CREEA - Compiling and Refining Environmental and Economic Accounts

D4.3 (Task 4.3):

Calculating standardized waste tables for The Netherlands

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1 Summary

This deliverable described the compilation of CREEA based waste accounts for the Netherlands. A comparison is also made with the Dutch waste accounts that are regularly compiled as part of the Dutch environmental accounting program.

2 Introduction

This draft report contains the description of Task 4.3: Compilation of standardized waste tables. Based on the framework in Task 4.1 and the data collection and calculations in Task 4.2, standardized waste tables for the Netherlands are developed in this Task 4.3. These tables show the supply and use (industries according to the NACE classification, households, imports, exports and flows to the environment) of all solid waste flows including dry matter in waste water of an economy.

In this task waste tables will be developed following the procedure that is followed as part of the PSUT (see task 4.2). Also, Statistics Netherlands has filled the tables with data available from National statistics, based on registrations, in order to be able to compare and assess the results obtained in Task 4.2.
This may provide on the one hand a quality assurance of the CREEA results, but on the other hand may also be used to further improve the Dutch waste accounts.

The structure of this report is the following: in section 3 we discuss general SEEA principles of waste. The separate supply and use tables are discussed in more detail. In section 4 we describe the Dutch waste accounts in terms of the main concepts and methods and compilation process. The appendix also contains Dutch waste accounts for 2007. In section 5 we give a description of the waste accounts that have been derived within the CREEA project. In section 6 we analyse differences in concepts and methods results between Dutch waste accounts and the CREEA waste accounts. Section 7 concludes.

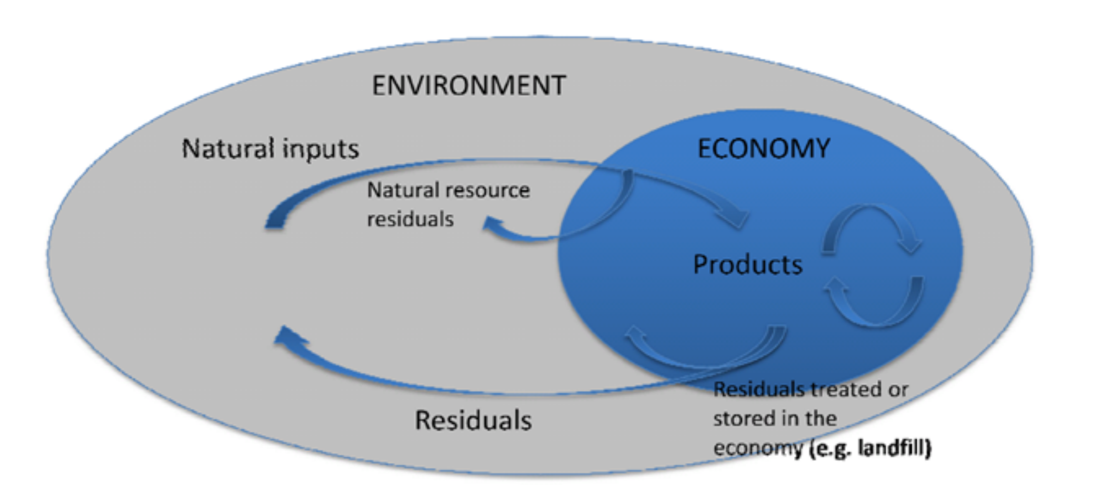
3 SEEA

3.1 SEEA general principles

Environmental accounts describe diverse topics concerning the environment, and the interaction between the environment and the economy. Examples are energy, environmental taxes, water quantity, air pollution, and thus waste accounts. At the beginning of 2012 a revised European handbook for environmental accounts was adopted. This handbook is called SEEA. SEEA stands for System of integrated Economic Environmental Accounting. It is the worldwide standard for compiling environmental accounts, including waste accounts. It contains guidelines for each separate topic and statistics have to be compiled in accordance with these guidelines for the purpose of international comparison.

We can distinguish three main areas in the SEEA framework (SEEA, 2012 p. 18). Firstly, physical flows within the economy and between the economy and the environment. Secondly, stocks of environmental assets. Thirdly, economic activity and transactions related to the environment. The waste accounts fall under the first category and consist of a physical supply and use table. These physical tables are an extension of the monetary supply and use tables as used in the national accounts. This means that they can be directly compared with the economic supply and use table, because definitions, scope and classifications are the same for national accounts as well as for environmental accounts.

Figure 1 Physical flows of natural inputs, products and residuals.



Source: SEEA, 2012, p. 40

3.2 Physical supply and use tables in general

The System of National Accounts (SNA) forms the basis for the SEEA. Environmental accounts have to be compiled in accordance with the same definitions and principles as described in the SNA. The three most important principles will be discussed here. The physical supply and use tables in SEEA have the same structure as the monetary supply and use tables in the SNA. The structure will be described in the section about solid waste accounts.

The first principle is the boundary of the data. In the National Accounting Matrix including Environmental Accounts (NAMEA) physical tables there is a strict distinction between economy and environment. The main boundary is the production boundary of the SNA 2008. The exact definition is as follows (SEEA 2012, p 39)

"The production boundary comprises a specific set of economic activities carried out under the control and responsibility of institutional units in which inputs of labour, capital and goods and services are used to produce outputs of goods and services (products)"

Compared to the monetary supply and use tables, the extra dimension in the NAMEA tables is the existence of physical flows from and to the environment besides the production boundary. Examples of flows from the environment are materials and energy. Flows to the environment could be emissions to air and water. This dimension leads to the important distinction between products and residuals. This is a distinction that does not exist in the monetary tables. We will discuss this distinction further on when presenting physical supply and use tables for solid waste. Flows in the environment are not included in the physical supply and use tables.

The second important principle of the national accounts is the resident principle. When describing the economy we take the economic territory into account. The economic territory is broader than the geographic boundary of a country. The official SEEA definition is as follows (SEEA 2012, p. 29):

"Economic territory is the area under effective control of a single government. It includes the land area of a country including islands, airspace, territorial waters and territorial enclaves in the rest of the world (for example embassies and military bases). It excludes territorial enclaves of other countries located in the reference country".

The accounting and balancing identities are the third principle and are the same for SNA as well as for NAMEA. Most important identity is that total supply has to be equal to total use. Looking to physical supply and use tables, total supply means domestic production plus imports plus flows from the environment. Total use is the sum of use by industries and households plus export plus flows to the environment. This identity does not hold just for the whole table. It is also required for totals of products as well as for residuals apart.

3.3 Solid waste accounts

The official definition of solid waste according to SEEA is as follows (SEEA 2012, p. 83):

"Solid waste covers discarded materials that are no longer required by the owner of user".

Discarded materials sold as second hand products are excluded in the solid waste accounts.

The demarcation between the economy and the environment is accompanied by a sub-categorization of waste with and without an economic value. Waste with an economic value to the generator is considered a waste product and has a monetary equivalent in the national accounts. Waste with no market value to the generator is considered a residual and appears in the substance account. Like products, residuals may be transferred within the economy as a result of recycling or waste collection and treatment activities. Monetary transactions as a result of waste treatment services are recorded in the national accounts. Waste treatment usually results in the replacement or transformation of residuals with the purpose of diminishing their environmental impacts. Those residuals that are not re-absorbed by the economy will be transferred from the economy into the natural environment. Flows of residuals from the environment to the economy can also occur. For example, tankers at sea may lose their cargo in a storm. Efforts might then be made to recover these residuals from the environment and bring them back into the economy for treatment. For a more profound discussion on the compilation of harmonious monetary and physical supply and use tables see the SEEA (UN et al., 2012). The SEEA, more or less, states that waste inputs with a positive price should be regarded as products and recorded as such. This implies a distinction between waste products and residuals. However, the SEEA gives no practical suggestion how to make this distinction.

At page 84 of the SEEA Handbook we can find the physical supply and use tables for solid waste accounts. Here, we will describe the tables in more detail.

Figure 2: physical supply table for solid waste

Table 3.6.3 Solid waste account		**(Mass units - kilograms/tonnes)**									
Physical supply table for solid waste											
		Generation of solid waste							**Flows with the rest of the world**	**Flows from the environment**	**Total supply**
		Waste collection, treatment and disposal industry					Other industries	Households	Imports of solid waste	Recovered residuals	
		Landfill	Incineration		Recycling and reuse	Other treatment					
			Total	Of which: Incineration to generate energy							
Generation of solid waste residuals											
	Chemical and healthcare waste										
	Radioactive waste										
	Metallic waste										
	Other recyclables										
	Discarded equipment and vehicles										
	Animal and vegetal wastes										
	Mixed ordinary waste										
	Mineral wastes and soil										
	Combustion wastes										
	Other wastes										
Generation of solid waste products											
	Chemical and healthcare waste										
	Radioactive waste										
	Metallic waste										
	Other recyclables										
	Discarded equipment and vehicles										
	Animal and vegetal wastes										
	Mixed ordinary waste										
	Mineral wastes and soil										
	Combustion wastes										
	Other wastes										

Figure 3. Physical use table for solid waste

Physical use table for solid waste											
		Intermediate consumption; Collection of residuals						Final consumption	Rest of the world	Environment	Total use
		Waste collection, treatment and disposal industry					Other industries	Households	Exports of solid waste		
		Landfill	Incineration		Recycling and reuse	Other treatment					
			Total	Of which: Incineration to generate energy							
Collection and disposal of solid waste residuals											
	Chemical and healthcare waste										
	Radioactive waste										
	Metallic waste										
	Other recyclables										
	Discarded equipment and vehicles										
	Animal and vegetal wastes										
	Mixed ordinary waste										
	Mineral wastes and soil										
	Combustion wastes										
	Other wastes										
Use of solid waste products											
	Chemical and healthcare waste										
	Radioactive waste										
	Metallic waste										
	Other recyclables										
	Discarded equipment and vehicles										
	Animal and vegetal wastes										
	Mixed ordinary waste										
	Mineral wastes and soil										
	Combustion wastes										
	Other wastes										

3.1 General description of the supply and use tables for waste

The supply and use table have the same structure. Before zooming in on the separate tables we discuss the general aspects of both. We can find the actors in the columns of the table. These actors can be divided into several industries, households and foreign trade. In the Netherlands there are no flows from the environment included in the waste accounts. For industries a distinction is made between the 'waste collection, treatment and disposal industry' and other industries. This is done because of the importance of this industry in the area of waste. The waste of this industry consists of two parts. Firstly, waste of waste. This part is not included in the waste accounts of the Netherlands. Secondly, waste such as machines and waste of the canteen, in other words, waste not related to the production process. This kind of waste is included in the waste accounts of the Netherlands.

In the rows of the table, we can find the different categories of waste. This classification is based on the European Waste Catalogue-Statistical version (EWC-Stat). In the EWC classification thirteen categories of waste can be distinguished. Each category has one or several subcategories. First we will sum up the main categories and give some examples of the different subcategories. After that we will link the categories to the SEEA division.

1) compound waste: acid, alkaline, motor oils
2) chemical preparation waste: agrochecmical waste, unused medicines
3) other chemical waste: chemical deposits
4) not included in the EWC classification
5) health care and biological waste: no subcategories
6) metallic waste: ferro and non-ferro
7) non-metallic waste: paper, glass, textile
8) discarded equipment: discarded vehicles or machines
9) animal and vegetable waste: waste of food preparation and green waste

10) mixed ordinary waste: household waste and mixed materials
11) common sludge: waste water treatment sludges
12) mineral waste: combustion or asbestos waste
13) solidified, stabilized and vitrified waste: no subcategories
99) unknown

In the SEEA tables there are ten different categories of waste. For the largest part they can be linked one to one with the EWC classification. There are some exceptions.

1) chemical and healthcare waste: summing up categories 1,2,3 and 5 of the EWC classification
2) radioactive waste: this category is not included in the Dutch waste accounts
3) metallic waste: category 6 of EWC classification
4) other recyclables: category 7 of EWC classification
5) discarded equipment and vehicles: category 8 of EWC classification
6) animal and vegetable waste: category 9 of EWC classification
7) mixed residential and commercial waste: category 10 of EWC classification
8) Mineral wastes and soil: categories 11 and 12 of EWC classification. Category 12 has the subcategory combustion waste. This subcategory is not part of this SEEA category, but is an apart category in SEEA
9) Combustion waste
10) Other waste: category 13 of EWC classification

There is a distinction between hazardous and non-hazardous waste in the EWC classification. In the SEEA tables this distinction is not made. Finally, the upper part of the supply table, as well as the use table, deals with residuals. The lower parts deal with products. Residual means waste with no monetary value for the generator. A waste product has a monetary value for the generator.

In the SEEA tables one of the actors is ‘other industries’. The official classification for industries is the NACE classification. It is a classification of different groups of industries. There are several NACE divisions. Most common for Eurostat is the division in 21 industrial categories, including different categories of commercial and non-commercial services. But there are also divisions with more detail. It is not necessary to be convenient with this classification for filling in the SEEA waste tables, but it is a good thing to know something about it. The focus of the NACE 21 classification is on commercial services, because of the importance of this sector for the economy. Unfortunately, there is just one group for industry. All the different sub industries, for example oil industry and paper industry, are summed up in the NACE 21 classification, but are distinguished in more detailed NACE divisions. As mentioned before, in SEEA there is a column ‘other industries’, so there is no division at all. Industries as well as commercial services are summed up to one figure. The possible disadvantages of the NACE classification are not a problem for the SEEA waste tables.

3.2 Supply table in more detail

Before waste can be used, it has to be generated. The information about this supply can be found in the so called supply table. This table contains information about the actors that generate waste. At least, the grey fields mean that the value is null by definition. First, products have a monetary value, so they will not be disposed on land. Second, according to national accounts definition, households cannot produce anything at all. Consequently, they cannot generate waste products, just waste residuals. Waste never has a monetary value for households. Third, flows between the environment and the economy are always flows of residuals. (See Figure 1). Logically, the combination of environment and products has to be also grey in the physical supply table.

In short, the information in the table is needed to answer the question how much solid waste is generated and what the diverse sources are. The total generated waste is used, because of the condition that total supply has to be equal to total use. Information about this use can be found in the so called use table.

3.3 Use table in more detail

There are several ways to treat waste. It can be recycled, disposed on land, incinerated, used by industries (note that this is not the same as recycling) and exported. In the Netherlands, the distinction between incineration with and without generating energy is not made. An example of other treatment is compost.

In the use table there are also grey fields. These fields are null by definition. First, waste products will not be disposed on land or incinerated. The only way to treat products is recycling or another way, such as compost. Second, the areas under households are grey, because, according to the definitions of national accounts, households never use waste. They just generate it. Third, flows to the environment are residuals, so the area under products is grey. (See also Figure 1).

The main question at this part of the waste accounts is how much waste is used at each kind of treatment as distinguished in the guidelines. A distinction between hazardous and non-hazardous waste is not made.

4 Dutch waste accounts

In this chapter we discuss the compilation of Dutch waste accounts. First we focus on four exclusions. Some items of the SEEA waste accounts are not included in the Dutch waste accounts. The chapter follows with a description of sources and methods of waste accounts in the Netherlands.

4.1 Exclusions

Some sorts of waste are not taken into account in the Dutch waste accounts. This deviates from the definitions in SEEA.

1) illegal waste is not taken into account. An example is the discharge of waste directly into the environment or the illegal shipping of waste to other countries. Due to a lack of data it is difficult to estimate the amount of illegal waste.
2) waste of waste is not taken into account. The first time waste is generated is included. The waste of the recycling industry that goes to landfill sites is included as well. But there are no estimates for the amount of recycled products in the Dutch waste accounts. As a consequence, part of total waste supply from recycling industry is included. Unfortunately, this results in waste accounts which are not fully according to the SEEA. In SEEA recycled products are included. Let us give an example in which way this partly waste of waste is taken into account. For example, there is waste of cars. In theory, all the waste goes to the recycling industry. After recycling, a part of the car comes back in the economy as a recycled product. The other part goes to landfill sites. In the Dutch waste accounts, a part of car waste is registered directly to landfill sites. The other part, the recycling part, is not taken into account. According to SEEA waste of waste has to be included.
3) unused flows are excluded. Unused flows are flows which are extracted, harvested or otherwise moved on a national territory, not intended for use. Examples are soil, unused biomass or rock excavated during construction.
4) there is no gross fixed capital formation in the Dutch waste accounts, but only additions to stocks (landfill sites) are recorded.

4.2 Supply

In the source data, on the supply side about 87 NACE categories are distinguished (notice that a small amount of waste could not be allocated to a NACE category) and 90 waste categories (so called eural codes). Waste is allocated to a waste category on the basis of its status at the time of generation. Thus, the amount of ferro waste refers to ferro waste that originated as such during a production or consumption process. This means that the amount of ferro in, for example, discarded vehicles or household waste is not included in the “ferro waste” category. However, other data sources, like the one on import/export, probably register ferro from different eural categories as “ferro waste”. The inconsistency in time of recording between different data sources of the same waste categories might provide problems when integrating the data sources. Another inconsistency between data sources lies in the allocation of different substances to a single waste category. For example, the non-ferro waste category in the national accounts also refers to slag and ashes that contain non-ferro waste. According to eural codes definitions, the non-ferro waste category does not contain slag and ashes.

For most waste types, AgentschapNL was not able to allocate a small amount to NACE categories. In order to allocate these amounts the following procedure seemed most logical to adopt. If the amount of waste, not allocated to NACE categories, was relative small (less than 10% of the total amount) it was proportional distributed among NACE categories. If the amount, not allocated to a NACE, was relative large, allocation took place on the basis of an expert guess. If these options were not satisfactory, allocations to NACE were made on the basis of information of a similar waste type. For example, an “unknown” hazardous amount could be allocated on the basis of the same non-hazardous waste type. The amounts of sludge are reported by AgentschapNL inclusive their water content. In Dutch waste accounts the amount is converted to dry matter, making use of information on Statline. The same applies for manure.

4.3 Use

On the use side, only data on waste treatment methods are available for different waste types. Thus, no information on NACE is available on the use side. AgentschapNL makes an effort to report final treatment method of specific waste types (recycling, landfill, incineration). Take for example discarded vehicles. Almost 100 percent goes to a recycler but they are booked as 85 percent recycled and 15 percent landfill. However, the treatment of industrial wastes seems to be determined on the basis of their first destination after disposal. Thus, waste destined for a recycler is booked as 100 percent recycled even if a certain percentage ends up at a landfill. Notice that AgentschapNL could not allocate all waste to a specific NACE, nor did they know the treatment method for all waste types.

Therefore, determination of waste-use by NACE is done on the basis of several sources. From statistics on sustainable energy by Statistics Netherlands the amount of biomass waste incinerated at electricity plants is obtained. Also, data on waste incineration by a cement manufacturer (NACE 26 (?)) can be obtained. Some data on waste use by NACE can be obtained from research reports or waste interest groups. Monetary data from the national accounts are also used to determine waste use by NACE. In the national accounts the following monetary data on waste use are available: ferro (6.1), aluminum (6.23), copper (6.24), other non-ferro metal (6.26), glass (7.1), paper (7.22), rubber (7.31), plastic (7.4), wood (7.52/7.53) and slag and ashes from thermal treatment and combustion (12.42). It is assumed that the monetary distribution of waste across NACE is similar to the physical distribution across waste categories. Therefore, the physical amounts of the above mentioned waste types can be allocated to NACE categories on the basis of the monetary distribution. Although this method is theoretically not completely sound, in practice it turns out that alternative methods do have problems as well. Waste that could not be allocated to a specific NACE is allocated to the following NACE categories: recycled waste to NACE 37 and waste treated differently to NACE 90. However, the way in which AgentschapNL reports use-data may pose some uncertainties on the above method of allocating waste to NACE 37 and NACE 90. Take for example batteries: in the AgentschapNL database the treatment of batteries is reported as 86% recycling and 14% disposal. These data do not imply that 86% of the total number of batteries is recycled. They only imply that, after treatment, 86% of the materials are re-used. According to the method discussed above batteries are considered residuals of which 86% is used by the recyclers (NACE 37) and 14% is used by disposal services (NACE 90). Regarding batteries, this may be incorrect. Most batteries are probably first used by the recyclers (NACE 37), only after treatment do residuals end up at disposal services (NACE 90) and waste products at other (unknown) NACE categories.

4.4 Import and export

The AgentschapNL database contains data from registered waste at the time of generation. It does not contain specific data on the import/export of waste. However, the amounts of produced and treated waste reported at both the supply and use side include exported waste (but not imported waste). According to the concept of the national accounts, the amounts of treated waste on the use side should contain imported waste but not exported waste. Therefore, adjustments at the use side have to be made before the AgentschapNL data can be implemented in the NAMEA. The AgentschapNL data on the supply side do not need adjustment. As discussed before, in order for the AgentschapNL data to fit the NAMEA concept a distinction has to be made between waste products and residuals.

Solution: Data on waste absorption from AgentschapNL include exported waste but do not include imported waste. In order for the data to fit the accounting concept, on the absorption side, data corrections have to be made: export has to be subtracted and import has to be added to the absorption data from AgentschapNL. Making these adjustments according to a particular methodology turns out to be difficult. A lot depends on the type of waste and the amounts given. When calculating the adjusted absorption (absorption plus import minus export) for each waste category with disregard of treatment method some negative values occur. These negative values can be a result of allocating eural codes to the wrong waste category. However, they may also be a result of other uncertainties in the data. There are several types of adjustments to solve the occurrence of negative values. Most adjustments involve transferring waste from one waste category to another (similar) waste category. All adjustments made in order to omit negative values are explicitly recorded. The difficulties that occur while adjusting the aggregated absorption data make adjusting the absorption data for separated treatment categories (landfill, incineration, discharge etc.) very difficult and time consuming. Therefore, it seems more appropriate to estimate amounts of waste for different treatment methods after the total supply and use tables are balanced.

Data on import and export of waste are mainly obtained from two sources: the Foreign trade statistics (FTS) and the 'Europese verordening overbrenging afvalstoffen' (EVOA). Data on waste types from the red (hazardous waste) and amber waste (semi-hazardous waste) list

(Annex III & IV of the Council Regulation (EEC) no. 259/93) are obtained from EVOA. Waste types that appear on these lists (mostly dangerous wastes) need to be reported to the EVOA. The EVOA import-export data are divided in recovered waste and finally disposed of waste. On the basis of background details and expert guesses, eural codes were allocated to the different waste types. Waste types also had to be labeled dangerous or non-dangerous. Data on waste types with a monetary value were obtained from the FTS compiled by Statistics Netherlands. Eural codes had to be assigned to the different waste types. It was assumed that in the FTS only waste types from the green list (Annex II of the Council Regulation (EEC) no. 259/93) appear. Data from the FTS (green list) and the EVOA (amber and red list) can be considered complementary.
Transit trade is included in the FTS but not in the EVOA data. Transit data on waste types recorded by EVOA are not known. In order to match the FTS and EVOA data, the FTS needs to be adjusted for transit waste. Unfortunately, the percentage of transit waste could only by estimated on the basis of aggregated commodity categories. In most cases, waste is only a part of these commodity groups. Applying a transit percentage derived from an aggregated commodity category to a waste category results only in a rough estimate of the amount of transit waste. A second problem is the fact that the percentage transit waste is calculated on basis of export data. This percentage is used to correct export as well as import data.

Data from the FTS are on a higher level of detail than found in the national accounts. In order to implement the FTS data in the waste database the highly detailed waste groups were allocated to eural codes on the bases of their description. In some cases allocating eural codes to FTS types of waste was not possible: a FTS waste description could mention too many different types of waste or a waste description could mention both waste products and other kind of products. Thus, some amounts of waste could not be taken into account. As a result, the total amounts of some of the waste categories are too low. Notice that in general the amounts of waste found in the FTS must be considered with great care. Only waste with a value above a certain threshold needs to be reported when imported or exported. Waste with a value below this threshold does not appear in the data source used by the FTS to estimate imports and exports.

4.5 Balancing

The amount of generated waste does not equal the amount of treated waste. Reasons for this discrepancy lie in the difficulty of eliminating double counted waste, storage of waste and merging or separation of waste flows (and thus a change in eural code). An effort is made to remove double counted waste. Waste produced by NACE 37 consists mostly of remains from recycled waste. This waste has already been reported when first produced and is not included in the database. Therefore only a small amount of waste produced by NACE 37 is presented in the database.

According to the national accounts concept the supply and use tables need to be balanced (i.e. domestic production plus import minus domestic absorption minus export equals zero). In order to balance the tables the following procedure is followed. First of all, the total production, import, absorption, export and balance for all waste types are presented in a table. If the balance shows an outstanding amount, the supply and use tables could still be adjusted. After the largest incongruities were eliminated a software application (Winadjust) was used to make small adjustments in order to balance the tables. The application is based on the Lagrangean approach of finding a matrix that minimizes a certain distance between the new matrix and the original one using weights and constraint. In the next step the supply and use for each NACE needs to be adjusted according to the balanced totals. In order to accomplish this, the difference between the balanced total and the unbalanced total for each waste type is determined. Next, these amounts are distributed among NACE categories according to the share each NACE took in the total amount of waste. As a result balanced supply and use tables were calculated for all NACE categories and waste types.

4.6 Residuals versus products

Distinguishing residuals from waste products is necessary to reconcile the data with NAMEA conventions. The current section attempts to divide the physical data in waste products and residuals. Due to a lack of reliable data, the distinction is based on national accounts supply data. The following procedure is followed. First of all, waste types that appear in the national accounts have by definition monetary values and can therefore be considered products. All other types of waste are considered residuals. Secondly, it is assumed that waste products supplied in the national accounts by NACE 51.57 (wholesale trade in waste and scrap) are former residuals Therefore, waste products supplied by NACE 51.57 appear as residuals in the supply and use tables derived from the registration data. In accordance with the above assumptions, for all waste types that appear in the national accounts the percentages of waste products are calculated (the waste supplied by all NACE categories except NACE 51.57 divided by total amount of waste supply). In order to calculate the above percentages, the monetary national accounts data are converted to physical data by using unit values (euro/kg). These percentages are used to estimate the amount of waste products and residuals in the supply and use tables.

The import-export data also need to be divided in residuals and waste products. EVOA data are reported as recycled waste or finally disposed of waste. As a default recycled wastes from EVOA and the FTS are considered waste products. Disposed wastes from EVOA are considered residuals. The above method results in supply and use tables for waste products and residuals. Notice, that the assumption is made that imported or exported waste products were generated as such and do not arise from produced residuals.

As it turns out, due to the adjusted import-export data, the individual tables for products and residuals are no longer balanced. In order to balance the product and residual tables the following procedure is adopted. If the residual balance was larger than zero i.e. a supply surplus, the amount of production is decreased with the balance amount. In case of a negative balance i.e. a use surplus, the amount of absorption is decreased with the balanced amount). As a consequence the waste product tables are balanced by increasing the amount of production or absorption. The reason to use this method seems very arbitrary. However, changing the amounts of production and absorption is any other way resulted in negative values. Another possibility is to balance the tables by changing the import/export amounts. It was decided not to alter the import/export data because they provide a relative strong indication on the differentiation between products and residuals.

4.7 Determining way of treatment

In order to derive indicators that relate to environmental problems it is important to distinguish waste treatment methods: landfill, incineration and recycling. In order to determine these treatment methods the total domestic absorption is divided in three treatment categories: dumping/discharging (landfill and elsewhere), incineration (including incineration with the purpose of energy recovery) and recycling. The treatment categories are compiled on the basis of the original AgentschapNL data on the amounts of treated waste. The share, in percentages, of each treatment method per waste category is calculated. These percentages are applied to the balanced data on residuals. Together with extra information on waste absorption by industry the waste treatment categories for products are determined. In theory, different treatment methods for each NACE category could be calculated. However, the results of this exercise will be unreliable due to the many assumptions made while compiling the data.

5 Compilation of CREEA waste accounts

In this section we explain how the CREEA based waste accounts are determined. Waste accounts are just a part of a wider framework that is the physical input output tables (PSUTs). Here we briefly describe such framework since it is already described in reports D4.1 and D4.2.

5.1 The adopted framework

One of main aims of the CREEA project is to generate PSUTs, where material flow accounting and waste accounts are determined. The resulting PSUTs are consistent with monetary supply and use tables (MSUTs). Figure 4 shows such framework.

Balanced PSUT	Activities	Stock formation	Final use	Export	Import	Total
Products	V'				N_c	q
Stock additions (classified as products)	ΔS					
Materials for treatment (classified as products)	W_V				N_w	
Emissions	B					
Total	g'					

Products	U	s^+	Y	N_c		q
Materials for treatment (reclassified homegeous)	W_U			N_w		
Natural resources	R					
Total	g'					

Figure 4 : The framework adopted in CREEA for MFA and waste accounts: physical supply and use tables.

In the upper part there is the supply side. Here there are the commodities produced by domestic activities (**V**), imports of goods (**N**$_C$) and of materials for treatment[1] (**N**$_W$), stock addition (**DS**), domestic supply of materials for treatment (**W**$_V$) and, finally, the emissions (**B**). In the lower part there is the use side. It includes the intermediate uses by domestic activities (**U**), stock formation (**s**$^+$), final demand (**Y**), exports of products (**N**$_C$) and materials for treatment (**N**$_W$), use of materials for treatment (**W**$_U$) and, finally, natural resources (**R**). In the CREEA project this framework is generated by a model, which assures consistency with the MSUTs. This model is briefly described in the following section. Here it is noteworthy to remember that waste accounts refer to the sum of matrices **DS** and **W**$_V$ for the supply side, and to the matrix **W**$_U$ for the use side.

5.2 The PSUTS generation model

The model makes use of all the available data and organizes them in order to get PSUTs in dry matter. Data used in the model are:

- MSUTs;
- trade data in physical units;
- supply of products by domestic activities in physical units. It includes also the supply waste treatment services;
- use of energy products;
- emission coefficients, which indicate how much substance is emitted per unit of used or supplied product;
- natural resource coefficients, which show how much resource is requested per unit of used or supplied product. They include also unused extraction material coefficients;
- transfer coefficients, which indicate how much of an input is embodied in the activity production. Metal concentrations are part of this set;
- dry matter coefficients, which are to convert wet weight in dry matter;
- manure excreted indoor/outdoor coefficients. They indicate per each animal category how much manure is excreted indoor and outdoor;
- waste-product to waste-fraction coefficients. They are used to convert waste product in waste fractions.

Some of these data are used for the generation of some accounts that are treated as exogenous. This means that they are kept constant in the model. These accounts are the matrices **V, W**$_U$ and partially also the Use table **U** for the part related to energy products. Trade data are also kept constant. The rest of data are used to complete the use table **U** and the remaining matrices. These are the final demand **Y**, the stock formation **s**$^+$, the emissions **B**, the resources **R** and, finally, the supply of materials for treatment **DS** plus stock addition W$_V$. This sum as said above is meant as supply of waste in the waste accounts. This is a

[1] Materials for treatment are defined as output flows of a human activity that remains in the technosphere and cannot directly (i.e. without further processing or emissions) displace another principal product of an activity. After processing in a waste treatment (re-processing or recycling) activity, the recovered materials for treatment may displace other products. See D4.1 for more information.

consequence of the steady-state assumption adopted in the procedure. An illustration of the model is in Figure 5.

However, because in the modern economies there could be an accumulation of materials, or a reduction of stocks, the procedure may imply differences between (endogenous) supply and (exogenous) use of waste fractions. This difference is defined as residual waste. When a residual waste fraction is positive it means that either there is an accumulation of materials or there are unregistered flows of waste fractions. Instead, when the residual is negative, it means that either there are waste flows not produced in the accounting period but in the precedent ones that are sent to treatment, or trade data have underestimated the import of waste flows (underestimation of the export of waste treatment services). Draft aggregated results for the Netherlands are shown in the Appendix 2.

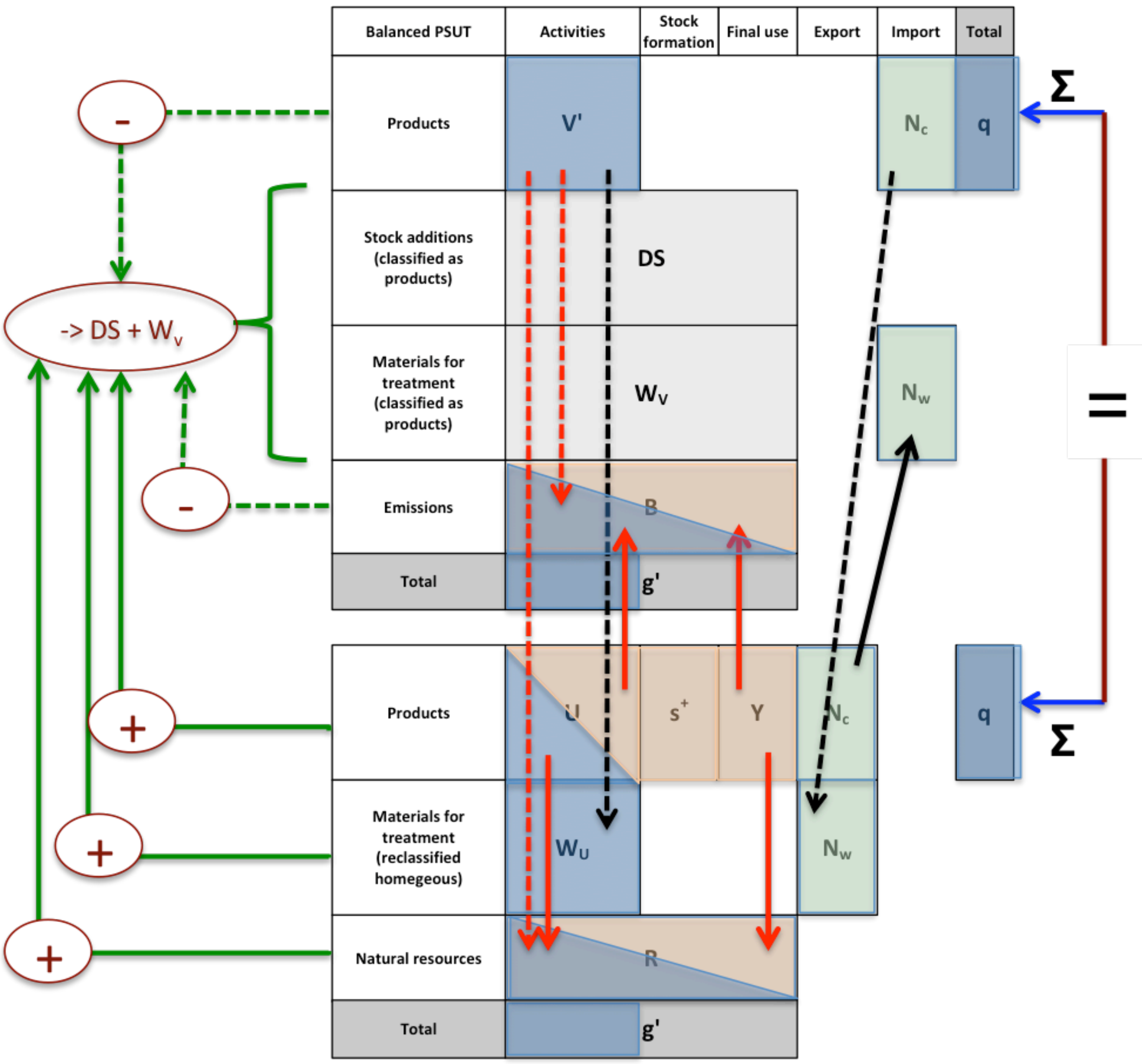


Figure 5 : The model used for generating the PSUTs. Accounts painted in blue and in green, are derived exogenously, while the others in orange, or in light grey, are determined endogenously. Accounts painted half in blue and half in orange are partially determined endogenously and partially exogenously. The dotted line indicates there is a relation that is triggered by the supply of; instead the continuous line shows a relation generated by the use of. Red lines are meant to indicate where

coefficients are used, while the red line where direct relation exists. Finally on the left side there is the equation for determining the supply of waste account, while on the right side the commodity balance.

6 Differences between CREEA and Statistics Netherlands waste accounts

6.1 Comparison of results

By comparing the data in the appendix, It can be seen that there are large differences between the two sets of resulting supply and use tables for waste. At first sight there are also striking differences in presentations, most notably that supply is not equal to use in the CREEA based waste accounts. However, as was discussed in section 5 the difference between supply and use of waste need not be a problem, as it is partly an expected result.

6.2 Assessment of differences

The starting points and definitions of 2.0 LCA are not the same as in the SEEA waste accounts, because the objectives are different. The main objective in CREEA is to make a distinction between the activities using virgin and secondary materials. In this way it is possible to model the advantage of the recycle processes in terms of environmental impact. For example the recycling is less energy demanding. Aggregating together process using virgin and secondary materials excludes this possibility. Waste accounts are part of that model. Within SEEA waste accounts follows the prescriptions of physical supply and use tables. This section focuses on the differences in definitions between SEEA and CREEA concerning waste.

Table 1: Differences between mode 2.0 LCA and SEEA waste accounts

CREEA / FORWAST Model	**Data Statistics Netherlands/SEEA**	**Solution**
No distinction products and residuals	Distinction between products and residuals	Using monetary information to make this distinction
Output is a service: assigned to sector where waste comes free	Waste is always assigned to sector where it comes free for the first time	Not available yet
Waste of waste is included	Waste of waste is included in SEEA, but not in the Dutch data	It is possible for 2.0 LCA to deliver data about waste of waste. Another solution is making use of percentages.
Recycling is seen as an industry, although it is a service	Preparation to recycling is the included industry	Converting is difficult. No solution available yet
All waste is used by ISIC 37, recycling	Waste can be used by the category other industries	Two possible solutions: making use of data in the column unregistered treatment or accept that there will be an empty column in the SEEA table
Unused flows are included in the model	Unused flows are excluded in the model	2.0 LCA tries to deliver data about unused flows (natural resources)
Data are in dry matter	Data are in wet matter	Making use of conversion factors. 2.0 LCA tries to deliver data in wet matter.
Detailed waste categories not corresponding with SEEA classification	SEEA waste categories	Statistics Netherlands has sent a more detailed classification. 2.0 LCA tries to convert their data into the SEEA classification
Discarded materials is not an apart category	Discarded materials is an apart category	2.0 LCA tries to aggregate their data, making use of fractions

7 Conclusions

In this task we have compiled two sets of supply and use tables of waste for the Netherlands. We have seen that there are large differences in outcomes. However, on the basis of an analysis of methods and objectives, we may conclude that differences in outcomes are to a large extent caused by differences in concepts and methods as detailed in Table 1. Most notably, the treatment of unused materials, the placement of recycling activities within ISIC, dry versus wet matter, the distinction between product and residual.

Further research will be needed to further assess the feasibility of the solutions provided in Table 1.

8 Literature

Delahaye, R., 2007. Waste accounts in a NAMEA framework. Discussion paper, Statistics Netherlands, Voorburg/Heerlen.

United Nations, European Commission, Food and Agriculture Organization, International Monetary Fund, Organisation for Economic Co-operation and Development, World Bank, 2012. System of Environmental-Economic Accounting Central Framework. White cover publication, pre-edited text subject to official editing, UNSD, New York.

Annex 1 – Dutch waste accounts

Table 3.6.3 Solid waste account		**(Mass units - kilograms/tonnes)**									
Physical supply table for solid waste											
		Generation of solid waste							**Flows with the rest of the world**	**Flows from the environment**	**Total supply**
		Waste collection, treatment and disposal industry					Other industries	Households	Imports of solid waste	Recovered residuals (recycling/recuperatie)	
		Landfill (storten)	Incineration (verbranden)		Recycling and reuse	Other treatment					
			Total	Of which: Incineration to generate energy							
Generation of solid waste residuals											
	Chemical and healthcare waste	0	70.253	0	998	0	1.393.475	22.984	144.197		1.631.907
	Radioactive waste	0	0	0	0	0	0	0	0		0
	Metallic waste	0	6.584	0	0	0	220.340	18.258	1.131.829		1.377.012
	Other recyclables	0	219	0	0	0	2.636.885	1.427.421	306.397		4.370.923
	Discarded equipment and vehicles	0	4.801	0	978	0	157.942	279.753	188.991		632.466
	Animal and vegetal wastes	0	40.602	0	0	0	7.163.754	1.786.618	72.602		9.063.575
	Mixed residential and commercial wastes	0	7.133	0	638	0	4.493.255	4.748.731	151.837		9.401.594
	Mineral wastes and soil	0	359.249	0	3	0	23.507.076	616.927	451.890		24.935.146
	Combustion wastes	0	1.449.456	0	0	0	3.343.916	0	139.551		4.932.924
	Other wastes	0	0	0	0	0	0	0	0		0
		0	1.938.298	0	2.617	0	42.916.645	8.900.694	2.587.294	0	56.345.547
Generation of solid waste products											
	Chemical and healthcare waste		0	0	0	0	1.928		279.042		280.970
	Radioactive waste		0	0	0	0	0		0		0
	Metallic waste		29.136	0	0	0	1.566.337		211.330		1.806.803
	Other recyclables		208	0	0	0	1.746.177		2.821.489		4.567.874
	Discarded equipment and vehicles		0	0	0	0	0		602		602
	Animal and vegetal wastes		1.178	0	0	0	5.376.424		7.440.102		12.817.704
	Mixed residential and commercial wastes		0	0	0	0	0		2.964		2.964
	Mineral wastes and soil		0	0	0	0	0		0		0
	Combustion wastes		219.597	0	0	0	532.499		0		752.095
	Other wastes		0	0	0	0	0		0		0
		0	250.119	0	0	0	9.223.365	0	10.755.528	0	20.229.012

Physical use table for solid waste											
		Intermediate consumption; Collection of residuals						**Final consumption**	**Rest of the world**	**Flows to the Environment**	**Total use**
		Waste collection, treatment and disposal industry					Other industries	Households	Exports of solid waste		
		Landfill	Incineration		Recycling and reuse	Other treatment					
			Total	Of which: Incineration to generate energy							
Collection and disposal of solid waste residuals											
	Chemical and healthcare waste	60.288	285.885	0	214.070	103.609	639.100		328.955		1.631.907
	Radioactive waste	0	0	0	0	0	0		0		0
	Metallic waste	3.973	69	0	1.141.025	97	165.335		66.513		1.377.012
	Other recyclables	10.560	38.675	0	717.969	155	2.400.211		1.203.353		4.370.923
	Discarded equipment and vehicles	35.972	8.009	0	492.987	6.129	0		89.369		632.466
	Animal and vegetal wastes	5.847	60.468	0	168.321	654.926	7.547.889		626.124		9.063.575
	Mixed residential and commercial wastes	1.062.215	5.676.960	0	436.993	139.971	17		2.085.438		9.401.594
	Mineral wastes and soil	601.063	558.615	0	11.622.785	2.596	11.463.576		686.510		24.935.146
	Combustion wastes	45.178	13.236	0	250.116	608	4.451.914		171.871		4.932.924
	Other wastes	0	0	0	0	0	0		0		0
		1.825.096	6.641.918	0	15.044.265	908.092	26.668.042	0	5.258.134	0	56.345.547
Use of solid waste products											
	Chemical and healthcare waste				26.060	55.408	54.757		144.745		280.970
	Radioactive waste				0	0	0		0		0
	Metallic waste				118.823	2.181	24.522		1.661.277		1.806.803
	Other recyclables				602.901	26.004	1.082.192		2.856.778		4.567.874
	Discarded equipment and vehicles				540	62	0		0		601
	Animal and vegetal wastes				160.893	871.318	7.489.867		4.295.626		12.817.704
	Mixed residential and commercial wastes				121	2.406	0		436		2.964
	Mineral wastes and soil				0	0	0		0		0
	Combustion wastes				7.584	243	249.505		494.764		752.095
	Other wastes				0	0	0		0		0
		0	0	0	916.922	957.621	8.900.843	0	9.453.625	0	20.229.012

Annex 2 – CREEA draft waste accounts for the Netherlands - data in dry matter tonnes

Fractions:	Use of materials for treatment	Supply of materials for treatment
Food waste	7,601,959	8,250,119
Manure	2,642,160	2,642,160
Textile waste	367,634	1,400,376
Wood and fiber waste	1,568,178	27,362,476
Paper waste	4,227,032	36,845,198
Plastic waste	681,057	4,295,756
Glass waste	1,598,741	1,291,264
Ashes	1,255,639	15,099,739
Steel waste	1,598,057	2,278,608
Precious metal waste	259,639	1,349
Aluminum waste	259,639	970,633
Lead waste	276,464	95,067
Copper waste	259,639	994,220
Non ferrous waste	259,639	243,620
Construction material waste	31,642,077	252,638,762
Oil and hazardous waste	1,318,783	61,839,330
Sewage	1,623,202	54,174,566
Unused extraction materials	0	0
Total	**57,439,538**	**470,423,245**