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Economy-wide material flow accounts in the Netherlands

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Introduction

1.1 Background

The development of economy wide material flow accounts (EW-MFA) is given high priority by Eurostat and the OECD. Work carried out by the OECD, Eurostat and their international partners has led to a series of guidance documents on *Measuring material flows and resource productivity* (Eurostat, 2001; OECD, 2008a,b,c). In 2007 Eurostat sent out a MFA-questionnaire to the European member states together with a "guide for beginners" (Eurostat and OECD, 2006). Eurostat provided Statistics Netherlands with a grant to support the compilation of the Dutch EW-MFA and the completion of the questionnaire. The current paper presents the outcome of the work done on the EW-MFA by Statistics Netherlands.

1.2 Economy wide material flow accounts (EW-MFA)

Economy-wide material flow accounts (EW-MFA) record all materials entering or leaving the national economy. Data from these accounts are often used to compile aggregated material flow and resource productivity indicators. These aggregated indicators are often dominated by bulk materials like sand. Therefore, their usefulness as an environmental-economic indicator is very much a point of discussion.

EW-MFA is only one of many ways to analyse material flows and can be extended depending on issues of concern and the questions being addressed (OECD, 2008d). EW-MFA can, for example, be elaborated with flows within the economy or environmental impacts related to flows. Furthermore, the level of detail of the materials specified can vary, different countries can be specified and certain flows (hidden and unused flows) can be in- or excluded.

In a broad sense MFA is a tool that can track materials that are harmful for the environment. Policy makers can use MFA to reduce environmental impact by stimulating appropriate dematerialization and material substitution. MFA can also be helpful to show the dependency on other countries for the supply of certain resolurces. Finally, he physical flows of the MFA could be useful in improving the monetary supply and use tables of the national accounts.

1.3 Objectives

The Eurostat questionnaire and its accompanying compilation guide will be the starting point for setting up the Dutch EW-MFA. However, the Dutch EW-MFA are developed within the framework of the environmental accounts

and, therefore, have to be compatible with the concepts of the SEEA (United Nations, 2003). Because the Eurostat guidelines are not specifically tailored to the framework of the environmental accounts, if necessary, there might some deviations from the MFA compilation guide. The EW-MFA will be set up in a way to provide maximum potential for use by policy makers and other research on physical flows.

Objectives of this survey are to extend the environmental accounts in the area of the MFA for the Netherlands. The newly developed accounts should:

- Give insights to flows of different kind of materials between the Dutch economy and foreign economies and between the Dutch economy and the environment in the year 2004.
- Be compatible with the national accounts framework
- Be compatible with the Eurostat compilation guide and questionnaire.
- Be suitable to be compiled on a regular (yearly) basis.
- Be suitable for further in dept research (e.g. hybrid input-output analyses)

1.4 Structure

After the introduction, in chapter 2 the methodology used to compile EW-MFA is discussed. Chapter 2 is divided into sections according to the MFA-questionnaire: extraction, import-export, domestic processed output and balancing items. Each section discusses the data sources used, the compilation method and the plausibility of the results. In the section on extraction and import-export the estimation of individual material flows are discussed. In chapter 3 some of the results are discussed. This paper ends with conclusions and further developments. The annex shows the results in the format of the MFA-questionnaire.

2. Methodology

The aim of Statics Netherland is to compile MFA that are fully consistent with the monetary data in the national accounts. To accomplish this relationship, physical flows are in general derived from price information and monetary flows. However, some materials do not have a monetary value or lack price information. In these cases other means were used to estimate physical flows.

2.1 Extraction

2.1.1 Introduction

The amounts of physical extraction do not always relate to the monetary data in the national accounts. Extracted materials might be processed before they are put on the market (which will be the first time they appear in the national accounts). Also, internal consumption of extracted materials does not appear in the national accounts but should be included in the EW-MFA. Therefore caution is taken when using price information to determine physical extraction on the basis of monetary flows in the national accounts. No metal ores are recorded as they are not extracted in the Netherlands.

2.1.2 Biomass and biomass products

Biomass comprises organic non-fossil material of biological origin. According to MFA conventions, domestic extraction of biomass includes all biomass of vegetable origin extracted by humans and their livestock, fish capture, and hunted animals. For cultivated biomass this approach is a deviation from the concepts of the national accounts. According to the system of national accounts (SNA), cultivated biomass is considered a commodity within the economy. Therefore, instead of cultivated biomass, ecosystem inputs should be recorded as flows from the environment to the economy (the so called harvest approach, see Schoer (2008)). For practical reasons the MFA do not follow the SNA concepts at this point. Similar to the approach adopted in the revised SEEA, the SNA concept is not followed for mainly practical reasons. Livestock and livestock products (e.g. milk, meat and eggs) are not accounted for as domestic extraction because cattle-fodder is already recorded as flows from the environment to the economy.

In the national accounts the output of biomass is covered by many commodities. The assignment of biomass, as recorded in the national accounts, to MFA categories presented in the questionnaire was done on the bases of CPA. MFA distinguishes primary crops, crop residues, fodder crops, wood, the category fish capture, crustaceans, molluscs and aquatic invertebrates, and hunting and gathering. For each of these categories the compilation method for estimating physical flows will be discussed.

A characteristic feature of all types of biomass is its considerable moisture content, which may account for more than 95 percent in the case of fresh living plant biomass. However, the moisture content varies across plant parts, species and vegetation periods. In many cases biomass is harvested at low moisture content (e.g. cereals) or dried during the harvesting process (e.g. hay making). In accordance with agricultural statistics, biomass is accounted

for as its weight at the time of harvest. In some cases crops are harvested at different moisture contents. In these cases moisture content has to be standardised according to the MFA compilation guide.

Monetary data were obtained from the supply and use tables of the national accounts. The output of the agriculture and fishing industry in physical values is taken from commodity boards and the Dutch Agricultural Economics Institute (LEI).

Primary crops

Primary crops include major staple foods from cropland and garden land such as cereals, roots and tubers, pulses, vegetables, fruits and nuts. The estimates of agricultural output in the national accounts are largely functional. As a result, most estimates are based on commodity flow data provided by commodities boards and LEI as opposed to information on commercial units (institutional data). Data on internal consumption of wheat and barley are also provided by commodity boards.

Flowers, flower bulbs and nursery products are categorised as 1.1.10 "Other crops". It should be noted that the compilation guide of Eurostat does not provide a MFA code for these commodities.

Crop residues (used)

In most cases the amount of cereals and sugar beets harvested is only a fraction of total grown crop biomass. Parts of the plant will be considered crop residues. Two types of crop-residues are distinguished: straw of cereals and all other crop-residues (mostly tops and leaves of sugar beets). Many of the crop residues are used for internal consumption. In order to include internal consumption, the amount of crop residues is estimated with help of the harvest index and recovery rates (Wirsenius, 2000).

For tops and leaves of sugar beets, however, the amounts derived from the harvest index and recovery rates appear too high to use for the MFA. The reason for this is that, for 2004 in the Netherlands, most tops and leaves of sugar beets are not used but remain on land. Therefore, the amount derived from data in the national accounts is used for the MFA.

Fodder crops, grassland harvest and grazed biomass

Fodder crops comprise all types of fodder crops from cropland. Commercial feed crops such as barley, maize, soy bean etc. are not included in this category. Biomass harvested from grassland comprises mown grass harvested from meadows for silage or hay production. According to the MFA compilation guide, fodder crops and grassland harvest are accounted for at air dry weight.

Data on fodder crops, grassland harvest and grazed grass are obtained from the statistic on manure production. For the compilation of this statistic the amount of roughage uptake by livestock animals is required. The amount of grazed biomass was cross-checked with estimates derived by using the methods suggested in the MFA compilation guide (chp. A 1.4). The results obtained from the different methods differed somewhat but not to a very large extent. Most of these differences were due to uncertainties in the choice of the conversion factors.

Wood

This category includes wood harvest from forests and short rotation plantations and wood from agricultural land. In the supply and use tables of the national accounts, the agriculture industry is the main producer of forestry products. These forestry products are Christmas trees and are considered nursery products. Therefore, they are accommodated under MFA classification 1.1.10 “Other crops”.

Besides the agricultural industry, other industries produce forestry products as well. Probos, a foundation which primary task is to collect, analyse and summarize market information on forestry, the harvest of wood is estimated in thousand cubic metres (Probos, 2005). For the conversion of solid cubic meters of wood to weight (at 15 percent moisture content), the conversion factors in the MFA compilation guide (Weisz et al., 2007) were not used. Instead, conversion factors for Dutch wood were used (Daamen, 2000) [1]. To estimate the amount of extracted wood, Probos data are preferred over national accounts data.

Fish capture, crustaceans, molluscs and aquatic invertebrates

In the MFA fish and seafood from aquaculture are not considered domestic extraction but a product of the livestock sector. Therefore, only fish capture and seafood from unmanaged fresh and seawater are taken into account. Fish capture is covered in the national accounts by two commodities: fresh fish and processed fish (e.g. gutting of herring on board a ship). Other aquatic products are covered in the national accounts as well. The monetary data in the national accounts are based on the physical data collected by the LEI. Therefore, physical amounts of fish capture and other aquatic products are taken from the LEI data.

[1] Coniferous wood; the conversion factor for volume (solid cubic meter) to weight (at 15% moisture content) is: 1 solid cubic meter is 500 kilos. Hardwood; the conversion factor for volume (solid cubic meter) to weight (at 15% moisture content) is: 1 solid cubic meter is 600 kilos (Daamen, 2000)

Hunting and gathering

There is no commercial hunting in the Netherlands. Hunting is essentially a feature of flora and fauna management, and is mainly confined to the shooting of weak and unhealthy animals. There is a limited amount of sport hunting, involving private consumption of the animals killed. There is virtually no value added in this category. As a result no estimates for hunting are made in the MFA.

2.1.3 Non metallic minerals primary and processed

In the national accounts the output of ornamental and building stone, sand, gravel, clay, chemical minerals, salt, and other mining and quarrying products are distinguished. For each of these product groups the compilation method for estimating physical flows will be discussed. The assignment of non-metallic minerals commodities, as recorded in the national accounts, to MFA categories presented in the questionnaire was done on the basis of CPA.

With regard to the extraction of non metallic minerals, Prodcom-statistics and international trade statistics were very useful to convert monetary values to physical values. These statistics report both the monetary and physical value of products. The Prodcom-statistics, however, are not representative for the total output of a product as firms with less than 20 employees are not included. Nevertheless, prices per tonne derived from these statistics are useful. Other sources used to compile the extraction of non metallic minerals are the Dutch Environmental Data Compendium (PBL, 2008), the Dutch Mining Authority (Staatstoezicht op de Mijnen, 2004) and the province of Limburg (Provincie Limburg, 2007).

Ornamental and building stone

The industry of cutting, shaping and finishing of ornamental and building stone (NACE DI.26.70) is the producer of ornamental and building stone. It is assumed that the reported output is ornamental and building stone that are being processed. Therefore this output should not be considered as extraction. Ornamental and building stones are extracted abroad and subsequently imported for processing in the Netherlands.

Sand and soil

Two types of sand are distinguished: construction sand and industrial sands. Industrial sands are being used in industrial processes to produce concrete and cement. Construction sand is used to level up beaches or infrastructural works. Construction sand is recorded as excavated soil in the MFA questionnaire. With help of price information derived from the Prodcom-

statistics, the monetary output in the national accounts was converted to physical amounts.

The Dutch Environmental Data Compendium shows the extraction of industrial sand in tons and construction sand in cubic metres[2]. For industrial sand there is only a small difference between the amounts in the Environmental Data Compendium and the amounts derived from national accounts. Therefore, the latter seem suitable to use for the MFA. For construction sand, the difference is large. In the national accounts the Dutch government is regarded as a producer of sand. The output of the government consists of compensations for the extraction of (construction) sand. For a single year the amount of compensation per tonne could be obtained. The compensation per tonne is much lower than the price per tonne derived from the Prodcom-statistics. When using the compensation per tonne to convert monetary values to physical values, the amount of construction sand corresponds to the amount in the Environmental Data Compendium. Because there is no annual data on the compensation provided by the government available, for construction sand the amount in the Environmental Data Compendium is used.

Gravel

The extraction of gravel (including crushed stone) can be estimated with help of the national accounts and price information derived from Prodcom-statistics. The estimated amount is much higher than the amount in the Environmental Data Compendium. Probably the output in the national accounts is overestimated. Firms in small size categories (0-20) receive a less detailed survey than firms with more than 20 employees. The product specification for firms with 0-20 employees is assumed equal to the product specification for firms with 20-50 employees. On the other hand, it is possible that the extraction of gravel is underestimated in the overview of the Environmental Data Compendium. These data originate from a survey with response rates below 50 percent (Koopmans en Wanders, 2006).

The national accounts' result of domestic consumption is in line with the estimated annual domestic consumption of gravel in the period 2000-2006 as stated in a report of the Dutch Association of Industrial Sand- and Gravelproducers[3] (IZGP, 2007). Therefore, the result of the national accounts

[2] Cubic meters construction sand are converted to tonnes according to a conversion factor of 1.7 tons per solid m^3 as reported by the province of Limburg "Primaire grondstoffen in Limburg: Monitoringsrapportage 2005".

[3] The estimated annual consumption in the period 2000-2006 is 32 million tons. The (domestic) consumption in the national accounts is 35 million tons. The overview of the Environmental Data Compendium reports a consumption of 21 million tons.

is considered more plausible than the data in the Environmental Data Compendium. For the extraction of gravel the result derived from the national accounts is used.

Clay

The Environmental Data Compendium reports the amount of extracted clay in cubic meters[4]. The estimated amount in tonnes is close to the amount derived from the national accounts and the Prodcom-price. In order to follow national accounts as closely as possible, the result of the national accounts is used for the extraction of clay.

Chemical minerals

The output in the national accounts is not related to extraction. It is assumed that producers did not extract chemical minerals, but mixed existing minerals into substrates. The websites of two firms in the Prodcom-statistics and other sources provided this insight. Consequently, it is assumed that there is no extraction of chemical minerals in the Netherlands.

Salt

The output derived from Prodcom-statistics differs from the amount reported by the Dutch Mining Authority (Staatstoezicht op de Mijnen, 2004). The Mining Authority mentioned three producers of salt that are also recorded in the Prodcom-statistics. The output of one firm, however, is much lower in the Prodcom-statistics. The explanation for this difference may be the internal use of salt by this firm. This firm is an affiliate of a multinational enterprise in the chemical industry. It can be assumed that there are deliveries among affiliates of this multinational enterprise which are not fully recorded in the Prodcom-statistics.

The output of another firm in the Prodcom-statistics is also lower than stated in the annual report of the Dutch Mining Authority. In the Prodcom-statistics this firm reported output of magnesia and salt. Based on the report of the Dutch Mining Authority it can be assumed that magnesia salt was internally used to produce magnesia. Again this internally used salt was not reported in the Prodcom-statistics.

For the extraction of salt, the results of the annual report of the Dutch Mining Authority are used. It is assumed that the results of Prodcom-statistics are exclusive of internal usage of salt.

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[4] In "Primaire grondstoffen in Limburg: Monitoringsrapportage 2005" a conversion factor of 1.5 tons per solid m^3 clay is reported. In the compilation guide (Weisz et al., 2007) conversion factors of 1 to 2 tons per m^3 clay are reported.

Other mining and quarrying products

The output of other mining and quarrying products is not related to extraction. In the Prodcom-statistics are two types of these products: magnesia and slags and ashes. Only one firm produces magnesia. It is assumed that this product originates from magnesia salt (see previous section on salt extraction). In the Prodcom-statistics only one firm produces slags and ashes. According to the website of this firm, these slags and ashes originate from power plants. Therefore there is no extraction of slags and ashes from the environment. The construction industry and wholesale business are producers of other mining and quarrying products as well. It is assumed that these producers do not extract magnesia and slags and ashes from nature either.

Limestone

In the national accounts the output of limestone by the producer of cement, ENCI, is not recorded. ENCI extracts limestone and uses this for the production of cement on-site. Information on the extraction of limestone can be obtained from ENCI's annual report as well as a report from the province of Limburg (Provincie Limburg, 2007).

2.1.4 Fossil energy carriers

In the Netherlands natural gas, condensate, oils and a small amount of peat are being extracted. Data on the extraction are derived from the national accounts (monetary data), the energy accounts and energy statistics (physical data). For natural gas, cubic meters are converted in kilograms using a conversion factor of 0,82 kg/m^3. Flared of gas (a relative small amount) is, in accordance with the MFA guide, not taken into account. For the extraction of peat only monetary data were available. Price information from the international trade statistics (export price) was used to determine the physical amounts of extracted peat.

2.2 Import - export

2.2.1 Data structure and sources

In order to estimate physical import and export flows for the Netherlands, definitions and concepts of the compilation guide (Weisz et al, 2007) are followed closely. However, we deviate from the compilation guide in that the physical information from the international trade statistics is not used directly. As pointed out in chapter 1, the aim of Statistics Netherlands is to link the physical flows of the MFA with the monetary flows of the national

Accounts. Therefore, the international trade statistics are used to estimate price information. Physical flows are estimated by combining price information with the monetary import export data from the national accounts. A distinction is made between intra and extra EU trade. Re-exports are also distinguished. Finally, the physical data, classified according to the national accounts classification, are converted to the MFA classification as specified in the Eurostat questionnaire.

Data from the international trade statistics are available for individual industries classified in Combined Nomenclature (only for the registered data) and Dutch national accounts commodities groups. national accounts commodity groups are allocated to the SITC (Standard International Trade Statistics) nomenclature. This is necessary to establish a link with the MFA import-export classifications in the Eurostat questionnaire because the MFA classifications are also related to the SITC classification.

Notice that the physical data are, in principle, in net weight, thus excluding packaging materials. Following the recommendation in the MFA compilation guide no attempt is made to estimate the gross weight.

2.2.2 Further considerations

The method used above needs some further considerations. First of all, adjustments made for discrepancies in the source data of the International trade statistics are mainly made for monetary data. The physical data do not receive a lot of consideration. Therefore, the absolute physical data recorded in the international trade statistics are not considered reliable enough to be used directly. Price information from the International trade statistics is derived after obvious inconsistencies in the ratio between monetary and physical data are removed.

Secondly, a price estimate is made after aggregation of commodities to a national accounts classification. As a consequence, price per kilo information refers to an aggregate of different products. For example, for copper and works of copper this implies a reduction in detail from 90 types of copper products to three types of copper products in the national accounts.

A third consequence of allocating commodities to MFA categories after aggregation has taken place, is that some commodities are allocated to a MFA category that would have been different if allocation had taken place on a more detailed level.

Fourthly, the national accounts commodity classification is not always specified enough to link with the MFA classification. As a result, no data can

be allocated to some of the MFA classifications and sometimes a choice has to be made to which MFA classification, physical data should be allocated.

2.2.3 Biomass and biomass products

The aggregation level of biomass commodities in the national accounts is sometimes too high to assign the commodities straightforward to MFA codes. For these commodities, their main content was determined. On the basis of their content, assignment to a MFA code took place. For most commodities this was not a problem as sound estimations could be made and/or there quantities were not very large. Commodities for which allocation to a MFA code was not straightforward are "Processed fish" and "Other starch products". Processed fish could be allocated to biomass products (MFA 1.9), residues (MFA 1.2.2) and fish (1.6). We decided to allocate processed fish to MFA code 1.6. Commodity "Other starch products", could be allocated to biomass products (1.9), vegetables (MFA 1.1.7) and residues (1.2.2). Other starch products are allocated to biomass products (MFA 1.9). Forestry products are allocated to "other crops" (MFA 1.1.10) because it turned out that most of these products are nursery plants and not wood (MFA 1.5.1). Beer in the national accounts consists of beer but also of waste from the production of beer. Therefore, beer can be allocated to "Products from biomass" (MFA 1.9) or residues (MFA 1.2.2). In the end, beer is allocated to "Products from biomass" but it was necessary to use price information of both beer and waste of beer production to estimate the total amount. Finally, flowers and the like are not allocated to "Products from biomass" (MFA 1.9) as is proposed by Eurostat but to "other crops" (MFA 1.1.10).

Following the Eurostat guidelines, some commodity conversions from SITC codes to MFA codes turned out to be slightly ambiguous. Commodity "Other dairy products" (SITC 061.9) is allocated to sugar crops (MFA 1.1.3). Groundnuts (SITC 222) are not allocated to nuts (MFA 1.1.5) but to oil bearing crops (MFA 1.1.6). Commodity "Pulses" is allocated to vegetables (MFA 1.1.7) and not to pulses (MFA 1.1.4). MFA category 1.1.4 remains empty as no SITC codes are assigned to this MFA classification. Finally, margarine is not allocated to dairy products (MFA 1.8.3) but to products from biomass (MFA 1.1.9). In order to keep in line with the allocations proposed by Eurostat no alterations were made except for pulses which are allocated to MFA 1.1.4.

Information on the export of a selection of vegetables can be derived from the Commodity board for horticulture. Comparisons with the MFA, compiled according to the method above, show a 14% lower total amount of selected vegetables. This discrepancy might be due to differences in definition, an

overestimated absolute monetary level in the national accounts or inaccuracies in the international trade data (used to estimate prices). Because the reason for the discrepancies is not clear the information from the commodity board was not used to adjust our data.

2.2.4 Metal ores and concentrates, processed metals

The national accounts commodity classification does not allow for an appropriate distinction between copper, nickel, lead, zinc, tin and precious metals. Many of these types of metal are assigned to the "Other non-ferro" commodity group. As a consequence the amounts in MFA group 2.2.1 to 2.2.6 are underestimated. For nickel (MFA 2.2.2), lead (MFA 2.2.3) and tin (2.2.5) no data at all are available. A lack in distinction of different kinds of metal is particularly bad because flows of metals are considered important from an environmental point of view. Therefore, in the future, Statistics Netherlands considers to distinct different kind of metals on the basis of the international trade statistic.

2.2.5 Non metallic minerals primary and processed

Due to a high aggregation level of some of the national accounts commodities an unambiguous allocation to MFA categories was not possible. This is especially problematic for commodities "Natural stone", "Artificial fertilizer" and "Limestone/Gypsum" as they are imported in relative large quantities. Natural stone could be allocated to building stone (MFA 1.3), limestone etc (MFA 3.2) and slate (MFA 3.3). On the basis of an expert guess it was decided to designate all natural stone as building stone. As a result no data were reported for slate (MFA 3.3).

2.2.6 Fossil energy carriers, primary and processed

Data on fossil energy carriers are derived from the energy accounts (contrary to the other imported and exported commodities which are estimated on the basis of the international trade statistic). The energy accounts, a module of the environmental accounts, match energy statistics and international trade statistics with data from the national accounts. Natural gas (and propane and butane) from the energy accounts are converted from cubic meters to kilograms using a conversion factor of 0,82 kg/m3.

In general the data from the energy accounts do not deviate much from the data that can be obtained from the international trade statistic (see table 2). Looking at the individual energy carriers (national accounts commodity classifications) some larger deviations can be observed, especially for minor flows. The reason for these discrepancies is not clear but might be due to

differences in definition or data uncertainties. The discrepancies were not considered large enough to make adjustments to the estimated data.

Table 1: Comparison between import-export energy accounts and international trade statistics

	Import		Export	
	Energy accounts	International trade	Energy accounts	International trade
	mln Kg			
Coal	21.660	22.598	8.370	8.185
Cokes	429	352	318	304
Crude oil	52.295	53.083	1.178	1.247
Natural gas condensate	8.381	8.236	28	28
Propane/Butane	702	554	1.156	952
LPG gas	826	523	526	247
Naphtha	7.123	7.141	7.156	6.619
Aromatics	4.383	3.219	3.898	1.944
Jet fuel	688	686	5.185	5.402
Petrol	2.858	2.857	8.345	7.872
Petroleum	484	408	313	234
Gas oil	703	76	25	29
Diesel	2.934	3.327	7.848	7.995
Gas oil processed	2.528	2.894	10.098	11.517
Fuel oil	4.642	4.602	15.286	14.259
Lubricant	141	288	574	567
bitumen	259	-	311	-
Petrochemical residue	2.279	3.014	2.765	2.905
Natural gas	14.610	16.244	40.961	42.154
Total	127 925	130 101	114 342	112 459

Due to the classification level of the national accounts no distinction is made between hard coal (MFA 4.2) and brown coal. No further attempt is made to separate brown coal in order to fill the MFA questionnaire because the imported and exported amounts are considered very small for the Netherlands. Therefore, no import or export of brown coal (MFA 4.1) is reported for the Netherlands. Petrochemical residues are another commodity group that could be partly allocated to MFA class 4.2. However, it was decided to allocate petrochemical residues to MFA class 4.3 (Petroleum).

2.2.7 Waste

The import and export of waste are derived from the waste accounts. Only waste residuals (without a monetary value) are reported because waste products (with a monetary value) are already included as products. In the questionnaire only waste for final treatment or disposal is asked for. From

this it seems that landfilled and incinerated waste should be included but recycled should not (the compilation guide does not elaborate on this). In the current paper recycled waste is included in the import and export data because it is not clear why recycled waste should be left out.

2.3 Plausibility check

A plausibility check is performed by comparing MFA results from this survey with MFA compiled in previous studies by Eurostat / IFF and the Sustainable Europe Research Institute (SERI). The Sustainable Europe Research Institute (SERI) maintains the website "materialflows.net". This website contains time series on extraction of a few material groups. On the website of Eurostat the MFA dataset for EU-15 between 1970 and 2005 can be accessed. The dataset is compiled by IFF, Vienna, and provides aggregated MFA data for the Netherlands. Table 2 shows the results from the different data sources. By the way, the relationship between Eurostat and SERI data is not completely clear to us.

Table 2: Comparisons between CBS. SERI and Eurostat data.

	Extraction			Import		Export	
	CBS	SERI	Eurostat / IFF	CBS	Eurostat / IFF	CBS	Eurostat / IFF
	mln Kg						
Gas	66 670	52 354	71 408	16 516	11 509	42 643	1 453
Oil	2 891	2 106	2 891	89 439	102 844	62 701	67 844
Biomass food	23 982	21 006	19 831	28 115	24 686	21 154	20 790
Biomass forestry	469	812	812	5 939	14 895	2 799	13 155
Biomass feed	14 177	13 891	19 429	7 916	11 454	8 496	9 985
Biomass animals	353	593	608	7 454	7 275	9 287	9 132
Other biomass		8					
Construction minerals	116 300	61 632	61 632	57 735	37 458	38 983	12 937
Industrial minerals		20 244	5 000		13 951		20 765
Total	224 841	172 645	181 611	213 113	224 073	186 063	156 062

Extraction

Total extraction was estimated on 225 billion Kg in the present survey. Eurostat and the SERI show considerable lower total amounts, respectively 182 and 173 billion Kg. The difference with the CBS data is mainly due to differences in mineral amounts. Our estimated quantity of sand used for construction and industrial activities is much higher. Sand turned out to be difficult to determine and, therefore, differences between data sources can be expected. Also, the estimated amount of food is much higher. This might be because in our estimate flower bulbs and cultivated plants are added to the primary crops category. It is not clear how Eurostat records these biomass flows.

Import - export

The import-export data presented in this paper match the Eurostat/IFF in general to a large extent. The low amount of exported gas reported by Eurostat/IFF is probably due to some error. The other discrepancies are probably due to differences in definition of the materials or the use of different data sources.

Concluding

Comparisons between the data compiled in this survey and Eurostat show that the amounts presented in this paper are in the right range. However, some substantial discrepancies do exist between the different data sets. However, these discrepancies have not led to any adjustments of our initially compiled data. Some data, especially the extraction of minerals, are difficult to estimate. It is assumed that Statistics Netherlands has better access to the data sources and, therefore, is able to make the best estimate.

2.4 Domestic processed output (DPO)

2.4.1 Emissions to air

Data on air emissions are derived from the environmental accounts. As a result, the data represents emissions from Dutch residents in the Netherlands or abroad. Air emissions produced by non-residents in the Netherlands are not taken into account. Also included are emissions from controlled landfill sites. Controlled landfills are considered part of the economy, and therefore emissions from landfill sites should be considered flows from the economy to the environment. Excluded from the air emission account data are emissions from flaring. The reason: the extraction of fossil fuels that are being flared are not included in the extraction table.

Due to the small amounts of hydroflourcarbons (HFCs), perflourocarbons (PFCs), sulfur hexaflouride (SF6) and chlorofluorocarbon (CFC) emissions, they are not include in the dataset. No data were available for heavy metals and persistent organic pollutants (POPs). No attempt is made to estimate the amounts of these emissions, as they are considered very small. A specification of CO_2 from biomass combustion could not be made.

2.4.2 Waste land filled

In the Dutch waste accounts all land fills are considered to be maintained by the environmental services industry. Consequently all land fills are controlled by and part of the economy. Therefore, in accordance with the SEEA 2003, waste dumped at land fills are considered flows within the economy and not

flows from the economy to the environment. As a result no amount of land filled waste was recorded as domestic processed output. At this point Statistics Netherlands deviates from the Eurostat guidelines. Also not included in the waste accounts and the questionnaire are dredged sediments that result from waterway maintenance.

2.4.3 Emissions to water

Emissions to water of nitrogen, phosphorus and heavy metals are derived from the water accounts. In accordance with the guidelines only emissions to water are counted if they are directly released to natural waters or after waste water treatment has taken place. Emissions from agriculture, like fertilisers, are omitted from the emissions to water because they are already included in "dissipative use of products". No data are available for other substances and materials that flow from the economy to a water body.

2.4.4 Dissipative use of products

Organic fertilizer (manure)

Data on manure which is used as soil amendment and fertilizer can be derived from our statistics on manure production. The total weight is presented in dry matter.

Mineral fertilizer

The domestic consumption in agriculture of the different kind of fertilizers reported in their nutrient contents. These contents are converted in order to estimate total weights.

Sewage sludge

Only a small amount of industrial sewage sludge is disposed on agricultural soil. Sewage sludge is converted to dry weight.

Compost

Different kind of composts are used on agricultural land for fertilization purposes. All compost is converted to dry weight.

Pesticides

Chemical pesticides that are used by the agricultural sector and government.

Seeds

Potatoes are also considered seeds. They make up for the main part of the total weight.

Other dissipative use of products or losses

Some dissipative losses (e.g. abrasion from tyres) are already accounted for in the emissions to water and air. An estimate on the use of road salt is provided by Senternovem (agency for the ministry of economic affairs). However, their estimate of 60 mln kilo's seems too low. On the basis of the monetary value in the national accounts and price information from the international trade statistics the total amount of road salt is estimated.

2.5 Balancing items

The aim of the EW-MFA is to establish a full mass balance for a national economy. In order to achieve a material balance some counterbalancing must take place on the input side and on the output side of the balance. Balancing items on the input side account for those flows of water and air that are accounted for in DPO but not in domestic extraction or imports. Firstly, the Eurostat compilation guide proposes to counterbalance for the oxygen used in the combustion process. This is necessary because on the output side the CO_2, as a result of the combustion of the carbon contained in the energy carrier, is counted. The oxygen for human and animal (considered socio-economic stocks) respiration is considered a balancing item on the input side. Thirdly, the nitrogen obtained from air in the production of ammonia (NH_3) is balancing items on the input side.

Balancing items on the output side are meant to equalise discrepancies resulting from data for material inputs. Two kinds of balancing items are taken into account. Energy carriers on the material input side contain water which is released through combustion as water vapour. Water vapour is added as a balancing item. Also, considered a balancing item on the output side are gasses from respiration of humans and livestock.

The balancing items are not included in the aggregated indicators. However, they are needed to make an estimate of the NAS (net addition to stock) indicator. The NAS is calculated as the difference between total inputs and total outputs. In order to calculate the balancing items, the compilation method and proposed coefficients in the Eurostat compilation guide are followed.

2.5.1 Apparent methodological inconsistencies

The issue of balancing is not completely clear and there seem to be some discrepancies and inconsistencies in the calculations. Most of them may result from the fact that bulk water (water not considered an embedded component in materials) is not taken into account in EW-MFA. Below some examples are given of apparent discrepancies:

1. Take for example a country that extracts spring water (not taken into account in EW-MFA) in order to produce and export bottles of mineral water. Contrary to spring water, bottled water is taken into account in EW-MFA. As a consequence it appears that matter (bottled water) has appeared out of nowhere.
2. The MFA compilation guide puts respiration of humans down as a balancing item. However, hydrogen excretion by humans not from respiration (faeces, urine and sweat) is not considered.
3. Stock changes of humans and livestock are ignored. Also not taken into account are domestic animals.
4. Only grass harvest, fodder directly taken up by ruminants and timber harvest are raw materials that are converted to dry matter content. Also converted to dry weight are sludge, compost, manure and waste flows. No adjustment of the moisture content of other materials is made.
5. Hydrogen taken from water in the process of producing NH_3 is not added as a balancing item.
6. Nitrogen used for the production of other (than NH_3) N compounds are not included.

A reason for the apparent inconsistencies pointed out in 1 and 2 might be that the amounts of water involved are relatively low and can, therefore, be omitted. The quantitative consequences of these assumptions are unfortunately not discussed in the compilation guide. Pointed out in the compilation guide are the assumptions made in 3 and 4. Stock changes of humans and livestock are ignored because these changes are relative small compared to stock accumulation through buildings, consumer durables and machinery. The converted raw materials may be harvested at different water contents and therefore their moisture content is standardized. It is not clear if sludge, compost, manure and waste flows are converted to dry weight for the same reason. A water content of 15% is chosen to make data from harvest statistics and estimates for grazing comparable. Considering point 5, it is probably not needed to take hydrogen into account because bulk water is not part of the EW-MFA. Finally, in 6, the amount of N obtained from air for the production of compounds other than NH_3 might be negligible.

3. Results

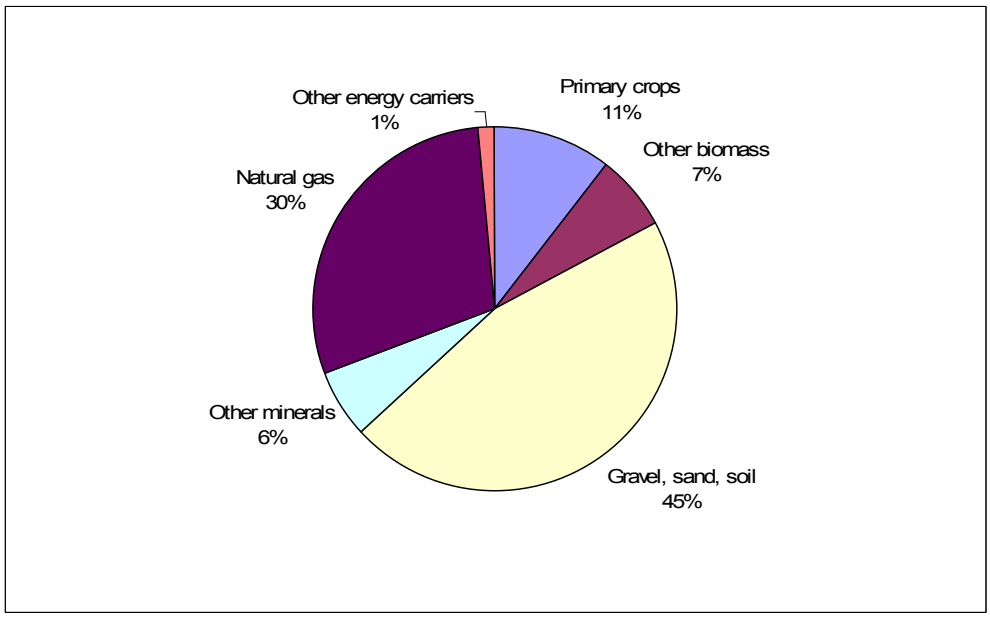
This section will first show the amount of material extraction in the Netherlands. Secondly, imports and exports are presented in more and less levels of detail. Energy carriers are discussed at a high level of detail. Other types of material are not discussed in detail in order to limit the extent of this paper. However, in the annex the results are shown at a level of detail required for the European questionnaire. The annex also includes the domestic processed outputs, the balancing items and the aggregated EW-MFA indicators.

3.1.1 Extraction

Domestic extraction in the Netherlands is, for a large part, determined by gravel, sand and soil. Unfortunately, the precise amount of these minerals, especially excavated soil (70% of the total minerals), turns out to be difficult to determine. As a result, the interpretation of the total amount of extracted materials (and thus also the interpretation of the derived indicators) for a single year should be regarded with great caution. These uncertainties emphasize the importance of presenting flows of individual of materials. The latter is also important with regard to the environmental impact related to individual material flows. The sand used in the Netherlands to strengthen dikes and raise the shoreline is not so relevant from an environmentally point of view.

The extraction of natural gas accounts for almost 30% of the total extraction. This is due to the exploitation of the substantial natural gas reserves of the Netherlands.

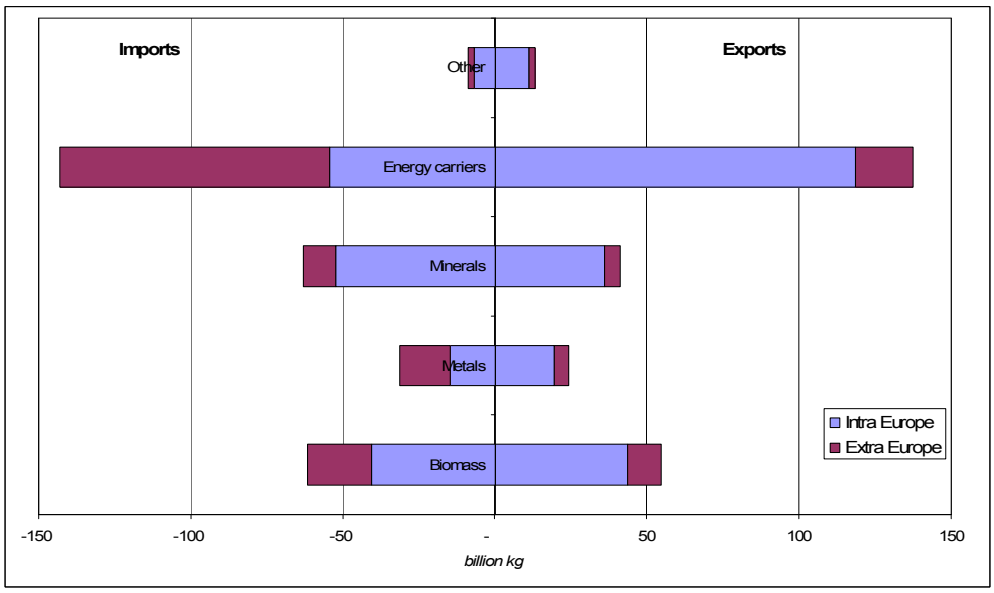
Figure 1: Domestic extraction (total of 225 billion Kg), Netherlands, 2004.



3.1.2 Imports-exports

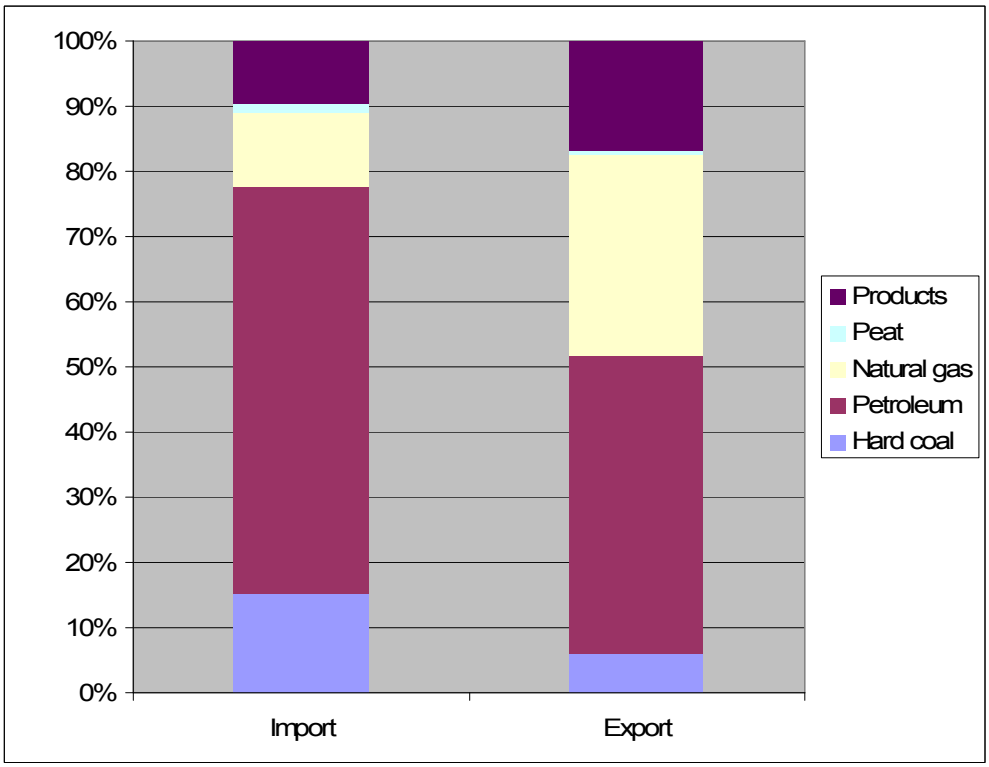
Figure 2 shows the import (-) and export (+) for 5 groups of materials. A distinction is made between flows from and to European countries (intra Europe) and from and to non-European countries (extra Europe). At first glance, the amount of import and export of each group of materials seems rather similar. However, on a more detailed level it will show that the imported and exported materials are of different kinds. The figure also shows relative large amounts of imported energy carriers and metals from outside of Europe. The reason for this, of course, is that crude oil and metals are mainly produced outside Europe.

Figure 2: Intra- and extra-European import (left hand side) and export (right hand side) for groups of materials Netherlands, 2004.



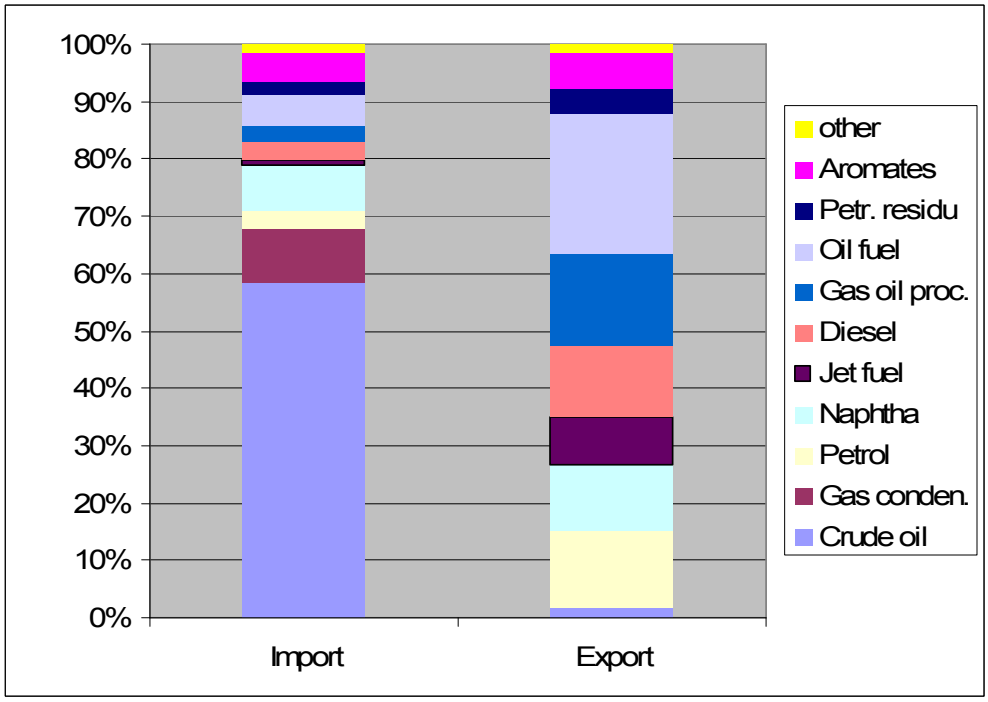
To elaborate on the difference in material composition between import and exports a closer look is taken at the energy carriers. Figure 3 shows the import and export of different kind of energy carriers. The figure shows that the Dutch imports, relative to the exports, consist of a substantial amount of coal. Coal is not extracted in the Netherlands and required for power plants. The opposite is true for natural gas: large amounts of extraction with consequently relative large exports. Furthermore, the figure shows a relative large share of exported products. In the Netherlands, many bulk materials are imported and subsequently processed into export products.

Figure 3: Share in import and export of different types of energy carriers Netherlands, 2004.



Considering petroleum commodities, the composition differs between imports and exports. This is shown in figure 4. Imported petroleum products consist for more than 50% of crude oil. Crude oil is used to make other petroleum products like different kind of fuels but also to make plastics. The share of crude oil in the export of petroleum products is rather small. The export mainly consists of products that are made from crude oil like oil fuel, processed gas oil, diesel, naphtha and petrol. Again, figure 4 shows, that for useful analysis of the data, information on the types of materials is needed at a rather detailed level.

Figure 4: Share in import and export of different types of petroleum products Netherlands, 2004



4. Conclusions

This paper presents the economy wide materials flow accounts for the Netherlands in 2004. The following conclusion can be drawn.

- The Eurostat MFA compilation guide has been very helpful but could do with some minor improvements. The compilation method used is simple enough to annually update the EW-MFA with a minimum of effort.
- The data certainty is somewhat impaired because prices are sometimes estimated for groups of materials that are inhomogeneous.
- The compilation method guarantees a link between the physical flows and the monetary flows of the national accounts. As a consequence, consistence environmental-economic indicators can be derived and analysed. The developed EW-MFA are part of the Dutch environmental accounts.
- For a useful interpretation of the data it is essential to distinguish materials at a reasonable level of detail. For some material flows (e.g. petroleum) the level of detail required for the Eurostat questionnaire does not seem sufficient.
- The presented results are an improvement on already existing estimates of EW-MFA for the Netherlands.

- Further developments and extension of the EW-MFA (see below) are needed to improve its usefulness for policymakers.

5. Future developments

5.1.1 Types of materials

Some materials, that are relevant from an environmental point of view, can not be distinguished on the basis of data from the national accounts. For example, more detail in types of metals is desirable. But also a distinction between oil from plants and animals can currently not be made. In the future more effort should put into distinguishing environmental relevant materials.

5.1.2 Time series

From the absolute amount of material flows in a single year, as presented in this paper, it is hard to draw conclusions. More interesting is a time series of MFA. A time series shows the development of different types of material flows in a country. Next year, Statistics Netherlands will develop EW-MFA time series.

5.1.3 Resource dependencies

The Netherlands very much depend on other countries for their resources. Currently only import from intra and extra Europe are distinguished. It would be interesting from an environmental and economical point of view to get more county detail on the origin of our imports. This will provide information on our resource dependency of other countries and the environmental burden associated with it.

5.1.4 Environmental impacts

The indicators derived from the current EW-MFA are compiled by taking together different types of materials. The usefulness of these aggregated indicators is very limited, especially for measuring environmental impacts. More preferable are environmentally weighted material flows. Unfortunately, a straightforward undisputed method to set up environmentally weighted material flows is not readily available. Some developments in this area are already taking place.

5.1.5 Flows within the economy

In the current EW-MFA, the economy is considered a black box with no flows within the economy. However, flows within the economy would provide useful information on productivity of different industrial branches. Also, policy relevant issues like dematerialization and material substitution would benefit from data that link material flows to industrial branches.

Another benefit of flows within the economy is that this will result in congruent physical supply and use tables. These physical tables will link with the monetary tables by price information. A framework of monetary and physical supply and use tables will improve the data quality and increases the analytical possibilities.

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7. Annex

Annex 1: Domestic extraction, the Netherlands 2004, 1000 kilograms.

A.1 Biomass	**38.981.000**
A.1.1 Primary crops	23.982.000
A.1.1.1 Cereals	1.642.000
A.1.1.2 Roots, tubers	8.432.000
A.1.1.3 Sugar crops	6.674.000
A.1.1.4 Pulses	363.000
A.1.1.5 Nuts	-
A.1.1.6 Oil bearing crops	9.000
A.1.1.7 Vegetables	3.124.000
A.1.1.8 Fruits	817.000
A.1.1.9 Fibres	38.000
A.1.1.10 Other crops (Spices Stimulant crops, Tobacco, Rubber and other crops)	2.883.000
A.1.2 Crop residues (used)	1.607.000
A.1.2.1 Straw	1.304.000
A.1.2.2 Other crop residues (sugar and fodder beet leaves, other)	303.000
A.1.3 Fodder crops incl grassland harvest	9.109.000
A.1.3.1 Fodder crops	3.298.000
A.1.3.2 Biomass harvested from grassland	5.811.000
A.1.4 Grazed biomass	3.461.000
A.1.5 Wood	469.000
A.1.5.1 Timber (Industrial roundwood)	469.000
A.1.5.2 Wood fuel and other extraction	-
A.1.6 Fish capture, crustaceans, molluscs and aquatic invertebrates	353.000
A.1.7 Hunting and gathering	.
A.2 Metal ores (gross ores)	**-**
A.3 Non metalic minerals	**116.300.000**
A.3.1 Ornamental or building stone	-
A.3.2 Limestone, gypsum, chalk, and dolomite	1.500.000
A.3.3 Slate	-
A.3.4 Gravel and sand	30.200.000
A.3.5 Clays and kaolin	6.100.000
A.3.6 Chemical and fertilizer minerals	-
A.3.7 Salt	6.100.000
A.3.8 Other mining and quarrying products n.e.c.	-
A.3.9 Excavated soil, only if used (e.g for construction work)	72.400.000
A.4 Fossil energy carriers	**69.563.474**
A.4.1 Brown coal incl. oil shale and tar sands	0
A.4.2 Hard coal	0
A.4.3 Petroleum	2.890.979
A.4.4 Natural gas	66.669.510
A.4.5 Peat	2.985

Annex 2: Intra and extra EU imports, the Netherlands 2004, 1000 kilogram.

	Intra EU	Extra EU
B.1 Biomass and biomass products	**40.513.362**	**21.271.976**
B.1.1 primary crops	17.582.773	10.532.051
B.1.1.1 Cereals, primary and processed	10.088.294	488.749
B.1.1.2 Roots and tubers, primary and processed	1.776.988	34.803
B.1.1.3 Sugar crops, primary and processed	583.404	43.693
B.1.1.4 Pulses, primary and processed	217.087	83.495
B.1.1.5 Nuts, primary and processed	223.598	261.149
B.1.1.6 Oil bearing crops, primary and processed	550.620	4.964.774
B.1.1.7 Vegetables, primary and processed	1.639.939	861.639
B.1.1.8 Fruits, primary and processed	1.837.907	2.277.092
B.1.1.9 Fibres, primary and processed	76.713	42.125
B.1.1.10 Other crops, primary and processed	588.222	1.474.532
B.1.2 Crop residues	2.602.901	4.971.447
B.1.2.2 Other crop residues (sugar and fodder beet leaves, other)	2.602.901	4.971.447
B.1.3 Fodder crops incl grassland harvest	272.777	69.168
B.1.3.1 Fodder crops	272.777	69.168
B.1.3.2 Biomass harvested from grassland	-	-
B.1.5 Wood primary and processed	4.099.568	1.839.485
B.1.5.1 Timber, primary and processed	1.646.301	1.193.810
B.1.5.2 Wood fuel and other extraction, primary and processed	2.453.267	645.675
B.1.6 Fish capture, crustaceans,etc. primary and processed	488.572	246.047
B.1.8 Live animals other than in B 1.6., meat and meat products	4.808.820	1.910.197
B.1.8.1 Live animals other than in B 1.6.	461.070	4.934
B.1.8.2 Meat and meat preparations	946.342	206.615
B.1.8.3 Dairy products, birds eggs, and honey	2.223.863	110.581
B.1.8.4 Other products from animals (animal fibres, skins, furs, leather etc.)	1.177.546	1.588.067
B.1.9 Products mainly from biomass	10.657.951	1.703.582
B.2 Metal ores and concentrates, processed metals	**14.501.326**	**16.617.002**
B.2.1 Iron ores and concentrates, iron and steel	8.598.151	12.310.075
B.2.2 non-ferrous metal ores and concentrates, processed metals	1.377.074	2.292.977
B.2.2.1 Copper	244.870	135.193
B.2.2.2 Nickel	.	.
B.2.2.3 Lead	.	.
B.2.2.4 Zinc	175.260	52.609
B.2.2.5 Tin	.	.
B.2.2.6 Gold, silver, platinum and other precious metals	1.416	258
B.2.2.7 Aluminium	672.701	1.103.360
B.2.2.8 Uranium and thorium	.	.
B.2.2.9 Other metals	282.827	1.001.556
B.2.3 Products mainly from metals	4.526.100	2.013.950
B.3 Non metalic minerals primary and processed	**52.243.752**	**10.832.771**
B.3.1 Ornamental or building stone	4.594.543	729.067
B.3.2 Limestone, gypsum, chalk, and dolomite	1.439.983	0
B.3.3 Slate	-	-
B.3.4 Gravel and sand	27.960.348	3.203.681
B.3.5 Clays and kaolin	1.462.160	937.048
B.3.6 Chemical and fertilizer minerals	2.202.299	1.618.323
B.3.7 Salt	536.336	100.563
B.3.8 Other mining and quarrying products n.e.c.	8.967.546	3.982.984
B.3.9 Excavated soil, only if used (e.g for construction work)	-	-
B.3.10 Products mainly from non-metalic minerals	5.080.538	261.105
B.4 Fossil energy carriers, primary and processed	**54.344.441**	**88.867.915**
B.4.1 Brown coal incl. oil shale and tar sands	-	-
B.4.2 Hard coal	333.232	21.326.871
B.4.3 Petroleum	31.351.508	58.087.085
B.4.4 Natural gas	11.156.542	5.359.611
B.4.5 Peat	1.681.484	192.957
B.4.6 Products mainly from fossil energy carriers	9.821.675	3.901.390
B.5 Other products	**6.071.515**	**2.178.753**
B.6 Waste imported for final treatment and disposal	**620.000**	

Annex 3: Intra and extra EU exports, the Netherlands 2004, 1000 kilograms.

	Intra EU	Extra EU
D.1 Biomass and biomass products	**43.616.494**	**11.237.752**
D.1.1 primary crops	17.634.348	3.520.067
D.1.1.1 Cereals, primary and processed	2.078.992	516.418
D.1.1.2 Roots and tubers, primary and processed	1.427.050	700.892
D.1.1.3 Sugar crops, primary and processed	884.909	202.893
D.1.1.4 Pulses, primary and processed	47.431	9.927
D.1.1.5 Nuts, primary and processed	224.878	22.617
D.1.1.6 Oil bearing crops, primary and processed	1.434.445	49.456
D.1.1.7 Vegetables, primary and processed	5.431.593	972.665
D.1.1.8 Fruits, primary and processed	2.680.415	316.326
D.1.1.9 Fibres, primary and processed	40.583	7.870
D.1.1.10 Other crops, primary and processed	3.384.053	721.003
D.1.2 Crop residues	7.188.997	1.077.292
D.1.2.2 Other crop residues (sugar and fodder beet leaves, other)	7.188.997	1.077.292
D.1.3 Fodder crops incl grassland harvest	194.994	35.173
D.1.3.1 Fodder crops	194.994	35.173
D.1.3.2 Biomass harvested from grassland	-	-
D.1.5 Wood primary and processed	2.435.424	363.992
D.1.5.1 Timber, primary and processed	828.656	87.503
D.1.5.2 Wood fuel and other extraction, primary and processed	1.606.768	276.490
D.1.6 Fish capture, crustaceans etc. primary and processed	768.408	184.718
D.1.8 Live animals other than in B 1.6., meat and meat products	7.078.629	1.254.915
D.1.8.1 Live animals other than in B 1.6.	645.116	42.220
D.1.8.2 Meat and meat preparations	2.246.652	217.252
D.1.8.3 Dairy products, birds eggs, and honey	2.194.762	627.833
D.1.8.4 Other products from animals (animal fibres, skins, furs, leather etc.)	1.992.099	367.610
D.1.9 Products mainly from biomass	8.315.693	4.801.594
D.2 Metal ores and concentrates, processed metals	**19.478.247**	**4.836.936**
D.2.1 Iron ores and concentrates, iron and steel	11.636.327	2.251.675
D.2.2 non-ferrous metal ores and concentrates, processed metals	2.042.596	412.494
D.2.2.1 Copper	185.377	105.102
D.2.2.2 Nickel	.	.
D.2.2.3 Lead	.	.
D.2.2.4 Zinc	294.502	18.139
D.2.2.5 Tin	.	.
D.2.2.6 Gold, silver, platinum and other precious metals	12.847	1.249
D.2.2.7 Aluminium	1.055.350	210.658
D.2.2.8 Uranium and thorium	.	.
D.2.2.9 Other metals	494.521	77.346
D.2.3 Products mainly from metals	5.799.324	2.172.768
D.3 Non metalic minerals primary and processed	**36.237.541**	**4.889.639**
D.3.1 Ornamental or building stone	475.535	36.549
D.3.2 Limestone, gypsum, chalk, and dolomite	68.531	0
D.3.3 Slate	-	-
D.3.4 Gravel and sand	11.767.544	555.980
D.3.5 Clays and kaolin	1.531.567	104.928
D.3.6 Chemical and fertilizer minerals	6.709.836	1.336.767
D.3.7 Salt	3.993.398	706.150
D.3.8 Other mining and quarrying products n.e.c.	9.814.711	1.881.361
D.3.9 Excavated soil, only if used (e.g for construction work)	-	-
D.3.10 Products mainly from non-metalic minerals	1.876.420	267.906
D.4 Fossil energy carriers, primary and processed	**118.419.373**	**19.180.556**
D.4.1 Brown coal incl. oil shale and tar sands	-	-
D.4.2 Hard coal	8.063.250	306.442
D.4.3 Petroleum	49.003.189	13.697.498
D.4.4 Natural gas	41.781.042	861.653
D.4.5 Peat	900.150	68.366
D.4.6 Products mainly from fossil energy carriers	18.671.742	4.246.598
D.5 Other products	**6.577.596**	**1.954.184**
D.6 Waste imported for final treatment and disposal	**4.607.000**	

F.1 Emissions to air	**213.832.135**
F.1.1 Carbon dioxide (CO2)	211.228.059
F.1.1.1 Carbon dioxide (CO2) from biomass combustion	.
F.1.1.2 Carbon dioxide (CO2) excluding biomass combustion	.
F.1.2 Methane (CH4)	808.102
F.1.3 Dinitrogen oxide (N2O)	57.767
F.1.4 Nitrous oxides (NOx)	591.180
F.1.5 Hydroflourcarbons (HFCs)	0
F.1.6 Perflourocarbons (PFCs)	0
F.1.7 Sulfur hexaflouride	0
F.1.8 Carbon monoxide (CO)	639.368
F.1.9 Non-methane volatile organic compounds (NMVOC)	165.749
F.1.10 Sulfur dioxide (SO2)	155.503
F.1.11 Ammonia (NH3)	134.163
F.1.12 Heavy metals	.
F.1.13 Persistent organic pollutantsPOPs	.
F.1.14 Particles (e.g PM10, Dust)	52.243
F.2 Waste land filled	**0**
F.2.1.a municipal waste - controlled	*0*
F.2.1.b municipal waste - uncontrolled	-
F.2.2.a industrial waste - controlled	*0*
F.2.2.b industrial waste - uncontrolled	-
F.3 Emissions to water	**43.863**
F.3.1 Nitrogen (N)	40.158
F.3.2 Phosphorus (P)	3.277
F.3.3 Heavy metals	427
F.3.4 Other substances and (organic) materials	.
F.3.5 Dumping of materials at sea	.
F.4 Dissipative use of products	**10.075.986**
F.4.1 Organic fertiliser (manure)	6.476.431
F.4.2 Mineral fertiliser	1.934.814
F.4.3 Sewage sludge	27.745
F.4.4 Compost	781.900
F.4.5 Pesticides	5.551
F.4.6 Seeds	459.000
F.4.7 Salt and other thawing materials spread on roads (incl grit)	390.545
F.4.8 Solvents, laughing gas and other	.
F.5 Dissipative losses	**.**

Annex 5: Selected balancing items, the Netherlands 2004, 1000 kilogram.

Balancing items: input side	**334.991.321**
G.1 Gases	
G.1.1 Oxygen for combustion processes	315.944.470
G.1.2 Oxygen for respiration (of humans and livestock)	17.874.562
G.1.3 Nitrogen for Haber-Bosch process	1.172.290
Balancing items: output side	**226.182.221**
G.2 Gases	
G.2.1 Water vapour from combustion	181.256.861
G.2.1.1 from water (H2O) content of fuels	288.854
G.2.1.2 from hydrogen (H) content of fuels	180.968.006
G.2.2 Gases from respitration (of humans and livestock)	44.925.360
G.2.2.1 Carbon dioxide (CO2)	20.856.582
G.2.2.2 Water vapour (H2O)	24.068.778

Annex 6: Aggregated EW-MFA indicators, the Netherlands 2004, 1000 kilogram.

H.1 Domestic extraction (used) (DE)		**224.844.474**
H.2 Imports		**308.062.812**
H.3 Exports		**271.035.319**
H.4 Direct material input (DMI)	DMI = DE + Imports	**532.907.287**
H.5 Domestic material consumption (DMC)	DMC = DE + Imports - Exports	**261.871.967**
H.6 Physical trade balance (PTB)	PTB = Imports - Exports	**37.027.493**
H.7 Domestic processed output (DPO)		**223.951.984**
H.8 Net additions to stock (NAS)	NAS = DE + Imports + Balancing items (input side) - Exports - DPO - Balancing items (output side)	**146.729.084**