frequency, this was possibly caused by a spelling error. Thus, in the term fiche *onzekerheidsanalyse* will be added to the first term level as this query yields 12.200 results in Google, 589 in Google Scholar, 196 in Google Books and 24 in EUR-Lex. The Dutch equivalent for *uncertainty propagation* was derived from van der Hauw (2013) in which both *onzekerheidsanalyse* and *foutenvoortplanting* are used interchangeably. *Foutenvoortplanting* will be added in the second term level, as lower frequencies are yielded than for *onzekerheidsanalyse*: 540 in Google, 37 in Google Scholar, 27 in Google Books and zero in EUR-Lex.

Table 34

Frequencies of Dutch terms for "uncertainty analysis" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
onzekerheidsanalyse	12.200	589	196	24
onderzekerheidsanalyse	4	1	0	0
foutenvoortplanting	540	37	27	0

The Dutch term definition is based on Baggelaar, van Tongeren, Knoben, & van Loon (2010). The Dutch contextual references in the term fiche are obtained from texts within the domain of

Environment but refer to the general concept, as the term fiche will be included in the domain of Economics as well.

onzekerheidsanalyse; foutenvoortplanting	methode waarmee de onzekerheid voor het hele systeem kan worden berekend aan de hand van de onzekerheid van de parameters binnen het systeem

6.13 Unit process

In chapter 5, the current entry for *unit process* in IATE was valued as insufficient. Not only is the only entry for this term incomplete, e.g. no definitions or contextual references are included, but in addition the current entry is placed within the domain of Chemical Compound due to which it refers to a different concept ("IATE - Entry ID 1397307," n.d.). Chemical compound is a subdomain of Industry in which *unit process* is defined as "any number of standard operations, such as filtration or distillation, that are widely used in various chemical and process industries" ("Unit process definition and meaning | Collins English Dictionary," n.d.). However, in the domain of Environment *unit process* is the smallest element of which data can be quantified within LCA with respect to the input and output of a product system (Sanz Requena et al., 2011). As the current entry for *unit process* refers to a different concept, a new entry will be proposed in consideration of the one concept per entry perspective of IATE (*IATE Handbook - Europa EU*, 2018).

6.13.1 English

Unit process is also used beyond the domain of Environment, as reflected by the difference in the amounts of results yielded for *unit process* and *unit process + LCA.* For *unit process* 349.000 results are yielded in the regular Google search engine, 39.300 in Google Scholar, 87.700 in Google Books and 8 in EUR-Lex. When *LCA* is included 38.100 results are yielded in Google, 5.500 in Google Scholar, 1.870 in Google Books and one in EUR-Lex. To ensure that the proposed entry refers to the relevant concept, the proposed term fiche will only

be added to the domain Environment and will not be expanded to other domains unless it can be justified that *unit process* refers to the same concept within that domain.

Table 35

Frequencies of "unit process" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
unit process	349.000	39.300	87.700	8
unit process + LCA	38.100	5.500	1.870	1

The definition for *unit process* is based on ISO 14044 (2006). If *unit process* refers to the smallest element for which data can be collected in other domains as well, the definition should be expanded by excluding the reference to life cycle assessment.

unit process	smallest element for which data about input and output can be collected during the inventory analysis in life cycle assessment

6.13.2 Dutch

The Dutch term equivalent *eenheidsproces* was obtained from *2013/179/EU: Commission Recommendation* (CELEX:32013H0179). In Dutch *eenheidsproces* is also used beyond the source-text concept, as reflected by the amounts of results yielded for the two search queries in the regular Google search engine (see: table 36). *Unit process* yields 825 results in Google, 15 in Google Scholar, 49 in Google Books and one in EUR-Lex. Combined with *LCA* the search query results in 105 hits in Google, 7 in Google Scholar, one in Google Books and one in EUR-Lex.

Table 36

Frequencies of Dutch terms for "unit process" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
eenheidsproces	852	15	49	1
eenheidsproces + LCA	105	7	1	1

The Dutch term definition was based on the definition for the English term for which ISO 14044 (2006) was used.

eenheidsproces	kleinste element waarvoor binnen de inventarisatie in een levenscyclusanalyse invoer- en uitvoergegevens kunnen worden verzameld

6.14 Waste cardboard

The term *waste cardboard* is derived from the source text by Pires et al. (2018) in which if referred to "waste paper or waste cardboard" (p. 185). For *waste paper* there are four different entries in IATE of which entry 134311 is the most relevant (even though no definitions or contextual references are included) as it is placed in the domains of Environment and Industry ("IATE - Entry ID 134311," n.d.). In addition, the Dutch term level contains both the idiomatic *oud papier* frequently used in daily life, and *papierafval* ("IATE - Entry ID 134311," n.d.). However, there is no entry for *waste cardboard* in IATE. In the Netherlands waste paper and waste cardboard are part of the same waste stream referred to as *oud papier*. Whereas both materials are collected together and are both solid wastes containing cellulose, in the municipality of Utrecht they are separated during the waste processing ("Wat gebeurt er met uw afval? | Gemeente Utrecht," n.d.). *Waste paper* includes different kinds of paper with different features, such as newspapers and printing paper (Merrild, Damgaard, & Christensen, 2008). Within the Netherlands, *kartonafval* is not part of *papierafval*, as it is recycled differently and has different properties. However, kartonafval is included in *oud papier*. Figure 10 reflects the relation between *oud papier*, *papierafval* and *kartonafval* in the Netherlands. Under *papierafval* five types of waste paper are mentioned based on information retrieved from the website of the municipality of Utrecht ("Welk afval in welke bak | Gemeente Utrecht," n.d.).

Ideally, there would be one entry for the concept of *oud papier* in which *papierafval* and *kartonafval* are mentioned, and in addition a separate entry for *papierafval* and a separate entry for *kartonafval* in which properties of the materials are examples of materials are mentioned.

However, domain experts should be consulted, whereas it is not clear if other countries and languages use an umbrella-term as well. For now, a new term fiche is proposed for *afvalkarton (waste cardboard),* which will be related to entry 134311 by cross-reference. Alterations to entry 134311 are beyond the scope of this study, however, it would be advised to include a definition and to exclude *papierafval* in the Dutch term level as this must be included in a separate entry with a narrower scope than entry 134311.

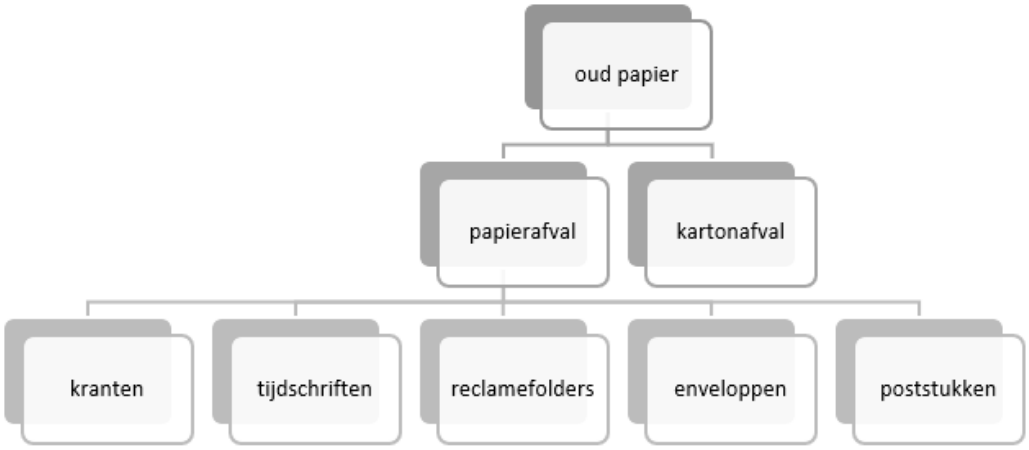


Figure 10: Relation of *papierafval (waste paper)* and *kartonafval (waste cardboard)* within the Dutch waste collection system regarding the waste stream *oud papier*

6.14.1 English

Waste cardboard yields 638.000 results in Google, 1.430 in Google Scholar, 2.400 in Google Books and 3 results in EUR-Lex.

Table 36

Frequencies of "waste cardboard" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
waste cardboard	638.000	1.430	2.400	3

The definition for *waste cardboard* is based on Iyer, Flores, & Torkelson (2015), who describe that waste cardboard is a cheap, environmental friendly source of cellulose (p. 78). Information

about the grammage of cardboard should be added to the definition based on ISO 536 *Paper and board – Determination of grammage* (2012).

waste cardboard	type of solid waste made up by cellulose

6.14.2 Dutch

The Dutch term equivalent *kartonafval* was derived from *Regulation (EC) No 1013/2006* (CELEX:32006R1013). However, *afvalkarton* was included in the search as well. The Dutch term equivalent derived from EUR-Lex yielded the most results: 6.350 in Google, 21 in Google Scholar, 110 in Google Books and 54 in EUR-Lex. *Afvalkarton* yielded lower amounts of results: 1.130 in Google, 3 in Google Scholar, 16 in Google Books and zero in EUR-Lex. Thus, *kartonafval* was included in the Dutch term level.

Table 37

Frequencies of Dutch terms for "waste cardboard" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
kartonafval	6.350	21	110	54
afvalkarton	1.130	3	16	0

In the Dutch term definition, information about the relation to *oud papier* and *papierafval* is included. In addition, information about the properties of waste cardboard should be included in this definition based on ISO 536: *Paper and board – Determination of grammage* (2012).

kartonafval	vaste afvalsoort die bestaat uit cellulose en samen met papierafval de afvalstroom oud papier vormt

6.15 Foreground system and background system

A product system consists out of two systems: the foreground and the background system. According to Tillman (2000), "The *foreground system* is the collection of processes on which measures may be taken concerning their selection or mode of operation as a result of decisions based on the study. The *background system* consists of all other modeled processes

influenced by measures taken in the foreground system." (p. 118). In LCA the objective is to include both the foreground and the background system in the analysis, however, the division between the two levels may be of importance, e.g. for analyzing possible improvements (Westhoek, 2019). In this section, both systems will be elaborated on, as they are interrelated. Thus, the difference between the two is also a means to ascribe meaning, as both terms are members of the same system and according to Saussure, members "are defined in relation to other members of that system" (Hall, 2013, p. 16).

6.15.1 English

Gaudreault et al. (2010) investigated the energy decision-making process in a pulp paper mill and describe factors included in the foreground and background system. According to Gaudreault et al. (2010), the waste paper feedstock is part of the foreground system and this consists of recycled pulp and paper and virgin pulp. They state that the transportation of the waste paper to the mill is part of the background system, as is the extraction of virgin materials for the virgin pulp. A more straightforward example, that can easily be expanded to other systems, is the use of energy. According to Gaudreault et al. (2010), the use of energy within the system is part of the foreground system, and the production of that energy is part of the background system. From a sustainable perspective it is of importance to include the costs and environmental burden of energy production into the main product system of the paper mill.

The English term *foreground system* is most frequently used in the domain of LCA, as is represented by the small difference between frequencies of *foreground system* and *foreground system + LCA. Foreground system* yields 12.900 results in Google, 1.730 in Google Scholar, 1.520 in Google Books and one in EUR-Lex. When *LCA* is included 10.800 results are yielded in Google, 1.270 in Google Scholar, 857 in Google Books and one in EUR-Lex. The frequency of *background system* is significantly higher than the frequencies of *foreground*

system, foreground system + LCA and *background system + LCA. Background system* results in 259.000 hits in Google, 9.750 in Google Scholar, 9.370 in Google Books and two in EUR-Lex. This is caused by the use of *background system* in various other domains, e.g. in photography, where a background system is used to photograph against, and in which domain the concept *background system* refers to differs fundamentally from the concept referred to in this study ("Background Systems," n.d.). For *background system + LCA* similar amounts of results are yielded as for *foreground system + LCA:* 15.400 in Google, 1.360 in Google Scholar, 857 in Google Books and 1 in EUR-Lex.

Table 38

Frequencies of "foreground system" and "background system" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
foreground system	12.900	1.730	1.520	1
foreground system + LCA	10.800	1.270	857	1
background system	259.000	9.750	9.370	2
background system + LCA	15.400	1.360	891	1

Definitions for foreground and background system are based on Gaudreault et al. (2010). Additional information derived from this source is also included in the term fiches (see appendices O and P).

foreground system	collection of processes that have a direct influence on the product system under investigation

background system	collection of processes that have an indirect influence on the product system under investigation

6.15.2 Dutch

The Dutch term equivalents for *foreground system* and *background system* were derived from *2013/179/EU: Commission Recommendation* (CELEX:32013H1079). *Achtergrondsysteem* generates large amounts of out-of-domain results in Google, mostly referring to the domain of photography in which an *achtergrondsysteem* is used to create a

smooth background to photograph against ("Bresser achtergrondsysteem met doek," n.d.). When *LCA* is included in the search queries for *voorgrondsysteem* and *achtergrondsysteem,* the queries yield low amounts of results in all search engines.

Table 39

Frequencies of Dutch terms for "foreground system" and "background system" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
voorgrondsysteem	156	1	0	1
voorgrondsysteem + LCA	7	1	0	1
achtergrondsysteem	68.900	5	77	1
achtergrondsysteem + LCA	18	3	1	1

The reliable sources among results for *voorgrondsysteem* and *achtergrondsysteem* in combination with *LCA* mostly depict specific systems within the hospitality and agricultural industry (Blonk, Reijs, & Vellinga, 2018; Cooreman-Algoed, 2017; Westhoek, 2019). Thus, a general definition for *voorgrondsysteem* and *achtergrondsysteem* could not be derived from Dutch texts and will be based on the English term definitions based on Gaudreault et al. (2010).

voorgrondsysteem	verzameling processen die specifiek zijn voor het productsysteem dat wordt onderzocht en hier direct van invloed op zijn

achtergrondsysteem	verzameling processen die niet specifiek zijn voor het productsysteem dat wordt onderzocht, maar hier indirect van invloed op zijn

6.16 Environmental burden

Environmental burden is used to refer to two interrelated concepts. First, e*nvironmental burden* is related to health, as environmental risks cause disease at local and national level ("WHO | About the environmental burden of disease," n.d.). Second, it is related to product systems or services as these can cause environmental burdens, e.g. the environmental burden of urban water systems described by Lane, de Haas, & Lant (2015) or the environmental burden of milk production researched by Bacenetti et al. (2016). It is proposed that two separate entries

will be constructed for these concepts, as in the domain of Health *environmental burden* causes disease, whereas in the domain of Environment *environmental burden* is caused by product systems and services. These terms should be related to each other in the cross-reference section. In this section, *environmental burden* caused by product systems or services will be addressed.

6.16.1 English

The English source-text term of *environmental burden* is used frequently beyond the source text as well, as is reflected by the amount of results for the search query. In Google *environmental burden* yields 369.000 results, in Google Scholar 40.300, in Google Books 44.300 and in EUR-Lex 100. As stated earlier, *environmental burden* refers to two interrelated concepts, and the results yielded in all search engines contain sources on both concepts. Thus, by adding minus *disease*, the results are filtered to exclude sources containing the word *disease*. This results in 284.000 hits in Google, 30.100 in Google Scholar, 35.800 in Google Books and 39 hits in EUR-Lex.

Table 40

Frequency of "environmental burden" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
environmental burden	369.000	40.300	44.300	100
environmental burden - disease	284.000	30.100	35.800	39

The definition for *environmental burden* is based on the definition retrieved from the website of the General Multilingual Environmental Thesaurus ("environmental burden," n.d.).

environmental burden	activity that influences the environment by causing or leading to environmental pollution, environmental dangers or the use of natural resources

6.16.2 Dutch

The frequency of *milieubelasting* in the regular Google search engine does not deviate significantly from the frequency of *environmental burden*, compared to most differences

between the number of results yielded by English and Dutch queries. However, the Dutch term *milieubelasting* is ambiguous, whereas the word *belasting* reflects both *tax* and as *burden.* For *milieubelasting* referring to taxes the Dutch term *milieuheffing* is used as well ("Betekenis-definitie milieubelasting: Ook: milieuheffing - DFB | De Financiële Begrippenlijst," n.d.). The use of the unambiguous *milieudruk* was proposed by a consulted Junior Assistant Professor from the Utrecht University who is related to the Copernicus Institute of Sustainable Development and is an expert within the domain of Energy & Resources. Consequently, *milieudruk* is included in the term level and m*ilieubelasting* is included under *LookUpForms.*

Table 41

Frequency of Dutch terms for "environmental burden" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
milieubelasting	281.000	4.570	4.320	495
milieudruk	43.100	1.590	1.130	164

The definition for the Dutch term equivalent is based on Blom (2005) and Nijdam & Wilting (2003).

milieudruk	veranderingen die de mens toebrengt aan het milieu die bijdragen aan ongewenste milieueffecten en kunnen leiden tot vermindering van de huidige of toekomstige leefkwaliteit

6.17 Mixed collection

Mixed collection refers to the collection of waste executed using different methods, e.g. drop-off sites in combination with curbside collection by the municipality (Pires, Sargedas, Miguel, Pina, & Martinho, 2017). Whereas in the source text *mix collection* was mentioned, this section argues that when different methods of waste collection are combined, this should be referred to by *mixed collection.* Thus, an entry will be proposed for *mixed collection.*

6.17.1 English

Mix collection + waste yields more results than *mixed collection + waste* in Google (149.000 versus 84.300) and Google Books (8.580 versus 1.690), however, in Google Scholar and EUR-Lex *mixed collection + waste* results in more hits (see: table 42). For Google Scholar and EUR-Lex it can be argued that they contain more specialized texts, as sources only originate from academics or from institutions of the European Union. In addition, the source-text authors use *mixed collection* as well, as described in section 5.3.

Table 42

Frequencies of "mixed collection" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
mixed collection	357.000	6.130	21.300	8
mixed collection + waste	84.300	1.090	1.690	4
mix collection	699.000	227	1.440	0
mix collection + waste	149.000	57	8.580	0

The definition for *mixed collection* was based on the case study by Pires et al. (2017).

mixed collection	combination of methods for waste collection, e.g. curbside collection and drop-off points

6.17.2 Dutch

The Dutch term equivalent could not be derived from a document in EUR-Lex, whereas for relevant documents containing *mixed collection* no multilingual variants were available. However, IATE contains an entry for *mixed waste* and an entry for *selective collection* ("IATE - Entry ID 1390587," n.d.; "IATE - Entry ID 1427097," n.d.). For *mixed waste* the Dutch term equivalent *gemengd afval* is provided, and the entry for *selective collection* includes the Dutch translation *selectieve inzameling.* From *mixed waste* the translation for *mixed* is obtained, and from *selective collection* the translation for *collection.* These are combined and after morphological alterations this results in *gemengde inzameling.* The Dutch term *gemengde inzameling* is probably solely used in relation to *afval* as the amounts of results yielded by

gemengde inzameling are similar to the frequencies of *gemengde inzameling + afval.*

Table 43

Frequencies of Dutch term for "mixed collection" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
gemengde inzameling	658	2	2	2
gemengde inzameling + afval	751	2	2	2

As the Dutch term equivalent results in little reliable sources, the Dutch term definition is based on the English term definition. The English definition is based on Pires et al. (2017).

gemengde inzameling	combinatie van systemen om afval in te zamelen, e.g. vuilniswagens die langs de deuren rijden en glasbakken waar glasafval naartoe kan worden gebracht

6.18 Economic allocation

According to ISO 14044 (2006), *allocation* refers to the division of input and output flows of a products system over one or more related product systems. It is the opposite of *system expansion* in which the product system is expanded to include other product systems. There are different types of allocation, such as physical allocation and economic allocation. In physical allocation the input and output flows are divided based on physical characteristics of the products, e.g. volume or mass (Ponsioen, 2015). In this section, an entry for *economic allocation* will be proposed. In economic allocation the input and output flows are divided based on the economic value of products and co-products (Chen, Habert, Bouzidi, Jullien, & Ventura, 2010).

6.18.1 English

Economic allocation yields 56.500 results in Google, 8.480 in Google Scholar, 16.300 in Google Books and 13 in EUR-Lex. However, *economic allocation* can also be applied to

waste and to LCA, thus, queries are performed for *economic allocation* including these terms. *Economic allocation + waste* results in 31.300 hits in Google, 3.500 in Google Scholar, 2.100 in Google Books and 4 hits in EUR-Lex. The combination of *economic allocation* and *LCA* yielded the lowest amount of results of these three queries: 12.600 in Google, 2.820 in Google Scholar, 1.120 in Google Books and 2 in EUR-Lex.

Table 44

Frequencies of "economic allocation" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
economic allocation	56.500	8.480	16.300	13
economic allocation + waste	31.300	3.500	2.100	4
economic allocation + LCA	12.600	2.820	1.120	2

The definition included in the term fiche for *economic allocation* is based on Chen et al. (2010) and in the term fiche additional information is added, as Chen et al. (2010) state that economic allocation can be unstable due to dynamic market prices (see: appendix S) (p. 1238).

economic allocation	distribution of environmental burdens related to the production over products within the investigated system and other product systems based on economic value of products and co-products

6.18.2 Dutch

The Dutch term equivalent for *economic allocation* was derived from 2013/179/EU: Commission Recommendation (CELEX:32013H0179). In this document *economic allocation* is translated as *economische allocatie.* Before *economische allocatie* will be elaborated on further, first the Dutch term equivalent for *allocation* in IATE entry 45110 will be discussed ("IATE - Entry ID 45110," n.d.). In the entry in IATE for *allocation* within the domain of Finance and Environment, the Dutch term equivalents provided for *allocation* are *bestemming* and *toewijzing.* In the process described in section 5.4, the translation of *toewijzing* was obtained from this entry ("IATE - Entry ID 45110," n.d.). However, it is important to consider text-internal coherence regarding term translations for *allocation* and *economic allocation.*

First, the frequencies of *economische allocatie* were compared to the frequencies of *economische toewijzing. Economische allocatie* yielded significantly more results in all search engines, also when *LCA* was included. Thus, for the Dutch term equivalent for *economic allocation* the use of *economische allocatie* was preferred. Subsequently, search queries were done for *allocatie* and *toewijzing.* Whereas more results are yielded for *toewijzing* than for *allocatie,* these differences level when *LCA* in included in the query. In Google Scholar there are even more results for *allocatie* + *LCA* than for *toewijzing* + *LCA* (see: table 45). Thus, it is suggested to add *allocatie* to the Dutch term level in IATE entry 45110. For the target text within this study *allocatie* will be used as Dutch term equivalent for *allocation,* as well when it is included in the multi-word term *economic allocation.*

Table 45

Frequencies of "economic allocation" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
economische allocatie	425	61	17	4
economische toewijzing	215	1	0	2
economische allocatie + LCA	271	38	0	1
economische toewijzing + LCA	0	0	0	0
toewijzing	1.450.000	13.000	57.600	25.804
toewijzing + LCA	8.660	107	215	20
allocatie	189.000	6.290	10.600	916
allocatie + LCA	1.510	160	320	6

The Dutch term definition is based on (Kool et al., 2009).

economische allocatie	verdeling van milieudruk die wordt veroorzaakt door de productie over alle producten binnen het onderzochte systeem en andere productsystemen op basis van de economische waarde van producten en bijproducten

6.19 Raw material extraction

From the source text the term *raw material extraction* was derived. E*xtraction of raw material* also occurred in the source text, and this relates to the same concept: taking virgin

natural resources from the environment to use them in production. However, some of these raw materials are not renewable and overexploitation of natural resources may lead to depletion (Söderholm, 2011). Raw material extraction can (partly) be substituted by reusing and recycling materials and to promote this some countries add a tax to raw materials to discourage its use (Söderholm, 2011).

Within LCA raw material extraction is the first step in the product's life cycle, depicting the cradle phase (Pleanjai, Gheewala, & Garivait, 2007).

6.19.1 English

In the source text two terms refer to the same concept, *raw material extraction* and *extraction of raw material.* In the search queries for the English term level both terms are included. The search queries are expanded with *virgin material extraction* and *extraction of virgin material,* as virgin material can also be used in this context. The terms containing *virgin material* will not be included in the term fiche, whereas the frequencies are significantly lower than the frequencies of terms containing *raw material.* In the proposed entry English term levels are added for both *raw material extraction* and *extraction of raw material.* This is based on frequency both terms yield high amounts of terms in Google, Google Scholar and Google Books. However, *raw material extraction* is included in the first term fiche, as its frequency is significantly higher than the frequencies of *extraction of raw material* (see: table 46).

Table 46

Frequencies of "raw material extraction" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
raw material extraction	252.000	13.500	11.300	54
extraction of raw material	1.360.000	1.660	16.800	6
virgin material extraction	6.600	214	587	0
extraction of virgin material	10.000	74	181	0

The definition for *raw material extraction* was based on Bruckner, Giljum, Lutz, & Wiebe

(2012) and Söderholm (2011). Additional information is added to the term fiche based on these sources as well (see: appendix T).

raw material extraction; extraction of raw material	deriving virgin resources from the environment to use them in production

6.19.2 Dutch

The Dutch term equivalent was obtained from *Opinion of the European Economic and Social Committee* (CELEX:52009AE0880) in which *raw material extraction* is translated with *grondstoffenwinning.* However, other variants were included in the search queries as well, such as morphological variants. Variants including *ruwe grondstoffen* were excluded from the term fiche as these resulted in the lowest amounts of results in all search engines. In the proposed entry *grondstoffenwinning*, *grondstofwinning* and *winning van grondstoffen* are added in the term levels, as they all are used in academic text in Google Scholar and text from the European Union in EUR-Lex. Though their frequency varies, all variants are relevant, as is reflected in the contextual references added in the proposed term fiche (see: appendix T).

Table 47

Frequencies of Dutch terms for "raw material extraction" in Google, Google Scholar, Google Books and EUR-Lex

Terms	Google	GS	GB	EUR-Lex
grondstoffenwinning	5.740	156	273	16
grondstofwinning	10.200	268	234	10
ruwe grondstoffenwinning	1	0	85	0
winning van grondstoffen	28.200	208	909	89
winning van ruwe grondstoffen	402	2	1	1

The definition for the Dutch term equivalent was based on the English term definition.

grondstoffenwinning; grondstofwinning; winning van grondstoffen	het onttrekken van ruwe materialen aan de natuur voor productiedoeleinden

6.20 Other source-text term translations

83 source-text terms were not of not sufficiently represented in the IATE database. In this chapter, new entries or alterations to current entries were proposed for 21 terms. Thus, 62 terms remain which are not represented in the IATE database nor by newly proposed term fiches. However, these terms are part of the source text that will be translated in the next chapter of this study. For this translation process Dutch term equivalents of these terms must be obtained. In appendix U a table is included with these source-text terms, their Dutch term equivalents and the source from which the Dutch term equivalent was obtained. Frequently used sources are texts from EUR-Lex and partially overlapping terms represented in IATE.

7. Translation

This chapter contains the English source text and the Dutch target text. First, the translation will be addressed. Subsequently, a table if provided containing the target text alongside the source text.

Memsource was used to produce the target text, as the CAT tool offers a segmentation based on sentence level. This makes it easier to perform the translation task. However, Memsource was mainly selected because of the possibility to create a termbase. English terms and their Dutch equivalents were added to the termbase before and during the translation process. A termbase enables the translator the manage terminology consistently, as the termbase suggests previously added Dutch term equivalents during the translation process. For some concepts, multiple related terms were added in relation to each other. However, during the translation process, text-internal coherence was monitored. The extracted termbase in included in the external appendix *Termbase Memsource*.

After the first draft of the target text was produced in Memsource, the target text was extracted and further processed in this chapter. In the table below, the source text is displayed on the left and the target text on the right. This does not only reflect the structure of Memsource, but also provides a means to contrast the source and target text directly. However, in this chapter, the source text is segmented according to sections rather than sentences. Consequently, the target-text's structure was altered, and additional changes to the content of the target text were also made during this process. Furthermore, the contents of figures and tables was altered to include the Dutch target text and alterations were made to the font of titles and English terms used in the target text.

Appendix V contains the original source-text fragment, and in appendix W, the target text is included. In the target text in appendix W, a reference list is included as well. As Memsource was merely used for term management and only a first draft of the target text was

produces, this target-text version is not included in this study.

In the source text, all terms are underlined to reflect the amounts of terms present. The different types of lines reflect whether there is an entry for the term in IATE, if a term fiche was produced for the term, or that the Dutch term equivalent was obtained from another source in section 6.20. The distinction if made as follows: terms represented in IATE receive a dotted underlining, term for which term fiches were made receive thick underlining, and terms for which the Dutch term translations was based on another source will receive a double underlining. Through this distinction it is made clear which portion of terms was not reflected in IATE, and which occurred in the parallel corpus.

There is overlap between different terms, such as *waste management* and *waste management system.* When this overlap occurred, the largest multi-word term was underlined according to its category. Terms in figures and tables were not underlined, resulting in the omission of a few terms as *secondary metal.* For terms that occur in singular form, plural was underlined as well. In addition, abbreviations of *life cycle assessment* (LCA), *life cycle inventory* (LCI), and *life cycle impact assessment* (LCIA) were included as well.

In this chapter, footnotes were added to address translation relevant source-text aspects beyond terminology. Factors included are spelling errors, structural remarks, and remarks regarding the use of sources. If necessary, the classification by Nord (2005) will be used. Nord's classification contains pragmatic translation problems caused by difference in source-text and target-text audience, convention-related translation problems caused by culture-specific norms and conventions, linguistic translation problems that occur between two specific languages, and text-specific translation problems that only occur in the specific text and are hard to generalize (2005, pp. 174-176).

Table 48. Source text and target text

Source text	Target text
Chapter 11	Hoofdstuk 11
Assessment[1] and Improvement[2]	Analyse en verbetering
Abstract	Samenvatting
Today's environmental concerns are related to the population and its consumption of resources, which have led to significant ecological global changes, such as climate change and resources overexploitation. The solid waste management, in an integrated way, has been capable of influencing and contributing to the solution of such challenges[3]. The purpose of this chapter is to discuss the assessment and improvement of the waste collection system by using	De huidige milieuproblemen komen voort uit het grondstoffenverbruik dat wereldwijd tot significante ecologische veranderingen heeft geleid, zoals klimaatverandering en overexploitatie van natuurlijke hulpbronnen. Het beheer van vast afval kan, als dit op geïntegreerde wijze wordt uitgevoerd, dit beïnvloeden en bijdragen aan de oplossing voor deze problematiek. In dit hoofdstuk wordt besproken hoe afvalinzamelingssystemen

[1] In de context van de brontekst wordt 'assessment' in verschillende combinaties met *beoordeling* of *analyse* vertaald. Het hoofdstuk waar 'Assessment and Improvement' de titel van is, gaat echter voornamelijk over levenscyclusanalyse ('Life Cycle Assessment') en daarom is er gekozen voor het gebruik van *analyse* in de titel.
[2] In Engelstalige titels krijgt elk inhoudswoord een hoofdletter, maar in het Nederlands krijgt alleen het eerste woord in titels en kopjes een hoofdletter. Dit is een talenpaarspecifiek vertaalprobleem ('linguistic translation problems') volgens de categorieën van Nord (2005).
[3] In de brontekst wordt eerst gesproken over 'environmental concerns' en daarna wordt hiernaar verwezen met 'such challenges'. Verderop in de brontekst komt ook een dergelijke verwijzing voor, waarbij eerst wordt gesproken over 'equipment' en daarna hiernaar wordt verwezen met 'devices'. Om het verband tussen zinnen waarin wordt verwezen te verduidelijken, is er in de verwijzende zin hetzelfde zelfstandige naamwoord gebruikt als in de eerste zin. Dit komt de structuur en leesbaarheid van de tekst op microniveau ten goede.

life cycle thinking, with a sustainable perspective. Several methodologies such as life cycle assessment, carbon footprint, life cycle costing, and social life cycle assessment will be presented and discussed concerning its application to waste collection systems and contribution to the integrated waste management system.	kunnen worden geanalyseerd en op een duurzame manier verbeterd kunnen worden vanuit levenscyclusbenadering. Verschillende methodes, zoals levenscyclusanalyse, koolstofvoetafdruk, levenscycluskostenberekening en sociale levenscyclusanalyse worden geïntroduceerd. Daarnaast wordt besproken hoe deze methodes van invloed zijn op afvalinzamelingssystemen en hoe zij kunnen bijdragen aan een geïntegreerd afvalbeheersysteem.
Keywords LCA · Social LCA · LCC · Environmental impacts · Public participation · Behavior studies	Sleutelwoorden: LCA; sociale LCA; LCC; milieueffecten; publieksdeelname; gedragswetenschappen
11.1 Life Cycle Assessment and Carbon Footprint	11.1 Levenscyclusanalyse en koolstofvoetafdruk
The life cycle assessment is a process to (a) evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying the energy and materials used, wastes, and emissions released to the environment; (b) assess the impact of those energy and material uses and releases to the environment; and (c) identify and evaluate opportunities that lead to environmental	Levenscyclusanalyse (LCA) is een proces waarmee: a) milieudruk geassocieerd met producten, processen of activiteiten kan worden geëvalueerd door de energie, gebruikte materialen, afval en uitgestoten emissies te identificeren en te kwantificeren; b) het effect van het gebruik van die energie, materialen en uitgestoten emissies kan worden beoordeeld;

improvements (Fava et al. 1991[4]; Consoli et al. 1993). According to the International Organization for Standardization (ISO 14040 2006a), LCA addresses[5] the environmental aspects and potential environmental impacts throughout a product's life cycle, from raw material acquisition through production, use, end-of-life treatment, recycling, and final disposal (i.e., cradle to grave). LCA is divided into four phases: goal and scope definition, inventory analysis, impact assessment, and interpretation. The goal and scope definition intends to define the purposes, specifications, and limits in the evaluation. The inventory analysis phase is responsible for the collection of data of the unit processes within the system and relating it to a functional unit. Impact assessment intends to make inventory	c) mogelijkheden tot verbetering kunnen worden geïdentificeerd en geëvalueerd (Fava et al., 1991; Consoli et al.,1993). Volgens de Internationale Organisatie voor Standaardisatie (ISO) (2006a) worden in LCA milieuaspecten en potentiële milieueffecten behandeld die een rol spelen in de gehele levenscyclus van een product, vanaf de grondstofwinning, via productie, de gebruiksfase, de behandeling in de eindfase van de levenscyclus, recycling en de definitieve verwijdering, oftewel van wieg tot graf. LCA is onderverdeeld in vier fasen: vaststelling van doel en reikwijdte, inventarisatie, effectbeoordeling en interpretatie. In de vaststelling van doel en reikwijdte worden het doel, de specificaties en de beperkingen van de analyse bepaald. Tijdens de inventarisatie worden de gegevens

[4] Verwijzingen in academische literatuur vallen onder de categorie cultuur specifieke vertaalproblemen ('convention-relation translation problems') van Nord (2005), omdat er sprake is van genreconventies die verschillen. Zowel in de brontekst als in de doeltekst wordt er gebruikt gemaakt van APA, maar in het Nederlands zijn de conventies anders en de referenties uit de brontekst dienen te worden aangepast. Daarnaast zal wat bronnen betreft de Nederlandse doeltekst als opzichzelfstaande tekst worden behandeld en worden (indien overeenkomstig met APA) alle auteurs de eerste keer genoemd.

[5] In de brontekst is sprake van een personificatie door te stellen dat de LCA, een niet-menselijke entiteit, iets doet, in plaats van dat er iets mee kan worden gedaan. Dit fenomeen komt vaak voor in de Engelse taal, maar is niet toegestaan in de Nederlandse taal. Dit is een vertaalprobleem dat specifiek is voor deze talenpaarcombinatie ('linguistic translation problems') volgens de classificatie van Nord (2005).

information more understandable through its translation into environmental impact categories. Final interpretation allows evaluating results obtained and comparing them with the initially defined goal (ISO 14040 2006a). LCA applied to solid waste collection systems can serve two purposes: to evaluate the service provided (in terms of technology implemented) and find where more environmental impact is occurring and to evaluate which level of source separation (number of streams and quality of material source separated, recycling rate) should be promoted, to reach higher amounts of recyclables and higher quality of recyclables collected in such a way that could be beneficial to the environment. LCA has been applied to solid waste management since the 1990s to treatment and recovery technology processes, where the focus on specific collection and recycling schemes is being increasing more recently.	van de eenheidsprocessen uit het systeem verzameld en gerelateerd aan de functionele eenheid. In de derde fase wordt een effectbeoordeling uitgevoerd waarin de informatie uit de inventarisatie wordt vertaald naar milieueffectcategorieën. In de interpretatie worden de verkregen resultaten geëvalueerd en worden deze vergeleken met het doel dat in de eerste fase is vastgesteld (ISO, 2006a). LCA kan op twee manieren worden toegepast op inzamelingssystemen van vast afval. Ten eerste kan het gebruikt worden om (de geïmplementeerde technologie in) de dienst te evalueren en te bepalen waar de meeste milieueffecten plaatsvinden. Daarnaast wordt met LCA bepaald welk niveau van bronscheiding (aantal stromen, de kwaliteit van het materiaal en de recyclingsnelheid) leidt tot de recycling van meer materiaal en gerecycled materiaal van een betere kwaliteit. De inzameling hiervan wordt tevens bekeken vanuit een duurzaamheidsperspectief. Sinds de jaren ‘90 wordt LCA al toegepast op bepaalde aspecten van het beheer van vast afval, zoals

	behandelingsprocessen en winningstechnologieën, maar sinds kort wordt er ook steeds meer aandacht besteed aan inzameling en recyclingprogramma's.
11.1.1 Goal and Scope Definition	11.1.1 Vaststelling van doel en reikwijdte
For a waste collection system, the goal of an LCA study depends on the type of decision-making process: a microlevel decision, where the decision to be made will not impact the background system, and a meso/macro-level, which can impact the background system. The micro-level decision is only devoted to the technical analysis and environmental inventory of the waste collection sector. Meso/ macro-level is related to the analysis of strategies with large-scale to background sector (like the market for recyclables), which are related to studies on a national scale, with implications on national and international plans. To understand which type of LCA to perform, foreground and background systems must be defined. In a waste collection system LCA study, the foreground system is the waste	Het doel van de LCA binnen afvalinzamelingssystemen is afhankelijk van het besluitvormingsproces. Het besluitvormingsproces kan plaatsvinden op microniveau, hierbij is er geen invloed op het achtergrondsysteem, of op het meso- of macroniveau, waarbij er wel invloed wordt uitgeoefend op het achtergrondsysteem. Het besluitvormingsproces op microniveau heeft alleen betrekking op de technische analyse en de milieu-inventarisatie van de afvalinzamelingssector. Op het meso- en macroniveau worden ook omvangrijkere aspecten geanalyseerd die invloed hebben op de achtergrondsector, zoals de markt voor recycleerbare materialen. Deze aspecten zijn verbonden aan nationale onderzoeken en de implicaties hiervan strekken zich uit tot op nationaal en internationaal niveau. Om

collection system to be analyzed, where real data will be gathered related to the collection and transport and to waste container production and transport; the background system is generic data which is more related to the electricity grid, for example.	te bepalen wat voor soort LCA er moet worden uitgevoerd, moeten eerst het voorgrond- en achtergrondsysteem worden gedefinieerd. Het voorgrondsysteem bestaat uit het afvalinzamelingssysteem dat wordt geanalyseerd. Hierop zijn gegevens uit de praktijk van toepassing, zoals over de inzameling en het transport van afval, maar ook over de productie en het transport van afvalcontainers. Het achtergrondsysteem bestaat uit generieke gegevens die bijvoorbeeld betrekking hebben op het elektriciteitsnet.
Functions of the System, the Functional Unit, and Reference Flow	Systeemfuncties, de functionele eenheid en referentiestromen
At a glance, a waste collection system just performs one function[6]: allows the temporary deposition of waste, its collection, and transport to a specific destination. However, the destination can also be included in the LCA, because waste collection can influence its destination. If packaging waste is source separated, it has recycling features; if organic waste is source separated, the production of a	Op het eerste gezicht lijkt de functie van een afvalinzamelingssysteem duidelijk afgebakend: de tijdelijke opslag van afval, de inzameling van dat afval en het transport van het afval naar een specifieke bestemming. De bestemming kan echter ook worden betrokken bij de LCA, omdat afvalinzameling van invloed is op de bestemming. Als verpakkingsafval aan de bron wordt gescheiden, kan het worden

[6] De brontekst is hier niet duidelijk, er wordt gesteld dat een afvalinzamelingssysteem maar één functie heeft en vervolgens worden er drie functies genoemd. In de doeltekst is dit aangepast door te stellen dat het lijkt alsof een afvalinzamelingssysteem een duidelijk afgebakende functie heeft, hier kunnen wel meerdere aspecten onder vallen.

high-quality compost occurs. Even if the waste results from mix collection, it can also generate electric energy.[7] When mixed waste collected is send for mechanical-biological treatment (by anaerobic digeston[8]), or to incineration or even at the landfill, the biogas is generated and used to produce electric energy. The way how the system is defined will determine the number of functions of the system, and, if multifunctionality occurs, it has to be solved. A possible functional unit is the collection of a specific amount of waste generated in a period by a specific group of inhabitants, for example, the selective collection service of 1500 tons a month of MSW generated in an urban locality with a density of 5000 inhabitants/km2 applied by Iriarte et al. (2009). Related to the functional unit is the	gerecycled en wanneer organisch afval aan de bron wordt gescheiden, kan er compost van hoge kwaliteit van worden gemaakt. Gemengd afval, of afval dat niet gescheiden is ingezameld, kan mechanische biologische behandeling ondergaan (zoals anaerobe vergisting), worden verbrand of worden gestort. Met het biogas dat dan wordt gegenereerd, kan elektriciteit worden opgewekt. [9]Hoe het systeem is gedefinieerd, bepaalt hoeveel functies er binnen het systeem zijn en of het systeem multifunctioneel is. Een mogelijke functionele eenheid is de inzameling van de hoeveelheid afval die een bepaalde groep mensen in een specifieke periode produceert. Aan de functionele eenheid is een referentiestroom verbonden waarmee de in- en uitvoergegevens worden genormaliseerd

[7] Deze zin is sterk gerelateerd aan de volgende zin en er is zelfs gedeeltelijke overlap tussen deze zinnen. In de doeltekst zijn de twee zinnen samengevoegd.
[8] De auteurs van de brontekst benoemen een proces waarmee afval kan worden behandeld, maar deze term is verkeerd gespeld. De juiste Engelse term is 'anaerobic digestion'. In de brontekst komen echter meer instanties voor van termen met spelfouten of met verkeerd geplaatste of inconsistent gebruikt van koppeltekens, een paar voorbeelden: 'cutoff approach' en 'cutoff method' (waar 'cut-off approach' en 'cut-off method' vaker worden gebruikt in academische literatuur) en 'gate-togate' (terwijl 'cradle-to-cradle', 'cradle-to-gate' en 'cradle-to-grave' wel correct van koppeltekens worden voorzien).
[9] In de brontekst is het fragment onder 'Functions of the System, the Functional Unit, and Reference Flow' niet opgedeeld in kleinere segmenten door bijvoorbeeld het gebruik van alinea's. In de doeltekst zijn wel alinea's aangebracht, omdat er op het punt van deze voetnoot over wordt gegaan op een ander onderwerp onder dit kopje. De alinea's helpen de lezer differentiëren tussen de verschillende onderwerpen die worden aangeboden.

reference flow for the normalization of input and output data (Chang and Pires 2015). In the case of Iriarte et al. (2009), the reference flow considered the theoretical recovery of 100% for the fractions: organic, paper, packaging, and glass present in the MSW. When comparing waste collection system for a specific waste stream, waste properties need to be studied, to ensure that the functional unit and the reference flow are the same. It is common that different waste collection vehicles have different waste compaction rates, changing the density of waste collected. Density is just one of the critical physical properties, but also moisture can be relevant for the collection of biodegradable waste or waste paper and waste cardboard.	(Chang & Pires, 2015).[10] Iriarte, Gabarrell & Rieradevall (2009) hebben onderzoek gedaan naar de selectieve inzameling van 1500 ton gemeentelijk vast afval (MSW) dat elke maand wordt geproduceerd door een stad met 5000 inwoners per vierkante kilometer. In dit onderzoek bestond de referentiestroom uit de theoretische winning van 100% van de organische materialen, papier, verpakkingsmateriaal en glas in het MSW (Iriarte et al., 2009). Als verschillende inzamelingssystemen worden vergeleken voor een bepaalde afvalstroom, moeten de functionele eenheid en de referentiestroom hetzelfde zijn. Dit kan worden bepaald door de eigenschappen van het afval te bestuderen, zoals de afvaldichtheid. Als verschillende soorten vuilniswagens afval verdichten met verschillende snelheden, verandert de afvaldichtheid, één van de essentiële fysieke eigenschappen van afval. Het vochtgehalte is tevens

[10] De structuur van de brontekst is aangepast in de doeltekst, omdat het verband tussen zinnen zo duidelijker wordt. In de doeltekst komt nu eerst de functionele eenheid en het belang van de referentiestroom aan bod en daarna wordt dit pas uitgelegd aan de hand van een voorbeeld. In de brontekst is de zin over de rol van de referentiestroom binnen de functionele eenheid ongelukkig geplaatst (binnen de bespreking van een casestudy) waardoor het algemene belang van de referentiestroom niet voldoende overkomt.

	van belang, bijvoorbeeld voor de inzameling van biologisch afbreekbaar afval, papierafval en kartonafval.
System Boundaries	Systeemgrenzen
The waste collection system studied in the LCA can be: • The service provided by a municipality or a private company. • The number of recyclables collected by the collection system. From a generic point of view, the waste collection system to be analyzed has, in the beginning, the stages of temporary deposition (containers) and waste collection vehicles. The frontiers of the waste collection also need to be addressed. The frontiers can be related to geographic locations, timescales, and technical components. Considering the technical components, LCA studies can be cradle-to-grave (starts with the extraction of materials, going through all life cycle[11]), cradle-to-gate (from raw material extraction, going until the	Het afvalinzamelingssysteem dat wordt onderzocht met LCA kan bestaan uit de dienst die wordt geleverd door een gemeente of een privaat bedrijf, of het aantal recycleerbare materialen dat wordt ingezameld binnen het inzamelingssysteem. De beginfase van het onderzochte afvalinzamelingssysteem bestaat over het algemeen uit de tijdelijke opslag van afval in vuilnisbakken en uit vuilniswagens, maar ook aspecten aan de grens van het systeem moeten worden geanalyseerd. Deze aspecten kunnen betrekking hebben op technische componenten, geografische locaties en tijd. Wat de technische componenten betreft, kan een LCA worden uitgevoerd van wieg tot graf (vanaf de grondstofwinning door alle

[11] Alle auteurs van de brontekst zijn verbonden aan de New University of Lisbon en hebben waarschijnlijk de Engelse taal niet als moedertaal aangeleerd. Helaas is dit op meerdere punten in de brontekst zichtbaar en zijn verschillende zinnen op onidiomatische wijze geformuleerd. In de voorbeelden zijn de probleemgebieden gemarkeerd met een dikgedrukt lettertype. Oniomatisch taalgebruik betreft de onjuiste verwerking van enkelvoud en meervoud zoals in 'LCA studies can be cradle-to-grave (starts with the extraction materials, going through all **life cycle**)' en 'Multifunctionality is related to **a** multi-output and multi-input **processes** (or systems).' Daarnaast ontbreken er in sommige zinnen

product leaves the factory), gate-togate (only regards a manufacturing process), and cradle-to-cradle (with a metabolic view where no waste exists) (Chang and Pires 2015). In waste collection systems, LCA can be only cradle-to-gate if the intention is to assess a particular waste collection technology without the use phase (like an environmental product declaration for waste bins), or the waste collection system itself can be a cradle-to-gate of the entire waste management system. A cradle-to-cradle applies to reverse logistic cases when the product is not waste or is for reuse. A typical waste collection LCA is a cradle-to-gate, or a streamlined LCA (also named screening and matrix LCA) because the assessment is only for a part of the life cycle. The definition is also applied when the LCA is not assessing all the environmental impact categories (Crawford 2011). The case study on Box 11.1 is an example of a streamlined LCA at recycling schemes.	fasen van de levenscyclus), van wieg tot poort (van grondstofwinning tot het product de fabriek verlaat), van poort tot poort (alleen het productieproces) of van wieg tot wieg (vanuit het perspectief van een ecosysteem waarin afval niet bestaat) (Chang & Pires, 2015). Als LCA wordt gebruikt om een specifieke afvalinzamelingstechnologie te analyseren zonder de gebruiksfase hierbij te betrekken, dan is er sprake van een analyse van wieg tot poort, zoals een milieuproductverklaring voor vuilnisbakken. Binnen het gehele afvalbeheersysteem kan het afvalinzamelingssysteem ook worden gezien als de fase van wieg tot poort. Een standaard LCA wordt vaak op slechts één deel van de levenscyclus van een product toegepast, net zoals een gestroomlijnde LCA (ook wel een screening of matrix LCA genoemd), en vindt daardoor plaats van wieg tot poort. In box 11.1 wordt een casestudy besproken waarin recyclingprogramma's zijn onderzocht met een gestroomlijnde LCA. Als niet alle milieueffectcategorieën worden

functiewoorden en worden verkeerde collocaties gebruikt: 'To conduct an LCA **is also needed** to **have in consideration** aspects related to geographic boundaries and time horizons.'

	beoordeeld in een LCA, is er ook sprake van wieg tot poort (Crawford, 2011). Retourlogistiek heeft een benadering van wieg tot wieg, omdat producten niet als afval worden beschouwd of worden hergebruikt.
Box 11.1 Comparison of Recycling Schemes in Portugal (Pires et al. 2017)	Box 11.1 Vergelijking van recyclingprogramma's in Portugal (Pires, Sargedas, Miguel, Pina, & Martinho, 2017)
A comparative study based on LCA and economic analysis through indicators was conducted for three waste collection systems for packaging waste in a municipality in Portugal. The analysis compares the environmental impact of existing collection systems and the costs involved in the operation of those systems. For the LCA, Umberto 5.5 software package was used. Three waste recycling systems were compared: a curbside system, where all non-glass packaging waste is collected by the curbside bags; a drop-off system, where all packaging waste is collected by drop-off containers; and a mixed system, where glass is deposited at drop-off containers and lightweight packaging is	In 2017 deden Pires et al. een vergelijkend onderzoek naar drie afvalinzamelingssystemen voor verpakkingsafval in een gemeente in Portugal op basis van LCA en een economische analyse. Voor de LCA werd de software Umberto 5.5 gebruikt en in de economische analyse werd een vergelijking gemaakt tussen de milieueffecten van de huidige inzamelingssystemen en wat deze systemen kosten. Er werden drie systemen vergeleken: een ophaalsysteem, waarbij al het verpakkingsafval (met uitzondering van glas) wordt opgehaald in vuilniszakken, een inleversysteem, waarbij verpakkingsafval wordt verzameld in inlevercontainers, en een gemengd systeem waarbij glas naar inlevercontainers wordt gebracht en lichtgewicht

deposited at drop-off and curbside systems. The LCA was used to analyze the environmental impacts, but only the collection system was assessed (the subsequent recycling was excluded). The results showed that the curbside system was less favorable economically and environmentally due to the more packaging and more fuel consumption per ton of waste, compared to drop-off collection system. Optimization of the curbside system is needed, through the use of reusable boxes and efficient collection routes (SEP 2018).	verpakkingsafval zowel wordt ingeleverd als opgehaald. De milieueffecten werden geanalyseerd met LCA, maar alleen het inzamelingssysteem werd beoordeeld en niet de recycling. Pires et al. (2017) concludeerden dat het ophaalsysteem duurder is en slechter voor het milieu dan het inleversysteem, omdat er meer vuilniszakken nodig zijn om het afval aan de straat te zetten en het brandstofgebruik hoger is per ton afval. Het ophaalsysteem kan geoptimaliseerd worden door het afval in herbruikbare boxen aan de straat te zetten en door efficiënte ophaalroutes (SEP, 2018).
In a waste collection LCA, there is no need to include the environmental impacts resulting from the extraction of material and production of goods that originate waste, neither product reuse with the application of the "zero burden assumption." The zero burden assumes that waste brings no upstream environmental impacts into the waste collection system neither to the waste management system (Ekvall et al. 2007). Such can be applied because all product life	Als de *zero burden-benadering* wordt toegepast op LCA van afvalinzameling, dan worden milieueffecten door grondstofwinning, het productieproces van producten die tot afval leiden en het hergebruik van producten niet meegewogen. Volgens de zero burden-benadering worden stroomopwaartse milieueffecten van afval niet meegenomen naar het afvalbeheersysteem en zo ook niet naar het afvalinzamelingssysteem dat daar onderdeel van is (Ekvall, Assefa,

cycle phases previous to the waste phase occur in the same way in the next waste collection alternatives. To conduct an LCA is also needed to have in consideration aspects related to geographic boundaries and time horizons. Concerning geographic boundaries, the waste collection systems are typically local and regional, but also can be national or international, when materials collected are sent to recycling, which can be outside the borders of the country. Data referent to process far from the place where waste collection efficiently occurs can be hard to collect (Chang and Pires 2015). In the case of time horizon, the functional unit in a waste collection system can be dependent on the respective year or another time unit, which is the case of the amount of waste generated and collected, which is not constant through the years, with fluctuations during the year. There is the need to identify the time horizon of the analysis appropriately. When conducting an LCA for a waste collection system which the system is only the collection	Björklund, Eriksson, & Finnveden, 2007, p.990). Er wordt namelijk gesteld dat alle fasen in de levenscyclus van een product, voorafgaand aan de fase waarin iets als afval wordt gezien, op dezelfde manier worden doorlopen, onafhankelijk van het afvalinzamelingssysteem. In LCA moeten de geografische grenzen en de tijdshorizon ook in overweging worden genomen. Wat de geografische grenzen betreft, zijn afvalinzamelingssystemen vaak lokaal en regionaal georganiseerd, maar ze kunnen ook plaatsvinden op nationaal of internationaal niveau als materialen worden gerecycled in het buitenland. Het kan echter moeilijk zijn om gegevens te achterhalen van processen die zich ver van de locatie van de afvalinzameling afspelen (Chang & Pires, 2015). De functionele eenheid binnen een afvalinzamelingssysteem kan worden verbonden aan het kalenderjaar of een andere tijdseenheid, dit is de tijdshorizon. Dit is van belang voor de hoeveelheid afval die wordt geproduceerd en ingezameld, omdat deze fluctueert gedurende het jaar en verschilt van jaar tot jaar. Het is belangrijk om een gepaste

itself, there is the need to include equipment and infrastructure data. In this situation, the useful life of devices needs to fit into the functional unit period. Another aspect to be defined during the goal and scope definition is the allocation procedure. According to ISO (2006b), allocation represents the portioning of input and output flows of a process or a system concerning the system under analysis and one or more other systems. Allocation applies[12] in cases of multifunctionality and when open recycling inside the system occurs (Ekvall and Tillman 1997). Multifunctionality is related to a multi-output and multi-input processes (or systems).[13] A multi-output process occurs when a single system produces more than one product	tijdshorizon te kiezen voor de LCA. Als er een LCA wordt uitgevoerd voor een afvalinzamelingssysteem waarbij afval alleen wordt ingezameld, moeten middelen en gegevens over infrastructuur ook in de LCA worden betrokken. De gebruiksduur van die middelen moet binnen de periode van de functionele eenheid vallen. Tijdens de vaststelling van het doel en de reikwijdte moet tevens de allocatieprocedure worden gedefinieerd. Volgens de ISO (2006b) wordt met allocatie de invoer- en uitvoerstroom van een proces of een productsysteem verdeeld tussen het productsysteem dat wordt onderzocht en een of meerdere andere productsystemen. Als het productsysteem multifunctioneel is of als er open-lus recycling voorkomt binnen het systeem, kunnen er problemen met allocatie

[12] In Ekvall & Tillman (1997) wordt gesteld dat 'The allocation problem occurs when an LCA includes multifunctional processes. It also occurs in open-loop recycling, i.e. when recycling results in material or energy being used in more than one product.' (p. 155). Dit is vervlakt in de brontekst waarin wordt gesteld dat er allocatie plaatsvindt binnen bepaalde systemen, maar er niet wordt gezegd dat er problemen met allocatie kunnen optreden. Aangezien Pires et al. (2018) zich zo duidelijk op deze specifieke zin van Ekvall & Tillman (1997) baseren, is het fragment in de doeltekst aangepast op basis van die bron. In deze bron wordt niet van 'open recycling' gesproken, maar van 'open-loop recycling'. In de brontekst is dit aangepast door de Nederlandse termequivalent voor *open-loop recycling* te gebruiken.

[13] In de brontekst wordt eerst uitvoer genoemd en daarna de invoer. In de doeltekst heb ik dit aangepast, omdat het logischer is om eerst de invoer te bespreken, aangezien deze ook eerder aan bod komt in een analyse. Het verdere verloop van de tekst is hier ook op aangepast.

or only one product is processed inside the system and at least one product is generated and is used outside the system (what is called a coproduct) (Klöpffer and Grahl 2014). A multi-input process in waste management systems occurs when several waste streams are collected and treated, while LCA tries to isolate one of them (Tillman 2010). When a product is recycled not at the same product but in a different one, it is a case of open recycling (Tillman 2010). The way how to proceed to solve them[14] is different if the LCA is of attributional type or consequential type, although there is no universal consensus. In general, the multioutput systems in waste management is usually solved by system expansion/substitution, whatever is an attributional or a consequential LCA, by ISO (2006b) and recommendations from EC-JRC-IES (2010). In a first step, system expansion is performed until all expanded systems produce the same quantities of the coproducts identified in the system, and in	optreden (Ekvall & Tillman, 1997). Er is sprake van open-lus recycling als materiaal of energie dat afkomstig is uit het recyclingproces voor meer dan één productsoort wordt gebruikt (Tillman, 2010, p. 155). Multifunctionaliteit heeft betrekking op processen of systemen die een meervoudige in- of uitvoer hebben. Afvalbeheersystemen hebben een multi-invoerproces als er verschillende afvalstromen worden ingezameld en behandeld, terwijl LCA vaak op slechts één afvalstroom wordt toegepast (Tillman, 2010). Multi-uitvoerprocessen komen voor als er meerdere producten worden geproduceerd in één productsysteem, of als er minstens één product wordt gegenereerd dat buiten het productsysteem wordt gebruikt, oftewel een bijproduct (Klöpffer & Grahl, 2014). Hoe problemen gerelateerd aan allocatie opgelost moeten worden, is afhankelijk van de soort LCA die wordt uitgevoerd, maar er is geen eenduidige richtlijn. Als er sprake is van een meervoudige

[14] In de brontekst is niet duidelijk waar 'them' naar verwijst. Dit is expliciet gemaakt in de doeltekst.

the next step, product outputs and inputs related with the coproducts are subtracted from all expanded systems (Bueno et al. 2015). In the case of multi-input, portioning made by physical or chemical classification is typically conducted (Meijer et al. 2017; Guinée et al. 2002). In the case of recycling allocation, "recycled content approach" (or cutoff approach) and the "end-of-life recycling approach" (or avoided burden approach) are used (Frischknecht 2010) (Fig. 11.1). The cutoff method considers the share of recycled material in the manufacture of the product, where the environmental impacts of recycled material were not attributed to the system under investigation because once recycled, they start a new life in a second product/process (Frischknecht 2010; Zampori and Dotelli 2014)[15]. In the avoided burden approach, the environmental impacts from the	invoer, wordt er standaard allocatie op fysieke of economische grondslag uitgevoerd (Meijer, Kasem, & Lewis, 2017, p. 31; Guinée et al., 2002, p. 677).[16]. Er kan ook allocatie plaatsvinden op basis van recycling, zoals in de benadering voor de inzet van gerecycled materiaal, ook wel de *cut-offbenadering* genoemd, en de benadering voor recycling aan het einde van de levensduur, ook bekend als vermeden impactbenadering, zie afbeelding 11.1 (Frischknecht, 2010). De *cut-offmethode* heeft betrekking op het aandeel van gerecycled materiaal in het productieproces van een ander product (Frischknecht, 2010). Volgens Zampori & Dotelli (2014) begint een gerecycled materiaal een nieuw leven in het onderzochte systeem en worden er daarom helemaal geen milieueffecten van het gerecyclede materiaal meegewogen. Frischknecht (2010) beschrijft echter dat de

[15] Alle informatie in deze zin is afkomstig van Frischknecht (2010). In de doeltekst zijn de referenties aangepast, omdat deze informatie niet afkomstig is uit Zampori & Dotelli (2014).

[16] Zowel Meijer, Kasem & Lewis (2017) als Guinée et al. (2002) beschrijven 'portioning' in relatie tot multi-invoer. Wat ze hiermee bedoelen is allocatie en volgens Guinée et al. (2002) kan dat worden uitgevoerd op basis van de economische waarde en volgens Meijeret al. (2017) op basis van fysieke overeenkomsten. De doeltekst is op basis hiervan aangepast, er wordt gesproken over allocatie en het gedeelte over chemische grondslag wordt vervangen door economische allocatie.

recycling include the system under investigation, avoiding the extraction of raw materials for the production of the product, and relating environmental impacts, crediting them to the product in the system in assessment (Frischknecht 2010; Zampori and Dotelli 2014). According to Pelletier et al. (2015), the multifunctionality needs to be adequately justified, and the different approaches to solving multifunctionality mostly relate to the schools of LCA practitioners, which view the purpose of LCA in different ways:	milieueffecten van de recycling van het materiaal wel worden meegewogen in het onderzochte productsysteem, zoals is weergegeven in afbeelding 11.1. Volgens de vermeden impactbenadering worden er milieueffecten vermeden in een productiesysteem als er gerecyclede materialen worden gebruikt in plaats van grondstoffen, omdat de milieudruk van grondstofwinning en -bewerking wordt vermeden. De voordelen van het gerecyclede materiaal worden toegeschreven aan het product waar het gerecyclede materiaal van afkomstig is (Frischknecht 2010). Volgens ISO (2006b) en de aanbevelingen van het Instituut voor Milieu en Duurzaamheid van de Europese Commissie (*ILCD Handbook*, 2010) kan systeemuitbreiding of vervanging worden toegepast op afvalbeheersystemen met meervoudige uitvoer, onafhankelijk van het soort LCA. Eerst wordt het onderzochte systeem uitgebreid met andere systemen met gedeelde (bij)producten tot het punt waarop geproduceerde hoeveelheden in alle systemen gelijk zijn. Vervolgens worden vermeden in- en uitvoer van de bijproducten in de

andere productsystemen afgetrokken van de in- en uitvoer van het onderzochte systeem (Bueno, Latasa, & Lozano, 2015).

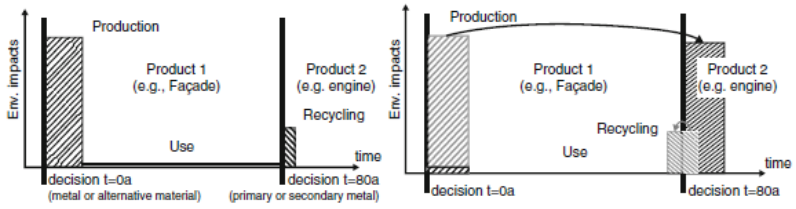
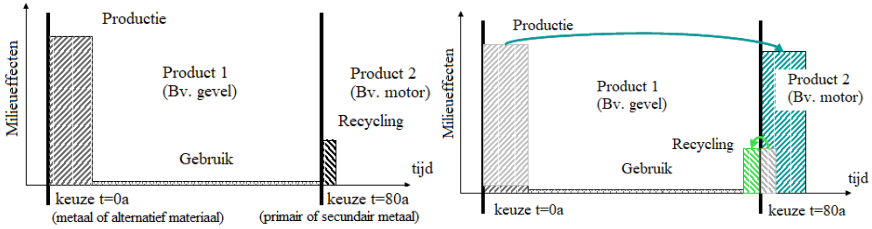


Fig. 11.1 Environmental impacts in the course of time during production, use, and end of life (recycling) of a long-living metal product. Left, recycled content approach; right end-of-life recycling approach. (Source: Frischknecht (2010))



Figuur 11.1 Milieueffecten na verloop van tijd, tijdens productie, gebruik en einde van de levensduur (recycling) van een metaalproduct met lange levensduur. Links: benadering voor de inzet van gerecycled materiaal, rechts: benadering voor recycling aan het einde van de levensduur. (Bron: Frischknecht, 2010, p. 667)

Table 11.1 Alternative multifunctionality hierarchies consistent with competing for understanding of nature, purpose, and conditions necessary to LCA

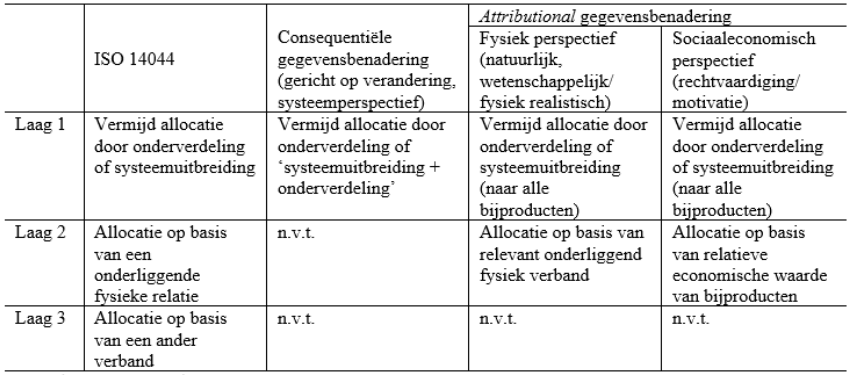
ISO 14044	Consequential data modeling approach	Attributional data modeling approach	
		Physical perspective	Socioeconomic perspective
Tier 1: Avoid allocation via subdivision or system expansion	Avoid allocation by subdivision or "system expansion + substitution"	Avoid allocation by subdivision or system expansion (reporting at level of all coproducts)	Avoid allocation by subdivision or system expansion (reporting at level of all coproducts)
Tier 2: Allocation based on an underlying physical relationship	NA	Avoid based on a relevant underlying physical relationship	Avoid based on a relevant underlying economic value of coproducts
Tier 3: Allocation based on some other reason	NA	NA	NA

Pelletier et al. (2015)

[17]	
multifunctionality is to be solved by system expansion or by physical allocation or by economic allocation (representing allocation based on "some other relationship"). Whatever the school of the practitioner, Pelletier et al. (2015) suggest the alternative multifunctionality to help in making allocation consistent and more transparent to practitioners (Table 11.1).	Volgens Pelletier, Ardente, Brandão, de Camillis & Pennington (2015)[18] hebben deskundigen met verschillende achtergronden verschillende visies op het doel van LCA en of er systeemuitbreiding of allocatie moet worden toegepast op multifunctionaliteit. Zij stellen dat deskundigen zich niet houden aan de richtlijnen van ISO 14044 (2006b) en zien een heterogeniteit aan gebruikte methodes met betrekking tot de multifunctionaliteit, maar volgende Pelletier et al. (2015) wordt in de literatuur niet gerechtvaardigd waarom een bepaalde methode wordt gebruikt. Om de keuze voor een methode transparant te laten verlopen en de consistentie tussen deskundigen te verbeteren, hebben zij een schema opgesteld (zie tabel 11.1) dat het

[17] In de brontekst wordt Pelletier, Ardente, Brandão, de Camillis & Pennington (2015) als bron gegeven bij tabel 11.1. Wanneer er echter naar dezelfde tabel in die bron wordt gekeken in Pelletier et al. (2015) op pagina 83, zijn er verscheidene verschillen te ontdekken. De twee belangrijkste verschillen zijn de titel van de tabel en het gebruik van 'Avoid based on…' in laag drie terwijl hier in de bron 'Allocation based on…' wordt gebruikt. Deze verschillen kunnen namelijk tot betekenisverschillen leiden bij de lezer. De andere verschillen zijn ook aangepast op basis van Pelletier et al. (2015).

[18] Het verband tussen deze zin en het zinsdeel dat (na de figuren en tabellen) volgt achter de dubbele punt is niet geheel duidelijk. Daarnaast wordt in de brontekst beweerd dat multifunctionaliteit gerechtvaardigd moet worden, maar niet waarom. Door de benoemde bron te lezen werd dit wel duidelijk en er zijn veranderingen doorgevoerd in de doeltekst op basis van pp. 74-74 van Pelletier, Ardente, Brandão, de Camillis & Pennington (2015).

	besluitvormingsproces kan leiden, onafhankelijk van de achtergrond van de deskundige.
	Tabel 11.1 Alternatieve hiërarchie voor multifunctionaliteit vanuit verschillende benaderingen van de aard, het doel en de voorwaarden die nodig zijn voor LCA  *n.v.t.* niet van toepassing (Bron: Pelletier, Ardente, Brandão, de Camillis & Pennington, 2015, p. 83)
11.1.2 Life Cycle Inventory	11.1.2 Levenscyclusinventarisatie
LCI represents the phase in the LCA where the collection and treatment of the data to perform the assessment occur. The steps of LCI include the data collection planning, collection itself, and validation of data. Concerning planning, there is the need to define the data to be collected regarding the type of LCA (attributional or consequential), type of the system (is data for the foreground or the	In de levenscyclusinventarisatie (LCI) worden gegevens verzameld op basis waarvan de analyse in een LCA wordt uitgevoerd. In LCI wordt een planning gemaakt voor de verzameling van gegevens, en worden de gegevens verzameld en gevalideerd. Allereerst moet worden bepaald welke gegevens worden verzameld aan de hand van het soort LCA (*attributional* of consequentieel), het soort systeem (hebben

	ISO 14044	Consequentiële gegevensbenadering (gericht op verandering, systeemperspectief)	*Attributional* gegevensbenadering	
			Fysiek perspectief (natuurlijk, wetenschappelijk/ fysiek realistisch)	Sociaaleconomisch perspectief (rechtvaardiging/ motivatie)
Laag 1	Vermijd allocatie door onderverdeling of systeemuitbreiding	Vermijd allocatie door onderverdeling of 'systeemuitbreiding + onderverdeling'	Vermijd allocatie door onderverdeling of systeemuitbreiding (naar alle bijproducten)	Vermijd allocatie door onderverdeling of systeemuitbreiding (naar alle bijproducten)
Laag 2	Allocatie op basis van een onderliggende fysieke relatie	n.v.t.	Allocatie op basis van relevant onderliggend fysiek verband	Allocatie op basis van relatieve economische waarde van bijproducten
Laag 3	Allocatie op basis van een ander verband	n.v.t.	n.v.t.	n.v.t.

background), and the LCA scale (is a full LCA or a streamlined). Depending on the type of LCA conducted – attributional or consequential – the type of information to be collected differs. For an attributional LCA, data to be collected is average or generic data that best represent the waste collection system. In consequential LCA, marginal data collection is related to operations during the life cycle that are affected by a change in the system under investigation (Ekvall and Weidema 2004). To develop the consequential analysis, scenario development and market forecasting can be applied. The one more used is the market forecasting, which only implies the knowledge of the existing market for outputs and inputs of the system, when the scenario development is critical to their application. Concerning foreground and background data, the approaches to collect information are different. In the case of foreground data, or primary data, data collection intends to characterize as far as possible	gegevens betrekking op het achtergrond- of voorgrondsysteem) en de grootte van de LCA (wordt er een volledige LCA uitgevoerd of een gestroomlijnde variant). Er worden verschillende soorten informatie verzameld in een attributional en een consequentiële LCA. In een attributional LCA worden gemiddelde of generieke gegevens verzameld die het afvalinzamelingssysteem het beste representeren. Binnen een consequentiële LCA worden marginale gegevens verzameld en gerelateerd aan processen in de levenscyclus die worden beïnvloed door veranderingen in het onderzochte productsysteem (Ekvall & Weidema, 2004). Om een consequentiële analyse uit te voeren, kunnen scenario-ontwikkeling en marktprognose worden toegepast. Marktprognose wordt vaker ingezet en hiermee worden voorspellingen gedaan voor de markt voor in- en uitvoerstromen van het systeem, terwijl deze in scenario-ontwikkeling juist kritisch worden geanalyseerd. Voorgrond- en achtergrondgegevens worden op verschillende

the system, being collected all data possible concerning inputs and outputs; background data, or secondary data, are related to information of secondary processes with no apparent influence on the core system (Chang and Pires 2015). Choosing between a full and a streamlined LCA should be based on the goal and scope of the study and the time available to conduct the assessment, because LCA is time-consuming and expensive (Wang et al. 2016). Streamlined LCA occurs by (1) adjusting the system boundary (both foreground and background systems) and (2) limiting the inputs, outputs, and environmental impacts considered in the assessment. Previous full LCA studies can indicate areas which have low significance to the LCA results, allowing a justified streamlined LCA (Chang and Pires 2015). LCI databases provide ready-made inventories to characterize	manieren verzameld. Voor voorgrondgegevens, oftewel primaire gegevens, wordt voor de gegevensverzameling het systeem tot in detail beschreven en worden alle gegevens over de in- en uitvoer verzameld (Chang & Pires, 2015). Achtergrondgegevens kunnen niet direct worden gemeten en worden gebaseerd op gegevens uit inventarisatiedatabases (Williams, Heidrich, & Sallis, 2010, p. 120).[20] De keuze voor een volledige of een gestroomlijnde LCA moet worden gebaseerd op het doel en de reikwijdte van het onderzoek (Wang, Zhuang, & Lin, 2016). Daarnaast moet er rekening worden gehouden met de tijd die beschikbaar is voor de analyse, omdat een LCA vaak veel tijd in beslag neemt en daardoor ook kostbaar is (Wang et al., 2016). In een gestroomlijnde LCA worden de systeemgrenzen aangepast om het voor- en achtergrondsysteem te betrekken, maar worden de invoer, uitvoer en milieueffecten voor de analyse juist

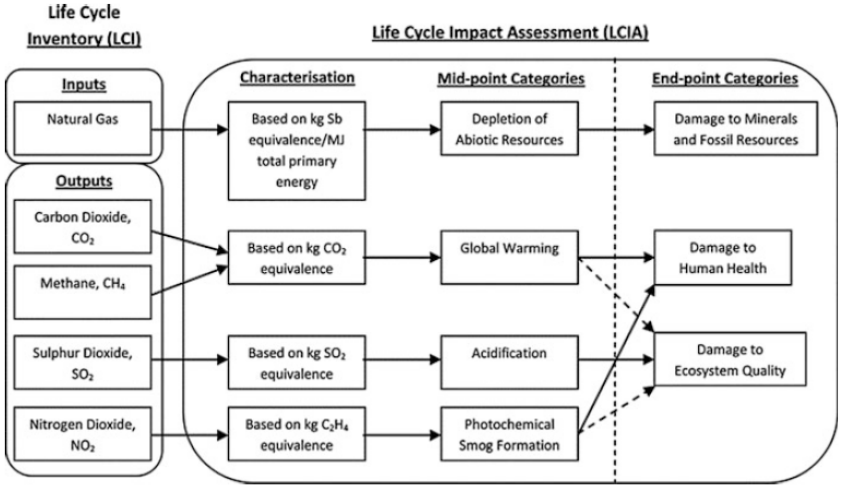
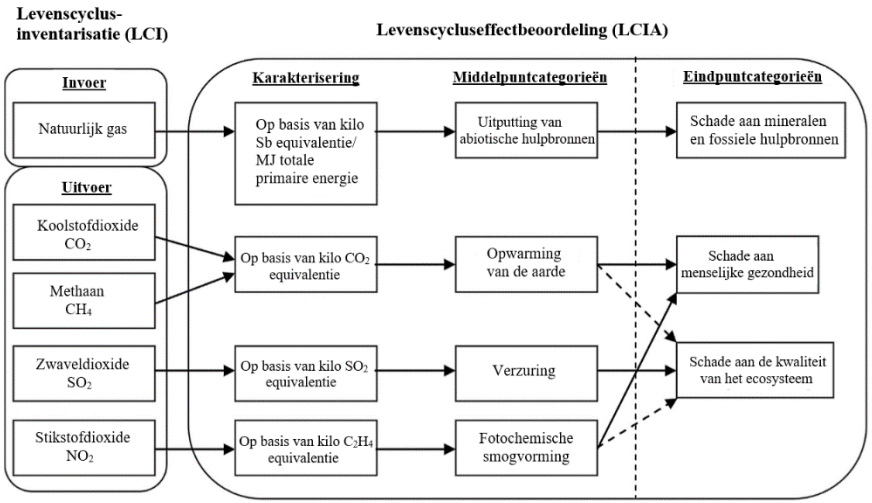
[20] In de brontekst wordt duidelijk verwezen naar de gegevensverzameling voor voorgrond- en achtergrondsystemen. Voor de voorgrondgegevens wordt een relevant voorbeeld gegeven, maar het voorbeeld over de achtergrondgegevens gaat niet over de verzameling van de gegevens, maar over waar die gegevens betrekking op hebben. Dit is echter al eerder in de tekst aan bod gekomen. In de doeltekst is informatie uit een andere bron toegevoegd waarin wel wordt besproken hoe de achtergrondgegevens worden verzameld.

waste collection systems. There are several databases which characterize several processes including waste collection and treatment processes. Most complete databases are the Ecoinvent (http://www.ecoinvent.org/), US Life Cycle Inventory Database (https://www.nrel. gov/lci/), and European Life Cycle Database (ELCD) (http://epLCA.jrc.ec.europa.eu/ ELCD3/), just to name a few. Documentation of data calculation for LCI occurs explicitly, where the explanation of all assumptions occurs[19]. The validation of data and relating data to unit processes and functional unit is needed to ensure the quality of LCA (ISO 2006b). The validation of data during LCI should be made through mass balances, energy balances, and comparison with data from other sources, like emission factors for specific processes (Guinée et al. 2002).	beperkt. Een gestroomlijnde LCA kan worden gerechtvaardigd door in eerder afgenomen volledige LCA's onderzoeksgebieden aan te duiden die een lage significantie hebben voor de resultaten (Chang & Pires, 2015). LCI-databases bevatten inventarisatiegegevens waarmee afvalinzamelingssystemen kunnen worden gekarakteriseerd. Er zijn verschillende databases die verscheidene processen karakteriseren, zoals afvalinzameling en behandelingsprocessen. Voorbeelden van uitgebreide databases zijn: Ecoinvent (http://www.ecoinvent.org/), de US Life Cycle Inventory Database (https://www.nrel.gov/lci/) en de European Life Cycle Database (ELCD) (http://eplca.jrc.ec.europa.eu/ ELCD3/). In de beschrijving van de dataset moeten de verschillende beperkingen die op de gegevens in database van toepassing zijn, worden geëxpliciteerd. Om de kwaliteit van de LCA te waarborgen moeten gegevens worden gevalideerd en gerelateerd aan

[19] Aangepast op basis van European Commission–Joint Research Centre–Institute for Environment and Sustainability (EC–JRC–IES) (2010) *International reference life cycle data system (ILCD) handbook general guide for life cycle assessment – detailed guidance,* p. 9.

	eenheidsprocessen en de functionele eenheid (ISO, 2006b). In de LCI vindt validatie plaats aan de hand van massa- en energiebalansen en door de vergelijking met gegevens van andere bronnen, zoals de emissiefactoren voor specifieke processen (Guinée et al., 2002).
11.1.3 Life Cycle Impact Assessment	11.1.3 Levenscycluseffectbeoordeling
The result of the LCI phase is the quantification of materials, energy, and substance flows which impact the environment. The LCIA intends to understand and evaluate the environmental impacts resulting from the system in the analysis, regarding the magnitude and the significance (ISO 2006b). The critical steps of the LCIA are (Curran 2006) selection and definition of impact categories, classification of substance flows with the selected impact category, and characterization of LCI impacts based on conversion factors scientifically based. Complexity reduction of the conversion of inventory into impact categories occurs by the impact categories definition in	Het resultaat van LCI is de kwantificering van grondstoffen, energie en de stroom van stoffen die effect hebben op het milieu. In de levenscycluseffectbeoordeling (LCIA) worden milieueffecten van het onderzochte systeem geïnterpreteerd en geëvalueerd met betrekking tot de omvang en de significantie (ISO, 2006b). De belangrijkste stappen binnen LCIA zijn de selectie en definitie van effectcategorieën, toekenning van resultaten van de LCI aan deze effectcategorieën en de karakterisering waarin door wetenschappelijke conversiefactoren verschillende milieueffecten binnen dezelfde effectcategorie met elkaar vergeleken kunnen worden (Curran, 2006, p. 47).

midpoint and endpoint indicators. Midpoint indicators calculate the impact of LCI outputs through various environmental mechanisms with less uncertainty; endpoint indicators include the characterization factors to link midpoint indicators through additional environmental mechanisms, which incorporates greater uncertainty (Li and Khanal 2016) (Fig. 11.2). In addition to the fundamental steps, other steps can be added to reach a more clear result, such as normalization, grouping, and weighting of impact categories, which will facilitate the comparison of LCA results and the interpretation phase (ISO 2006b). According to ISO (2006b) and Ashby (2009), normalization intends to	Om de complexiteit te verminderen en verschillende effecten binnen een categorie met elkaar te kunnen vergelijken, zijn de effectcategorieën ingedeeld in middelpunt- en eindpuntindicatoren. Met middelpuntindicatoren kan het milieueffect van de LCI-uitvoer worden berekend met minder onzekerheid, maar eindpuntindicatoren leiden tot meer methodische onzekerheid, omdat verdere karakterisering plaatsvindt om de middelpuntindicatoren aan elkaar te verbinden, zie afbeelding 11.2 (Li & Khanal 2016, p. 530). Om een duidelijker resultaat te krijgen en om de resultaten en interpretatie van LCA's te vergelijken, kunnen er extra stappen worden ondernomen, zoals groepering van milieueffecten in effectcategorieën, normalisatie en het wegen van effectcategorieën om hier waardes aan toe te kennen (ISO 14044, 2006b; Ashby, 2009). Als de waardes van de verschillende effectcategorieën worden opgeteld dan komt hier een Milieu Kosten Indicator-waarde uit voort. Er wordt ook kritiek geuit op het gebruik van Milieu Kosten Indicator-waardes, omdat

	normalisatie en wegingsfactoren niet zijn gestandaardiseerd en de toegekende waarde geen fysieke verschijningsvorm heeft (Ashby, 2009).
 **Fig. 11.2** Typical LCA framework linking LCI via midpoint categories to endpoint categories for selected damage types. Indicators can be formed from either category after normalization and optional weighting step. (Source: Rimos et al. (2014))	 Afbeelding 11.2 Standaard LCA kader waarin LCI via middelpuntcategorieën naar eindpuntcategorieën leidt voor de geselecteerde milieueffecten. Indicatoren kunnen worden gebaseerd op beide categorieën na normalisatie en weging (Bron: Rimos, Hoadley, & Brennan, 2014, p. 851).
remove the units and reduce the data to a standard scale, grouping intends to sort and rank the impact categories if possible,	Voor een LCIA worden normaliter verschillende methodes gebruikt en met de indicatoren die hieruit voortkomen, kan het

and weighting of each impact category helps to understand which are the most critical impacts compared to the other category impacts.[21] The result of these additional key steps is a value, an eco-indicator, which condensates all the information resulting from the LCA into one number. There is some criticism on the use of eco-indicators since there is no agreement on normalization and weighting factors and the value has no physical significance (Ashby 2009). The LCIA is typically made by different methodologies, from their resulting indicators that could help to quantify and compare the environmental impact of the product or service. Several methodologies exist: CML (Guinée et al. 2002), Eco-Indicator 99 (EI'99) (Goedkoop and Spriensma 2000), Environmental Priority System 2000 (EPS 2000) (Steen 1999), EDIP (Hauschild and Potting 2005), IMPACT 2002+ (Jolliet et al. 2003), TRACI (Bare et al.	milieueffect van een product of dienst worden gekwantificeerd en vergeleken. Voorbeelden van verschillende methodes zijn CML (Guinée et al., 2002), Eco-Indicator 99 (EI'99) (Goedkoop & Spriensma 2000), Environmental Priority System 2000 (EPS, 2000) (Steen, 1999), EDIP (Hauschild & Potting, 2005), IMPACT 2002+ (Jolliet et al., 2003), TRACI (Bare, Norris, & Pennington, 2003), USEtox 2.0 (Fantke et al., 2015), ReCiPe (Goedkoop et al., 2009) en ES'06 (Frischknecht, Steiner, & Jungbluth, 2008). Volgens Rosenbaum et al. (2018) kunnen de volgende vragen helpen bij het kiezen van een LCIA-methode: • Welke effectcategorieën moet ik meenemen en kan ik rechtvaardigen dat ik effectcategorieën uitsluit? • Welke kenmerken heeft de regio waarin het geanalyseerde systeem is gelokaliseerd?

[21] Het is belangrijk om de structuur van dit fragment aan te passen in de doeltekst. In Ashby (2009) wordt namelijk eerst besproken dat er een Milieu Kosten Indicator-waarde kan worden toegekend en vervolgens hoe dit kan worden gedaan. Normalisatie is de tweede stap van de vier stappen die moeten worden ondernomen om een waarde toe te kunnen kennen. De volgorde in de brontekst is afwijkend en de zin van 'According to ISO' tot 'other category impacts' is onduidelijk.

2003), USEtox 2.0 (Fantke et al. 2015), ReCiPe (Goedkoop et al. 2009), and ES'06 (Frischknecht et al. 2008). Choosing the LCIA system should address the following questions (Rosenbaum et al. 2018): • Which impact categories do I need to cover and can I justify those that I am excluding? • Which are the features of the region where the system in the analysis occurs? • What kind of LCIA do I need, midpoint, endpoint, or both, and are the normalization steps also needed? • Which elementary flows do I need to identify and know? • Is there any information from organizations that could help me to choose? • How can the LCIA results be interpreted and communicated? • How well is the method scientifically supported? • How proven is the method?	• Moeten middelpunt- of eindpuntcategorieën worden meegenomen in de LCIA en moeten deze genormaliseerd worden? • Welke elementaire stromen moet ik karakteriseren? • Is er informatie van relevante organisaties beschikbaar die mijn keuze beïnvloedt? • Hoe kunnen de resultaten van de LCIA worden geïnterpreteerd en gecommuniceerd? • In hoeverre is de methode op wetenschap gebaseerd? • In hoeverre is de methode getoetst? • Leiden gegevens vanuit de LCI ook tot deze LCIA-methode? • Moet de onzekerheid worden gekwantificeerd? Er kan ook worden gekozen uit LCIA-methodes die al eerder zijn gebruikt voor LCA van afvalinzamelingssystemen. Dan kunnen de resultaten van het huidige onderzoek tevens met die van eerder onderzoek worden vergeleken.

• Is there available data from my LCI to support the LCIA method? • Is uncertainty an issue that needs to be quantified? One possible strategy to choose an LCIA method can be the existence of LCA studies made to the waste collection system and the LCIA method used. Probably there is a method more frequently used, which can also be chosen, helping in the comparison of the results.	
11.1.4 Interpretation	11.1.4. Interpretatie
According to ISO (2006b), the interpretation is the last phase of the LCA, where results are summarized for conclusions and recommendation and help on decisionmaking, depending on the goals and scope defined at the beginning of the LCA. Due to its looping plus iterative procedure, the discussion conducted can dictate changes in previous decisions during the LCA like allocation rules, system boundaries, goal and scope features, data collected to perform the LCA, and environmental impact categories chosen, just to name a few of the possible consequences of interpretation phase	De laatste fase van LCA is de interpretatie waarin de resultaten worden samengevat om conclusies te kunnen trekken en aanbevelingen te kunnen doen of om het besluitvormingsproces te ondersteunen (ISO, 2006b). Dit is afhankelijk van het doel en de reikwijdte die bij aanvang zijn vastgesteld. De interpretatiefase kan steeds worden herhaald en is verbonden aan de eerdere fasen, waardoor feedback teruggevoerd kan worden naar beslissingen die eerder in de LCA zijn genomen, zoals allocatie, systeemgrenzen, doel en reikwijdte, verzamelde gegevens en milieueffectcategorieën (Chang en Pires, 2015; ISO, 2006b). De ISO

(Chang and Pires 2015; ISO 2006b). Interpretation phase recommends a critical analysis done by an external entity (ISO 2006b). Uncertainty and sensitivity analyses are conducted during the interpretation phase. Sensitivity analysis intends to understand how the model inputs influence the results; uncertainty analysis (also named propagation) aims to know quantitatively the overall uncertainty of results reached during LCA (Laurent et al. 2014). The most common method used to assess sensitivity is scenario analysis. These are one-factor-at-a-time (OFAT) methods with the intention to investigating the robustness of the results and finding the sensitive parameters that could influence LCA results and, in the last case, alter the recommendations to decision-makers (Laurent et al. 2014). Sensitivity analysis is performed by varying the inputs within a specific range and analyzing the impacts on the results, showing which are the results that must be regarded more carefully, and which	(2006b) raadt aan om in deze fase een kritische analyse uit te laten voeren door een externe partij. Tijdens de interpretatiefase worden tevens gevoeligheids- en onzekerheidsanalyses uitgevoerd. Met een gevoeligheidsanalyse kan worden berekend hoe de invoer de resultaten beïnvloedt en met een onzekerheidsanalyse (ook bekend als foutenvoortplanting) kan de totale onzekerheid van de LCA-resultaten worden berekend (Laurent et al. 2014). De meest gebruikte gevoeligheidsanalyse is scenarioanalyse. Bij deze methode wordt er één variabele per keer veranderd (one-factor-at-a-time) (OFAT), waardoor de betrouwbaarheid kan worden onderzocht (Laurent et al., 2014). Er kan tevens worden bepaald of gevoelige parameters de resultaten van de LCA beïnvloeden en daardoor ook van invloed zijn op de aanbevelingen aan beleidsmakers (Laurent et al., 2014). In een gevoeligheidsanalyse wordt de invoer binnen bepaalde grenzen gevarieerd en het effect dat dit op de resultaten heeft geanalyseerd om

assumptions must be justified and validated (Li and Khanal 2016). Uncertainty in waste collection system is generally related to the waste composition itself and the waste fraction distributions and chemical composition (e.g., water content, density). The system model used for the collection itself, the choice of a collection scheme, and the parameters dependent of the collection scheme, like fuel consumption, emissions, source-sorting efficiencies, and the transport distance, at least should be subjected to uncertainty analysis (Clavreul et al. 2012). Uncertainty analysis is usually conducted by Monte Carlo analysis, which consists in randomly sampling the probability distribution of each uncertain parameter in a large number of times, resulting in a frequency histogram and a probability distribution representing model results (Clavreul et al. 2012). When conducting an LCA comparing different waste management solutions, the Monte Carlo simulation can indicate, for each solution, which is the probability that a specific result occurs (e.g., which is	aan te tonen welke resultaten nader moeten worden onderzocht en welke aannames worden gerechtvaardigd en bevestigd (Li & Khanal 2016). Volgens Clavreul, Guyonnet & Christensen (2012) moeten verschillende parameters worden meegenomen in een onzekerheidsanalyse: het afvalinzamelingsysteem, de keuze voor een bepaald inzamelingsprogramma en de parameters binnen dat inzamelingsprogramma, zoals brandstofgebruik, emissies, efficiëntie van bronscheiding en de transportafstand. De onzekerste parameters binnen het afvalinzamelingssysteem zijn de samenstelling van het afval, de distributie van afvalfractie en de chemische samenstelling van het afval, zoals het watergehalte en de afvaldichtheid. Om de onzekerheid te berekenen, wordt vaak de Monte Carlo-analyse gebruikt. Er wordt hierin herhaaldelijk een steekproef genomen van de waarschijnlijkheidsverdeling van alle parameters waardoor er een histogram wordt gevormd met de waarschijnlijkheidsverdeling van het gehele systeem (Clavreul et al. 2012). Als verschillende oplossingen

the probability of the result "incineration is better than anaerobic digestion" occur).	voor afvalbeheer worden vergeleken, kan met een Monte Carlo-simulatie worden bekeken wat voor elke oplossing de waarschijnlijkheid is dat een bepaald resultaat zich voordoet, bijvoorbeeld wat is de waarschijnlijkheid dat het resultaat 'verbranding is beter dan anaerobe vergisting' zich voordoet.
11.1.5 LCA Software	11.1.5 LCA-software
There are several on-market software to conduct an LCA study on waste collection, like Gabi, SimaPro, Team, and Umberto software. There is also more friendly software explicitly devoted to waste management, including solid waste collection, which can make the streamlined LCA easier. Those software/applications are IWM-2 (McDougall et al. 2001), WISARD/WRATE (Ecobilan 2004), EASEWASTE (Christensen et al. 2007), and ORWARE (Dalemo et al. 1997; Björklund et al. 1999). The development and use of waste LCA tools justify the need to deal with a reference flow composed of a mixture of materials (waste and its several waste streams); the	LCA's voor afvalinzameling kunnen worden uitgevoerd met behulp van verschillende softwarepakketten, zoals Gabi, SimaPro, Team en Umberto. Er is ook toegankelijke software beschikbaar die specifiek is gericht op afvalbeheer en de inzameling van vast afval. Hierdoor is het gemakkelijker om een gestroomlijnde LCA uit te voeren. Voorbeelden van dergelijke software zijn IWM-2 (McDougall, White, Frank, & Hindle, 2001), WISARD/WRATE (Ecobilan, 2004), EASEWASTE (Christensen et al., 2007) en ORWARE (Dalemo et al., 1997; Björklund, Dalemo, & Sonesson, 1999). LCA-modellen die specifiek zijn ontworpen voor afvalbeheer

LCA practitioner can evaluate more natural the influence of several parameters of the waste management scheme on the LCA results, making more accessible for the practitioner to track the impacts from heterogeneous waste streams and the impacts caused by each material (Clavreul et al. 2014).[22]	verschillen volgens Clavreul, Baumeister, Christensen & Damgaard (2014) van algemene LCA-modellen. Daarnaast beschrijven zij dat in de helft van de onderzoeken voorkeur wordt gegeven aan een specifieke LCA, wat de relevantie van de ontwikkeling van deze modellen onderschrijft. In deze specifieke LCA-modellen wordt het behandelingsproces van afval ook meegenomen. Dit heeft als voordeel dat de invloed van parameters in afvalbeheer makkelijker kunnen worden geëvalueerd. Daarnaast kan vanuit de milieueffecten beredeneerd worden welk materiaal binnen de heterogene afvalstroom het milieueffect veroorzaakt, omdat milieueffecten direct zijn verbonden aan de eigenschappen van het materiaal (Clavreul et al., 2014).
No matter which is the software, the practitioner of an LCA to waste collection system must have in mind that capital goods may have significant importance on the LCA environmental impacts, not being adequate to exclude them. According to Brogaard and Christensen (2012), the impact of producing the capital goods for waste collection and transport – vehicles and containers – should not be neglected as the capital goods can be responsible for more than 85% of some of the environmental impact categories from all	Bij een LCA van afvalinzamelingssystemen moet altijd het

[22] De zin in de brontekst bevat sterk gecomprimeerde elementen van drie verschillende zinnen uit Clavreul, Baumeister, Christensen & Damgaard (2014), waardoor de betekenis niet duidelijk is. In de doeltekst is deze zin opgedeeld en is informatie uit Clavreul et al. (2014, p. 19) toegevoegd ter verduidelijking. Eerst is er een zin toegevoegd om de relatie van deze zin ten opzichte van het fragment duidelijk te maken, Clavreul et al. (2014) wordt namelijk aangehaald omdat hierin de voordelen van specifieke LCA voor de afvalsector worden besproken in relatie tot algemene LCA. Dit is één van de vele voorbeelden waarin niet secuur is omgegaan met wat er in de genoemde bronnen staat (hier zijn dan ook meerdere voetnoten aan gewijd), tevens zijn de voorbeelden van spelfouten en foutief overgenomen termen bewijs van de onzorgvuldigheid van de auteurs.

environmental impacts occurring for collection and transport waste (when a transport distance of 25 km was assumed).	milieueffect van kapitaalgoederen worden meegewogen, ongeacht welke software wordt gebruikt. Volgens Brogaard & Christensen (2012) moet de productie van kapitaalgoederen die worden gebruikt in afvalinzameling en -transport, zoals vuilniswagens en vuilnisbakken, ook worden onderzocht. Zij beschrijven dat bij afvalinzameling met een veronderstelde transportafstand van 25 kilometer ruim 85% van een aantal van de milieueffecten die worden veroorzaakt door afvalinzameling en -transport voortkomen uit de productie van kapitaalgoederen.

8. Conclusion and discussion

The first section in this chapter addresses the main conclusions of this study. Then, in the second section, the implications of the main findings for translators will be discussed. Next, the generalizability of the results is discussed with respect to other texts and language pairs. In addition, recommendations will be made with respect to IATE in CAT tools used by the translation service of the European Union.

This study conducted a bottom-up analysis to answer the following research question: *To which extent is IATE suitable for the translation of terminology in English source texts to Dutch within the domain of Life Cycle Assessment applied to Waste Management?*

The results of this results have shown that the IATE database is only suitable for this purpose to a limited extent. The selected source-text fragment contains 185 terms, of which 109 terms are represented by an entry in IATE. However, for 7 of these terms, the available entry (or entries) is insufficient, due to the inclusion of inadequate Dutch term equivalents, or because the term referred to a different concept caused by domain differences. IATE does not contain entries for the remaining 76 source-text terms. Thus, a total of 83 source-text terms are not, or insufficiently, represented in the database.

These findings have several implications for the translator's task. As stated in the introductory chapter of this study, translators must compete with strict deadlines (Montero Martinez & Faber, 2009). As a result, terminology is not managed in a systematic manner, since this is too time consuming (Bononno, 2000; Montero Martinez & Faber, 2009; Thelen, 2002). Multilingual databases provide translators with appropriate target-language term equivalents (Kerremans, 2019). However, this study has shown that not all terms occurring in texts from the domain of LCA applied to Waste Management are included in the database. Thus, when texts containing these terms must be translated, IATE is of limited use to the translator. Consequently, the appropriate Dutch term equivalents must be obtained from other sources,

resulting in an increased effort on the translator's part. In addition, this may lead to inconsistency in term translation between different translators, as different translators may rely on different sources. If individual translators do not record terms and their target-language equivalents in a systematic manner, this may lead to intertext variation within the same translator as well.

In addition to the increased effort of the translator regarding terms that are not represented in IATE, translators may also need to make decisions with respect to terms that are represented in the database. Despite the *one concept, one entry* objective of IATE, for most concepts more than one entry is available. It is proposed that entries referring to the same concept are merged and, if needed, expanded over more domains. Single entries containing multiple term levels can also increase the time needed to obtain term equivalents. However, in accordance with Kerremans (2019), multiple terms referring to the same entry may reflect the dynamic use of terms and if they serve this objective, must be maintained.

Two limitations to the generalizability of this study's conclusion should be considered. First, the suitability of IATE for terminology translation within the domain of LCA applied to Waste Management was assessed based on a case study using a single source text. However, the terms occurring in this text are highly relevant to these domains. First, 102 of the 185 source-text terms are represented in IATE. In addition, of the 83 terms not (sufficiently) represented in IATE 21 terms occurred in the parallel corpus with 20 recently published academic domain-specific texts. From the 62 remaining terms, 29 are used in texts of the European Union provided by EUR-Lex. As 152 of the 185 terms are represented in reliable sources, there is a high probability that these terms will be used in the future regarding this subject. As the subject of Waste Management and its umbrella domain of CE is of growing interest for the Dutch government, it is expected that texts containing these terms will be translated in an increasing amount as well ("€ 80 miljoen extra voor circulaire economie," 2019; *Nederland circulair in*

2050. In het kort., 2016).

Second, this research was conducted with regards to the language pair combination of English-Dutch, as most text on the subject are produced in English, and the Dutch government has showed increasing interest in the topic. However, other governments have showed recent interest in CE and Waste Management as well. The German government has even launched an European Climate Initiative to improve cooperation within the EU to counter climate change, e.g. by measure taken with respect to waste management ("Federal Government | News | 2019 call for project ideas now open," 2019). If documents regarding this initiative were to be translated into German, the same problems with the limited suitability of IATE would apply. Terms that were not represented by an entry in IATE for the language combination English to Dutch, are also not represented in other language pair combinations, such as English to German. This is caused by the structure of IATE, as it is concept-based and not language-based. Terms not represented by IATE in this research are thus extendable to other language pair combinations.

To conclude, two important recommendations can be made based on the current study. Within the European Union, texts are translated by the Directorate-General for Translation. The translation service uses CAT tools to translate EU-texts into all EU languages. Texts are automatically translated with Machine Translation based on other translated EU texts and the IATE database is implemented in the CAT tools for term management. If a source text contains a term, the incorporated version of IATE provides a target-language term equivalent. However, currently, there is no feedback-loop with which translators or revisors can provide the system with information on which terms they cross, which are not represented by IATE. It is suggested that such a feedback system is implemented into the IATE feature in the used CAT tool, to ensure that the terminology service TermCoord is notified about relevant terms

from a bottom-up perspective. When a certain threshold is reached, TermCoord can decide to research a term, or for example include them in the IATE project to be reached by students.

The last factor addressed in this discussion (although many more could be added from the abundance of aspects and methods included in this study), is term standardization. As described in the introductory chapter of this study, the need for term standardization emerged in the 1900s, due to the rapid emergence of new concepts (Pearson, 1998). From the 1990s onwards, there was a swift increase in the interest in CE resulting in the development of this domain including the development of related concepts (Finnveden et al., 2009; Guinée et al., 1993). Terms referring to concepts with respect to LCA have been standardized by ISO, e.g. in guideline 14044 (ISO, 2006). However, these guidelines are drawn up in English and thus, only contain English terms. It would be recommended that translations of guidelines relevant to CE, LCA and Waste Management are provided in other languages as well. For this study, the lack of Dutch term standardization was challenging. In addition to academic articles and governmental reports, experts were consulted, such as an assistant professor related to the Copernicus Institute of Sustainable Development of the Utrecht University, and the general manager of a Belgian company specialized in LCA and Waste Management. None of them were able to provide standardized Dutch term equivalents for various terms used in LCA and Waste Management. Whereas IATE provides translators with term equivalents, they merely reflect standardized terms and do not produce standardized term equivalents. It is upon the International Organization of Standardization to fulfil this task to remove the barriers for translation of texts on these important subjects.

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10. Appendices

Appendix A: Empty term fiche

**<IATE-N°>	
<Domain>	
<Domain_note>	
<Collection>	
<CrossRef>	
<ProblemLanguage>	
<Graphics>	
<Graph_Reference>	

<Language>	
<Definition>	
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<Def_Note>	
<RelatedMaterial>	

<TermType>	
<TermGroup>	
<Evaluation>	
<en-English>	
<Reliability>	
<Term_Reference>	
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	
<*Gender*>	
<*LookUpForms*>	
<Context>	
<Cont_Reference>	

<Language>	
<Definition>	
<Def_Reference>	
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<RelatedMaterial>	

<TermType>	
<TermGroup>	
<Evaluation>	

<nl-Nederlands>	
<Reliability>	
<Term_**Reference**>	
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	
<***Gender***>	
<***LookUpForms***>	
<**Context**>	
<Cont_**Reference**>	

Appendix B: Term fiche for *impact*

<IATE-N°**>**	50323
<**Domain**>	52; 2841
<**Domain_note**>	
<**Collection**>	
<**CrossRef**>	Narrower: ###### *environmental impact* Narrower: ###### *impact assessment* Narrower: ###### *life cycle impact assessment* Narrower: ###### *impact category*
<**ProblemLanguage**>	EN
<**Graphics**>	
<Graph_**Reference**>	

<**Language**>	en
<**Definition**>	changes to nature and the environment caused by human influence
<Def_**Reference**>	Based on: Common glossary - ILCA. (n.d.). Retrieved August 13, 2019, from https://ilca.es/teaching-materials/common-glossary/#A
<Def_**Note**>	
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**en-English**>	impact
<**Reliability**>	2
<Term_**Reference**>	Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment, CELEX: 32011L0092/EN
<Term_**Note**>	
<***LangUsage***>	countable noun
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	
<***LookUpForms***>	
<**Context**>	1. “A 5-month monitoring program was undertaken in South Wales in the UK to determine the fate of 55 pharmaceuticals, personal care products, endocrine disruptors and illicit drugs (PPCPs) in two contrasting wastewater plants utilising two different wastewater treatment technologies: activated sludge and trickling filter beds. The **impact** of treated wastewater effluent on the quality of receiving waters was also assessed.” 2. “A consequence of many armed conflicts is the massive migration of people to safer areas. The increased human pressure at the destination can

	cause serious environmental issues, since it often implies overexploitation of their natural resources. Severe deforestation, desertification, unsustainable groundwater extraction, soil and groundwater pollution, are all **impacts** that can be observed in the surroundings of densely populated camps by internally displaced persons (IDPs) or transnational refugees." 3. "It is necessary to take into account that thermal processing (treatment) of the waste can also bring negative **impacts**. That concerns especially the possible generation of emissions of contaminants in flue gas; the presence of hazardous substances in the ash, pollution of water used in particular technological points of the incineration equipment etc."
<Cont_**Reference**>	1. Kasprzyk-Hordern, B., Dinsdale, R. M., & Guwy, A. J. (2009). The removal of pharmaceuticals, personal care products, endocrine disruptors and illicit drugs during wastewater treatment and its impact on the quality of receiving waters. *Water Research, 43*(2), p. 363. https://doi.org/10.1016/j.watres.2008.10.047 2. Certini, G., Scalenghe, R., & Woods, W. I. (2013). The impact of warfare on the soil environment. *Earth-Science Reviews, 127,* pp. 5-6. https://doi.org/10.1016/j.earscirev.2013.08.009 3. Tabasová, A., Kropáč, J., Kermes, V., Nemet, A., & Stehlík, P. (2012). Waste-to-energy technologies: Impact on environment. *Energy, 44*(1), p. 147. https://doi.org/10.1016/j.energy.2012.01.014

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: verandering aan de natuur en het milieu veroorzaakt door menselijke invloed
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	effect
<**Reliability**>	2
<Term_**Reference**>	Richtlijn 2011/92/EU van het Europees Parlement en de Raad van 13 december 2011 betreffende de milieueffectbeoordeling van bepaalde openbare en particuliere projecten, CELEX:32011L0092/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Neuter
<***LookUpForms***>	

<**Context**>	1. “Gewasbeschermingsmiddelen, bijvoorbeeld neonicotinoïden, kunnen een negatief **effect** hebben op de overleving van bijen en insecten. Andere factoren kunnen ook een rol spelen, zoals de opkomst van de varroamijt en verarming (monocultures) van het landschap.” 2. “De **effecten** van grote ingenieurswerken (verdieping vaargeulen, bouw van de buitenhaven van Zeebrugge) op de verspreiding van cohesieve sedimenten werd bestudeerd rekening houdend met de natuurlijk optredende veranderingen. In een dynamisch kustgebied is de natuurlijke variabiliteit immers heel hoog en moet worden getracht deze van de antropogene invloeden te onderscheiden.” 3. “Uit onderzoek van de afgelopen 20 jaar is er veel bewijs gevonden dat ammoniakdepositie de kwaliteit an bossen en natuurgebieden aantast. Veldstudies wezen uit dat er effecten zijn op ecosystemen en op bodem en waterkwaliteit. De grootste problemen ontstaan in natuurgebieden op de droge zandgronden. De schade aan deze ecosystemen ontstaat door een overmaat aan stikstof – in de vorm van ammoniak (NH_3), ammonium (NH_4^+) en stikstofdioxide (NO_x).”
<Cont_**Reference**>	1. Verschoor, A., Zwartkruis, J., Hoogsteen, M., Scheepmaker, J., de Jong, F., van der Knaap, Y., … Tamis, W. (2019). *Tussenevaluatie van de nota “Gezonde Groei, Duurzame Oogst” Deelproject Milieu*, p.11. 2. Lauwaert, B., Delgado, R., Derweduwen, J., Devriese, L., Fettweis, M., Hostens, K., … Verwaest, T. (2011). *Syntheserapport over de effecten op het mariene milieu van baggerspeciestortingen (vergunningsperiode 2010-2011)*, p. 7. 3. Kros, J., de Haan, B. J., Bobbink, R., van Jaarsveld, J. A., Roelofs, J. G. M., & de Vries, W. (2008). *Effecten van ammoniak op de Nederlandse natuur*, p. 9.

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	
<**nl-Nederlands**>	impact
<**Reliability**>	2
<Term_**Reference**>	Verordening (EU) nr. 1380/2013 van het Europees Parlement en de Raad van 11 december 2013 inzake het gemeenschappelijk visserijbeleid, tot wijziging van Verordeningen (EG) nr. 1954/2003 en (EG) nr. 1224/2009 van de Raad en tot intrekking van Verordeningen (EG) nr. 2371/2002 en (EG) nr. 639/2004 van de Raad en Besluit 2004/585/EG van de Raad, CELEX:32013R1380/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Masculine
<***LookUpForms***>	

<**Context**>	1. “Voor de andere loswallen kan geconcludeerd worden dat er geen directe **impact** kan worden aangetoond van het storten van baggerspecie op de demersale visfauna. De reden daarvoor lijkt logisch, omdat demersale vissen zeer mobiel zijn, en dus snel de loswallen kunnen verlaten en opnieuw recoloniseren vanuit de omliggende gebieden.” 2. “De veranderingen in het bodemmilieu zijn duidelijk verslechterd sinds de afsluiting van de Grevelingen en de negatieve trend duurt voort tot op heden. De veranderingen kunnen worden gerelateerd aan de menselijke impact (sluiting van het systeem in 1971, en beperkte herintroductie van getij in 1978).”
<Cont_**Reference**>	1. Lauwaert, B., Delgado, R., Derweduwen, J., Devriese, L., Fettweis, M., Hostens, K., … Verwaest, T. (2011). *Syntheserapport over de effecten op het mariene milieu van baggerspeciestortingen (vergunningsperiode 2010-2011)*, p. 13. 2. p. 25 https://www.deltaexpertise.nl/images/0/05/GM_-_Foraminiferen_en_zuurstofcondities_-_TNO_-_111209.pdf

Appendix C: Term fiche for *(environmental) impact category & EF impact category*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Related: 795327 *Environmental impact*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	collection of several negative interrelated impacts on the environment
<Def_Reference>	Based on Brentrup, F., Küsters, J., Kuhlmann, H., & Lammel, J. (2004). Environmental impact assessment of agricultural production systems using the life cycle assessment methodology: I. Theoretical concept of a LCA method tailored to crop production. *European Journal of Agronomy*, *20*(3), 247-264. Kim, T., Tae, S., & Chae, C. (2016). Analysis of environmental impact for concrete using LCA by varying the recycling components, the compressive strength and the admixture material mixing. *Sustainability*, *8*(4), 389.
<Def_Note>	
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	impact category
<Reliability>	2
<Term_Reference>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_Note>	
<*LangUsage*>	countable noun
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. “This example relates to an office building with a heated floor area of 3.314 m2 and illustrates the basic calculations for the climate change **impact category** disaggregated into operating energy and

	building materials and also showing the impacts per building element." 2. "This section includes wastewater stream contribution analysis, process contribution analysis and substance contribution analysis. The three types of analysis are used to differentiate the contribution of three wastewater streams, to identify the influential processes in the system boundary and to identify dominant substances for each **impact category**." 3. "The **impact category** land use is often closely linked to the water use category. This is typically the case for irrigated agriculture, where the irrigation is part of the land use practice, but at the same time linked to the water used."
<Cont_**Reference**>	1. Tarantini, M., Loprieno, A. D., & Porta, P. L. (2011). A life cycle approach to Green Public Procurement of building materials and elements: A case study on windows. *Energy*, *36*(5), p. 1906. 2. Ng, B. J., Zhou, J., Giannis, A., Chang, V. W. C., & Wang, J. Y. (2014). Environmental life cycle assessment of different domestic wastewater streams: policy effectiveness in a tropical urban environment. *Journal of environmental management*, *140*, p. 64. 3. Koellner, T., De Baan, L., Beck, T., Brandão, M., Civit, B., Margni, M., … Müller-Wenk, R. (2013). UNEP-SETAC guideline on global land use impact assessment on biodiversity and ecosystem services in LCA. International Journal of Life Cycle Assessment, p. 1199. https://doi.org/10.1007/s11367-013-0579-z

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	
<**en-English**>	environmental impact category
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_**Note**>	
<***LangUsage***>	uncountable noun
<***RegionalUsage***>	
<***PartOfSpeech***>	Adjective + Noun + Noun
<***Gender***>	
<***LookUpForms***>	
<**Context**>	1. "By fitting regression lines to the environmental impact data of circa 2400 households, we obtained expenditure elasticities for the **environmental impact categories** climate change, acidification, eutrophication and smog formation (see Table 3). All four environmental impact categories increase with increasing equivalent household

	expenditures (elasticityN0). The degree, though, to which the environmental impact increases, depends on the impact category." 2. "Let T be the environmental impact of the packaging production and packaging waste handling per unit of purchased food (the unit of food in this paper is kg, but it could also be litres, nutrient content, etc.). The **environmental impact categories** considered here are energy use, global warming potential (GWP), eutrophication potential (EP) and acidification potential (AP). The environmental categories are not weighted or aggregated in this model. Energy use and global warming are important on a global level and eutrophication and acidification are important for food products on a regional level." 3. "Although coffee consumption in itself is not new, the technology for brewing coffee and its corresponding environmental impact has been evolving rapidly in recent years, particularly with the widespread adoption of the single-serve coffee pod. This work utilizes a midpoint life cycle assessment with multiple **environmental impact categories**, to assess the environmental impact of a conventional (drip filter) brewing system, compared to a novel (single-serve coffee pod) brewing system, from cradle to grave."
<Cont_**Reference**>	1. Kerkhof, A. C., Nonhebel, S., & Moll, H. C. (2009). Relating the environmental impact of consumption to household expenditures: An input–output analysis. *Ecological Economics*, *68*(4), p. 1164. 2. Williams, H., & Wikström, F. (2011). Environmental impact of packaging and food losses in a life cycle perspective: a comparative analysis of five food items. *Journal of Cleaner Production*, *19*(1), p. 44. 3. Hicks, A. L., & Halvorsen, H. (2019). Environmental impact of evolving coffee technologies. *The International Journal of Life Cycle Assessment*, p. 1.

<**TermType**>	Term
<**TermGroup**>	3
<**Evaluation**>	
<**en-English**>	EF impact category
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun + Noun
<***Gender***>	
<***LookUpForms***>	
<**Context**>	1. "Completeness refers not only to an individual dataset, but the whole system is also considered. In this indicator, it is not easy to identify the level of quality. Thus, quality needs to be decided by an expert with respect to

	the coverage for each **EF impact category** and in comparison to an ideal data quality.”
<Cont_**Reference**>	1. Poolsawad, N., Thanungkano, W., Mungkalasiri, J., Wisansuwannakorn, R., Suksatit, P., Jirajariyavech, A., & Datchaneekul, K. (2017). Thai national life cycle inventory readiness for product environmental footprint. *International Journal of Life Cycle Assessment*, *12*(11), 1738–1740. https://doi.org/10.1007/s11367-016-1257-8

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: verzameling van onderling verbonden aspecten die een negatieve invloed op het milieu uitoefenen
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	effectcategorie
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	countable noun
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	
<**Context**>	1. “Bij ingaande stromen moet worden gedacht aan het gebruik van grondstoffen, zoals mineralen, energiedragers en water. De uitgaande stromen betreffen de emissies naar bodem, water en lucht. In de onderhavige rapportage worden de geaggregeerde resultaten gepresenteerd, waarbij de vijf meest bijdragende **effectcategorieën** apart worden getoond.” 2. “Er zijn ook **effectcategorieën** met negatieve waarden, hetgeen een milieuvoordeel betekent (bijvoorbeeld humane toxiciteit: -2 euro). Resomeren wordt gedomineerd door vermesting (10 euro) en de sterke negatieve waarden voor humane toxiciteit (- 7 euro) en broeikaseffect (-1,5 euro).” 3. “In aquatische ecosystemen kan de vergrote biomassa leiden tot verlaagde zuurstofniveaus, vanwege het extra zuurstofverbruik door

	biomassa-afbraak. Aangezien emissies van afbreekbare organische materie een vergelijkbaar effect hebben, worden zulke emissies ook meegenomen onder de **effectcategorie** [vermesting].”
<Cont_**Reference**>	1. Lighthart, T., & van den Oever, M. (2018). *Milieu-impact van twee verwerkingsroutes voor warme drankenbekers: Vergisting en papierrecycling van karton-PLA koffiebekers* (No. 1792). Wageningen Food & Biobased Research, p. 10. 2. Keijzer, E. E. & Kok, H. J. G. (2011). *Milieueffecten van verschillende uitvaarttechnieken*. Utrecht: TNO, p. 4. 3. van der Lans, C. J. M., Vermeulen, P. C. M., Raaphorst, M. G. M., & Spruijt, J. (2013). *Duurzaamheidsvergelijking van biologische teelt en teelt op natuurlijk substraat in de glastuinbouw: Duurzaamheidsvergelijking met de LCA methode*. Wageningen UR Glastuinbouw, p. 17.

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	
<**nl-Nederlands**>	milieueffectcategorie
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	countable noun
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	
<**Context**>	1. “Bij cremeren en resomeren is er een efficiënte recycling van kleine metalen, waaronder goud, waaraan een compenserend (negatief) milieueffect wordt toegekend aan de **milieueffectcategorie** zoetwater ecotoxiciteit. Daardoor komen cremeren en resomeren netto uit op een negatieve milieuscore voor deze categorie.” 2. “De scores voor de verschillende **milieueffectcategorieën** kunnen binnen ReCiPe met gestandaardiseerde weegmethoden worden opgeteld tot één totale eindscore voor de milieuprestatie. De eindscores van de verschillende scenario’s kunnen worden vergeleken om de onkruidbestrijdingstechniek met de beste milieuprestatie te bepalen. Ook is het nuttig om scenario’s per **milieueffectcategorie** met elkaar te vergelijken. Milieueffecten die extra aandacht verdienen (bijvoorbeeld vanwege beleidsdoelstellingen) kunnen op die manier specifiek vergeleken worden.”

<Cont_**Reference**>	1. Keijzer, E. E., ten Broeke, H., Ansems, I. A., & Almere, O. Y. H. B. (2014). *Milieueffecten van verschillende uitvaarttechnieken-update van eerder TNO onderzoek*. Utrecht: TNO, p. 38. 2. Jonkers, N. (2012). LCA-quickscan vergelijking onkruidbestrijdingsmethoden. *IVAM rapport 1217v, Amsterdam*, p. 8.

<**TermType**>	Term
<**TermGroup**>	3
<**Evaluation**>	
<**nl-Nederlands**>	EF-effectcategorie
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	
<**Context**>	1. “Het doel van de EF-effectbeoordeling (54) is de geïnventariseerde gegevens in het hulpbronnengebruik- en emissieprofiel te groeperen en samen te voegen volgens de respectieve bijdragen aan elk van de EF-effectcategorieën. Dit verschaft de benodigde basis voor de interpretatie van de EF-resultaten in het licht van de doelen van het PEF-onderzoek (bijvoorbeeld het vaststellen van "zwakke plekken" in de toeleveringsketen en "opties" voor verbetering). De selectie van EF-effectcategorieën zou daarom veelomvattend moeten zijn, in de zin dat de categorieën alle relevante milieuaangelegenheden moeten bestrijken die verband houden met de toeleveringsketen van het betrokken product.”
<Cont_**Reference**>	1. 2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL.

Appendix D: Term fiche for *waste management system*

**<IATE-N°>	293104
<Domain>	5206
<Domain_note>	
<Collection>	
<CrossRef>	Narrower: 1229890 *solid-waste management system* Narrower: ###### *integrated waste management system* Broader: 1427050 *waste management* Related: 3577029 *waste handling* Related: 1390591 *solid waste management*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	procedure for the total waste chain, from collection and transport to recovery and disposal of waste and maintenance of disposal sites
<Def_Reference>	Based on: waste management system. (n.d.). Retrieved May 21, 2019, from https://www.eionet.europa.eu/gemet/en/concept/15326
<Def_Note>	Includes the supervision of such operations and the after-care of disposal sites and can be used for different types of waste, e.g. solid waste, hospital waste, e-waste.
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	waste management system
<Reliability>	2
<Term_Reference>	Application of waste management directive European Parliament resolution of 2 February 2012 on the issues raised by petitioners in relation to the application of the Waste Management Directive, and related directives, in the Member States of the European Union (2011/2038(INI)), CELEX:52012IP0026/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. "[…] most waste management models consider economic and environmental aspects, but very few consider social aspects. For a **waste management system** to be sustainable, it needs to be environmentally effective, economically affordable and socially acceptable […]"

	2. “The main ‘recognized’ or formal stakeholders included the local authority, some ministries from central government and private contractors providing services. Participants in the workshops acknowledged the national and the local governments as the most important stakeholders which set up policies and the provision of solid **waste management systems** respectively. The private contractors are also regarded as important stakeholders as well as the service users such as: households, civil organizations, commercial and industrial sector. Less mentioned are educational and research institutions, political parties, farmers (including poultries, fisheries), health care centers, media, donor organizations, Chamber of Commerce and Industry, recycling companies, police and religious leaders. The ‘unrecognized’ or informal stakeholders include waste pickers collecting door to door, at the street or in the disposal site, itinerant waste buyers, junk shop owners and street sweepers.” 3. “At the heart of all waste legislation is the question – is this a waste and what type of waste is it? Waste definitions can determine whether a material is a ‘waste’ or a ‘product’ or ‘resource’, and that determination can have significant regulatory, environmental and financial impacts for the whole **waste management system**, including waste generators, processors, transporters and disposal operators.”
<Cont_**Reference**>	1. Morrissey, A. J., & Browne, J. (2004). Waste management models and their application to sustainable waste management. *Waste Management*, p. 298. https://doi.org/10.1016/j.wasman.2003.09.005 2. Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management*, pp. 223-224 https://doi.org/10.1016/j.wasman.2012.09.008 3. Lamb, G., Pogson, S., & Schliebs, D. (2012). WASTE DEFINITIONS AND CLASSIFICATIONS REPORT ON ISSUES, OPPORTUNITIES AND INFORMATION GAPS, p. 2.

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: werkwijze voor de uitvoering van afvalbeleid van a tot z, i.e. van inzameling en transport tot verwerking, inclusief beheer van stortplaatsen Aanvullende informatie: Dit systeem heeft vaststaande eigenschappen, maar ook eigenschappen die veranderen afhankelijk van het soort afval (e.g. vast afval, huisafval, verpakkingsafval).
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	afvalbeheersysteem
<**Reliability**>	2

<Term_**Reference**>	Toepassing van de afvalstoffenrichtlijn Resolutie van het Europees Parlement van 2 februari 2012 over de in verzoekschriften opgeworpen vragen betreffende de toepassing van de afvalstoffenrichtlijn en aanverwante richtlijnen in de lidstaten van de Europese Unie (2011/2038(INI)), CELEX52012IP0026/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Neuter
<***LookUpForms***>	
<**Context**>	1. Nederland beschikt tegenwoordig al in het hele land over een infrastructuur voor de verwijdering van gemengd huishoudelijk restafval, waarbij al sprake is van overcapaciteit. Elke wijziging in het **afvalbeheersysteem** zal consequenties hebben voor de deelnemers en voor hun taak binnen het verwijderingstraject. Deze wijziging zal bovendien kwalitatieve en kwantitatieve consequenties hebben voor de bestaande materiaalstromen en de installaties die voor de verwerking hiervan worden gebruikt.
<Cont_**Reference**>	1. van Velzen, E. T., & Timmermans, A. J. M. (2011). *Cradle to cradle verpakkingslogistiek: transitieproces kringloopsluiting levensmiddelenketens* (No. 1225). Wageningen UR-Food & Biobased Research, p. 11.

Appendix E: Term fiche for *integrated waste management*

**<IATE-N°>	
<Domain>	5206
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 6811 *waste* Broader: 2243597 *waste* Broader: 1427050 *waste management* Narrower: ###### *integrated waste management system* Narrower: ###### *integrated solid waste management* Related: 3577029 *waste handling*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	method regarding the handling of waste that involves multiple parties, waste streams and waste treatment processes and connects those different aspects
<Def_Reference>	Based on: Quattrociocchi, B., Mercuri, F., & Pasqualino, L. (2014). Network Approach for the Implementation of an Integrated Waste Management System. *Managerial Challenges of the Contemporary Society*, 7.
<Def_Note>	
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	integrated waste management
<Reliability>	2
<Term_Reference>	COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Towards a circular economy: A zero waste programme for Europe, CELEX:52014DC0398/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Adjective + Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. “The purpose of defining the term ‘waste’ was to enable legislators to demarcate articles and practices that needed to be dealt with in a managed way. If individual waste streams are managed in isolation, the result is the

	ever increasing quantities of waste that are accumulating in the world. A more modern approach is the concept of **integrated waste management**." 2. "In response to pressure from the EU, through Directives such as those mentioned above, and an appreciation of mounting levels of municipal waste (associated with the economic boom experienced by the country in the last decade), waste management planning in Ireland has recently undergone a radical overhaul. The development of regional waste management plans following the 1996 Waste Management Act demonstrates the Government of Ireland's desire to move away from policies that relied solely on landfill towards **integrated waste management**. However, the introduction and location of the infrastructure associated with an integrated approach to waste management have met with resistance, particularly to proposals for municipal waste incinerators, but also in relation to the extension of landfills and even the location of recycling facilities."
<Cont_**Reference**>	1. Seadon, J. K. (2006). Integrated waste management - Looking beyond the solid waste horizon. Waste Management, 26(12), p. 1328. https://doi.org/10.1016/j.wasman.2006.04.009 2. Fahy, F. (2005). The right to refuse: Public attitudes and behaviour towards waste in the west of Ireland. *Local Environment*, *10*(6), p. 552.

<**Language**>	nl
<**Definition**>	aanpak van afval waarbij alle partijen, afvalstromen en manieren om afval te verwerken worden betrokken en aan elkaar worden verbonden
<Def_**Reference**>	Op basis van: *Internationaal Natuur- en Milieubeleid; Notitie "Milieu en Armoedebestrijding."* (2001).
<Def_**Note**>	
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	geïntegreerd afvalbeheer
<**Reliability**>	2
<Term_**Reference**>	MEDEDELING VAN DE COMMISSIE AAN HET EUROPEES PARLEMENT, DE RAAD, HET EUROPEES ECONOMISCH EN SOCIAAL COMITÉ EN HET COMITÉ VAN DE REGIO'S Naar een circulaire economie: Een afvalvrij programma voor Europa, CELEX:52014DC0398/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Adjective + Noun
<***Gender***>	Neuter
<***LookUpForms***>	

<**Context**>	1. […] de PVC-industrie [is] op dit moment bezig met het opzetten van effectieve oplossingen voor **geïntegreerd afvalbeheer**, voor PVC-producten met zowel een korte als een lange levensduur. In Europa is al een aantal recycleprogramma's in werking en vele hiervan hebben mogelijkheden voor het uitbreiden van hun capaciteit indien de beschikbaarheid van recyclebaar materiaal beter wordt." 2. "In 2004 werden vooral inspanningen geleverd om het **geïntegreerd afvalbeheer** te optimaliseren. In samenwerking met een externe partner werden de afvalstromen in kaart gebracht. Naast een betere afvalsortering biedt dit ook mogelijkheden op gebied van afvalreductie. In 2005 ligt de nadruk op efficiënt energieverbruik."
<Cont_**Reference**>	*1. Duurzame ontwikkeling van de PVC-industrie*. (2010), pp. 5-6. 2. *Picanol Group jaarverslag 2004*. (2004), p. 27.

Appendix F: Term fiche for *integrated waste management system*

**<IATE-N°>	
<Domain>	5206
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 6811 *waste* Broader: 2243597 *waste* Broader: 1427050 *waste management* Broader: ###### *integrated waste management* Related: ###### *integrated solid waste management* Related: 3577029 *waste handling*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	framework in which various parties, waste streams, and strategies (e.g. prevention, collection, recycling, disposal) are handled in an interrelated way
<Def_Reference>	Based on: Marchi, M., Pulselli, F. M., Mangiavacchi, S., Menghetti, F., Marchettini, N., & Bastianoni, S. (2017). The greenhouse gas inventory as a tool for planning integrated waste management systems: a case study in central Italy. *Journal of Cleaner Production*, 142, 351–359. https://doi.org/10.1016/j.jclepro.2016.05.035
<Def_Note>	
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	integrated waste management system
<Reliability>	2
<Term_Reference>	Opinion of the Economic and Social Committee on the 'Communication from the Commission on the review of the Community strategy for waste management', CELEX:51997AC0096/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Adjective + Noun + Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. "The principal aim of the National Waste Management Plan (KPGO) is to determine the range of tasks necessary for the functioning in the country of the **integrated waste management system**. The system should ensure environmental protection, taking into account the current and future

	technical, organizational and economic possibilities, as well as the level of the existing infrastructure. The waste management system is affected and shaped by waste management plans worked out at the national, provincial, county and district levels." 2. "Adopting maximum recycling with waste-to-energy in an **integrated waste management system** would significantly reduce dumping in India. Waste-to-energy technologies are available that can process unsegregated low-calorific value waste, and industry is keen to exploit these technologies in India. Several waste-to-energy projects using combustion of un-segregated low-calorific value waste are currently being developed. Alternative thermal treatment processes to combustion include gasification, pyrolysis, production of refuse derived fuel and gas-plasma technology." 3. "The continuous depletion of natural resources related to our lifestyle cannot be sustained indefinitely. Two majorlines of action can be taken to overcome this challenge: the application of waste prevention policies and the shiftfrom the classical linear **Integrated Waste Management Systems** (IWMSs) that focus solely on the treatment of Municipal Solid Waste (MSW) to circular IWMSs (CIWMSs) that combine waste and materials management, incentivizing the circularity of resources."
<Cont_**Reference**>	1. Kulczycka, J., & Kowalski, Z. (2008). Principles of municipal waste management in Poland and selected regions of Europe. *Polish Journal of Chemical Technology*, *10*(4), p. 29. 2. Kumar, S., Smith, S. R., Fowler, G., Velis, C., Kumar, S. J., Arya, S., ... & Cheeseman, C. (2017). Challenges and opportunities associated with waste management in India. *Royal society open science*, *4*(3), p. 8. 3. Cobo, S., Dominguez-Ramos, A., & Irabien, A. (2018). From linear to circular integrated waste management systems: a review of methodological approaches. *Resources, Conservation and Recycling*, 135, 279. https://doi.org/10.1016/j.resconrec.2017.08.003

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: kader waarbinnen verschillende partijen, afvalstromen en strategieën (e.g. ter preventie van afvalproductie, voor afvalinzameling, recycling of verwerking) worden beschouwd als één geheel
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	geïntegreerd afvalbeheersysteem
<**Reliability**>	2
<Term_**Reference**>	Advies van het Economisch en Sociaal Comité over de "Mededeling van de Commissie betreffende de actualisering van de communautaire strategie voor het afvalbeheer", CELEX:51997AC0096/NL

<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Adjective + Noun
<***Gender***>	Neuter
<***LookUpForms***>	
<**Context**>	1. “Ons huidig afvalbeheersysteem is duidelijk aan verandering toe. Het behoeft niet altijd geld en materieel te zijn die tot verbetering van ons huidig afvalbeheer systeem zullen leiden maar ook de verandering van sociale, institutionele, legale en politieke condities zijn vereist. De introductie van een duurzaam afvalbeheer systeem kan de kern zijn tot de oplossing van ons afvalproblematiek. In Suriname is er nooit een gedetailleerd onderzoek gedaan naar de introductie van een ‘**geïntegreerd afvalbeheersysteem’**. Om de duurzaamheid van dit systeem te kunnen garanderen moet er aandacht besteed worden aan de kennis en inzicht in het potentieel van dit systeem.”
<Cont_**Reference**>	1. Zuilen, L. (2006). *Planning of an integrated solid waste management system in Suriname: a case study in Greater Paramaribo with focus on households*. Ghent University, p. 346.

Appendix G: Term fiche for *source separation*

**<IATE-N°>	48916
<Domain>	5206
<Domain_note>	
<Collection>	
<CrossRef>	Antonym: ###### *post separation* Broader: 48914 *separated collection* Broader: 1228742 *separate collection* Broader: 1427184 *collection of waste* Broader: 49643 *waste collection* Related: 1427327 *separation* Related: 872353 *waste stream* Related: 1427180 *household waste* Related: 1442713 *municipal waste*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	sorting of waste into different containers to form same-waste streams at the moment the waste is produced (e.g. in households and offices) to make recycling simpler and more efficient
<Def_Reference>	Based on: *Source Separation of Waste - Position Statement*. (2014).
<Def_Note>	e.g. separation of paper, metal and glass from other waste. The separation can be performed by multiple actors in various settngs, e.g. on building sites.
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	source separation
<Reliability>	2
<Term_Reference>	Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, CELEX:32008L0098/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. “Although some progress has been made towards the **source separation** of MSW, there is still a large gap in household waste reduction and

	recycling as compared with many advanced countries. Several major factors limited the practical application of the established systems: (1) the sorting method was not well-defined and residents were easily confused by the general concepts such as recyclables and non-recyclables, combustible and non-combustible materials; (2) recovery became difficult once recyclables were mixed with high water content waste; and (3) there was a lack of compatible facilities for separated waste treatment. Accordingly, it is essential to develop a simple, economical and practical **source separation** and management system which enables the separation of recyclables from wet materials." 2. "This study was conducted in the city of Borås, Sweden, which has applied a **source separation** system for more than 20 years. The municipality provides inhabitants with free plastic bags in two different colours so that they can sort their residual waste athome into two separate fractions; food waste (black bag) and com-bustible waste (white bag). The black and white bags are not separated but collected in a common container, and subsequently mechanically separated in an optical sorting plant. Here, combustible waste refers to the non-recyclable, non-packaging and non-hazardous waste such as diapers and tissue. The food waste is processed for biogas production, which can be used to fuel cars and busses for public transportation, whereas combustible waste is incinerated in the city's power plant with heat and electricity recovery. Other materials, such as packaging, newsprint, batteries, hazardous waste, and bulky waste, should be collected at designated drop-off points." 3. "The poor techniques of waste management are particularly affecting the immediate environment and wellbeing of city households in developing countries. City households in developing countries rarely practice the hierarchical activities of waste management – waste reduction, **source separation**, reuse and recycling and appropriate disposal. Household waste separation at source is perhaps among the best ways for appropriate waste management and thereby avoid environmental and health hazards. The concern that households have for the environment (while separating, disposing and burning wastes) can also be a factor in the success for good waste management."
<Cont_**Reference**>	1. Zhuang, Y., Wu, S. W., Wang, Y. L., Wu, W. X., & Chen, Y. X. (2008). Source separation of household waste: A case study in China. *Waste Management*, *28*(10), p. 2023. https://doi.org/10.1016/j.wasman.2007.08.012 2. Rousta, K., Bolton, K., Lundin, M., & Dahlén, L. (2015). Quantitative assessment of distance to collection point and improved sorting information on source separation of household waste. *Waste Management*, *40*, p. 23. https://doi.org/10.1016/j.wasman.2015.03.005 3. Tadesse, T. (2009). Environmental concern and its implication to household waste separation and disposal: Evidence from Mekelle, Ethiopia. *Resources, Conservation and Recycling*, *53*(4), p. 184. https://doi.org/10.1016/j.resconrec.2008.11.009

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	

<en-English>	separation at source
<Reliability>	3
<Term_**Reference**>	Institution: EEA; Title: GEMET - GEneral Multilingual Environmental Thesaurus; Publication Year: 1999; Publication Month: August; Volume No: 5;
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun + Preposition + Noun
<***Gender***>	
<***LookUpForms***>	
<**Context**>	1. "[…] the social survey (using questionnaires) to analyse public's view and influencing factors towards participation in source separation of food waste in households based on the theory of planned behaviour technique (TPB) was performed in June and July 2011 among selected staff in Universiti Putra Malaysia, Serdang, Selangor. The survey demonstrates that the public has positive intention in participating provided the opportunities, facilities and knowledge on waste **separation at source** are adequately prepared by the respective local authorities. Furthermore, good moral values and situational factors such as storage convenience and collection times are (*sic)* also encouraged public's involvement and consequently, the participations rate." 2. "In the absence of waste reduction, waste **separation at source** is the next best option to pursue. Separation at source enhances opportunities for composting, recycling of plastics, paper, metals and food waste to use as feedstock in anaerobic digesters. Increased **separation at source** and recycling leads to subsequent reduction of wastes that go to dumpsites and landfills." 3. "The poor techniques of waste management are particularly affecting the immediate environment and wellbeing of city households in developing countries. City households in developing countries rarely practice the hierarchical activities of waste management – waste reduction, source separation, reuse and recycling and appropriate disposal. Household waste **separation at source** is perhaps among the best ways for appropriate waste management and thereby avoid environmental and health hazards. The concern that households have for the environment (while separating, disposing and burning wastes) can also be a factor in the success for good waste management."
<Cont_**Reference**>	1. Ab, W. A. W., Ghani, K., Rusli, I. F., Biak, D. R. A., & Idris, A. (2013). An application of the theory of planned behaviour to study the influencing factors of participation in source separation of food waste. *Waste Management*, 33(5), p. 1276. https://doi.org/10.1016/j.wasman.2012.09.019 2. Mbiba, B. (2014). Urban solid waste characteristics and household appetite for separation at source in Eastern and Southern Africa. *Habitat International*, 43, pp. 157, 160. https://doi.org/10.1016/j.habitatint.2014.02.001 3. Tadesse, T. (2009). Environmental concern and its implication to household waste separation and disposal: Evidence from Mekelle, Ethiopia. *Resources, Conservation and Recycling, 53*(4), p. 184.

	https://doi.org/10.1016/j.resconrec.2008.11.009

<**TermType**>	Term
<**TermGroup**>	3
<**Evaluation**>	
<**en-English**>	source segregation
<**Reliability**>	2
<Term_**Reference**>	COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directives 2008/98/EC on waste, 94/62/EC on packaging and packaging waste, 1999/31/EC on the landfill of waste, 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment, CELEX:52014SC0207/EN
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun + Noun
<***Gender***>	
<***LookUpForms***>	
<**Context**>	1. “The contribution of the N_2O and CH_4 emissions generated during pre-collection of the organic fraction ofmunicipal solid waste was investigated for an existing Italian collection district in a life cycle perspective. This district consisted of about 24,000 inhabitants generating 35.6 Mg/day of municipal solid waste, ofwhich 7.27 Mg/day was the organic fraction. Different **source segregation** intensities and collection frequencies (day^{1}) were analyzed. The amount of the organic fraction not segregated at source was assumed to be collected commingled with the residual waste. The main findings showed that the lowerwas the collection frequency, the lower was the fuel consumption of the collection vehicles.” 2. “Literature research also shows that most experts find obtaining systematic and precise research data and evidence on **source segregation** a permanent challenge. This is due mainly to the informal nature of the municipal solid waste sector, social judgements and stigma around activities involving waste picking and handling, and also individual interests of different stakeholders which may bias their answers to researchers.” 3. “The potential renewable resource of biomethane from food waste is shown to be equivalent to 2.8% of energy in transport in Ireland; this is significant as it surpasses the resource associated with electrifying 10% of the private car fleet in Ireland, which is currently the preferred option for renewable energy in transport in the country. However for this resource to be realised within the EU, **source segregation** of food waste must be effected. According to the Animal By-Products Regulations, digestate from source segregated food waste may be applied to agricultural land post anaerobic digestion. Digestate from food waste derived from a mixed waste

	source may not be applied to agricultural land. Thus biomethane from food waste is predicated on **source segregation** of food waste."
<Cont_**Reference**>	1. Di Maria, F., Micale, C., & Morettini, E. (2016). Impact of the pre collection phase at different intensities of source segregation of bio-waste: An Italian case study. *Waste Management*, *53*, p. 12. https://doi.org/10.1016/j.wasman.2016.04.026 2. Matter, A., Dietschi, M., & Zurbrügg, C. (2013). Improving the informal recycling sector through segregation of waste in the household – The case of Dhaka Bangladesh. *Habitat International*, *38*, pp. 151–152. https://doi.org/10.1016/j.habitatint.2012.06.001 3. Browne, J. D., & Murphy, J. D. (2013). Assessment of the resource associated with biomethane from food waste. *Applied Energy*, *104*, p. 170. https://doi.org/10.1016/j.apenergy.2012.11.017

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: apart verzamelen van verschillende soorten afval, e.g. papier, glas, en plastic, op het moment dat het afval geproduceerd wordt, e.g. in huishoudens of op kantoren Aanvullende informatie: Verzameling kan plaatsvinden in huishoudens, publieke ruimtes of binnen bedrijven.
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	bronscheiding
<**Reliability**>	2
<Term_**Reference**>	Lijst van schriftelijke vragen van leden van het Europees Parlement met aanduiding van vraagnummer, originele taal, auteur, fractie, aangeschreven instelling, datum van indiening en onderwerp, CELEX:C2011/243E/01/NL
<Term_**Note**>	voorscheiding
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	
<**Context**>	1. "Het implementeren van systemen die **bronscheiding** mogelijk maken in bestaand stedelijk gebied is een aanpak die moet worden overwogen bij vervanging van de bestaande riolering. Dit kan en mag niet los worden gezien van de overige delen van de afvalwaterketen. Het

	sanitatievraagstuk, ofwel een hernieuwde kijk op de rioolkwestie, vraagt om een visie op de samenhang tussen toiletkeuze, type inzamel- en transportsysteem en wijze van behandeling, rekening houdend met de veelheid aan eisen en randvoorwaarden zoals die hiervoor zijn besproken. Een vergaande samenwerking tussen experts op de verschillende betrokken vakgebieden is daarbij voorwaarde. Ten slotte wordt erop gewezen dat flexibiliteit een belangrijk aspect moet zijn bij het ontwerpen van nieuwe inzamel- en transportconcepten zodat snel kan worden ingespeeld op veranderende omstandigheden zoals een toe- of afname van de hoeveelheid of de samenstelling van afvalwater." 2. "Inzameling van papier en karton vindt plaats door **bronscheiding**. Papier en karton kunnen circa 7 keer gerecycled worden voordat de vezels zo klein zijn geworden dat ze uit de papiercyclus verdwijnen en in het proceswater terecht komen. Om de juiste kwaliteit te verkrijgen, worden mengsels van gerecyclede en virgin (nieuwe) grondstoffen gebruikt."
<Cont_**Reference**>	1. Clemens, F. H. L. R. (2014). Bronscheiding in afvalwatersystemen: Ook in bestaande situaties?. *TVVL Magazine, 43 (9)*, p. 4. 2. Molenveld, K., van den Oever, M., & Bos, H. (2015). Biobased Packaging Catalogue. Wageningen, p. 19.

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	
<**nl-Nederlands**>	scheiding aan de bron
<**Reliability**>	3
<Term_**Reference**>	Richtlijn 2008/98/EG van het Europees Parlement en de Raad van 19 november 2008 betreffende afvalstoffen en tot intrekking van een aantal richtlijnen, CELEX:32008L0098/NL
<Term_**Note**>	sorteren bij de bron
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun + Preposition + Noun
<***Gender***>	
<***LookUpForms***>	scheiding bij de bron
<**Context**>	1. "Voor afvalwater wordt op beleidsniveau geen eenduidige prikkel afgeven. **Scheiding aan de bron** is een belangrijk uitgangspunt in het afvalstoffenbeleid, waaronder afvalwater. Echter het huidige (huishoud)afvalwaterbeleid is niet gericht op deze **scheiding aan de bron**." 2. "In de situaties waar het gaat om kleine hoeveelheden specifiek ziekenhuisafval kan autoclaveren in de, reeds in het ziekenhuis aanwezige, destructiestoomsterilisator een geschikte oplossing zijn. Gezien de beperkte capaciteit van een dergelijke destructiestoomsterilisator moet de afvalstroom beperkt worden door een goede **scheiding aan de bron**."
<Cont_**Reference**>	1. Spijker, J., & Van der Grinten, E. (2014). *Einde-afval bij afvalwater en bouwstoffen. Mogelijkheden om hergebruik te stimuleren binnen de circulaire economie*, p. 9.

	2. Van Drongelen, A. W., De Bruijn, A. C. P., & Peters-Volleberg, G. W. M. (2005). *Decontaminatietechnieken specifiek ziekenhuisafval*, p. 5.

Appendix H: Term fiche for *inventory analysis*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 875848 *life cycle assessment* Related: 924233 *Life Cycle Inventory*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	second phase within Life Cycle Assessment in which all energy, material flows and emissions (from input to output) within the system are quantified
<Def_Reference>	Based on: Islam, S. ul, & Kumar, A. (2019). Life Cycle Assessment of Rubber Dam. In S. Thomas, A. V.K., A. Dutta, A. V. Rane, & K. Kanny (Eds.), *Hydraulic Rubber Dam* (pp. 99–122). https://doi.org/10.1016/b978-0-12 812210-5.00008-0
<Def_Note>	
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	inventory analysis
<Reliability>	2
<Term_Reference>	Proposal for a Council Regulation (EC) on a revised Community eco-label award scheme /* COM/96/0603 FINAL - SYN 96/0312 */, CELEX:51996PC0603/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	life cycle inventory analysis (LCIA)
<Context>	1. “The **inventory analysis** step is one of the most time and cost consuming processes in an LCA (Suh and Huppes, 2002). If the scope of the study is not adequately defined, excessive time may be wasted obtaining and analysing data that is beyond the scope required for the intended purpose of the study.”

	2. The **inventory analysis** is the most important stage in the process of LCA. Energy, greenhouse gases and principal pollution emissions are covered in the life-cycle inventory (LCI) models of building energy system, which are the so-called environmental load factors."
<Cont_**Reference**>	1. Crawford, R. H. (2008). Validation of a hybrid life-cycle inventory analysis method. *Journal of Environmental Management*, *88*(3), p. 497. https://doi.org/10.1016/j.jenvman.2007.03.024 2. Xing, S., Xu, Z., & Jun, G. (2008). Inventory analysis of LCA on steel and concrete-construction office buildings. *Energy and Buildings*, *40*(7), p. 1189. https://doi.org/10.1016/j.enbuild.2007.10.016

<**Language**>	nl
<**Definition**>	tweede fase in levenscyclusanalyse waarin gegevens over de energie, materialen en uitstoot in het productsysteem (van invoer tot uitvoer) worden verzameld en gekwantificeerd ten behoeve van analyse
<Def_**Reference**>	Gebaseerd op: Valk, E. De, Hollander, A., & Zijp, M. (2016). Milieubelasting van de voedselconsumptie in Nederland.
<Def_**Note**>	
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	inventarisatie
<**Reliability**>	2
<Term_**Reference**>	013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	inventarisatie-analyse; inventarisatie analyse; inventarisanalyse
<**Context**>	1. "[…] de stappen in de levenscyclus van voedingsmiddelen weergegeven die in de **inventarisatie** zijn meegenomen. De levenscyclus start met de productiefase van alle ingrediënten die nodig zijn voor het produceren van het product. Dus in het geval van vlees en zuivel ook de productie van het veevoer, en als er sprake is van verpakking ook de productie van verpakkingsmateriaal. Vervolgens worden transport, opslag en distributie beschouwd, met auto, boot, trein en vliegtuig. De derde fase is de retailfase, de verhandeling van de producten in de

	supermarkt, en de vierde fase is de fase bij de consument (bewaren en bereiden).”
<Cont_**Reference**>	1. Valk, E. De, Hollander, A., & Zijp, M. (2016). *Milieubelasting van de voedselconsumptie in Nederland*, pp. 22-23.

Appendix I: Term fiche for *system expansion*

**<IATE-N°>	
<Domain>	52; 16
<Domain_note>	
<Collection>	
<CrossRef>	Related: 45110 *allocation* Related: ###### *economic allocation* Related: ###### *substitution* Related: 3548916 *system boundary*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	inclusion of impacts and benefits of coproducts to the product system that is analyzed
<Def_Reference>	Based on: Samuel-Fitwi, B., Schroeder, J. P., & Schulz, C. (2013). System delimitation in life cycle assessment (LCA) of aquaculture: Striving for valid and comprehensive environmental assessment using rainbow trout farming as a case study. *International Journal of Life Cycle Assessment*, 18(3), p. 578. https://doi.org/10.1007/s11367-012-0510-z
<Def_Note>	Allocation can be avoided by the use of system expansion.
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	system expansion
<Reliability>	2
<Term_Reference>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. “The **system expansion** approach takes into account all processes that are affected by a change in the production of a product. By an increase in the production of sugar, the co-production of molasses is also increased. In order to avoid allocation between molasses and sugar, resource use and emissions associated with molasses are included in the sugar production. As a way to compensate for this, the sugar cane system is expanded to

	include the avoided production of animal feed elsewhere. The assumption behind this is that the increased production of molasses resulting from increased sugar production will reduce feed production in other systems." 2. "In order to compare waste wood cascading to the use of primary wood with LCA, a functional equivalence of the systems has to be achieved. We applied a **system expansion** approach, considering different options for providing the additionally needed energy for the cascading system. […] We found that the cascading systems create fewer environmental impacts than the primary wood systems, if **system expansion** is based on wood energy. The most noticeable advantages were detected for the impact categories of land transformation and occupation and the demand of primary energy from renewable sources." 3. "If it is necessary to break down impacts into the constituent elements, the impacts need to be fairly distributed across both the ferrous and non-ferrous components. It is recommended that the impacts from the ferrous component are credited to the non-ferrous component using **system expansion**. Practitioners should be careful to apply the credit using an equivalent ferrous product, such as scrap, rather than sinter, pellet, hot metal, or finished steel products. **System expansion** is justified here because iron is predominately produced in isolation from other metals."
<Cont_**Reference**>	1. Nguyen, T. L. T., & Hermansen, J. E. (2012). System expansion for handling co-products in LCA of sugar cane bio-energy systems: GHG consequences of using molasses for ethanol production. *Applied energy*, *89*(1), p. 256. 2. Höglmeier, K., Weber-Blaschke, G., & Richter, K. (2014). Utilization of recovered wood in cascades versus utilization of primary wood—a comparison with life cycle assessment using system expansion. *International Journal of Life Cycle Assessment*, 19(10), p. 1755. https://doi.org/10.1007/s11367-014-0774-6 3. Santero, N., & Hendry, J. (2016). Harmonization of LCA methodologies for the metal and mining industry. International Journal of Life Cycle Assessment, 21(11), p. 1550. https://doi.org/10.1007/s11367-015-1022-4

<**Language**>	nl
<**Definition**>	toevoeging van milieudruk en -voordelen van bijproducten aan het productsysteem dat wordt onderzocht
<Def_**Reference**>	Op basis van: Kleijn, R., Huppes, G., Wrisberg, N., & Hermans, P. (2000). *Methodologische Afstemming LCC/LCA met als cases IBA en Riolering*.
<Def_**Note**>	Door systeemuitbreiding kan allocatie worden vermeden.
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	systeemuitbreiding
<**Reliability**>	2

<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	countable noun
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	uitbreiding van het systeem
<**Context**>	1. “Emissies zijn berekend tot het moment dat de melk het bedrijf verlaat, exclusief energiegebruik op het bedrijf zelf en emissies gerelateerd aan transport, verwerking en verpakking van de melk. Door middel van zgn. **systeemuitbreiding** is rekening gehouden met het vlees dat geproduceerd wordt wanneer koeien geslacht worden en kalveren opgefokt worden in de witvleesindustrie. Deze productie resulteert in extra emissies, maar vervangt de productie (en bijbehorende emissise) van ander vlees, en de totale emissies zijn hiervoor gecorrigeerd.” 2. “In deze studie hebben we allocatie vermeden. Hiervoor hebben we aangenomen dat de coproducten ook worden geoogst en dat deze worden omgezet in energie. Gecombineerd met **systeemuitbreiding** betekent dit dat bijvoorbeeld stro wordt verbrand, waarbij stoom en electriciteit worden geproduceerd, die een mix van fossiele brandstoffen vervangen. De DDGS wordt vergist tot biogas, dat aardgas vervangt. De vermeden fossiele brandstoffen kunnen worden afgetrokken van het gebruik van niet-hernieuwbare energie en de CO2 uitstoot die deze brandstoffen zouden veroorzaken kan worden afgetrokken van de broeikasgasuitstoot. Het voordeel van deze aanpak is dat de verschillende gewassen beter met elkaar vergelijkbaar zijn.”
<Cont_**Reference**>	1. Kok, A., van Middelaar, C. E., Mostert, P. F., van Knegsel, A. T. M., Kemp, B., de Boer, I. J. M., & Hogeveen, H. (2018). Effecten van droogstandslengte op melkproductie, inkomen en broeikasgasemissies van melkvee. In A. T. M. van Knegsel, R. J. van Hoeij, & A. Kok (Eds.), *Droogstand op maa*t, p. 79. 2. Bos, H., Conijn, S., Corré, W., Meesters, K., & Patel, M. K. (2011). Duurzaamheid van biobased producten: energiegebruik en broeikasgasemissie van producten met suikers als grondstof, p. 22.

Appendix J: Term fiche for *treatment process*

**<IATE-N°>	
<Domain>	5206
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 3504805 *treatment* Broader: 1427045 *waste treatment* Narrower: 1493574 *anearobic digestion* Related: pre-treatment process Related: waste treatment plant
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	
<Def_Reference>	
<Def_Note>	No definition was found. Proposed definition: procedure aimed towards breaking down waste Additional information: Different treatment processes, e.g. thermal treatment, anaerobic digestion, can be used for different types of waste, e.g. (sewage) water, electronic waste, municipal waste, biological waste, but various treatment processes can be also used for a specific type of waste. Based on: Lagerkvist, A., & Dahlén, L. (2019). Solid Waste Generation and Characterization. In N. J. Themelis & A. C. Bourtsalas (Eds.), *Recovery of Materials and Energy from Urban Wastes* (pp. 7–20). Springer.
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	treatment process
<Reliability>	2
<Term_Reference>	Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste, CELEX:32006R1013/EN
<Term_Note>	waste treatment process
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	waste treatment process

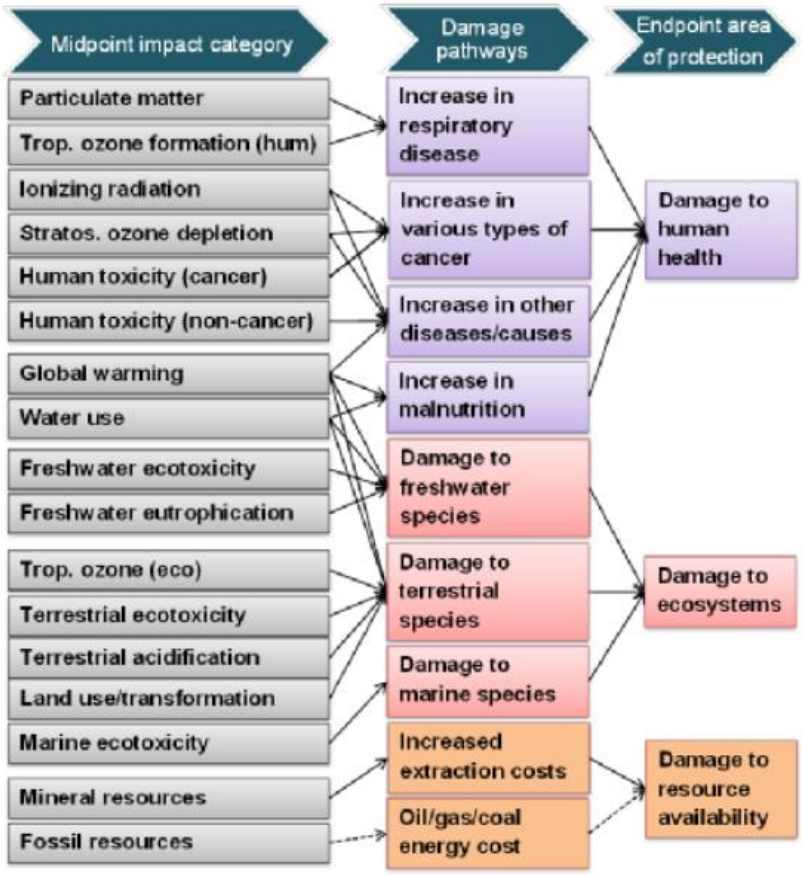
<**Context**>	1. “Both incineration and sanitary landfill has the highest global warming potential due to CO2 and methane emission to the atmosphere. For landfill, methane emission control of the landfill site is very difficult and costly processes. Incineration uses air for the thermal process and produce large amount of syngas during waste **treatment process** which is also produce large amount of CO_2.” 2. “Sedimentation is a waste **treatment process** whereby suspended and coagulated particles of density greater than that of the liquid medium are removed. Sedimentation may be classified as primary or secondary. The purpose of primary settling is to reduce the suspended and organic load on subsequent treatment units. […] Secondary sedimentation is employed for the clarification of sludge waste mixtures and for the thickening of biological sludges.”
<Cont_**Reference**>	1. Zaman, A. U. (2010). Comparative study of municipal solid waste treatment technologies using life cycle assessment method. *International Journal of Environmental Science & Technology*, *7*(2), p. 232. 2. Eckenfelder, W. W., & O'Connor, D. J. (2013). *Biological waste treatment*. Elsevier, p. 52.

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: procedure om afval te bewerken ter bevordering van de afbraak Aanvullende informatie: Eventueel ter voorbereiding op verdere afbraak. Verschillende soorten processen, waaronder thermische, mechanische, fysisch/chemische en anaerobe behandelingsprocessen kunnen worden ingezet voor de afbraak van één of meerdere soorten afval, e.g. chemisch afval, papier en karton, glas of bouwafval.
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	behandelingsproces
<**Reliability**>	2
<Term_**Reference**>	Verordening (EG) nr. 1013/2006 van het Europees Parlement en de Raad van 14 juni 2006 betreffende de overbrenging van afvalstoffen, CELEX:32006R1013/NL
<Term_**Note**>	afvalbehandelingsproces
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun

<***Gender***>	Neuter
<***LookUpForms***>	
<**Context**>	1. “Door DSM zijn in 1988 de toepassingsmogelijkheden van dit proces voor verwerking van mest onderzocht. Het experimentele deel van het onderzoek is uitgevoerd met een bench scale opstelling van de firma Modar. Deze firma heeft het superkritisch **behandelingsproces** voor organische slurries ontwikkeld. Het experimentele onderzoek is uitgevoerd met varkensdrijfmest bij een reactor temperatuur van 600 °C en een druk in een reactorsysteem van twee na elkaar geschakelde reactoren (om ongewenste by passing te voorkomen) bij een druk van 255 bar. Het oxidatieproces werd uitgevoerd met lucht.” 2. “Het biologisch **behandelingsproces** bij afvalwater is gebaseerd op het optimaliseren van de groei van micro-organismen in een gecontroleerd milieu. Parameters waar de groei van afhankelijk is, zijn bijvoorbeeld temperatuur, pH, zuurstof en de aanwezigheid van allerlei nutriënten. Verschillende families van micro-organismen zijn in staat om samen organische stoffen af te breken en anorganische stoffen op te nemen of om te zetten.”
<Cont_**Reference**>	1. Smit, A., Sanders, J. P. M., Verdoes, N., Teng, C., & Brunt, M. T. (2012). *Verwerking van digestaat van mestvergisting: terreinverkenning van mogelijkheden tot kostenreductie* (No. 2310). Alterra, p. 55. 2. De Wandel, S., Chys, M., & Van Hulle, S. (2017). FYBAR: Gevorderde FYsico-chemische Behandeling van Biologisch gestabiliseerd Afvalwater afkomstig van Afvalverwerkende en Recyclerende bedrijven, p. 21.

Appendix K: Term fiche for *midpoint*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 875848 l*ife cycle assessment* Broader: 3501803 *life cycle impact assessment* Broader: ###### *midpoint method* Broader: ###### *midpoint approach* Narrower: ###### *midpoint indicator* Narrower: ###### *midpoint level indicator* Narrower: ###### *midpoint category* Narrower: ###### *midpoint impact category* Narrower: ###### *midpoint characterization factor* Related: ###### endpoint Related: ###### endpoint indicator Related: ###### *endpoint category*
<ProblemLanguage>	EN
<Graphics>	
<Graph_**Reference**>	LCIA: the ReCiPe model | RIVM. (2011). Retrieved May 20, 2019, from https://www.rivm.nl/en/life-cycle-assessment-lca/recipe

<Language>	en
<Definition>	aggregation level of environmental impact containing impact categories that is located between the start and the endpoint

<Def_**Reference**>	Based on: LCIA: the ReCiPe model | RIVM. (2011). Retrieved May 20, 2019, from https://www.rivm.nl/en/life-cycle-assessment-lca/recipe
<Def_**Note**>	Additional information: Not to be confused with midpoint referring to midpoint indicators. Impacts on midpoint level can lead to impacts on the endpoint level.
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**en-English**>	midpoint
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	
<***LookUpForms***>	midpoint level
<**Context**>	1. "The purpose of this article is to present a framework of carrying capacity-based normalisation references in LCA and to develop European and global carrying capacity-based normalisation references compatible with characterised indicator scores at **midpoint** for impact categories that link to the natural environment area of protection. After presenting definition and framework, the concept of carrying capacity is made operational for Life Cycle Impact Assessment (LCIA), and European and global carrying capacity-based normalisation references for each midpoint indicator are developed." 2. "Most LCA methods address water scarcity (**midpoint**), and some model potential impacts on human health or biodiversity (endpoint)." 3. "Traditional characterisation methods are examples of midpoint modelling, meaning that they choose an indicator somewhere between emission and endpoint in the environmental mechanism (a ''**midpoint**'') and model the impact on this indicator. The indicator is typically chosen where it is judged that further modelling is not feasible or involves too large uncertainties, or where a relative comparison can be made without the need for further modelling."
<Cont_**Reference**>	1. Bjørn, A., & Hauschild, M. Z. (2015). Introducing carrying capacity-based normalisation in LCA: framework and development of references at midpoint level. *International Journal of Life Cycle Assessment*, 20(7), p. 1006. https://doi.org/10.1007/s11367-015-0899 2p. 1006. 2. Pfister, S., Boulay, A. M., Berger, M., Hadjikakou, M., Motoshita,

	M., Hess, T., … Henderson, A. (2017). Understanding the LCA and ISO water footprint: A response to Hoekstra (2016) "A critique on the water-scarcity weighted water footprint in LCA." *Ecological Indicators*, 72, p. 356. https://doi.org/10.1016/j.ecolind.2016.07.051 3. Finnveden, G., Hauschild, M. Z., Ekvall, T., Guinée, J., Heijungs, R., Hellweg, S., … Suh, S. (2009). Recent developments in Life Cycle Assessment. *Journal of Environmental Management*, 91(1), p. 10. https://doi.org/10.1016/j.jenvman.2009.06.018

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: niveau van aggregatie van milieueffecten onderverdeeld in effectcategorieën dat zich bevindt tussen het begin- en eindpunt
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	middelpunt
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Neuter
<***LookUpForms***>	midpunt; klassemidden
<**Context**>	1. "De impacts kunnen vervolgens worden uitgedrukt in **middelpunt** of een eindpunt indicatoren (figuur 2). Eindpunt indicatoren zijn gericht op directe bijdrage of schade, bijvoorbeeld verloren levens of schade aan ecosystemen. De **middelpunt** benadering ligt tussen de Life Cycle Inventory (LCI) en het eindpunt in. De bijdrage aan klimaatverandering is een voorbeeld van een middelpunt indicator. Middelpunt en eindpunt resultaten hebben ieder hun eigen sterkten en zwakten. Eindpunt indicatoren worden vaak beter begrepen door niet-experts, maar hebben een hogere mate van onzekerheid, terwijl middelpunt indicatoren vaak moeilijker zijn te begrijpen en doorzien, maar een lagere onzekerheid hebben." 2. "Voor de categorieën op middelpuntniveau is er een bijkomende moeilijkheid. Er zijn vele processen die uiteindelijk tot hetzelfde effect

	leiden en dus tot hetzelfde **middelpunt**. Het komt er dus op aan om een impactcategorie op middelpuntniveau zo te kiezen dat al deze effecten meegerekend worden in dit punt. Indien men de impactcategorie 'te vroeg' plaatst in een bepaald proces, bestaat de kans dat andere processen die uiteindelijk tot hetzelfde effect leiden in een verder stadium niet meegerekend worden. Dit zou dan uiteindelijk leiden tot een grote toename aan middelpunt impactcategorieën." 1. *Handreiking bij stap één in LCA : Doel & Scope*, n.d. Retrieved August 8, 2019, from https://www.rvo.nl/sites/default/files/bijlagen/Handreiking%20bij%20stap%201%20van%20een%20LCA%20-%20Doel%20Scope.pdf, p. 7. 2. Vandaele, M. (2013). *Levencyclusanalyse van nulenergiewoning: milieu-impact van bouwmaterialen en installaties*. Universiteit Gent, p. 18.
<Cont_**Reference**>	

Appendix L: Term fiche for *uncertainty analysis & uncertainty propagation*

**<IATE-N°>	
<Domain>	52; 16
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 766436 *analysis* Narrower: 1110129 *sensitivity-uncertainty analysis* Related: 1612841 *uncertainty* Related: 1688440 *Monte-Carlo test* Related: 1609441 *propagation uncertainty*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	method to determine the uncertainty in a system by calculating parameter uncertainty and their effects on the total system
<Def_Reference>	Based on: Cacuci, D. (2003). *Sensitivity & Uncertainty Analysis Theory* (Vol. 1). https://doi.org/10.1201/9780203498798
<Def_Note>	
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	uncertainty analysis
<Reliability>	2
<Term_Reference>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Adjective + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. "[…] it is recognized that an essential part of **uncertainty analysis** is the analysis of dependence. Indeed, if all uncertainties are independent, then their propagation if mathematically trivial (though perhaps computationally challenging). Sampling and propagating independent uncertainties can easily be trusted to the modellers themselves. However, when uncertainties are depedent, things become much more subtle, and we enter a domain for which the modellers' training has not prepared them."

	2. “We use the lifespan definition of the average interval between purchasing main computers, which does not include storage time. The EuP study apparently uses a lifespan definition of the total length of time a computer is owned. We argue this definition is inappropriate and significantly skews results because it includes time spent unused in storage. However, according to our **uncertainty analysis**, even extending lifespan to 6 years would only increase the use phase to approximately 50% of the total, which suggests that other methodological differences are also significant.”
<Cont_**Reference**>	1. Kurowicka, D., & Cooke, R. M. (2006). *Uncertainty analysis with high dimensional dependence modelling*. John Wiley & Sons, pp. 3-4. 2. Deng, L., Babbitt, C. W., & Williams, E. D. (2011). Economic balance hybrid LCA extended with uncertainty analysis: Case study of a laptop computer. Journal of Cleaner Production, 19(11), p. 1205. https://doi.org/10.1016/j.jclepro.2011.03.004

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	
<**en-English**>	uncertainty propagation
<**Reliability**>	2
<Term_**Reference**>	
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	
<***LookUpForms***>	undercertainty propagation analysis
<**Context**>	1. “This analysis provides the modeller with the uncertainty relative to each scenario’s results through parameter **uncertainty propagation** (Step 2b). The uncertainty of the final decision is obtained by considering the difference between two alternative scenarios in the discernibility analysis (Step 2c). Considering the amount of data required in order to inform the uncertainties pertaining to input parameters, it is recommended to use the results of the sensitivity analysis to reduce the number of uncertainties implemented in the **uncertainty propagation**. The number of scenarios and impact categories investigated can also be reduced to the most critical ones.”
<Cont_**Reference**>	1. Clavreul, J., Guyonnet, D., & Christensen, T. H. (2012). Quantifying uncertainty in LCA-modelling of waste management systems. *Waste Management*, 32(12), p. 2493. https://doi.org/10.1016/j.wasman.2012.07.008

<**Language**>	nl
<**Definition**>	methode waarmee de onzekerheid voor het hele systeem kan worden berekend aan de hand van de onzekerheid van de parameters binnen het systeem
<Def_**Reference**>	Op basis van:

	Baggelaar, P., van Tongeren, O., Knoben, R., & van Loon, W. (2010). Rapporteren van betrouwbaarheid van de KRW--beoordelingen. *H2O*, *16*, 21-25.
<Def_**Note**>	
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	onzekerheidsanalyse
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	foutenvoortplanting
<**Context**>	1. “Bij de interpretatie van de bandbreedtes zoals hiervoor beschreven moet verder in ogenschouw worden genomen dat zij veelal betrekking hebben op projectiewaarden binnen een specifiek kader. Binnen dat kader zijn niet altijd alle onzekerheden relevant. Zo wordt de onzekerheid als gevolg van mogelijke wijzigingen van het vastgestelde dan wel voorgenomen beleid niet in de bandbreedte meegenomen. Ook zijn veranderingen in monitoringprotocollen en definities (van bijvoorbeeld de omrekenfactoren voor mondiale opwarmingspotentielen van niet-CO2-broeikasgassen) niet in de **onzekerheidsanalyse** betrokken. In de bandbreedte wordt bovendien geen rekening gehouden met extreme gebeurtenissen, zoals oorlogen of grote rampen. Tenslotte wordt ook geen rekening gehouden met plotselinge doorbraak van technologische game-changers en wordt, gezien hun aard, ook niet geanticipeerd op nu nog onbekende onzekerheden (‘unknown unknowns’).” 2. “Zoals is toegelicht in paragraaf 3.2 is de RDE-regelgeving voor personenauto’s en bestelauto’s nog niet meegenomen als vastgesteld beleid in de NEV 2015. De NOx-emissie van Euro-6 dieselpersonenauto’s ligt daardoor in de praktijk nog aanzienlijk hoger dan die van Euro-6 benzineauto’s. Hoeveel hoger is onzeker omdat er nog maar weinig metingen zijn verricht aan Euro-6 auto’s. In de **onzekerheidsanalyse** is daarom inzichtelijk gemaakt wat de invloed is op de geraamde NOx-emissies van een 20% lagere praktijkemissie van Euro-6 dieselauto’s (personenauto’s en bestelauto’s) en van een situatie waarin de NOx-emissies van Euro-6 auto’s in de praktijk op hetzelfde niveau liggen als Euro-5 auto’s.”
<Cont_**Reference**>	1. Menkveld, M., Smekens, K. E. L., Tigchelaar, C., van der Welle, A. J., Stralen, J. V., Hekkenberg, M., ... & Peek, K. (2017). Achtergronddocument onzekerheidsanalyse Nationale Energieverkenning 2017, p. 10.

	2. Geilenkirchen, G., ten Broeke, H., & Hoen, A. (2016). Verkeer en vervoer in de Nationale Energieverkenning 2015. *Achtergronden van de NEV-raming verkeer en vervoer, Den Haag: Planbureau voor de Leefomgeving*, p. 88.

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	
<**nl-Nederlands**>	foutenvoortplanting
<**Reliability**>	2
<Term_**Reference**>	
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	
<**Context**>	1. De meest algemene techniek van de analyse van **foutenvoortplanting** is de Monte Carlo-simulatie. Bij Monte Carlo-simulatie worden trekkingen {z_1,z_2, .. ,Z_n} gedaan uit de gezamenlijke kansdichtheidsfunctie (ook wel "kansverdeling" genoemd) van Z_1,Z_2,…Z_n. Zo'n trekking is eigenlijk een kansexperiment, zoals het gooien van een dobbelsteen: de stochastische variabele *N* is het aantal ogen, en het feitelijke aantal ogen *n* na een worp is een trekking uit de kansverdeling van *N*; door de dobbelsteen een zeer groot aantal malen te rollen kunnen we schatten wat de kans is dat *n*=5 door te tellen hoeveel maal l de dobbelsteen op 5 ogen blijft liggen en dit te delen door het aantal keer dat is geworpen." 2. "Voor een goede beoordeling van water- en stofbalansen is het van groot belang onzekerheden mee te nemen in de analyse. Op verzoek van de STOWA is daarom de tool SigmaB ontwikkeld. Deze tool verzorgt onder andere de **foutenvoortplanting** bij het maken van een balans en het daarvoor noodzakelijke opvullen van onvolledige reeksen. Daarmee is een stap gezet naar het analyseren en kwantificeren van de onzekerheid in balansstudies. Uit de cases die zijn uitgevoerd blijkt dat het een nuttig hulpmiddel is bij het bepalen van de grootte van de fout van balansposten."
<Cont_**Reference**>	1. Bierkens, M. F. P. (1996). *Foutenanalyse in waterbalansstudies*, p. 26. 2. van der Hauw, K. (2013). Water- en stofbalansen: betrouwbaar of drijfzand? *Stromingen*, 9(2), p. 34.

Appendix M: Term Fiche for *unit process*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 875848 *life cycle assessment* Broader: ###### *inventory analysis*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	smallest element for which data about input and output can be collected during the inventory analysis in life cycle assessment
<Def_Reference>	Based on: ISO 14044 (2006): *environmental management – life cycle assessment: requirements and guidelines.* International Organization for Standardization, Geneva.
<Def_Note>	
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	unit process
<Reliability>	2
<Term_Reference>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. "At first, we established the energy-material balances for each **unit process** based on the 1 tDM (ton in dry mass) of the input sludge to the process. Then, we made the inventories of each system (scenarios) based on the 1 tDM of the input sludge to the first process of the scenarios. Following parts of this chapter show in detail, how we obtained the energy–mass balances of each **unit process**." 2. "The recommendation to trace all flows to the "cradle" or the "grave" implies an accounting perspective, that everything should be included and accounted for, whether relevant or not. The criteria as to whether a **unit**

	process may be omitted are based on whether its flows are negligible (or not); i.e., they are not based on its relevance to a potential change in the system being modeled."
<Cont_**Reference**>	1. Suh, Y. J., & Rousseaux, P. (2002). An LCA of alternative wastewater sludge treatment scenarios. *Resources, Conservation and Recycling*, *35*(3), p. 194. https://doi.org/10.1016/S0921-3449(01)00120-3 2. Tillman, A. M. (2000). Significance of decision-making for LCA methodology. *Environmental Impact Assessment Review*, *12*(1), p. 114. https://doi.org/10.1016/S0195-9255(99)00035-9

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: kleinste element waarvoor binnen de inventarisatie in een levenscyclusanalyse invoer- en uitvoergegevens kunnen worden verzameld
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	eenheidsproces
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Neuter
<***LookUpForms***>	
<**Context**>	1. "Productsystemen kunnen tientallen **eenheidsprocessen** bevatten. Een goede keuze van systeemgrenzen, om het productsysteem goed af te bakenen en mogelijk te simplificeren, is daarom van belang. Subsystemen die waarschijnlijk binnen de foutenmarge van uitkomst van de vergelijking liggen kunnen worden weggelaten. Ook **eenheidsprocessen** die voor alle alternatieven gelijk zijn kunnen in de vergelijking worden weggelaten. Deze hebben immers geen invloed op de uiteindelijke rangorde van de verschillende alternatieven van een product. Het weglaten van deze **eenheidsprocessen** wordt ook wel *stroomlijnen* genoemd."
<Cont_**Reference**>	1. van 't Noordende, W. J. C. (2008). *Appels en peren: Het debat rondom milieu-product-vergelijkingen*, p. 50. https://doi.org/10.1007/s12428-010-0040-z

Appendix N: Term fiche for *waste cardboard*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 134311 *waste paper*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	type of solid waste made up by cellulose
<Def_Reference>	Based on: Iyer, K. A., Flores, A. M., & Torkelson, J. M. (2015). Comparison of polyolefin biocomposites prepared with waste cardboard, microcrystalline cellulose, and cellulose nanocrystals via solid-state shear pulverization. *Polymer*, 75, 78–87. https://doi.org/10.1016/j.polymer.2015.08.029
<Def_Note>	Additional information: This type of waste is caused by multiple parties, such as individuals in households and companies. Corrugated cardboard is made up by three layers, and paperboard is made up of one thin layer. ISO 536 contains information about the grammage of cardboard per square meter. Based on: Allaoui, S., Aboura, Z., & Benzeggagh, M. L. (2009). Phenomena governing uni-axial tensile behaviour of paperboard and corrugated cardboard. *Composite Structures*, *87*(1), 80–92. https://doi.org/10.1016/j.compstruct.2008.01.001
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	waste cardboard
<Reliability>	2
<Term_Reference>	Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste, CELEX:32006R1013/EN
<Term_Note>	
<*LangUsage*>	uncountable
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	cardboard waste

<**Context**>	1. “As a significant part of municipal solid waste (MSW), **waste cardboard** (CB) is a sustainable, inexpensive, and rich source of cellulose.” 2. The paper and cardboard market faces competition both internally and on the international markets, with raw virgin materials and imported recycled products being a viable substitute to the products recycled within national borders. Nonetheless there are a number of specialized dealers and itinerant waste brokers that collect segregated **waste cardboard** and paper from the contractors at the camp, as well as, at the dumpsites, where cardboard is only recovered in Al-Hussainy yat dumping site.” 3. “The local waste cardboard collection varies between the communities. It can either be collected separately or mixed with waste paper. While in some communities the **waste cardboard** is collected at the curbside, other municipalities rely on central collection points. After the local collection, the **waste cardboard** is transported by lorry or train either directly to sorting or to intermediate recycling plants.”
<Cont_**Reference**>	1. Iyer, K. A., Flores, A. M., & Torkelson, J. M. (2015). Comparison of polyolefin biocomposites prepared with waste cardboard, microcrystalline cellulose, and cellulose nanocrystals via solid-state shear pulverization. Polymer, 75, p. 78. https://doi.org/10.1016/j.polymer.2015.08.029 2. Saidan, M. N., Drais, A. A., & Al-Manaseer, E. (2017). Solid waste composition analysis and recycling evaluation: Zaatari Syrian Refugees Camp, Jordan. Waste Management, 61, p. 64. https://doi.org/10.1016/j.wasman.2016.12.026 3. Haupt, M., Kägi, T., & Hellweg, S. (2018). Life cycle inventories of waste management processes. Data in Brief, 19, p. 1444. https://doi.org/10.1016/j.dib.2018.05.067

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: vaste afvalsoort die bestaat uit cellulose en samen met papierafval de afvalstroom oud papier vormt Aanvullende informatie: Dit type afval wordt veroorzaakt door verschillende partijen (burgers, bedrijven, etc.). ISO 536 bevat informatie over het gewicht van karton per vierkante meter.
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	kartonafval
<**Reliability**>	2

<Term_**Reference**>	Verordening (EG) nr. 1013/2006 van het Europees Parlement en de Raad van 14 juni 2006 betreffende de overbrenging van afvalstoffen, CELEX: 32006R1013/NL
<Term_**Note**>	
<***LangUsage***>	uncountable
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Neuter
<***LookUpForms***>	
<**Context**>	1. “Toch wordt er vaak beweerd dat bekers met een PLA coating wel bij het karton mogen. Dit komt omdat deze coatings, vaak gemaakt van maiszetmeel of suikerriet, biologisch afbreekbaar zijn. Dit wordt vaak verward met recyclebaar. De koffiebekers kunnen niet worden gerecycled tot nieuw karton, maar worden gecomposteerd. Deze bekers worden dus op een volledig andere manier verwerkt dan gewoon papier- en **kartonafval**. Samen inzamelen is daarom dus niet mogelijk. PE coatings worden gemaakt van kunststof, gemaakt van aardolie. Deze coatings zitten ook in drankkartons zoals melk- en frisdrankpakken en hebben een andere verwerking dan karton.”
<Cont_**Reference**>	1. Waarom koffiebekers nooit bij het karton mogen - Wastenet inzameling. (2019). Retrieved August 9, 2019, from https://www.wastenet.nl/waarom-koffiebekers-nooit-bij-het-karton-weggegooid-mogen-worden/

Appendix O: Term fiche for *foreground system*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Narrower: ####### *foreground process* Related: ####### *background system* Related: ####### *background process* Related: 875848 *life cycle assessment*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	collection of processes that have a direct influence on the product systeem under investigation
<Def_Reference>	Based on: Gaudreault, C., Samson, R., & Stuart, P. R. (2010). Energy decision making in a pulp and paper mill: Selection of LCA system boundary. *International Journal of Life Cycle Assessment*, *15*(2), 198–211. https://doi.org/10.1007/s11367-009-0125-1
<Def_Note>	These processes are called foreground processes.
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	foreground system
<Reliability>	2
<Term_Reference>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. “Direct and indirect impacts of fossil fuel electricity production and supply dominate most impact categories, with sea water desalination responsible for over 60% of the **foreground system** electricity consumption.” 2. “The **foreground system** evaluated is an agricultural process under the operational and management control of Agropalma, a conventional

	commercial farm located in the Brazilian State of Para, where the firm has been in operation since 1982. […] The agricultural production consists of several stages: seedling production in nurseries (in poly bags for thirteen to sixteen months); immature plantations (young palms up to four years old with reduced yields) and mature plantations. The **foreground system** includes immature and mature plantations, whereby seed production and nursery stages are excluded."
<Cont_**Reference**>	1. Opher, T., & Friedler, E. (2016). Comparative LCA of decentralized waste water treatment alternatives for non-potable urban reuse. *Journal of environmental management*, *182*, p. 474. 2. Bicalho, T., Sauer, I., Rambaud, A., & Altukhova, Y. (2017). LCA data quality: A management science perspective. *Journal of Cleaner Production*, *156*, p. 891.

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: verzameling processen die specifiek zijn voor het productsysteem dat wordt onderzocht en hier direct van invloed op zijn Aanvullende informatie: Processen in het voorgrondsysteem worden voorgrondprocessen genoemd.
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	voorgrondsysteem
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Neuter
<***LookUpForms***>	
<**Context**>	1. "De systeemgrenzen zijn from-cradle-to-plate waarbij heel de productieketen van de maaltijdcomponenten tot aan het serveren van de maaltijden wordt beschouwd. De maaltijdcomponenten die in het restaurant worden weggegooid, worden ook in rekening gebracht. De productiestappen binnen het restaurant worden beschouwd als het

	voorgrondsysteem. Het **voorgrondsysteem** wordt in detail geanalyseerd en de data daarvan zijn specifiek voor het restaurant." 2. "Een aantal processen en systemen zijn specifiek voor landbouw, zoals de akkerbouw en de veehouderij, met alles wat daarbij hoort. Dit wordt het '**voorgrondsysteem**' genoemd."
<Cont_**Reference**>	1. Cooreman-Algoed, M. (2017). *KWANTIFICATIE EN PROMOTIE VAN DUURZAME MAALTIJDEN UIT GROOTKEUKENS*, p. 19. 2. Westhoek, H. (2019). *KWANTIFICERING VAN DE EFFECTEN VAN VERSCHILLENDE MAATREGELEN OP DE VOETAFDRUK VAN DE NEDERLANDSE VOEDSELCONSUMPTIE*, p. 16.

Appendix P: Term fiche for *background system*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Narrower: ######*background process* Related: ###### *foreground system* Related: ###### *foreground process*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	collection of processes that have an indirect influence on the product system under investigation
<Def_Reference>	Based on: Gaudreault, C., Samson, R., & Stuart, P. R. (2010). Energy decision making in a pulp and paper mill: Selection of LCA system boundary. *International Journal of Life Cycle Assessment*, *15*(2), 198–211. https://doi.org/10.1007/s11367-009-0125-1
<Def_Note>	Processes within the background system are called background processes.
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	background system
<Reliability>	2
<Term_Reference>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Noun + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. “GW indicator is an example where indirect effects can be significant compared to the direct effects. Second, the EU indicator is an example where indirect effects are in the opposite direction from other effects (i.e., an overall improvement in the life cycle but a deterioration in other systems). In this case, the increase of EU in the **background system** is due to mills that would have to use more virgin fiber pulp to compensate for the lose in recycled paper. These two observations illustrate the importance of

	including the indirect effects for decision accounting for all potential impacts." 2. "Applying the LCA framework, this work shows that when a high share of waste is collected separately, and processes assumed in the **background system** are adequately characterized, especially the production of the electricity mix, then prioritizing material recovery provides better results even inenvironmental categories tightly related to fossil energy consumption, such as the global warmingpotential impact category."
<Cont_**Reference**>	1. Gaudreault, C., Samson, R., & Stuart, P. R. (2010). Energy decision making in a pulp and paper mill: selection of LCA system boundary. *The International Journal of Life Cycle Assessment*, *15*(2), pp. 208. 2. Bueno, G., Latasa, I., & Lozano, P. J. (2015). Comparative LCA of two approaches with different emphasis on energy or material recovery for a municipal solid waste management system in Gipuzkoa. *Renewable and Sustainable Energy Reviews*, *51*, p. 449.

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: verzameling processen die niet specifiek zijn voor het product systeem dat wordt onderzocht, maar hier indirect van invloed op zijn Aanvullende informatie: Deze processen worden achtergrondprocessen genoemd.
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	achtergrondsysteem
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Neuter
<***LookUpForms***>	
<**Context**>	1. "Productieketens bestaan uit schakels die functioneren in een systeemcontext. Zo komen de kalveren voor kalfsvleesproductie uit de

	melkveehouderij, worden granen geteeld in een meerjarig bouwplan met andere gewassen en wordt de glastuinbouw meer en meer gekoppeld aan restwarmte en rest-CO2. De prestatie op productniveau is daarmee afhankelijk van het functioneren van het **achtergrondsysteem,** zoals de melkveehouderij, de akkerbouw of de energieproducenten." 2. "De systeemgrenzen zijn from-cradle-to-plate waarbij heel de productieketen van de maaltijdcomponenten tot aan het serveren van de maaltijden wordt beschouwd. De maaltijdcomponenten die in het restaurant worden weggegooid, worden ook in rekening gebracht. De productiestappen binnen het restaurant worden beschouwd als het voorgrondsysteem. Het voorgrondsysteem wordt in detail geanalyseerd en de data daarvan zijn specifiek voor het restaurant. De rest van de productieketen behoort tot het **achtergrondsysteem**." 3. "Een aantal processen en systemen zijn specifiek voor landbouw, zoals de akkerbouw en de veehouderij, met alles wat daarbij hoort. Dit wordt het 'voorgrondsysteem' genoemd. Een aantal processen zijn niet specifiek voor de landbouw, zoals elektriciteitsproductie, efficiency van transport en verpakkingen. Dit wordt samen het '**achtergrondsysteem**' genoemd. Dit onderscheid is vooral relevant bij het nader analyseren van mogelijke verbeteringen."
<Cont_**Reference**>	1. Blonk, H., Reijs, J., & Vellinga, T. (2018). *Monitoring klimaateffect van NL agroproductie: verkenning van behoeften en ideeën om het klimaateffect geïntegreerd te meten*. Wageningen Economic Research, p. 12. 2. Cooreman-Algoed, M. KWANTIFICATIE EN PROMOTIE VAN DUURZAME MAALTIJDEN UIT GROOTKEUKENS, p. 19. 3. Westhoek, H. (2019). *KWANTIFICERING VAN DE EFFECTEN VAN VERSCHILLENDE MAATREGELEN OP DE VOETAFDRUK VAN DE NEDERLANDSE VOEDSELCONSUMPTIE*, p. 16.

Appendix Q: Term fiche for *environmental burden*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Broader: 1573198 *environment* Related: ###### *environmental pressure* Related: 159570 *ecological burden* Related: ###### *environmental burden (domain of Health)*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	activity that influences the environment by causing or leading to environmental pollution, environmental dangers or the use of natural resources
<Def_Reference>	Based on; environmental burden. (n.d.). Retrieved May 21, 2019, from https://www.eionet.europa.eu/gemet/en/concept/15153
<Def_Note>	
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	environmental burden
<Reliability>	2
<Term_Reference>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Adjective + noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. “It can be seen that the LCA results are sensitive to the method of allocation employed. When the energetic content of the ethanol and exported electricity was used to allocate the **environmental burden**, the bioethanol was found to have significantly greater **environmental burdens** than when system expansion was used, with the GHG and fossil-energy burdens increasing by 83% and 73%, respectively.”

	2. “Not all foods make an equal contribution to these linked problems of climate, biodiversity loss, resource depletion and pollution. Numerous assessments of individual food products find that meat and dairy products carry a disproportionately high **environmental burden**, with GHG emissions a particular concern (7–10). Global estimates suggest that livestock production accounts for about 12–18 % of global GHG emissions (11,12) and about half of the food system’s total impacts, more when land use change impacts are included (13). Since consumption of these foods is high in developed nations, growing rapidly in industrialising, and starting to increase among urban consumers in low income countries, their contribution is set to rise.”
<Cont_**Reference**>	1. Stephenson, A. L., Dupree, P., Scott, S. A., & Dennis, J. S. (2010). The environmental and economic sustainability of potential bioethanol from willow in the UK. *Bioresource technology*, *101*(24), 9612-9623, p. 9616. 2. Garnett, T. (2013). Food sustainability: problems, perspectives and solutions. *Proceedings of the Nutrition Society*, *72*(1), p. 30.

<**Language**>	nl
<**Definition**>	veranderingen die de mens toebrengt aan het milieu die bijdragen aan ongewenste milieueffecten en die kunnen leiden tot vermindering van de huidige of toekomstige leefkwaliteit
<Def_**Reference**>	Op basis van: Blom, I. S. (2005). Aanzet tot een nieuw LCA-model voor gebouwen. *Theoretische en praktische knelpunten in de levenscyclusanalyse voor gebouwen en de zwaartepunten in het milieuprofiel van woningen. Technische Universiteit Eindhoven*, p. 7. Nijdam, D. S., & Wilting, H. C. (2003). *Milieudruk consumptie in beeld. Dataverwerking en resultaten.*
<Def_**Note**>	
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	milieudruk
<**Reliability**>	2
<Term_**Reference**>	Besluit (EU) 2018/813 van de Commissie van 14 mei 2018 inzake het sectorale referentiedocument betreffende de beste milieubeheerpraktijken, sectorale milieuprestatie-indicatoren en criteria voor topprestaties voor de landbouwsector in het kader van Verordening (EG) nr. 1221/2009 van het Europees Parlement en de Raad inzake de vrijwillige deelneming van organisaties aan een communautair milieubeheer- en milieuauditsysteem (EMAS), CELEX:32018D0813/NL
<Term_**Note**>	
<***LangUsage***>	
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun

<***Gender***>	Feminine
<***LookUpForms***>	milieubelasting (Niet te verwarren met 46482 *milieubelasting & milieuheffing.)*
<**Context**>	1. “In het bijzonder aan het eind van de keten leidt voedselspilling tot een hoge **milieudruk**, omdat wat de consument koopt via de supermarkten de hele voedselketen doorlopen heeft. Door het reduceren van voedselverspilling snijdt het mes dus aan twee kanten voor wat betreft verminderen van **milieudruk**: -als er minder voedsel wordt verspild, hoeft minder voedsel te worden geproduceerd; -minder voedselverspilling leidt tot minder voedselafval dus minder afvalverwerking.” 2. “Tijdens de levenscyclus van 1 kg biologische melk wordt minder fossiele energie verbruikt en worden minder vermestende stoffen uitgestoten dan tijdens de levencyclus van 1 kg gangbare melk. De emissie van broeikasgassen en verzurende gassen per kg melk is gelijk. De lokale **milieudruk**, geëvalueerd als vermestings- of verzuringpotentieel per ha, is lager voor biologische melk. Deze extensievere vorm van melkproductie leidt dus tot een lagere lokale **milieudruk**, een lagere of vergelijkbare globale **milieudruk**, maar vereist per kg melk meer hectares, vooral in Nederland.”
<Cont_**Reference**>	1. Bos-Brouwers, H., Kuulman, C., Timmermans, T., Knip, H., & Peeks, W. (2011). *Reductie milieu- druk voedsel*, p. 17 2. de Boer, I. J. M., & Udo, H. M. J. (2010). De kracht van het verschil: diversiteit in duurzaamheid van dierhouderijsystemen. In H. Eijsackers & M. Scholten (Eds.), *Over zorgvuldige veehouderij. Veel instrumenten, één concert*, p. 157.

Appendix R: Term fiche for *mixed collection*

**<IATE-N°>	
<Domain>	52
<Domain_note>	
<Collection>	
<CrossRef>	Related: 3506407 *collection rate* Broader: 1427184 *collection of waste* Related: 48916 *separation at source*
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	combination of methods for waste collection, e.g. curbside collection and drop-off points
<Def_Reference>	Based on: Pires, A., Sargedas, J., Miguel, M., Pina, J., & Martinho, G. (2017). A case study of packaging waste collection systems in Portugal – Part II: Environmental and economic analysis. *Waste Management*, *61*, 108–116. https://doi.org/10.1016/j.wasman.2016.11.032
<Def_Note>	
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	mixed collection
<Reliability>	2
<Term_Reference>	Commission staff working document - Accompanying the Communication from the Commission on future steps in bio-waste management in the European Union {COM(2010) 235 final}, CELEX:52010SC0577/EN
<Term_Note>	Not to be confused with *mixed waste* 1427097
<*LangUsage*>	uncountable noun
<*RegionalUsage*>	
<*PartOfSpeech*>	Adjective + Noun
<*Gender*>	
<*LookUpForms*>	
<Context>	1. An understanding of the environmental impacts and costs related to waste collection is needed to ensurethat existing waste collection schemes are the most appropriate with regard to both environment andcost. […] Here, the **mixed collection** system is compared to an exclusive curbside system and an exclusive bring system. […] The results show that the bring system has lower environmental impacts and lower economic costs, and is capable of reducing the environmental impacts of the mixed system. However, a

	sensitivityanalysis shows that these results could differ if the curbside collection were to be optimized.
<Cont_**Reference**>	1. Pires, A., Sargedas, J., Miguel, M., Pina, J., & Martinho, G. (2017). A case study of packaging waste collection systems in Portugal–Part II: Environmental and economic analysis. *Waste management, 61*, p. 108.

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: combinatie van systemen om afval in te zamelen, e.g. vuilniswagens die langs de deuren rijden en glasbakken waar glasafval naartoe kan worden gebracht
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	gemengde inzameling
<**Reliability**>	2
<Term_**Reference**>	
<Term_**Note**>	
<***LangUsage***>	uncountable noun
<***RegionalUsage***>	
<***PartOfSpeech***>	Adjective + Noun
<***Gender***>	
<***LookUpForms***>	
<**Context**>	1. **Gemengde inzameling**: Dit afval wordt na inzameling grotendeels naar verbrandingsovens of stortplaatsen afgevoerd. Een beperkt deel wordt in voorscheidingsinstallaties uit het afval gehaald voor materiaalhergebruik.
<Cont_**Reference**>	1. Mennen, M. G., van Putten, E. M., Fortezza, F., van Veen, R. P. M., & van Dijk, J. (2003). Orienterend onderzoek naar zware metalen in verpakkingen. Onderzoek ten behoeve van de handhaving van de Regeling verpakkingen, p. 25.

Appendix S: Term fiche for *economic allocation*

**<IATE-N°>	
<Domain>	52; 16
<Domain_note>	
<Collection>	
<CrossRef>	Broader: (45110) *allocation* Related: ###### p*hysical allocation* Related: ###### system expansion
<ProblemLanguage>	EN
<Graphics>	
<Graph_Reference>	

<Language>	en
<Definition>	distribution of environmental burdens related to the production over products within the investigated system and other product systems based on economic value of products and co-products
<Def_Reference>	Based on: Chen, C., Habert, G., Bouzidi, Y., Jullien, A., & Ventura, A. (2010). LCA allocation procedure used as an incitative method for waste recycling: An application to mineral additions in concrete. *Resources, Conservation and Recycling*, *54*(12), 1231–1240. https://doi.org/10.1016/j.resconrec.2010.04.001
<Def_Note>	Additional information: This method can be unstable as market prices fluctuate. Based on: Chen, C., Habert, G., Bouzidi, Y., Jullien, A., & Ventura, A. (2010). LCA allocation procedure used as an incitative method for waste recycling: An application to mineral additions in concrete. *Resources, Conservation and Recycling*, *54*(12), 1231–1240. https://doi.org/10.1016/j.resconrec.2010.04.001
<RelatedMaterial>	

<TermType>	Term
<TermGroup>	1
<Evaluation>	
<en-English>	economic allocation
<Reliability>	2
<Term_Reference>	2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations, CELEX:32013H0179/EN
<Term_Note>	
<*LangUsage*>	
<*RegionalUsage*>	
<*PartOfSpeech*>	Adjective + Noun
<*Gender*>	
<*LookUpForms*>	

<**Context**>	1. “The results of the **economic allocation** no longer stress the importance of an explicit closed-loop recycling for window frames and the use of a high percentage of recycled material. More realistically, emphasis is laid on a frame construction suitable for recycling aiming to maintain the inherent properties of aluminium at the highest possible level over the life cycle. Therefore, the highest possible separability of the metals in the window scrap is one of the key conditions to optimise the ecological profile of aluminium frames.” 2. “In the milk study, **economic allocation** was used to distribute the environmental burden from the production of purchased concentrate feed. This feed was mainly rapeseed meal, which is a co-product of rapeseed oil production. The use of purchased concentrate feed was however very small, since the milk system studied is organic with a very high degree of home-produced fodder. In the beef study, **economic allocation** was used to partition a small part (10%) of the environmental burden to the co-products of meat which have a market and thereby an economic value. These co-products were mainly hides and some intestines.”
<Cont_**Reference**>	1. Werner, F., & Richter, K. (2000). Economic allocation in LCA: A case study about aluminium window frames. *The international journal of life cycle assessment*, *5*(2), pp. 82-83. 2. Cederberg, C., & Stadig, M. (2003). System expansion and allocation in life cycle assessment of milk and beef production. *The International Journal of Life Cycle Assessment*, *8*(6), p. 350.

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	verdeling van milieudruk die wordt veroorzaakt door de productie over alle producten binnen het onderzochte systeem en andere productsystemen op basis van de economische waarde van producten en bijproducten
<Def_**Note**>	Op basis van: Kool, A., Blonk, H., Ponsioen, T., Sukkel, W., Vermeer, H. M., de Vries, J. W., & Hoste, R. (2009). *Carbon footprints van conventioneel en biologisch varkensvlees: uitgebreide samenvatting: analyse van typische productiesystemen in Nederland, Denemarken, Engeland en Duitsland*. Blonk Milieu Advies, p. 4.
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	economische allocatie
<**Reliability**>	2
<Term_**Reference**>	2013/179/EU: Aanbeveling van de Commissie van 9 april 2013 over het gebruik van gemeenschappelijke methoden voor het meten en bekendmaken van de milieuprestatie van producten en organisaties gedurende hun levenscyclus, CELEX:32013H0179/NL
<Term_**Note**>	economische toewijzing

<***LangUsage***>	uncountable noun
<***RegionalUsage***>	
<***PartOfSpeech***>	Adjective + Noun
<***Gender***>	Feminine
<***LookUpForms***>	
<**Context**>	1. **Economische allocatie** heeft bijvoorbeeld plaatsgevonden bij de productie van krachtvoer (grondstoffen) of vochtrijke bijproducten. Een voorbeeld is de productie van bierbostel, een vochtrijk bijproduct dat kan worden gebruikt als aanvulling of vervanging van krachtvoerachtige voeders. Bierbostel wordt geproduceerd uit gerst. Wanneer gerst wordt geteeld, wordt naast de korrel ook stro geproduceerd. Dit betekent dat een deel van de milieubelasting (door bijvoorbeeld het gebruik van gewasbeschermingsmiddelen) wordt toegerekend aan de korrel, die uiteindelijk in de bierbostel terecht komt, en een ander deel aan het stro. Naast de allocatie bij het teeltproces, vindt er allocatie plaats bij het productieproces. Bierbostel is namelijk een restproduct van de productie van bier. Omdat bierbostel een veel lagere economische waarde heeft dan bier, wordt maar een beperkt deel (circa 8%) toegerekend aan bierbostel." 2. Zoals reeds eerder vermeld is vlees(waar) slechts een deel van het dier dat bruikbaar is voor de mens. In figuur 16 is het aandeel te zien van vlees en overige onderdelen van o.a. een varken. Hieruit is op te maken dat ruim 40% van het levend gewicht van een varken uit dierlijke bijproducten bestaat. Om de milieueffecten die zijn 21 opgetreden in de vorige schakels (landbouw tot en met slachterij) te verdelen is het gebruikelijk om **economische allocatie** toe te passen."
<Cont_**Reference**>	1. De Boer, H. C., Dolman, M. A., Gerritsen, A. L., Kros, J., Sonneveld, M. P. W., Stuiver, M., ... & Bouma, J. (2012). *Effecten van kringlooplandbouw op ecosysteemdiensten en milieukwaliteit: een integrale analyse van People, Planet & Profit, effecten op gebiedsniveau, en de potentie voor zelfsturing, met de Noardlike Fryske Wâlden als inspirerend voorbeeld*. Wageningen UR, p. 9. 2. Luske, B., & Blonk, H. (2009). *Milieueffecten van dierlijke bijproducten*. Blonk Milieu Advies, pp. 20-21.

Appendix T: Term fiche for *raw material extraction*

****<IATE-N°>**	
<Domain>	52
<Domain_note>	

<**Collection**>	
<**CrossRef**>	Broader: 46572 *extraction* Related: 48570 *raw material*
<**ProblemLanguage**>	EN
<**Graphics**>	
<Graph_**Reference**>	

<**Language**>	en
<**Definition**>	deriving virgin resources from the environment to use them in production
<Def_**Reference**>	Based on: Bruckner, M., Giljum, S., Lutz, C., & Wiebe, K. S. (2012). Materials embodied in international trade - Global material extraction and consumption between 1995 and 2005. *Global Environmental Change*, *22*(3), 568–576. https://doi.org/10.1016/j.gloenvcha.2012.03.011 Söderholm, P. (2011). Taxing virgin natural resources: Lessons from aggregates taxation in Europe. *Resources, Conservation and Recycling*, *55*(11), 911–922. https://doi.org/10.1016/j.resconrec.2011.05.011
<Def_**Note**>	Additional information: (part of) The extraction of raw materials can be substituted by recycling of materials, or possibly avoided by reuse of products. Examples of raw materials are agricultural products, minerals and fossil fuels. When countries are heavily industrialized they may have to import raw materials extracted in other countries. Based on: Bruckner, M., Giljum, S., Lutz, C., & Wiebe, K. S. (2012). Materials embodied in international trade - Global material extraction and consumption between 1995 and 2005. *Global Environmental Change*, *22*(3), 568–576. https://doi.org/10.1016/j.gloenvcha.2012.03.011 Söderholm, P. (2011). Taxing virgin natural resources: Lessons from aggregates taxation in Europe. *Resources, Conservation and Recycling*, *55*(11), 911–922. https://doi.org/10.1016/j.resconrec.2011.05.011
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**en-English**>	raw material extraction
<**Reliability**>	2
<Term_**Reference**>	Opinion of the European Economic and Social Committee on the Communication from the Commission to the European Parliament and the Council: The raw materials initiative — meeting our critical needs for growth and jobs in Europe COM(2008) 699 final, CELEX:52009AE0880/EN
<Term_**Note**>	

<***LangUsage***>	uncountable
<***RegionalUsage***>	
<***PartOfSpeech***>	Adjective + Noun + Noun
<***Gender***>	
<***LookUpForms***>	
<**Context**>	1. "High costs associated with **raw material extraction**, as well as the damage that the extraction causes to the environment, are also important reasons to motivate the use of industrial process residues. Depletion of reliable trustable raw material reserves and conservation of non-renewable sources also contribute to such reuse of waste materials." 2. "The components are evaluated from the materials extraction through the use phase including supply chains. For example, the manufacturing of an automobile includes the energy and emissions from **extraction of raw materials** such as iron ore for steel through the assembly of that steel in the vehicle."
<Cont_**Reference**>	1. Bragança, S. R., Vicenzi, J., Guerino, K., & Bergmann, C. P. (2006). Recycling of iron foundry sand and glass waste as raw material for production of whiteware. *Waste Management and Research*, *24*(1), pp. 60-61. https://doi.org/10.1177/0734242X06061155 2. Chester, M. V., & Horvath, A. (2009). Environmental assessment of passenger transportation should include infrastructure and supply chains. *Environmental Research Letters*, *4*(2), p. 2. https://doi.org/10.1088/1748 9326/4/2/024008

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	
<**en-English**>	extraction of raw material
<**Reliability**>	2
<Term_**Reference**>	2013/131/EU: Commission Decision of 4 March 2013 establishing the user's guide setting out the steps needed to participate in EMAS, under Regulation (EC) No 1221/2009 of the European Parliament and of the Council on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) (notified under document C(2013) 1114), CELEX: 32013D0131/EN
<Term_**Note**>	
<***LangUsage***>	uncountable
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun + Preposition + Adjective + Noun
<***Gender***>	
<***LookUpForms***>	extraction of raw materials
<**Context**>	1. "Concrete is probably the most extensively used construction material in the world. The addition of mineral admixture in cement has dramatically increased along with the development of concrete industry, due to the consideration of cost saving, energy saving, environmental protection and conservation of resources. However, environmental concerns both in terms of damage caused by the **extraction of raw**

	material and carbon dioxide emission during cement manufacture have brought pressures to reduce cement consumption by the use of supplementary materials." 2. "A sustainable product is a product which results as little impact on the environment as possible during its life cycle. The sustainable aspects of products include **extraction of raw material**, production, use and final recycling (or degradation)."
<Cont_**Reference**>	1. Patil, B., & Kumbhar, P. (2012). Strength and Durability Properties of High Performance Concrete incorporating High Reactivity Metakaolin. *Ijmer.Com*, *2*(3), p. 1099. 2. Zhou, C. C., Yin, G. F., & Hu, X. B. (2009). Multi-objective optimization of material selection for sustainable products: Artificial neural networks and genetic algorithm approach. *Materials and Design*, *30*(4), p. 1209. https://doi.org/10.1016/j.matdes.2008.06.006

<**Language**>	nl
<**Definition**>	
<Def_**Reference**>	
<Def_**Note**>	Geen definitie gevonden. Voorgestelde definitie: het onttrekken van ruwe materialen aan de natuur voor productiedoeleinden Aanvullende informatie: kan leiden tot de uitputting van natuurlijke hulpbronnen, grondstoffenwinning kan deels worden voorkomen door hergebruik en deels worden vervangen door recycling van materialen
<**RelatedMaterial**>	

<**TermType**>	Term
<**TermGroup**>	1
<**Evaluation**>	
<**nl-Nederlands**>	grondstoffenwinning
<**Reliability**>	2
<Term_**Reference**>	Advies van het Europees Economisch en Sociaal Comité over de mededeling van de Commissie aan het Europees Parlement en de Raad Het grondstoffeninitiatief — voorzien in onze kritieke behoeften aan groei en werkgelegenheid in Europa (COM(2008) 699 definitief), CELEX:52009AE0880/NL
<Term_**Note**>	
<***LangUsage***>	uncountable
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	

<**Context**>	1. “Als vuistregel zijn bij circulariteitsstrategieën die hoger op de ladder staan, minder materialen nodig die bovendien vaker bestaan uit gerecycled (secundair) materiaal. Hierdoor hoeven dan minder grondstoffen te worden gewonnen om nieuwe (primaire) materialen te produceren. Zo wordt ook de milieudruk van de **grondstoffenwinning** en productie van primaire materialen voorkomen.” 2. “Via externe effecten bij de winning en opwerking van andere niet-hernieuwbare grondstoffen spelen energiedragers ook een rol. Het winnen en opwerken van grondstoffen vergt vaak veel energie. Als dit energiegebruik milieuschade met zich mee brengt, moet het een rol spelen in de analyse. Anders kan niet worden vastgesteld of het niveau van **grondstoffenwinning** en –verwerking maatschappelijk optimaal is. Voordat grondstoffen als onderdeel van een eindproduct bij de gebruiker belanden doorlopen ze eerst de fasen van winning en verwerking. Na het winnen van ruwe grondstoffen worden deze in een volgende fase verwerkt tot materialen, halffabrikaten en eindproducten. De fasen kunnen verspreid zijn over meerdere landen en bedrijven, maar er kan ook sprake zijn van (een zekere mate van) verticale integratie.”
<Cont_**Reference**>	1. Potting, J., Hanemaaijer, A., Delahaye, R., Ganzevles, J., Hoekstra, R., & Lijzen, J. (2018). *Circulaire economie: Wat we willen weten en kunnen meten. Systeem en nulmeting voor monitoring van de voortgang van de circulaire economie in Nederland*, p. 10 2. Mot, E., Hoogendoorn, S., Hendrich, T., Jansema-Hoekstra, K., Tijm, J., Romijn, G., & Verrips, A. (2018). *Niet-hernieuwbare grondstoffen voor de circulaire economie: Een economische analyse van de werking en beperking van grondstoffenmarkten*, p.9

<**TermType**>	Term
<**TermGroup**>	2
<**Evaluation**>	
<**nl-Nederlands**>	grondstofwinning
<**Reliability**>	2
<Term_**Reference**>	Resolutie van het Europees Parlement van 5 juli 2016 over de uitvoering van de aanbevelingen van 2010 van het Parlement over de sociale en milieunormen, de mensenrechten en maatschappelijk verantwoord ondernemen (2015/2038(INI)), CELEX: 52016IP0298/NL
<Term_**Note**>	
<***LangUsage***>	uncountable
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun
<***Gender***>	Feminine
<***LookUpForms***>	
<**Context**>	1. “Het Ministerie I&M wil met het nieuwe Landelijk Afvalbeheerplan 2009-2021 de hele materiaalketen verduurzamen. Hiermee wil ze op termijn het Landelijk Afvalbeheersplan vervangen door een Materiaalbeleidsplan. Van **grondstofwinning** tot productie en gebruik, tot de uiteindelijke fase waarin het materiaal als afval vrijkomt. Daarvoor is het ministerie in maart 2009 onder andere gestart met het programma Ketengericht Afvalbeleid waarin toeleveranciers, producenten, afnemers

	en afvalverwerkers samen naar manieren zoeken om de milieudruk in zeven ketens te verlagen met 20%." 2. "Het exploiteren van een natuurlijke hulpbron heeft invloed op de mogelijkheden voor toekomstig gebruik van deze voorraad. In geval van mijnbouw, bijvoorbeeld, gaat de huidige extractie van ertsen ten koste van grondstofwinning in de toekomst. Dit impliceert dat bij het delven van een eenheid erts, in aanvulling op de pure extractiekosten, rekening moet worden gehouden met de zogenaamde *opportunity costs*. In dit verband wordt met *opportunity costs* bedoeld de mogelijke baten die de eenheid erts in de toekomst had kunnen opleveren."
<Cont_**Reference**>	1. Bos-Brouwers, H., Kuulman, C., Timmermans, T., Knip, H., & Peeks, W. (2011). *Reductie milieudruk voedsel met nadruk op voedselverspilling door huishoudens*, p. 9. 2. Bulte, E. H. (1997). Essays in economics of renewable resources. Wageningen University, pp. 276-277.

<**TermType**>	Term
<**TermGroup**>	3
<**Evaluation**>	
<**nl-Nederlands**>	winning van grondstoffen
<**Reliability**>	2
<Term_**Reference**>	Verordening (EU) nr. 1291/2013 van het Europees Parlement en de Raad van 11 december 2013 tot vaststelling van Horizon 2020 - het kaderprogramma voor onderzoek en innovatie (2014 -2020) en tot intrekking van Besluit nr. 1982/2006/EG, CELEX: 32013R1291/NL
<Term_**Note**>	
<***LangUsage***>	uncountable
<***RegionalUsage***>	
<***PartOfSpeech***>	Noun + Preposition + Noun
<***Gender***>	
<***LookUpForms***>	
<**Context**>	1. "Grondstoffen worden schaarser. Hoewel voorraden eigenlijk oneindig lijken moet steeds dieper in de grond worden gewonnen. In afgelegen (natuur)gebieden en in landen met zwakke instituties. Dit heeft verregaande gevolgen voor mensenrechten en milieu en wordt aan het begin van de productieketen zichtbaar in slechte arbeidsomstandigheden of in vervuiling van het milieu bij de **winning van grondstoffen**." 2. "Fase 1 betreft de **winning van grondstoffen** waarbij, onder andere door de inzet van machines en energie, milieuschade ontstaat. Denk hierbij aan zowel emissies naar de lucht door energetisch gebruik van fossiele brandstoffen, als emissies naar bodem en water wanneer bij de winning afval ontstaat. Een ander voorbeeld van relevante schade, die echter buiten de context van dit rapport valt, zijn aardbevingen bij de winning van aardgas."
<Cont_**Reference**>	1. Kamphof, R. (2013). Grondstoffen. Stichting Ncdo, p. 16.

	2. Vollebergh, H., Dijk, J., Drissen, E., Eerens, H., & Vrijburg, H. (2017). FISCALE VERGROENING: BELASTINGVERSCHUIVING VAN ARBEID NAAR GRONDSTOFFEN, MATERIALEN EN AFVAL: Verkenning van belastingen voor het stimuleren van de circulaire economie, pp. 29-30.

Appendix U: Table 49. 62 remaining term translations and sources

	Source-text term	Dutch term equivalent	Source
1	attributional LCA	attributional LCA	Boukris, E., van Gijlswijk, R. N., Ansems, A. M. M., & Jongeneel, L. S. (2015). DoorTAStend, LCA studie van draagtassen. English term is kept, as Dutch direct translation of attributionale LCA is advised against, as in the ILCD handbook (by the european commission) it is defined differently than a regular attribution LCA. The term is introduced in italics.
2	avoided burden approach	vermeden impactbenadering	Bruyn, S. M., Sevenster, M. N., van der Voet, E., & van Oers, L. (2006). Materiaalverbruik en milieu-impact Data 1990-2004. Based on use of impactbenadering in source *General manager of RDC Environment suggested *vermeden impact aanpak* (this is not standardized, but merely a guess of a domain expert of how to translate the term). However, *aanpak* is not the equivalent of *approach.*
3	complexity reduction	complexiteitsreductie	Context in source text offers more information. Complexiteitsreductie yields 1.580 results in Google when milieu is included. However, no documents were found relating complexiteitsreductie to milieueffectcategorieën. Further investigation is advised, however, this is beyond the scope of this research.
4	consequential LCA	consequentiële LCA	Visser, C., Odegard, I. Y. R., Naber, N. R., Bergsma, G. C., van Nieuwenhuijzen, A. F., & Sanders, M. H. A. (2016). Levenscyclusanalyse van grondstoffen uit rioolwater. No recommendations are made about consequentiële LCA, as are of atributionele LCA.
5	consumption of resources	verbruik van hulpbronnen	CELEX:52012AE0831
6	cradle-to-gate	wieg tot poort	CELEX:32013H0179
7	cradle-to-grave	wieg tot graf	CELEX:32013H0179
8	critical analysis	kritische analyse	CELEX:32017R0746
9	curbside bag	vuilniszak	https://www.google.com/search?rlz=1C1JZAP_nlNL811NL812&biw=1458&bih=691&tbm=isch&sa=1&ei=rjNVXYjPL8LXkwWKtYLoCA&q=%22curbside+bag%22&oq=%22curbside+bag%22&gs_l=img.3...6464.7897..8151...0.0..0.53.99.2.....0....1..gws-wiz-img.iHP5EL0WUT8&ved=0ahUKEwiI3vae1YTkAhXC66QKHYqaAI0Q4dUDCAY&uact=5 Based on google images for curbside bag
10	curbside system	ophaalsysteem	Based on additional information about curbside system derived from the source text in which curbside is contrasted with drop-off. There is no consistency between curbside bag and curbside system, however the two Dutch term equivalents are idiomaticly related.

11	cut-off approach	cut-offbenadering	Boukris, E., van Gijlswijk, R. N., Ansems, A. M. M., & Jongeneel, L. S. (2015). DoorTAStend, LCA studie van draagtassen. Based on cut-off methode used in source. The term is introduced in italics.
12	cut-off method	cut-offmethode	Boukris, E., van Gijlswijk, R. N., Ansems, A. M. M., & Jongeneel, L. S. (2015). DoorTAStend, LCA studie van draagtassen. space removed between cut-off and methode based on Dutch rules for word compounds (https://taaladvies.net/taal/advies/tekst/127). The term is introduced in italics.
13	drop-off container	inlevercontainer	contrast with curbside container, which are picked up by the municipality (Retrieved August 14, 2019, from https://www.brunswickcountync.gov/solid-waste-and-recycling/recycling/). To contrast ophaalsysteem, inleversysteem is used, thus, this is expanded to container as well (inlevercontainer).
14	drop-off system	inleversysteem	contrast with curbside container, which are picked up by the municipality (Retrieved August 14, 2019, from https://www.brunswickcountync.gov/solid-waste-and-recycling/recycling/). To contrast ophaalsysteem, inleversysteem is used.
15	eco-indicator	Milieu Kosten Indicator-waarde (MKI-waarde)	Retrieved August 14, 2019, from https://www.rijkswaterstaat.nl/zakelijk/zakendoen-met-rijkswaterstaat/inkoopbeleid/duurzaam-inkopen/duurzaamheid-bij-contracten-en-aanbestedingen/dubocalc/index.aspx based on the definition of the English term contrasted with the same concept in Dutch
16	electricity grid	elektriciteitsnet	CELEX:32013H0179
17	elementary flow	elementaire stroom	CELEX:32013H0179
18	emission factor	emissiefactor	CELEX:32003L0087
19	end-of-life recycling approach	benadering voor recycling aan het einde van de levensduur	Schut, E., Crielaard, M., & Mesman, M. (2015). Beleidsverkenning circulaire economie in de bouw Een perspectief voor de markt en overheid. Based on use of recycling aan het einde van de levensduur in relation to sustainable choices in contrast with economic investment in the domain of Construction in the source.
20	end-of-life treatment	behandeling in de eindfase van de levenscyclus	CELEX:32013H0179
21	endpoint	eindpunt	CELEX:32013H0179
22	endpoint category	eindpuntcategorie	Based on Dutch term equivalent for endpoint (EUR-LEX, CELEX:32013H0179)
23	endpoint indicator	eindpuntindicator	Based on Dutch term equivalent for endpoint (EUR-LEX, CELEX:32013H0179)
24	environmental inventory	milieu-inventarisering	CELEX:52008IP0233

25	environmental mechanism	milieumechanisme	CELEX:32013H0179
26	extraction of raw material	grondstoffenwinning	Synonym of raw material extraction, added to proposed term fiche for raw material extraction
27	frequency histogram	histogram	as stated in excel
28	gate-to-gate	poort-tot-poort	CELEX:32013H0179
29	heterogeneous waste	heterogene afvalstoffen*	CELEX:51993PC0275 *changed to heterogeen afval for consistency with other term containing waste
30	macro-level	macroniveau	CELEX:32014D0202
31	market forecasting	marktprognose	CELEX:52011AE0360
32	mechanical-biological treatment	mechanische biologische behandeling (MBB)	CELEX:32018D1147
33	metabolic view	ecosysteemperspectief	Jelier, W. P. C. (2011). het concept Stedelijk Metabolisme: Verkenning van het concept 'Stedelijk Metabolisme' met het oog op de bruikbaarheid ervan voor duurzame stedelijke ontwikkeling. TU Delft. In the source one of the perspectives on a metabolic city is that from the point of view of an ecosystem. This can be related as well to waste, in an ecosystem there is no waste, as for example dead leaved form food for insects as wurms.
34	micro-level	microniveau	CELEX:52016AE6926
35	midpoint category	middelpuntcategorie	Based on Dutch term equivalent in newly proposed entry for midpoint
36	midpoint indicator	middelpuntindicator	Based on Dutch term equivalent in newly proposed entry for midpoint
37	multi-input process	multi-invoerproces	Based on translation for multi-output process
38	multi-output process	multi-uitvoerproces	Retrieved August 14, 2019, from https://www.duurzaaminstaal.nl/upload/File/SBK_Toetsingsprotocol_1_7_2011.pdf space removed between multi-invoer and proces to apply Dutch rules regarding word compounds (https://taaladvies.net/taal/advies/tekst/127)
39	open recycling	open-lus recycling	Guinée, J. B., Huppes, G., Lankreijer, R. M., Udo de Haes, H. A., & Wegener Sleeswijk, A. (1992). Milieugerichte levenscyclusanalyses van produkten. Translation for open-loop recycling, as in the source Pires et al. (2018) refer to open-loop recycling is described and not open recycling.
40	physical allocation	allocatie op fysieke grondslag	Blonk, H., Kool, A., Luske, B., Ponsioen, T., & Scholten, J. (2009). Berekening van broeikasgasemissies door de productie van tuinbouwproducten Verkenning en

			oplossingen van methodiekvragen ten eve van de ontwikkeling van het Nederlandse footprint protocol voor tuinbouwproducten.
41	primary data	primaire gegevens	CELEX:32013H0179
42	recovery technology	winningstechnologie	CELEX:92002E002216
43	recyclables	recycleerbare materialen	CELEX:32018D1147
44	recycled content approach	benadering voor de inzet van gerecycled materiaal	Thoden van Velzen, U., & Timmermans, T. (2011). Cradle to Cradle Verpakkingslogistiek: Transitieproces kringloopsluiting levensmiddelenketens. Based on inzet van gerecycled materiaal in source.
45	recycling scheme	recyclingprogramma	CELEX:52006XC0114(03)
46	reference flow	referentiestroom	CELEX:32013H0179
47	resource overexploitation	overexploitatie van natuurlijke hulpbronnen	Based on Dutch term equivalent for exploitation (IATE entry 48028) and Dutc term equivalent for resource (IATE entry 112303)
48	scenario development	scenario-ontwikkeling	CELEX:32014L0025
49	secondary data	secundaire gegevens	CELEX:32013H0179
50	selective collection service	dienst voor selectieve inzameling*	CELEX:32001D0663 *Changed to selectieve inzamelingsdienst for consistency with terms as selective collection, and to reflect source-text term word order.
51	social life cycle assessment	sociale levenscyclusanalyse	Andres, E. S., Barthel, L., BeckTabea, L., Benoît, C., Ciroth, A., Cucuzzella, C., … Weidema, B. (2009). Richtlijnen voor de Sociale Levenscyclus-Analyse van Producten.
52	solid waste collection system	inzamelingssysteem voor vast afval	Based on Dutch term equivalent for waste collection (IATE entry 49643) and Dutch term equivalent for solid waste (IATE entry 1427137). Word order based on Dutch term equivalent for solid waste management in IATE (entry ID 1390591)
53	substance flow	de stroom van de stoffen	CELEX:52002AP0560
54	sustainable perspective	duurzaam perspectief	CELEX:52009AE1456 Translated as duurzaam perspectief in two documents, in one translated as duurzame invalshoek, and in one no clear translation
55	temporary deposition	tijdelijke storting	Based on Dutch term equivalent for deposition (IATE entry 1427112)
56	upstream environmental impact	stroomopwaarts millieueffect	Combination of upstream (IATE entry 843884) and environmental impact (IATE entry 795327)
57	use phase	gebruiksfase	CELEX:32019D0062
58	waste collection sector	afvalinzamelingssector	Based on Dutch term equivalent for waste collection in IATE entry 49643
59	waste collection system	afvalinzamelingssyteem	CELEX:52018AR3652

60	waste compaction rate	afvalverdichtingssnelheid	Based on Dutch term equivalent of waste compaction in IATE entry 1108203, but altered in section 5.4 to afvalverdichting
61	waste recycling system	afvalrecyclingssysteem	Based on Dutch term equivalent of waste recycling in IATE entry 830978
62	zero burden assumption	zero burden benadering	No Dutch term equivalents were found, thus, the English term will be used and explained. The term will be introduced in italics. A hyphen will be used between burden and the Dutch equivalent of assumption as the English zero burden is not that common (yet) in the Dutch language and a hyphen highlights this (Retrieved August 16, 2019, from https://onzetaal.nl/taaladvies/engelse-woorden-in-nederlandse-samenstellingen) *The general manager of RDC Environment suggested *nul-impact hypothese* (this is not standardized, but merely a guess of a domain expert of how to translate the term). However, this exact term did not yield any results in Google. In addition, it may be confused with the *nul hypothese* from the domain of Mathematics.

Chapter 11
Assessment and Improvement

Abstract Today's environmental concerns are related to the population and its consumption of resources, which have led to significant ecological global changes, such as climate change and resources overexploitation. The solid waste management, in an integrated way, has been capable of influencing and contributing to the solution of such challenges. The purpose of this chapter is to discuss the assessment and improvement of the waste collection system by using life cycle thinking, with a sustainable perspective. Several methodologies such as life cycle assessment, carbon footprint, life cycle costing, and social life cycle assessment will be presented and discussed concerning its application to waste collection systems and contribution to the integrated waste management system.

Keywords LCA · Social LCA · LCC · Environmental impacts · Public participation · Behavior studies

11.1 Life Cycle Assessment and Carbon Footprint

The life cycle assessment is a process to (a) evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying the energy and materials used, wastes, and emissions released to the environment; (b) assess the impact of those energy and material uses and releases to the environment; and (c) identify and evaluate opportunities that lead to environmental improvements (Fava et al. 1991; Consoli et al. 1993). According to the International Organization for Standardization (ISO 14040 2006a), LCA addresses the environmental aspects and potential environmental impacts throughout a product's life cycle, from raw material acquisition through production, use, end-of-life treatment, recycling, and final disposal (i.e., cradle to grave). LCA is divided into four phases: goal and scope definition, inventory analysis, impact assessment, and interpretation. The goal and scope definition intends to define the purposes, specifications, and limits in the evaluation. The inventory analysis phase is responsible for the collection of data of the unit processes within the system and relating it to a functional unit. Impact assessment intends to make inventory information more understandable

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through its translation into environmental impact categories. Final interpretation allows evaluating results obtained and comparing them with the initially defined goal (ISO 14040 2006a).

LCA applied to solid waste collection systems can serve two purposes: to evaluate the service provided (in terms of technology implemented) and find where more environmental impact is occurring and to evaluate which level of source separation (number of streams and quality of material source separated, recycling rate) should be promoted, to reach higher amounts of recyclables and higher quality of recyclables collected in such a way that could be beneficial to the environment. LCA has been applied to solid waste management since the 1990s to treatment and recovery technology processes, where the focus on specific collection and recycling schemes is being increasing more recently.

11.1.1 Goal and Scope Definition

For a waste collection system, the goal of an LCA study depends on the type of decision-making process: a microlevel decision, where the decision to be made will not impact the background system, and a meso−/macro-level, which can impact the background system. The micro-level decision is only devoted to the technical analysis and environmental inventory of the waste collection sector. Meso−/macro-level is related to the analysis of strategies with large-scale to background sector (like the market for recyclables), which are related to studies on a national scale, with implications on national and international plans. To understand which type of LCA to perform, foreground and background systems must be defined. In a waste collection system LCA study, the foreground system is the waste collection system to be analyzed, where real data will be gathered related to the collection and transport and to waste container production and transport; the background system is generic data which is more related to the electricity grid, for example.

Functions of the System, the Functional Unit, and Reference Flow

At a glance, a waste collection system just performs one function: allows the temporary deposition of waste, its collection, and transport to a specific destination. However, the destination can also be included in the LCA, because waste collection can influence its destination. If packaging waste is source separated, it has recycling features; if organic waste is source separated, the production of a high-quality compost occurs. Even if the waste results from mix collection, it can also generate electric energy. When mixed waste collected is send for mechanical-biological treatment (by anaerobic digeston), or to incineration or even at the landfill, the biogas is generated and used to produce electric energy. The way how the system is defined will determine the number of functions of the system, and, if multifunctionality occurs, it has to be solved. A possible functional unit is the

collection of a specific amount of waste generated in a period by a specific group of inhabitants, for example, the selective collection service of 1500 tons a month of MSW generated in an urban locality with a density of 5000 inhabitants/km^2 applied by Iriarte et al. (2009). Related to the functional unit is the reference flow for the normalization of input and output data (Chang and Pires 2015). In the case of Iriarte et al. (2009), the reference flow considered the theoretical recovery of 100% for the fractions: organic, paper, packaging, and glass present in the MSW. When comparing waste collection system for a specific waste stream, waste properties need to be studied, to ensure that the functional unit and the reference flow are the same. It is common that different waste collection vehicles have different waste compaction rates, changing the density of waste collected. Density is just one of the critical physical properties, but also moisture can be relevant for the collection of biodegradable waste or waste paper and waste cardboard.

System Boundaries

The waste collection system studied in the LCA can be:

- The service provided by a municipality or a private company.
- The number of recyclables collected by the collection system.

From a generic point of view, the waste collection system to be analyzed has, in the beginning, the stages of temporary deposition (containers) and waste collection vehicles. The frontiers of the waste collection also need to be addressed. The frontiers can be related to geographic locations, timescales, and technical components. Considering the technical components, LCA studies can be cradle-to-grave (starts with the extraction of materials, going through all life cycle), cradle-to-gate (from raw material extraction, going until the product leaves the factory), gate-to-gate (only regards a manufacturing process), and cradle-to-cradle (with a metabolic view where no waste exists) (Chang and Pires 2015). In waste collection systems, LCA can be only cradle-to-gate if the intention is to assess a particular waste collection technology without the use phase (like an environmental product declaration for waste bins), or the waste collection system itself can be a cradle-to-gate of the entire waste management system. A cradle-to-cradle applies to reverse logistic cases when the product is not waste or is for reuse. A typical waste collection LCA is a cradle-to-gate, or a streamlined LCA (also named screening and matrix LCA) because the assessment is only for a part of the life cycle. The definition is also applied when the LCA is not assessing all the environmental impact categories (Crawford 2011). The case study on Box 11.1 is an example of a streamlined LCA at recycling schemes.

Box 11.1 Comparison of Recycling Schemes in Portugal (Pires et al. 2017)

A comparative study based on LCA and economic analysis through indicators was conducted for three waste collection systems for packaging waste in a municipality in Portugal. The analysis compares the environmental impact of existing collection systems and the costs involved in the operation of those systems. For the LCA, Umberto 5.5 software package was used.

Three waste recycling systems were compared: a curbside system, where all non-glass packaging waste is collected by the curbside bags; a drop-off system, where all packaging waste is collected by drop-off containers; and a mixed system, where glass is deposited at drop-off containers and lightweight packaging is deposited at drop-off and curbside systems. The LCA was used to analyze the environmental impacts, but only the collection system was assessed (the subsequent recycling was excluded). The results showed that the curbside system was less favorable economically and environmentally due to the more packaging and more fuel consumption per ton of waste, compared to drop-off collection system. Optimization of the curbside system is needed, through the use of reusable boxes and efficient collection routes (SEP 2018).

In a waste collection LCA, there is no need to include the environmental impacts resulting from the extraction of material and production of goods that originate waste, neither product reuse with the application of the "zero burden assumption." The zero burden assumes that waste brings no upstream environmental impacts into the waste collection system neither to the waste management system (Ekvall et al. 2007). Such can be applied because all product life cycle phases previous to the waste phase occur in the same way in the next waste collection alternatives.

To conduct an LCA is also needed to have in consideration aspects related to geographic boundaries and time horizons. Concerning geographic boundaries, the waste collection systems are typically local and regional, but also can be national or international, when materials collected are sent to recycling, which can be outside the borders of the country. Data referent to process far from the place where waste collection efficiently occurs can be hard to collect (Chang and Pires 2015). In the case of time horizon, the functional unit in a waste collection system can be dependent on the respective year or another time unit, which is the case of the amount of waste generated and collected, which is not constant through the years, with fluctuations during the year. There is the need to identify the time horizon of the analysis appropriately. When conducting an LCA for a waste collection system which the system is only the collection itself, there is the need to include equipment and infrastructure data. In this situation, the useful life of devices needs to fit into the functional unit period.

Another aspect to be defined during the goal and scope definition is the allocation procedure. According to ISO (2006b), allocation represents the portioning of input and output flows of a process or a system concerning the system under analysis and one or more other systems. Allocation applies in cases of multifunctionality and

when open recycling inside the system occurs (Ekvall and Tillman 1997). Multifunctionality is related to a multi-output and multi-input processes (or systems). A multi-output process occurs when a single system produces more than one product or only one product is processed inside the system and at least one product is generated and is used outside the system (what is called a coproduct) (Klöpffer and Grahl 2014). A multi-input process in waste management systems occurs when several waste streams are collected and treated, while LCA tries to isolate one of them (Tillman 2010). When a product is recycled not at the same product but in a different one, it is a case of open recycling (Tillman 2010). The way how to proceed to solve them is different if the LCA is of attributional type or consequential type, although there is no universal consensus. In general, the multi-output systems in waste management is usually solved by system expansion/substitution, whatever is an attributional or a consequential LCA, by ISO (2006b) and recommendations from EC-JRC-IES (2010). In a first step, system expansion is performed until all expanded systems produce the same quantities of the coproducts identified in the system, and in the next step, product outputs and inputs related with the coproducts are subtracted from all expanded systems (Bueno et al. 2015). In the case of multi-input, portioning made by physical or chemical classification is typically conducted (Meijer et al. 2017; Guinée et al. 2002). In the case of recycling allocation, "recycled content approach" (or cutoff approach) and the "end-of-life recycling approach" (or avoided burden approach) are used (Frischknecht 2010) (Fig. 11.1). The cutoff method considers the share of recycled material in the manufacture of the product, where the environmental impacts of recycled material were not attributed to the system under investigation because once recycled, they start a new life in a second product/process (Frischknecht 2010; Zampori and Dotelli 2014). In the avoided burden approach, the environmental impacts from the recycling include the system under investigation, avoiding the extraction of raw materials for the production of the product, and relating environmental impacts, crediting them to the product in the system in assessment (Frischknecht 2010; Zampori and Dotelli 2014).

According to Pelletier et al. (2015), the multifunctionality needs to be adequately justified, and the different approaches to solving multifunctionality mostly relate to the schools of LCA practitioners, which view the purpose of LCA in different ways:

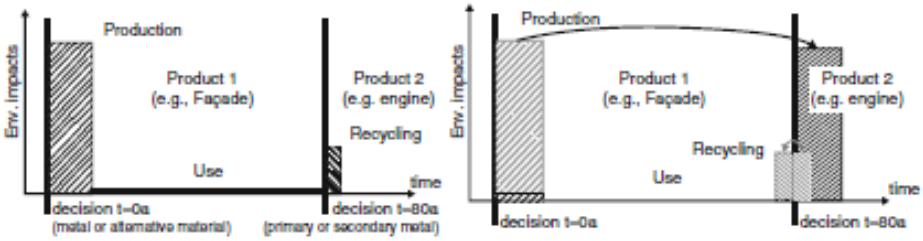


Fig. 11.1 Environmental impacts in the course of time during production, use, and end of life (recycling) of a long-living metal product. Left, recycled content approach; right end-of-life recycling approach. (Source: Frischknecht (2010))

Table 11.1 Alternative multifunctionality hierarchies consistent with competing for understanding of nature, purpose, and conditions necessary to LCA

		Attributional data modeling approach	
ISO 14044	Consequential data modeling approach	Physical perspective	Socioeconomic perspective
Tier 1: Avoid allocation via subdivision or system expansion	Avoid allocation by subdivision or "system expansion + substitution"	Avoid allocation by subdivision or system expansion (reporting at level of all coproducts)	Avoid allocation by subdivision or system expansion (reporting at level of all coproducts)
Tier 2: Allocation based on an underlying physical relationship	NA	Avoid based on a relevant underlying physical relationship	Avoid based on a relevant underlying economic value of coproducts
Tier 3: Allocation based on some other reason	NA	NA	NA

Pelletier et al. (2015)

multifunctionality is to be solved by system expansion or by physical allocation or by economic allocation (representing allocation based on "some other relationship"). Whatever the school of the practitioner, Pelletier et al. (2015) suggest the alternative multifunctionality to help in making allocation consistent and more transparent to practitioners (Table 11.1).

11.1.2 Life Cycle Inventory

LCI represents the phase in the LCA where the collection and treatment of the data to perform the assessment occur. The steps of LCI include the data collection planning, collection itself, and validation of data. Concerning planning, there is the need to define the data to be collected regarding the type of LCA (attributional or consequential), type of the system (is data for the foreground or the background), and the LCA scale (is a full LCA or a streamlined). Depending on the type of LCA conducted – attributional or consequential – the type of information to be collected differs. For an attributional LCA, data to be collected is average or generic data that best represent the waste collection system. In consequential LCA, marginal data collection is related to operations during the life cycle that are affected by a change in the system under investigation (Ekvall and Weidema 2004). To develop the consequential analysis, scenario development and market forecasting can be applied. The one more used is the market forecasting, which only implies the knowledge of the existing market for outputs and inputs of the system, when the scenario development is critical to their application.

Concerning foreground and background data, the approaches to collect information are different. In the case of foreground data, or primary data, data collection intends to characterize as far as possible the system, being collected all data possible

concerning inputs and outputs; background data, or secondary data, are related to information of secondary processes with no apparent influence on the core system (Chang and Pires 2015).

Choosing between a full and a streamlined LCA should be based on the goal and scope of the study and the time available to conduct the assessment, because LCA is time-consuming and expensive (Wang et al. 2016). Streamlined LCA occurs by (1) adjusting the system boundary (both foreground and background systems) and (2) limiting the inputs, outputs, and environmental impacts considered in the assessment. Previous full LCA studies can indicate areas which have low significance to the LCA results, allowing a justified streamlined LCA (Chang and Pires 2015).

LCI databases provide ready-made inventories to characterize waste collection systems. There are several databases which characterize several processes including waste collection and treatment processes. Most complete databases are the Ecoinvent (http://www.ecoinvent.org/), US Life Cycle Inventory Database (https://www.nrel.gov/lci/), and European Life Cycle Database (ELCD) (http://eplca.jrc.ec.europa.eu/ELCD3/), just to name a few.

Documentation of data calculation for LCI occurs explicitly, where the explanation of all assumptions occurs. The validation of data and relating data to unit processes and functional unit is needed to ensure the quality of LCA (ISO 2006b). The validation of data during LCI should be made through mass balances, energy balances, and comparison with data from other sources, like emission factors for specific processes (Guinée et al. 2002).

11.1.3 Life Cycle Impact Assessment

The result of the LCI phase is the quantification of materials, energy, and substance flows which impact the environment. The LCIA intends to understand and evaluate the environmental impacts resulting from the system in the analysis, regarding the magnitude and the significance (ISO 2006b). The critical steps of the LCIA are (Curran 2006) selection and definition of impact categories, classification of substance flows with the selected impact category, and characterization of LCI impacts based on conversion factors scientifically based.

Complexity reduction of the conversion of inventory into impact categories occurs by the impact categories definition in midpoint and endpoint indicators. Midpoint indicators calculate the impact of LCI outputs through various environmental mechanisms with less uncertainty; endpoint indicators include the characterization factors to link midpoint indicators through additional environmental mechanisms, which incorporates greater uncertainty (Li and Khanal 2016) (Fig. 11.2).

In addition to the fundamental steps, other steps can be added to reach a more clear result, such as normalization, grouping, and weighting of impact categories, which will facilitate the comparison of LCA results and the interpretation phase (ISO 2006b). According to ISO (2006b) and Ashby (2009), normalization intends to

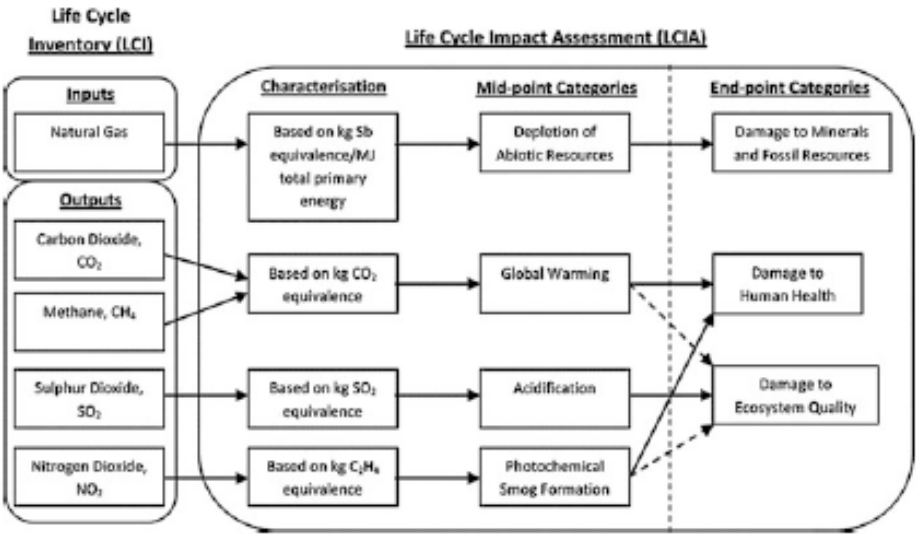


Fig. 11.2 Typical LCA framework linking LCI via midpoint categories to endpoint categories for selected damage types. Indicators can be formed from either category after normalization and optional weighting step. (Source: Rimos et al. (2014))

remove the units and reduce the data to a standard scale, grouping intends to sort and rank the impact categories if possible, and weighting of each impact category helps to understand which are the most critical impacts compared to the other category impacts. The result of these additional key steps is a value, an eco-indicator, which condensates all the information resulting from the LCA into one number. There is some criticism on the use of eco-indicators since there is no agreement on normalization and weighting factors and the value has no physical significance (Ashby 2009).

The LCIA is typically made by different methodologies, from their resulting indicators that could help to quantify and compare the environmental impact of the product or service. Several methodologies exist: CML (Guinée et al. 2002), Eco-Indicator 99 (EI'99) (Goedkoop and Spriensma 2000), Environmental Priority System 2000 (EPS 2000) (Steen 1999), EDIP (Hauschild and Potting 2005), IMPACT 2002+ (Jolliet et al. 2003), TRACI (Bare et al. 2003), USEtox 2.0 (Fantke et al. 2015), ReCiPe (Goedkoop et al. 2009), and ES'06 (Frischknecht et al. 2008). Choosing the LCIA system should address the following questions (Rosenbaum et al. 2018):

- Which impact categories do I need to cover and can I justify those that I am excluding?
- Which are the features of the region where the system in the analysis occurs?
- What kind of LCIA do I need, midpoint, endpoint, or both, and are the normalization steps also needed?
- Which elementary flows do I need to identify and know?
- Is there any information from organizations that could help me to choose?

- How can the LCIA results be interpreted and communicated?
- How well is the method scientifically supported?
- How proven is the method?
- Is there available data from my LCI to support the LCIA method?
- Is uncertainty an issue that needs to be quantified?

One possible strategy to choose an LCIA method can be the existence of LCA studies made to the waste collection system and the LCIA method used. Probably there is a method more frequently used, which can also be chosen, helping in the comparison of the results.

11.1.4 Interpretation

According to ISO (2006b), the interpretation is the last phase of the LCA, where results are summarized for conclusions and recommendation and help on decision-making, depending on the goals and scope defined at the beginning of the LCA. Due to its looping plus iterative procedure, the discussion conducted can dictate changes in previous decisions during the LCA like allocation rules, system boundaries, goal and scope features, data collected to perform the LCA, and environmental impact categories chosen, just to name a few of the possible consequences of interpretation phase (Chang and Pires 2015; ISO 2006b). Interpretation phase recommends a critical analysis done by an external entity (ISO 2006b).

Uncertainty and sensitivity analyses are conducted during the interpretation phase. Sensitivity analysis intends to understand how the model inputs influence the results; uncertainty analysis (also named propagation) aims to know quantitatively the overall uncertainty of results reached during LCA (Laurent et al. 2014). The most common method used to assess sensitivity is scenario analysis. These are one-factor-at-a-time (OFAT) methods with the intention to investigating the robustness of the results and finding the sensitive parameters that could influence LCA results and, in the last case, alter the recommendations to decision-makers (Laurent et al. 2014). Sensitivity analysis is performed by varying the inputs within a specific range and analyzing the impacts on the results, showing which are the results that must be regarded more carefully, and which assumptions must be justified and validated (Li and Khanal 2016). Uncertainty in waste collection system is generally related to the waste composition itself and the waste fraction distributions and chemical composition (e.g., water content, density). The system model used for the collection itself, the choice of a collection scheme, and the parameters dependent of the collection scheme, like fuel consumption, emissions, source-sorting efficiencies, and the transport distance, at least should be subjected to uncertainty analysis (Clavreul et al. 2012). Uncertainty analysis is usually conducted by Monte Carlo analysis, which consists in randomly sampling the probability distribution of each uncertain parameter in a large number of times, resulting in a frequency histogram and a probability distribution representing model results (Clavreul et al. 2012). When conducting an LCA comparing different waste management solutions, the

Monte Carlo simulation can indicate, for each solution, which is the probability that a specific result occurs (e.g., which is the probability of the result "incineration is better than anaerobic digestion" occur).

11.1.5 LCA Software

There are several on-market software to conduct an LCA study on waste collection, like Gabi, SimaPro, Team, and Umberto software. There is also more friendly software explicitly devoted to waste management, including solid waste collection, which can make the streamlined LCA easier. Those software/applications are IWM-2 (McDougall et al. 2001), WISARD/WRATE (Ecobilan 2004), EASEWASTE (Christensen et al. 2007), and ORWARE (Dalemo et al. 1997; Björklund et al. 1999). The development and use of waste LCA tools justify the need to deal with a reference flow composed of a mixture of materials (waste and its several waste streams); the LCA practitioner can evaluate more natural the influence of several parameters of the waste management scheme on the LCA results, making more accessible for the practitioner to track the impacts from heterogeneous waste streams and the impacts caused by each material (Clavreul et al. 2014).

No matter which is the software, the practitioner of an LCA to waste collection system must have in mind that capital goods may have significant importance on the LCA environmental impacts, not being adequate to exclude them. According to Brogaard and Christensen (2012), the impact of producing the capital goods for waste collection and transport – vehicles and containers – should not be neglected as the capital goods can be responsible for more than 85% of some of the environmental impact categories from all environmental impacts occurring for collection and transport waste (when a transport distance of 25 km was assumed).

Appendix W: Target text

Hoofdstuk 11 Analyse en verbetering

Samenvatting De huidige milieuproblemen komen voort uit grondstoffenverbruik dat wereldwijd tot significante ecologische veranderingen heeft geleid, zoals klimaatverandering en overexploitatie van natuurlijke hulpbronnen. Het beheer van vast afval kan, als dit op geïntegreerde wijze wordt uitgevoerd, dit beïnvloeden en bijdragen aan de oplossing voor deze problematiek.

In dit hoofdstuk wordt besproken hoe afvalinzamelingssystemen kunnen worden geanalyseerd en op een duurzame manier verbeterd kunnen worden vanuit levenscyclusbenadering. Verschillende methodes, zoals levenscyclusanalyse, koolstofvoetafdruk, levenscycluskostenberekening en sociale levenscyclusanalyse worden geïntroduceerd. Daarnaast wordt besproken hoe deze methodes van invloed zijn op afvalinzamelingssystemen en hoe zij kunnen bijdragen aan een geïntegreerd afvalbeheersysteem.

Sleutelwoorden: LCA; sociale LCA; LCC; milieueffecten; publieksdeelname; gedragswetenschappen

11.1 Levenscyclusanalyse en koolstofvoetafdruk

Levenscyclusanalyse (LCA) is een proces waarmee:

a) milieudruk geassocieerd met producten, processen of activiteiten kan worden geëvalueerd door de energie, gebruikte materialen, afval en uitgestoten emissies te identificeren en te kwantificeren;

b) het effect van het gebruik van die energie, materialen en uitgestoten emissies kan worden beoordeeld;

c) mogelijkheden tot verbetering kunnen worden geïdentificeerd en geëvalueerd (Fava et al., 1991; Consoli et al.,1993).

Volgens de Internationale Organisatie voor Standaardisatie (ISO) (2006a) worden in LCA milieuaspecten en potentiële milieueffecten behandeld die een rol spelen in de gehele levenscyclus van een product, vanaf de grondstofwinning, via productie, de gebruiksfase, de behandeling in de eindfase van de levenscyclus, recycling en de definitieve verwijdering, oftewel van wieg tot graf. LCA is onderverdeeld in vier fasen: vaststelling van doel en reikwijdte, inventarisatie, effectbeoordeling en interpretatie. In de vaststelling van doel en

reikwijdte worden het doel, de specificaties en de beperkingen van de analyse bepaald. Tijdens de inventarisatie worden de gegevens van de eenheidsprocessen uit het systeem verzameld en gerelateerd aan de functionele eenheid. In de derde fase wordt een effectbeoordeling uitgevoerd waarin de informatie uit de inventarisatie wordt vertaald naar milieueffectcategorieën. In de interpretatie worden de verkregen resultaten geëvalueerd en worden deze vergeleken met het doel dat in de eerste fase is vastgesteld (ISO, 2006a).

LCA kan op twee manieren worden toegepast op inzamelingssystemen van vast afval. Ten eerste kan het gebruikt worden om (de geïmplementeerde technologie in) de dienst te evalueren en te bepalen waar de meeste milieueffecten plaatsvinden. Daarnaast wordt met LCA bepaald welk niveau van bronscheiding (aantal stromen, de kwaliteit van het materiaal en de recyclingsnelheid) leidt tot de recycling van meer materiaal en gerecycled materiaal van een betere kwaliteit. De inzameling hiervan wordt tevens bekeken vanuit een duurzaamheidsperspectief. Sinds de jaren '90 wordt LCA al toegepast op bepaalde aspecten van het beheer van vast afval, zoals behandelingsprocessen en winningstechnologieën, maar sinds kort wordt er ook steeds meer aandacht besteed aan inzameling en recyclingprogramma's.

11.1.1 Vaststelling van doel en reikwijdte

Het doel van de LCA binnen afvalinzamelingssystemen is afhankelijk van het besluitvormingsproces. Het besluitvormingsproces kan plaatsvinden op microniveau, hierbij is er geen invloed op het achtergrondsysteem, of op het meso- of macroniveau, waarbij er wel invloed wordt uitgeoefend op het achtergrondsysteem. Het besluitvormingsproces op microniveau heeft alleen betrekking op de technische analyse en de milieu-inventarisatie van de afvalinzamelingssector. Op het meso- en macroniveau worden ook omvangrijkere aspecten geanalyseerd die invloed hebben op de achtergrondsector, zoals de markt voor recycleerbare materialen. Deze aspecten zijn verbonden aan nationale onderzoeken en de implicaties hiervan strekken zich uit tot op nationaal en internationaal niveau. Om te bepalen wat voor soort LCA er moet worden uitgevoerd, moeten eerst het voorgrond- en achtergrondsysteem worden gedefinieerd. Het voorgrondsysteem bestaat uit het afvalinzamelingssysteem dat wordt geanalyseerd. Hierop zijn gegevens uit de praktijk van toepassing, zoals over de inzameling en het transport van afval, maar ook over de productie en het transport van afvalcontainers. Het achtergrondsysteem bestaat uit generieke gegevens die bijvoorbeeld betrekking hebben op het elektriciteitsnet.

Systeemfuncties, de functionele eenheid en referentiestromen

Op het eerste gezicht lijkt de functie van een afvalinzamelingssysteem duidelijk afgebakend: de tijdelijke opslag van afval, de inzameling van dat afval en het transport van het afval naar een specifieke bestemming. De bestemming kan echter ook worden betrokken bij de LCA, omdat afvalinzameling van invloed is op de bestemming. Als verpakkingsafval aan de bron wordt gescheiden, kan het worden gerecycled en wanneer organisch afval aan de bron wordt gescheiden, kan er compost van hoge kwaliteit van worden gemaakt. Gemengd afval, of afval dat niet gescheiden is ingezameld, kan mechanische biologische behandeling ondergaan (zoals anaerobe vergisting), worden verbrand of worden gestort. Met het biogas dat dan wordt gegenereerd, kan elektriciteit worden opgewekt.

Hoe het systeem is gedefinieerd, bepaalt hoeveel functies er binnen het systeem zijn en of het systeem multifunctioneel is. Een mogelijke functionele eenheid is de inzameling van de hoeveelheid afval die een bepaalde groep mensen in een specifieke periode produceert. Aan de functionele eenheid is een referentiestroom verbonden waarmee de in- en uitvoergegevens worden genormaliseerd (Chang & Pires, 2015). Iriarte, Gabarrell & Rieradevall (2009) hebben onderzoek gedaan naar de selectieve inzameling van 1500 ton gemeentelijk vast afval (MSW) dat elke maand wordt geproduceerd door een stad met 5000 inwoners per vierkante kilometer. In dit onderzoek bestond de referentiestroom uit de theoretische winning van 100% van de organische materialen, papier, verpakkingsmateriaal en glas in het MSW (Iriarte et al., 2009).

Als verschillende inzamelingssystemen worden vergeleken voor een bepaalde afvalstroom, moeten de functionele eenheid en de referentiestroom hetzelfde zijn. Dit kan worden bepaald door de eigenschappen van het afval te bestuderen, zoals de afvaldichtheid. Als verschillende soorten vuilniswagens afval verdichten met verschillende snelheden, verandert de afvaldichtheid, één van de essentiële fysieke eigenschappen van afval. Het vochtgehalte is tevens van belang, bijvoorbeeld voor de inzameling van biologisch afbreekbaar afval, papierafval en kartonafval.

Systeemgrenzen

Het afvalinzamelingssysteem dat wordt onderzocht met LCA kan bestaan uit de dienst die wordt geleverd door een gemeente of een privaat bedrijf, of het aantal recycleerbare materialen dat wordt ingezameld binnen het inzamelingssysteem.

De beginfase van het onderzochte afvalinzamelingssysteem bestaat over het algemeen uit de tijdelijke opslag van afval in vuilnisbakken en uit vuilniswagens, maar ook aspecten aan de grens van het systeem moeten worden geanalyseerd. Deze aspecten kunnen betrekking

hebben op technische componenten, geografische locaties en tijd. Wat de technische componenten betreft, kan een LCA worden uitgevoerd van wieg tot graf (vanaf de grondstofwinning door alle fasen van de levenscyclus), van wieg tot poort (van grondstofwinning tot het product de fabriek verlaat), van poort tot poort (alleen het productieproces) of van wieg tot wieg (vanuit het perspectief van een ecosysteem waarin afval niet bestaat) (Chang & Pires, 2015). Als LCA wordt gebruikt om een specifieke afvalinzamelingstechnologie te analyseren zonder de gebruiksfase hierbij te betrekken, dan is er sprake van een analyse van wieg tot poort, zoals een milieuproductverklaring voor vuilnisbakken. Binnen het gehele afvalbeheersysteem kan het afvalinzamelingssysteem ook worden gezien als de fase van wieg tot poort. Een standaard LCA wordt vaak op slechts één deel van de levenscyclus van een product toegepast, net zoals een gestroomlijnde LCA (ook wel een screening of matrix LCA genoemd), en vindt daardoor plaats van wieg tot poort. In box 11.1 wordt een casestudy besproken waarin recyclingprogramma's zijn onderzocht met een gestroomlijnde LCA. Als niet alle milieueffectcategorieën worden beoordeeld in een LCA, is er ook sprake van wieg tot poort (Crawford, 2011). Retourlogistiek heeft een benadering van wieg tot wieg, omdat producten niet als afval worden beschouwd of worden hergebruikt.

Box 11.1 Vergelijking van recyclingprogramma's in Portugal (Pires, Sargedas, Miguel, Pina, & Martinho, 2017)

In 2017 deden Pires et al. een vergelijkend onderzoek naar drie afvalinzamelingssystemen voor verpakkingsafval in een gemeente in Portugal op basis van LCA en een economische analyse. Voor de LCA werd de software Umberto 5.5 gebruikt en in de economische analyse werd een vergelijking gemaakt tussen de milieueffecten van de huidige inzamelingssystemen en wat deze systemen kosten. Er werden drie systemen vergeleken: een ophaalsysteem, waarbij al het verpakkingsafval (met uitzondering van glas) wordt opgehaald in vuilniszakken, een inleversysteem, waarbij verpakkingsafval wordt verzameld in inlevercontainers, en een gemengd systeem waarbij glas naar inlevercontainers wordt gebracht en lichtgewicht verpakkingsafval zowel wordt ingeleverd als opgehaald. De milieueffecten werden geanalyseerd met LCA, maar alleen het inzamelingssysteem werd beoordeeld en niet de recycling.

Pires et al. (2017) concludeerden dat het ophaalsysteem duurder is en slechter voor het milieu dan het inleversysteem, omdat er meer vuilniszakken nodig zijn om het afval aan de straat te zetten en het brandstofgebruik hoger is per ton afval. Het ophaalsysteem kan geoptimaliseerd worden door het afval in herbruikbare boxen aan de straat te zetten en door

efficiënte ophaalroutes (SEP, 2018).

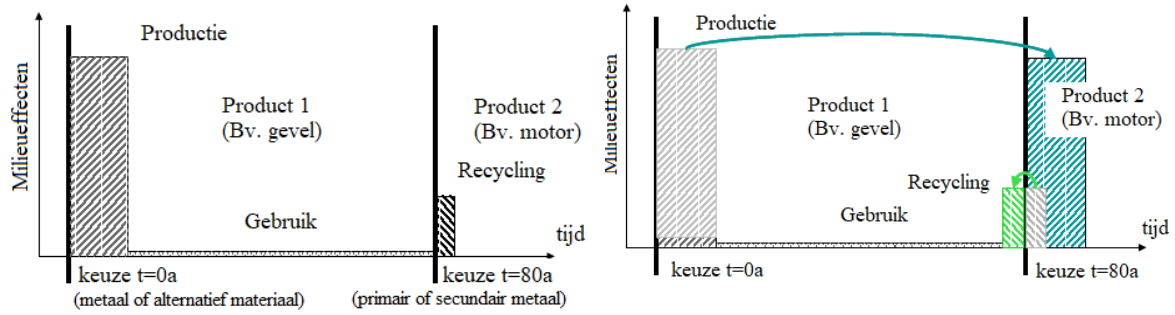
Als de *zero burden*-benadering wordt toegepast op LCA van afvalinzameling, dan worden milieueffecten door grondstofwinning, het productieproces van producten die tot afval leiden en het hergebruik van producten niet meegewogen. Volgens de *zero burden*-benadering worden stroomopwaartse milieueffecten van afval niet meegenomen naar het afvalbeheersysteem en zo ook niet naar het afvalinzamelingssysteem dat daar onderdeel van is (Ekvall, Assefa, Björklund, Eriksson, & Finnveden, 2007, p.990). Er wordt namelijk gesteld dat alle fasen in de levenscyclus van een product, voorafgaand aan de fase waarin iets als afval wordt gezien, op dezelfde manier worden doorlopen, onafhankelijk van het afvalinzamelingssysteem.

In LCA moeten de geografische grenzen en de tijdshorizon ook in overweging worden genomen. Wat de geografische grenzen betreft, zijn afvalinzamelingssystemen vaak lokaal en regionaal georganiseerd, maar ze kunnen ook plaatsvinden op nationaal of internationaal niveau als materialen worden gerecycled in het buitenland. Het kan echter moeilijk zijn om gegevens te achterhalen van processen die zich ver van de locatie van de afvalinzameling afspelen (Chang & Pires, 2015). De functionele eenheid binnen een afvalinzamelingssysteem kan worden verbonden aan het kalenderjaar of een andere tijdseenheid, dit is de tijdshorizon. Dit is van belang voor de hoeveelheid afval die wordt geproduceerd en ingezameld, omdat deze fluctueert gedurende het jaar en verschilt van jaar tot jaar. Het is belangrijk om een gepaste tijdshorizon te kiezen voor de LCA. Als er een LCA wordt uitgevoerd voor een afvalinzamelingssysteem waarbij afval alleen wordt ingezameld, moeten middelen en gegevens over infrastructuur ook in de LCA worden betrokken. De gebruiksduur van die middelen moet binnen de periode van de functionele eenheid vallen.

Tijdens de vaststelling van het doel en de reikwijdte moet tevens de allocatieprocedure worden gedefinieerd. Volgens de ISO (2006b) wordt met allocatie de invoer- en uitvoerstroom van een proces of een productsysteem verdeeld tussen het productsysteem dat wordt onderzocht en een of meerdere andere productsystemen. Als het productsysteem multifunctioneel is of als er open-lus recycling voorkomt binnen het systeem, kunnen er problemen met allocatie optreden (Ekvall & Tillman, 1997). Er is sprake van open-lus recycling als materiaal of energie dat afkomstig is uit het recyclingproces voor meer dan één productsoort wordt gebruikt (Tillman, 2010, p. 155). Multifunctionaliteit heeft betrekking op processen of systemen die een meervoudige in- of uitvoer hebben. Afvalbeheersystemen hebben een multi-invoerproces als er verschillende afvalstromen worden ingezameld en behandeld, terwijl LCA vaak op slechts één

afvalstroom wordt toegepast (Tillman, 2010). Multi-uitvoerprocessen komen voor als er meerdere producten worden geproduceerd in één productsysteem, of als er minstens één product wordt gegenereerd dat buiten het productsysteem wordt gebruikt, oftewel een bijproduct (Klöpffer & Grahl, 2014).

Hoe problemen gerelateerd aan allocatie opgelost moeten worden, is afhankelijk van de soort LCA die wordt uitgevoerd, maar er is geen eenduidige richtlijn. Als er sprake is van een meervoudige invoer, wordt er standaard allocatie op fysieke of economische grondslag uitgevoerd (Meijer, Kasem, & Lewis, 2017, p. 31; Guinée et al., 2002, p. 677). Er kan ook allocatie plaatsvinden op basis van recycling, zoals in de benadering voor de inzet van gerecycled materiaal, ook wel de cut-offbenadering genoemd, en de benadering voor recycling aan het einde van de levensduur, ook bekend als vermeden impactbenadering, zie afbeelding 11.1 (Frischknecht, 2010). De cut-offmethode heeft betrekking op het aandeel van gerecycled materiaal in het productieproces van een ander product (Frischknecht, 2010). Volgens Zampori & Dotelli (2014) begint een gerecycled materiaal een nieuw leven in het onderzochte systeem en worden er daarom helemaal geen milieueffecten van het gerecyclede materiaal meegewogen. Frischknecht (2010) beschrijft echter dat de milieueffecten van de recycling van het materiaal wel worden meegewogen in het onderzochte productsysteem, zoals is weergegeven in afbeelding 11.1. Volgens de vermeden impactbenadering worden er milieueffecten vermeden in een productiesysteem als er gerecyclede materialen worden gebruikt in plaats van grondstoffen, omdat de milieudruk van grondstofwinning en -bewerking wordt vermeden. De voordelen van het gerecyclede materiaal worden toegeschreven aan het product waar het gerecyclede materiaal van afkomstig is (Frischknecht 2010). Volgens ISO (2006b) en de aanbevelingen van het Instituut voor Milieu en Duurzaamheid van de Europese Commissie (*ILCD Handbook*, 2010) kan systeemuitbreiding of vervanging worden toegepast op afvalbeheersystemen met meervoudige uitvoer, onafhankelijk van het soort LCA. Eerst wordt het onderzochte systeem uitgebreid met andere systemen met gedeelde (bij)producten tot het punt waarop geproduceerde hoeveelheden in alle systemen gelijk zijn. Vervolgens worden vermeden in- en uitvoer van de bijproducten in de andere productsystemen afgetrokken van de in- en uitvoer van het onderzochte systeem (Bueno, Latasa, & Lozano, 2015).



Afbeelding 11.1 Milieueffecten na verloop van tijd, tijdens productie, gebruik en einde van de levensduur (recycling) van een metaalproduct met lange levensduur. Links: benadering voor de inzet van gerecycled materiaal, rechts: benadering voor recycling aan het einde van de levensduur. (Bron: Frischknecht, 2010, p. 667)

Volgens Pelletier, Ardente, Brandão, de Camillis & Pennington (2015) hebben deskundigen met verschillende achtergronden verschillende visies op het doel van LCA en of er systeemuitbreiding of allocatie moet worden toegepast op multifunctionaliteit. Zij stellen dat deskundigen zich niet houden aan de richtlijnen van ISO 14044 (2006b) en zien een heterogeniteit aan gebruikte methodes met betrekking tot de multifunctionaliteit, maar volgende Pelletier et al. (2015) wordt in de literatuur niet gerechtvaardigd waarom een bepaalde methode wordt gebruikt. Om de keuze voor een methode transparant te laten verlopen en de consistentie tussen deskundigen te verbeteren, hebben zij een schema opgesteld (zie tabel 11.1) dat het besluitvormingsproces kan leiden, onafhankelijk van de achtergrond van de deskundige.

Tabel 11.1 Alternatieve hiërarchie voor multifunctionaliteit vanuit verschillende benaderingen van de aard, het doel en de voorwaarden die nodig zijn voor LCA

			Attributional gegevensbenadering	
	ISO 14044	Consequentiële gegevensbenadering (gericht op verandering, systeemperspectief)	Fysiek perspectief (natuurlijk, wetenschappelijk/ fysiek realistisch)	Sociaaleconomisch perspectief (rechtvaardiging/ motivatie)
Laag 1	Vermijd allocatie door onderverdeling of systeemuitbreiding	Vermijd allocatie door onderverdeling of 'systeemuitbreiding + onderverdeling'	Vermijd allocatie door onderverdeling of systeemuitbreiding (naar alle bijproducten)	Vermijd allocatie door onderverdeling of systeemuitbreiding (naar alle bijproducten)
Laag 2	Allocatie op basis van een onderliggende fysieke relatie	n.v.t.	Allocatie op basis van relevant onderliggend fysiek verband	Allocatie op basis van relatieve economische waarde van bijproducten
Laag 3	Allocatie op basis van een ander verband	n.v.t.	n.v.t.	n.v.t.

n.v.t. niet van toepassing
(Bron: Pelletier, Ardente, Brandão, de Camillis & Pennington, 2015, p. 83)

11.1.2 Levenscyclusinventarisatie

In de levenscyclusinventarisatie (LCI) worden gegevens verzameld op basis waarvan de analyse in een LCA wordt uitgevoerd. In LCI wordt een planning gemaakt voor de verzameling van gegevens, en worden de gegevens verzameld en gevalideerd. Allereerst moet worden bepaald welke gegevens worden verzameld aan de hand van het soort LCA (*attributional* of consequentiële), het soort systeem (hebben gegevens betrekking op het achtergrond- of voorgrondsysteem) en de grootte van de LCA (wordt er een volledige LCA uitgevoerd of een gestroomlijnde variant). Er worden verschillende soorten informatie verzameld in een attributional en een consequentiële LCA. In een attributional LCA worden gemiddelde of generieke gegevens verzameld die het afvalinzamelingssysteem het beste representeren. Binnen een consequentiële LCA worden marginale gegevens verzameld en gerelateerd aan processen in de levenscyclus die worden beïnvloed door veranderingen in het onderzochte productsysteem (Ekvall & Weidema, 2004). Om een consequentiële analyse uit te voeren, kunnen scenario-ontwikkeling en marktprognose worden toegepast. Marktprognose wordt vaker ingezet en hiermee worden voorspellingen gedaan voor de markt voor in- en uitvoerstromen van het systeem, terwijl deze in scenario-ontwikkeling juist kritisch worden geanalyseerd.

Voorgrond- en achtergrondgegevens worden op verschillende manieren verzameld. Voor voorgrondgegevens, oftewel primaire gegevens, wordt voor de gegevensverzameling het systeem tot in detail beschreven en worden alle gegevens over de in- en uitvoer verzameld (Chang & Pires, 2015). Achtergrondgegevens kunnen niet direct worden gemeten en worden gebaseerd op gegevens uit inventarisatiedatabases (Williams, Heidrich, & Sallis, 2010, p. 120).

De keuze voor een volledige of een gestroomlijnde LCA moet worden gebaseerd op het doel en de reikwijdte van het onderzoek (Wang, Zhuang, & Lin, 2016). Daarnaast moet er rekening worden gehouden met de tijd die beschikbaar is voor de analyse, omdat een LCA vaak veel tijd in beslag neemt en daardoor ook kostbaar is (Wang et al., 2016). In een gestroomlijnde LCA worden de systeemgrenzen aangepast om het voor- en achtergrondsysteem te betrekken, maar worden de invoer, uitvoer en milieueffecten voor de analyse juist beperkt. Een gestroomlijnde LCA kan worden gerechtvaardigd door in eerder afgenomen volledige LCA's onderzoeksgebieden aan te duiden die een lage significantie hebben voor de resultaten (Chang & Pires, 2015).

LCI-databases bevatten inventarisatiegegevens waarmee afvalinzamelingssystemen kunnen worden gekarakteriseerd. Er zijn verschillende databases die verscheidene processen karakteriseren, zoals afvalinzameling en behandelingsprocessen. Voorbeelden van uitgebreide

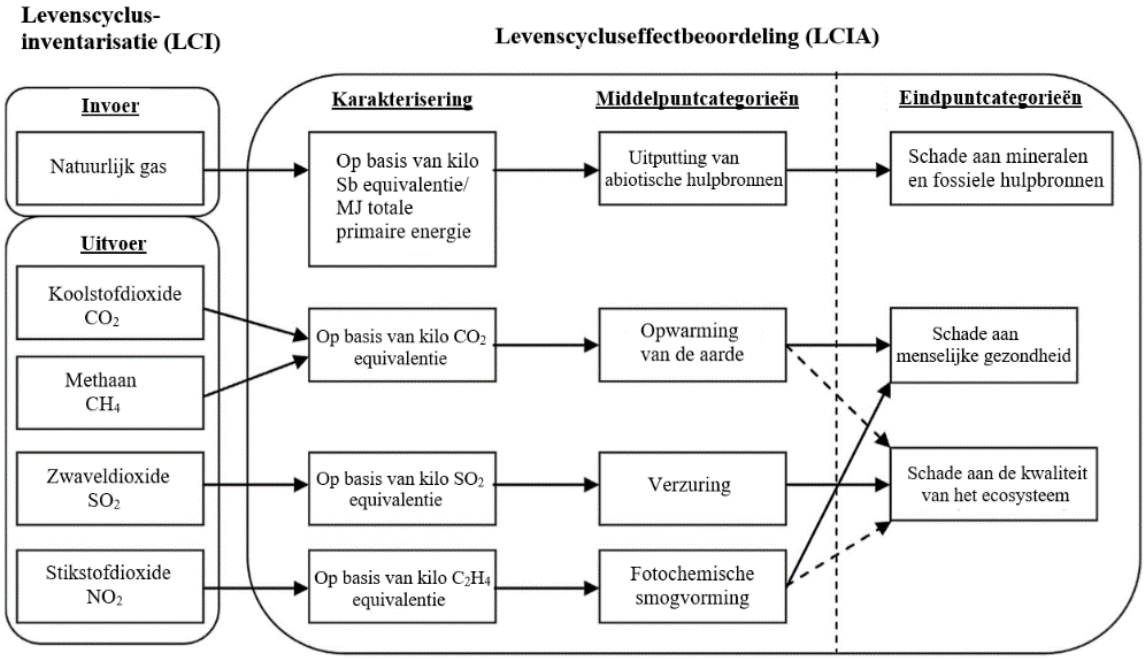
databases zijn: Ecoinvent (http://www.ecoinvent.org/), de US Life Cycle Inventory Database (https://www.nrel.gov/lci/) en de European Life Cycle Database (ELCD) (http://eplca.jrc.ec.europa.eu/ ELCD3/). In de beschrijving van de dataset moeten de verschillende beperkingen die op de gegevens in database van toepassing zijn, worden geëxpliciteerd. Om de kwaliteit van de LCA te waarborgen moeten gegevens worden gevalideerd en gerelateerd aan eenheidsprocessen en de functionele eenheid (ISO, 2006b). In de LCI vindt validatie plaats aan de hand van massa- en energiebalansen en door de vergelijking met gegevens van andere bronnen, zoals de emissiefactoren voor specifieke processen (Guinée et al., 2002).

11.1.3 Levenscycluseffectbeoordeling

Het resultaat van LCI is de kwantificering van grondstoffen, energie en de stroom van stoffen die effect hebben op het milieu. In de levenscycluseffectbeoordeling (LCIA) worden milieueffecten van het onderzochte systeem geïnterpreteerd en geëvalueerd met betrekking tot de omvang en de significantie (ISO, 2006b). De belangrijkste stappen binnen LCIA zijn de selectie en definitie van effectcategorieën, toekenning van resultaten van de LCI aan deze effectcategorieën en de karakterisering waarin door wetenschappelijke conversiefactoren verschillende milieueffecten binnen dezelfde effectcategorie met elkaar vergeleken kunnen worden (Curran, 2006, p. 47).

Om de complexiteit te verminderen en verschillende effecten binnen een categorie met elkaar te kunnen vergelijken, zijn de effectcategorieën ingedeeld in middelpunt- en eindpuntindicatoren. Met middelpuntindicatoren kan het milieueffect van de LCI-uitvoer worden berekend met minder onzekerheid, maar eindpuntindicatoren leiden tot meer methodische onzekerheid, omdat verdere karakterisering plaatsvindt om de middelpuntindicatoren aan elkaar te verbinden, zie afbeelding 11.2 (Li & Khanal 2016, p. 530).

Om een duidelijker resultaat te krijgen en om de resultaten en interpretatie van LCA's te vergelijken, kunnen er extra stappen worden ondernomen, zoals groepering van milieueffecten in effectcategorieën, normalisatie en het wegen van effectcategorieën om hier waardes aan toe te kennen (ISO, 2006b; Ashby, 2009). Als de waardes van de verschillende effectcategorieën worden opgeteld dan komt hier een Milieu Kosten Indicator-waarde uit voort. Er wordt ook kritiek geuit op het gebruik van Milieu Kosten Indicator-waardes, omdat normalisatie en wegingsfactoren niet zijn gestandaardiseerd en de toegekende waarde geen fysieke verschijningsvorm heeft (Ashby, 2009).



Afbeelding 11.2 Standaard LCA kader waarin LCI via middelpuntcategorieën naar eindpuntcategorieën leidt voor de geselecteerde milieueffecten. Indicatoren kunnen worden gebaseerd op beide categorieën na normalisatie en weging (Bron: Rimos, Hoadley, & Brennan, 2014, p. 851).

Voor een LCIA worden normaliter verschillende methodes gebruikt en met de indicatoren die hieruit voortkomen, kan het milieueffect van een product of dienst worden gekwantificeerd en vergeleken. Voorbeelden van verschillende methodes zijn CML (Guinée et al., 2002), Eco-Indicator 99 (EI'99) (Goedkoop & Spriensma 2000), Environmental Priority System 2000 (EPS, 2000) (Steen, 1999), EDIP (Hauschild & Potting, 2005), IMPACT 2002+ (Jolliet et al., 2003), TRACI (Bare, Norris, & Pennington, 2003), USEtox 2.0 (Fantke et al., 2015), ReCiPe (Goedkoop et al., 2009) en ES'06 (Frischknecht, Steiner, & Jungbluth, 2008).

Volgens Rosenbaum et al. (2018) kunnen de volgende vragen helpen bij het kiezen van een LCIA-methode:

• Welke effectcategorieën moet ik meenemen en kan ik rechtvaardigen dat ik effectcategorieën uitsluit?

• Welke kenmerken heeft de regio waarin het geanalyseerde systeem is gelokaliseerd?

• Moeten middelpunt- of eindpuntcategorieën worden meegenomen in de LCIA en moeten deze genormaliseerd worden?

• Welke elementaire stromen moet ik karakteriseren?

• Is er informatie van relevante organisaties beschikbaar die mijn keuze beïnvloedt?

• Hoe kunnen de resultaten van de LCIA worden geïnterpreteerd en gecommuniceerd?

• In hoeverre is de methode op wetenschap gebaseerd?
• In hoeverre is de methode getoetst?
• Leiden gegevens vanuit de LCI ook tot deze LCIA-methode?
• Moet de onzekerheid worden gekwantificeerd?

Er kan ook worden gekozen uit LCIA-methodes die al eerder zijn gebruikt voor LCA van afvalinzamelingssystemen. Dan kunnen de resultaten van het huidige onderzoek tevens met die van eerder onderzoek worden vergeleken.

11.1.4. Interpretatie

De laatste fase van LCA is de interpretatie waarin de resultaten worden samengevat om conclusies te kunnen trekken en aanbevelingen te kunnen doen of om het besluitvormingsproces te ondersteunen (ISO, 2006b). Dit is afhankelijk van het doel en de reikwijdte die bij aanvang zijn vastgesteld. De interpretatiefase kan steeds worden herhaald en is verbonden aan de eerdere fasen, waardoor feedback teruggevoerd kan worden naar beslissingen die eerder in de LCA zijn genomen, zoals allocatie, systeemgrenzen, doel en reikwijdte, verzamelde gegevens en milieueffectcategorieën (Chang en Pires, 2015; ISO, 2006b). De ISO (2006b) raadt aan om in deze fase een kritische analyse uit te laten voeren door een externe partij.

Tijdens de interpretatiefase worden tevens gevoeligheids- en onzekerheidsanalyses uitgevoerd. Met een gevoeligheidsanalyse kan worden berekend hoe de invoer de resultaten beïnvloedt en met een onzekerheidsanalyse (ook bekend als foutenvoortplanting) kan de totale onzekerheid van de LCA-resultaten worden berekend (Laurent et al. 2014). De meest gebruikte gevoeligheidsanalyse is scenarioanalyse. Bij deze methode wordt er één variabele per keer veranderd (*one-factor-at-a-time*) (OFAT), waardoor de betrouwbaarheid kan worden onderzocht (Laurent et al., 2014). Er kan tevens worden bepaald of gevoelige parameters de resultaten van de LCA beïnvloeden en daardoor ook van invloed zijn op de aanbevelingen aan beleidsmakers (Laurent et al., 2014). In een gevoeligheidsanalyse wordt de invoer binnen bepaalde grenzen gevarieerd en het effect dat dit op de resultaten heeft geanalyseerd om aan te tonen welke resultaten nader moeten worden onderzocht en welke aannames worden gerechtvaardigd en bevestigd (Li & Khanal 2016). Volgens Clavreul, Guyonnet & Christensen (2012) moeten verschillende parameters worden meegenomen in een onzekerheidsanalyse: het afvalinzamelingsysteem, de keuze voor een bepaald inzamelingsprogramma en de parameters binnen dat inzamelingsprogramma, zoals brandstofgebruik, emissies, efficiëntie van

bronscheiding en de transportafstand. De onzekerste parameters binnen het afvalinzamelingssysteem zijn de samenstelling van het afval, de distributie van afvalfractie en de chemische samenstelling van het afval, zoals het watergehalte en de afvaldichtheid. Om de onzekerheid te berekenen, wordt vaak de Monte Carlo-analyse gebruikt. Hierin wordt herhaaldelijk een steekproef genomen van de waarschijnlijkheidsverdeling van alle parameters waardoor er een histogram wordt gevormd met de waarschijnlijkheidsverdeling van het gehele systeem (Clavreul et al. 2012). Als verschillende oplossingen voor afvalbeheer worden vergeleken, kan met een Monte Carlo-simulatie worden bekeken wat voor elke oplossing de waarschijnlijkheid is dat een bepaald resultaat zich voordoet, bijvoorbeeld wat is de waarschijnlijkheid dat het resultaat 'verbranding is beter dan anaerobe vergisting' zich voordoet.

11.1.5 LCA-software

LCA's voor afvalinzameling kunnen worden uitgevoerd met behulp van verschillende softwarepakketten, zoals Gabi, SimaPro, Team en Umberto. Er is ook toegankelijke software beschikbaar die specifiek is gericht op afvalbeheer en de inzameling van vast afval. Hierdoor is het gemakkelijker om een gestroomlijnde LCA uit te voeren. Voorbeelden van dergelijke software zijn IWM-2 (McDougall, White, Frank, & Hindle, 2001), WISARD/WRATE (Ecobilan, 2004), EASEWASTE (Christensen et al., 2007) en ORWARE (Dalemo et al., 1997; Björklund, Dalemo, & Sonesson, 1999).

LCA-modellen die specifiek zijn ontworpen voor afvalbeheer verschillen volgens Clavreul, Baumeister, Christensen & Damgaard (2014) van algemene LCA-modellen en in de helft van de onderzoeken wordt voorkeur gegeven aan een specifieke LCA, wat de relevantie van de ontwikkeling van deze modellen onderschrijft. In deze specifieke LCA-modellen wordt het behandelingsproces van afval ook meegenomen. Dit heeft als voordeel dat de invloed van parameters in afvalbeheer makkelijker kunnen worden geëvalueerd. Daarnaast kan vanuit de milieueffecten beredeneerd worden welk materiaal binnen de heterogene afvalstroom het milieueffect veroorzaakt, omdat milieueffecten direct zijn verbonden aan de eigenschappen van het materiaal (Clavreul et al., 2014).

Bij een LCA van afvalinzamelingssystemen moet altijd het milieueffect van kapitaalgoederen worden meegewogen, ongeacht welke software wordt gebruikt. Volgens Brogaard & Christensen (2012) moet de productie van kapitaalgoederen die worden gebruikt in afvalinzameling en -transport, zoals vuilniswagens en vuilnisbakken, ook worden

onderzocht. Zij beschrijven dat bij afvalinzameling met een veronderstelde transportafstand van 25 kilometer ruim 85% van een aantal van de milieueffecten die worden veroorzaakt door afvalinzameling en -transport voortkomen uit de productie van kapitaalgoederen.

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