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Compilation of physical energy flow accounts (PEFA) for the Netherlands

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COMPILATION OF PHYSICAL ENERGY FLOW ACCOUNTS (PEFA) FOR THE NETHERLANDS

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1. Introduction

There is an increasing demand for good statistics on energy in order to monitor the monetary and physical demand and supply of energy within and between countries. Energy is essential for the economy because nearly all economic activities either directly or indirectly consume energy. The global demand for energy is ever increasing. Upcoming new economies like China, India and Brazil need ever more quantities of energy, and thus the demand for natural resources like coal, oil and gas is increasing. The last few years, energy prices have gone up sharply, which have put the national economies under stress. Security of energy supply is becoming a more important issue for many countries. Furthermore, energy use is closely related to the emission of greenhouse gasses, as most energy use is still associated with fossil fuel consumption. The increasing concerns about climate change lead to more attention for issues related to renewable energy production and energy savings.

The energy accounts represent a consistent framework in which energy data, both in monetary and physical terms, have been integrated into the national accounting framework. Physical energy flow accounts (PEFA) show all energy flows that occur within the economy, with the rest of the world and with the environment. The supply and use tables, part of the system of National Accounts, provide an overall accounting structure for the energy flow accounts in values and quantities. For each energy commodity, they show how much is imported and produced domestically, and how much is used within a country (by intermediate and final consumption) and is imported and exported. The conceptual framework for energy flow accounts is described in detail in SEEA-CF (UN, 2012a) and SEEA-energy (UN, 2012b). A Eurostat taskforce is working on a compilation guide for the energy accounts to be implemented in Europe (Eurostat, 2012).

According to the most recent proposal of Eurostat, physical energy flow accounts will be added to the Regulation on European environmental accounts (No 691/2011). At present, Statistics Netherlands compiles and publishes only so-called net energy accounts (Statistics Netherlands. 2012)[1]. Some work has been done in the past on gross energy accounting, but this is not consistent with the SEEA-CF and the energy accounts that are being developed by the Eurostat taskforce. Also, no time series are yet available for the gross physical accounts.

The first aim of this project is to determine whether it is possible to compile gross physical energy flow accounts (PEFA) for the Netherlands according to the guidelines provided by the SEEA-CF and the Eurostat taskforce on energy accounts. This will improve the net energy flow accounts that are already being published. In addition emission relevant energy accounts will be compiled. This will make the Dutch energy accounts up tot date for the upcoming second round for the legal base for Environmental accounts. The second goal of this study is to provide an overview of the possibilities what you can do with the energy flow accounts. The results of the PEFA will be used to show what indicators can be derived and what kind of analyses can be done (particularly structural decomposition analysis, in combination with the air emission accounts).

[1] The net energy accounts are a subset of the (gross) physical energy flow accounts and show only the energy that is actually consumed for final purposes and imported (use table) and all energy that is extracted within a country and is imported (supply table).

2. Structure and classifications for the energy flow accounts

2.1 Energy flow accounts in SEEA

In SEEA-CF physical flows are recorded by compiling supply and use tables in physical units of measurement. These tables are commonly known as physical supply and use tables, or PSUT (par. 2.38). A key characteristic of the PSUT as described in SEEA is that is takes the perceptive of the economy. It thus describes flows of materials, water and energy that enter and leave the economy and flows of materials and energy within the economy itself. In broad terms, the flows from the environment to the economy are recorded as natural inputs (e.g. flows of minerals, timber, fish, water), flows within the economy are recorded as product flows (including additions to the stock of fixed assets) and flows from the economy to the environment are recorded as residuals (e.g. solid waste, air emissions, return flows of water) (par. 2.14).

Physical energy flow accounts are a special case and subset of the physical flow accounts of SEEA. Energy flow accounts describe energy flows, in physical units, from its initial extraction or capture from the environment into the economy, and within the economy in the form of supply and use, all expressed in quantitative terms (SEEA-E par. 5.5). The compilation of the physical flow accounts for energy allows for a consistent monitoring of the supply and use of energy by energy type and by the economic agents (industries and households).

Structure of the PSUT for energy

PSUT for energy follow the general structure for physical PSUT as described in SEEA-CF (par. 3.152-3,175) and SEEA-E (par. 3.19-3.34). PSUTs are based on the monetary supply and use tables with an additional column for the environment.

2.1.1 General structure of the PSUT

SUPPLY	Industries	Households	Accumulation	ROW	Environment	TOTAL
Natural inputs					A	TSNI
Products	C			D		TSP
Residuals	I	J	K			TSR
TOTAL						

USE	Industries	Households	Accumulation	ROW	Environment	TOTAL
Natural inputs	B					TUNI
Products	E	F	G	H		TUP
Residuals	N		O		Q	TUR
TOTAL						

The columns of the PSUT are structured to reflect both the activity underlying the flow (e.g. production, consumption or accumulation) and the economic units involved.

- The first column (Industries) covers the production and intermediate consumption of energy from natural inputs / energy products / energy residuals by industries.

- The second column (Households) represents the consumption of energy products and the generation of energy residuals by private households. According to the guidelines of SEEA any energy that is extracted by households for their own use (for example the production of solar energy) is an productive activity and should be recorded in column one under the heading of the relevant industry. Here we have deviated from this guideline, in order to show this relevant information.
- The third column (Accumulation) registers changes in energy stock. By convention these are shown in the use table only. In the column for accumulation also a) the supply of waste is shown which is used for energetic purposes (i.e. energy that originated from within the economy but is entering the energy system), and b) the use of energy for non energetic purposes (i.e. energy that stays within the economy but is leaving the energy system) is registered.
- The fourth column (Rest of the world (ROW)) registers the exchanges of energy products between national economies (imports and exports).
- The fifth column (Environment) covers the energy flows from and to the environment.

In the rows the three categories of energy flows are registered (SEEA-CF 3.143-3.151):

- *Energy from natural inputs:* These comprise flows of energy from the removal and capture of energy from the environment by resident economic units. These flows include energy from mineral and energy resources (e.g. oil, natural gas, coal and peat, uranium), natural timber resources, and inputs from renewable energy sources (e.g. solar, wind, hydro, geothermal).

- *Energy products:* Energy products are products that are used (or might be used) as a source of energy. They comprise (i) fuels that are produced/generated by an economic unit (including households) and are used (or might be used) as sources of energy; (ii) electricity that is generated by an economic unit (including households); and (iii) heat that is generated and sold to third parties by an economic unit. Energy products include energy from biomass and solid waste that are combusted for the production of electricity and/or heat. Some energy products may be used for non-energy purposes.

- *Energy residuals:* Energy residuals consist of three different categories. First, and most important, these are the losses of energy. This is primarily energy that is lost as heat after final energetic use, but also energy that is lost during extraction (e.g. flaring and venting), during distribution or storage, and during transformation. Second, these are energy flows that consist of energy that is incorporated into products (non energetic final use). Thirdly, other residuals (solid or fluid waste) that is used for the generation of energy. The energy embodied in solid waste is shown as entering the energy system as a residual flow before becoming an energy product.

Accounting identities

Basis for the PSUT framework are two accounting identities (SEEA-CF 3.35-3.44). The first one is the *supply-use identity*, which is the starting point for the balancing of the PSUT. According to this identity the supply of a certain physical entity (energy) must always equal its use. This identity holds respectively for natural inputs, products and residuals:

A) *Total Supply of Energy from Natural inputs* = Energy flows from environment (A)

is identical to

Total Use of Energy from Natural inputs = Extraction of natural inputs (B)

B) *Total Supply of Energy Products* = Domestic production (including household production on own account) (C) + Imports (D)

is identical to

Total Use of Energy Products = Intermediate consumption (E) + Final Consumption Households (F) + Accumulation (G) + Exports (H)

C1) *Total Supply of Energy residuals* = Energy Residuals generated by industries (I) + Energy Residuals generated by household consumption (J)

is identical to

Total Use of Energy residuals = Residual flows direct to the environment (Q)

C2) *Total Supply of residuals from end-use for non energy purposes* = energy incorporated in products by industries (I) + energy incorporated in products by households (J)

is identical to

Total Use of residuals from end-use for non energy purposes = Accumulation of energy incorporated in products (O)

C3) *Total Supply of Energy from solid waste* = Solid waste from accumulation (K)

is identical to

Total Use of Energy from solid waste = solid waste used by industries as a energy source (N) + solid waste used by households as a energy source (N)

The second accounting identity, known as the *input-output identity*, requires that the total flows into the economy, or an enterprise or household are, over an accounting period, either returned to the environment or accumulate in the economy (SEEA-E par. 2.45). For example, flows of energy into an enterprise in the form of electricity and petroleum products must be released to the environment after using the energy (as losses of residual heat); stored (as inventories for future use); or incorporated into non-energy products (e.g. petroleum products used to manufacture plastics). The input-output identity is valid for the economy as a whole, for a certain industry or for households.

A) For the economy as a whole :

Energy into the economy = Energy flows from the environment (A) + Imports (D)

is equal to

Energy out of the economy = Flows of residuals to the environment (Q)+ Exports (H)

Plus

Net additions to stock in the economy = stock changes (G) + energy incorporated in products (O) - Solid waste from accumulation (K)

B) For industries:

Energy into industries = Extraction of natural inputs (B) + Intermediate consumption (E) + solid waste used as a energy source (N)

is equal to

Energy out of industries = Domestic production (C) + Energy losses generated by industry (I)

C) For households:

Energy into (used by) households = Household final Consumption of energy product (F)

is equal to

Energy out of (supplied by) households =Energy Residuals generated by household consumption (J)

2.2 Classifications and terminology

Energy commodities

Natural energy inputs are grouped into two broader groups: non-renewable natural energy inputs, and renewable natural energy inputs. The Eurostat Task force further proposes to apply the hierarchical classification of natural energy inputs has been derived in a rather pragmatic way from the classification used in European energy statistics (Eurostat, 2012). Generally, physical and monetary flows of energy products should be classified using the *Standard International Energy product Classification* (SIEC) presented in the IRES (SEEA-CF, par 3.149). Often, monetary flows will be classified using the CPC. The classification for energy residuals does not relate to any existing classification and has been developed by the Eurostat Task Force (Eurostat, 2012). The main purpose was to 'accommodate' all potential energy residual flows necessary to balance Tables A and B column-wise for industries and private households.

The classification of energy commodities used for Dutch PEFA tables follows the classification that is available from the energy balances. For energy products this classification can easily be linked to the classification used in the National accounts (which is based on CPC). Annex 1 provides an overview of the classification that has been used.

Industry classification

The Dutch PEFA tables are compiled on the most detailed level available at Statistics Netherlands namely 130 industries. This is the same level at which monetary supply and use tables are constructed and can be analysed. However, this is not the level at which the energy accounts will eventually be published. The classification concurs with the NACE2008 classification.

Terminology

Energy statistics/balances employ their specific terminology which has developed over the past decades (Eurostat, 2012). The same applies for National and environmental Accounts. Unfortunately, the two 'languages' are not consistent and may cause confusion. Table 2 of the draft Eurostat compilation guide for PEFA tables provides a synopsis of important terms and how they are employed in energy statistics.

In this study we use the terminology as is used in SEEA-CF and SEEA-E. However, there is still some confusion with regard to certain items. One important example is the aggregate for 'Net Domestic Energy Use' (as defined in SEEA-CF par. 3.182) which reflects the net amount of energy used in an economy through production and consumption activity. In the PEFA compilation guide this item is called 'total energy use by resident units'.

3. Compilation of the Dutch PEFA tables

The PEFA tables, as proposed by Eurostat, consist of five tables:

1. **Table A:** Physical supply table for energy flows. This table records the supply of natural energy inputs, energy products, and energy residuals (row-wise) by origin (column-wise).
2. **Table B:** Physical use table for energy flows. This table records the use of natural energy inputs, energy products, and energy residuals (row-wise) by destination, i.e. 'user' (column-wise).
3. **Table C:** physical use table of emission-relevant use of energy flows. This table records the emission-relevant use of natural energy inputs and energy products (rowwise) by the using and emitting unit (column-wise). Emission-relevant use of energy denotes the use of energy carriers resulting in physical flows of emissions to air.
4. **Table D:** Key energy indicator 'total energy use by resident units' in a breakdown by industries and households[2]. This indicator can be derived from Tables A, B and C.
5. **Table E:** Bridge table showing the various elements making up the difference between the key energy indicator 'Total Energy Use by Resident Units' contained in Table D and the common key energy indicator as presented by energy statistics 'Gross Inland Energy Consumption'.

In this chapter we will first describe the Dutch energy balance which is the main data source, and next we will focus on the compilation of PEFA table A, B and C. It will also be discussed how a table for own account production / use is compiled.

[2] Here we refer to this indicator as 'Net domestic energy use'.

3.1 Data sources: the energy balances

The energy balances (EB) are the most important source for the derivation of the energy accounts. The Dutch energy balance provides an overview of energy flows in the Netherlands. This consists on the one hand of the indigenous production (extraction), imports and exports and stock changes, and on the other hand of energy consumption. Energy transformations take place, e.g. in the production of electricity from natural gas. Energy balance sheets describe the supply and the type of consumption of energy commodities, but also the energy consumption by industry. The Dutch energy balance sheet is only compiled at the national level. There is no regional breakdown.

The main parameter in the EB is the consumption balance, which is computed on two levels. The first one is calculated on micro level, i.e. for companies (based on survey data) as

indigenous production + supply (i.e. receipts) – deliveries + stock changes = energy consumption

The second one is computed on macro level:

indigenous production + imports – exports – bunkering + stock changes = energy consumption

Energy consumption is a net use concept as it equals total final energy consumption (for energetic and non energetic purposes) plus net energy transformation (i.e. energy losses occurring during energy transformation). Net energy transformation is equal to transformation input – production. Accordingly, we can now deduce total supply and total use for energy carriers according to the energy balances:

Total supply = indigenous production + imports – exports – bunkering + stock changes + production

Which equals

Total use = total final energy consumption + input for transformation

The Dutch EB covers all energy commodities in the Netherlands. Renewable energy sources have since a few years been disaggregated (solar energy, water power, biofuels, etc.).

Next to the energy balances, several other data sources have been used to construct the PEFA tables. These data sources are discussed below.

3.2 Compilation of PEFA table A (supply) and B (use)

Supply table A and Use Table B constitute the core of the energy flow accounts. Compilation takes place in three subsequent steps:

1. Compilation of the physical supply and use tables based on data the energy balances
2. Correction of the supply and use tables for the concepts of the National accounts
3. Allocation of supply and use to different industries and households

Below we will describe these steps in detail.

3.2.1 Compilation of the physical supply and use tables based on data of the energy balances

The Dutch energy balance is a highly suitable source of data for drawing up physical supply and use tables thanks to its comprehensive description of energy production and use, as well as its level of breakdown details.

The first step consists of a reorganising the data from the energy balance into the supply-use framework. Figure 3.2.1 shows how the data items from the energy balances have to be fitted into the supply use framework. Below we also indicate by the letters in which block of the PSUT they are to be recorded (see also figure 2.1.1).

3.2.1 Data items of the energy balances in the supply use framework

SUPPLY		Industries	Households	Accumulation	ROW	Bunkering	Environment	TOTAL
Natural inputs							Total indigenous production	
Products		Production + indigenous production			Imports			
Residuals	Waste			From accumulation				
	Energy incorporated into products	Final consumption for non-energetic purposes						
	Losses during transformation	Net energy transformation						
	Other losses	Other losses						
	Residual heat losses	Final consumption for energetic purposes						
TOTAL								

USE		Industries	Households	Accumulation	ROW	Bunkering	Environment	TOTAL
Natural inputs		Indigenous production						
Products		Total final energy conmsumption + total transformation input		Stock changes	Exports	Bunkers		
Residuals	Waste	Indigenous production						
	Energy incorporated into products			To accumulation				
	Losses during transformation						Total transformation losses	
	Other losses						Total other losses	
	Residual heat losses						Total residual heat losses	
TOTAL								

A) Natural inputs

Use of natural inputs (B) is equal to total indigenous production by industry/sector, as is directly recorded in the EB. For some energy carriers such as waste, nuclear energy and biofuels, the use is registered in EB as indigenous production, while according to SEEA these are products or residuals. Accordingly, the “extraction” of these energy carriers is not inserted in the natural inputs block (B), but in block N (Use of residuals for energy purposes) or E (intermediate consumption of energy products).

By definition all natural inputs are supplied by the environment (A).

B) Energy products

Supply of energy products is equal to production by industries + indigenous production by industries (both C) + imports (D)

Use of energy products is equal to total final energy consumption by industries (E) and households (F) + transformation input by industries (E) and households (F) + stock changes (G) + exports (H) + bunkering (in separate column, in the next step to be redistributed)

All these variables can directly be obtained from the EB. Stock changes in the energy statistics are defined as opening stock minus closing stock. Positive values thus indicate that the stock has diminished and negative values that the stock has increased.

According to SEEA ‘Energy products include energy from biomass and solid waste that are combusted for the production of electricity and/or heat (SEEA-CF 3.146)’. Accordingly, when waste is used to produce heat or electricity, it has to be recorded both in the use (E) and supply table (C). This thus results is double counting (in fact the production and use of waste as a product is own account production / use).

C) residuals

Waste: In the energy balances biogenic waste and other waste are identified separately. The use of waste that has to be recorded in the use table (N) and is equal to indigenous production in the EB (as it is recorded that way in the energy balances). In addition, the biomass that has been recorded in the production block (C) has to be counterbalanced in the residual block and thus has to be added to the row of waste. Biomass may also be directly harvested from the environment, but this is (at present) not the case for the Netherlands. By definition, all waste is supplied from the accumulation column (K).

Energy incorporated in products: Energy incorporated in products (I) that is recorded in the supply table can be directly obtained from the energy balances by sector as this is equal to final energy consumption for non energetic purposes. By definition, in the use table these are recorded in the accumulation column (O).

Transformation losses: Transformation losses (I) that are recorded in the supply table can be directly obtained from the energy balances by sector as this is equal to the net energy transformation. By definition, in the use table these losses are recorded in the environment column (Q).

Residual heat losses: Residual heat losses (I) that are recorded in the supply table can be directly obtained from the energy balances by sector as this is equal to energetic final energy use. By definition, in the use table these losses are recorded in the environment column (Q).

Other losses: For two other kind of losses information is available: Losses that occur during flaring and venting from the oil and gas extraction and distribution losses of electricity. Supply of these losses is again recorded in block I. By definition all use is recorded in the environment column (Q) .

The sector ‘transport’, which in the energy balance is not allocated to NACE or households, is in this step recorded as four different columns (rail, road, water and air transport).

The result of step 1 is a supply and use table where both supply equal use, but also the columns for industries and households in de supply and use table are equal (input output identity).

3.2.2 Correction of the supply and use tables for to the concepts of the National accounts

In the drawing up of the physical supply and use tables it is important to concur with the conventions of the national accounts. The main conceptual difference between energy balances and accounts is the geographical coverage (IRES 11.11; SEEA-CF 3.178). The reference territory for the energy balances is the national territory and statistics are compiled for all the units physically located on the territory. Units physically located outside the territory are considered as part of the rest of the world. This coverage is referred to as the territory principle. The energy accounts, on the other hand, use (consistent with the national accounts) the concept of the economic territory with statistics compiled for all the units resident of that economy independently on where they are physically located). A resident of a country is an institutional unit with a centre of economic interest in the economic territory of that country. Units resident outside the territory are considered as part of the rest of the world. This coverage is referred to as the residence principle.

A) Adding energy use by residents abroad and subtracting energy use by non residents

Several data sources have been used to correct for the resident principle for the different transport modes:

a) Road transport: Traffic statistics provide information on kilometres driven by specific vehicle type. Using information on the specific energy use (i.e. energy use per kilometre) the energy use can be calculated. Traffic statistics in the Netherlands are based on register information. They thus provide information on resident units which can be directly used to estimate the total energy use. Traffic statistics provide information both on the total kilometres driven by residents abroad and kilometres driven in the Netherlands by non residents.

b) Water transport: For inland water transport data are available on ton kilometres, both by residents domestically and abroad and by non residents. Using data on specific energy use the associated energy use can be calculated. For sea shipping monetary data on fuel use is available from the production statistics which can be confronted with price information to calculate the associated energy use in physical terms.

c) **Air transport:** The energy use from the largest Dutch airline is known directly from the annual environmental report. From the production statistics the total share of this airline in total air transport (ca. 70 %) is know and this is used to calculate the total use of jetfuel.

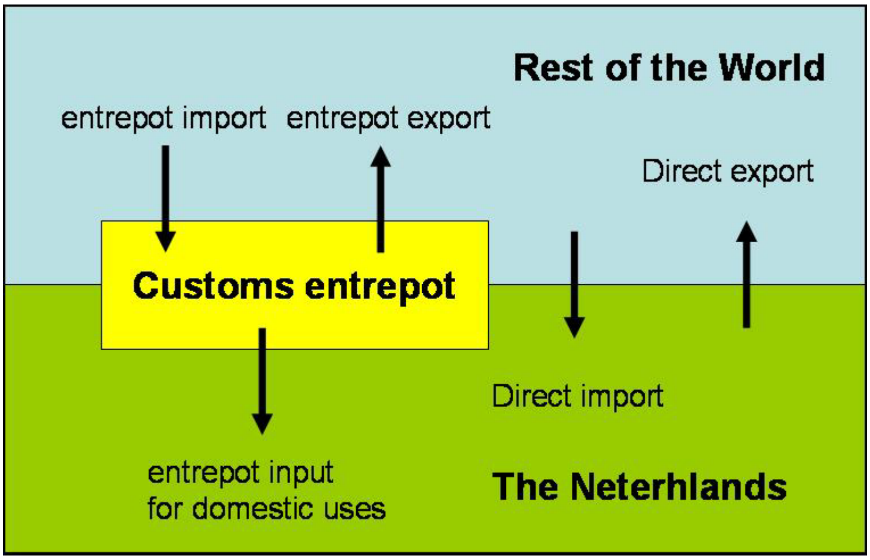
d) **Fisheries:** Statistics on fisheries provide information on the total use of diesel and fuel oil.

Subsequently, this information is inserted in table A and B. The use of non residents is recorded in a separate column as part of export. The use of residents abroad is recorded in a separate column as import. The columns for rail, road, water and air transport are overwritten with the information on total energy use by residents. Finally, the column for bunkering in the use table is adjusted: this now only records bunkering to non residents (which is part of exports). Finally, a check is made that supply still equals use and that also the input-output identity still holds for different industries and the economy as a whole. Differences are corrected on the exports.

B) Conceptual translation of import / export data from the energy balances into National accounts

Import and export of energy products is differently treated in the EB and the National accounts. The EB records all energy commodities entering or leaving the national territory. This includes energy products entering the so called customs entrepot. For the Netherlands this is very important. In Rotterdam, one on the largest harbours in the world, a lot of imports are re-exported again. In the national accounts goods entering and leaving the customs entrepot (which are products in transit through the economic territory) are excluded from the international trade statistics, as the customs entrepot is considered not to be part of the national economy (see figure 3.3.2). Accordingly, the physical import / export data from the EB have to be corrected to make them correspond to national accounts definitions. The corrected imports and exports were added to the physical supply and use tables created in the previous section.

3.2.2 Different import and export flows between the Netherlands and the ROW



3.2.3 Allocation of supply and use to different industries and households

In the energy flow accounts, the presentation of statistics for economic activities and households strictly follows the principles of classification and the structure of the International Standard Industrial Classification of All Economic Activities (ISIC). Thus, information on any specific enterprise/establishment (be it on the production or on the consumption side) is presented under the ISIC division/class of the principal activity of the unit involved. The energy balances, however, do not follow the same principle as information on a specific enterprise/establishment is not explicitly linked to the relevant ISIC division/class of the unit involved, rather it is presented in different section of the balances depending on the type of use and the ISIC division/class of the unit involved.

In the last important step the columns for industries/ households in the supply and use tables have to be disaggregated to the 130 industries and households. For this purpose, several data sources were used:

- More detailed information of the energy balances (microdata) was used to allocate supply and use of energy products by the manufacturing industries.
- The statistics on renewable energy provide much information which can be used to assign both supply and use of the different energy products / natural inputs to the different industries.

Most important is the allocation of electricity, natural gas and motorfuels, as these are the energy commodities that are used by almost all industries. Below, it is described in detail how this allocation was done. It should be noted that the reallocation key was calculated for one year (2009) only. For this moment, this key was also applied to the time series. Clearly, future research is needed to also correct the time series before the PEFA tables can be published.

Motorfuels

The monetary allocation of motor fuels for road transport to industries and households is compiled in three steps by using the different data sources plus a key variable on the capital stock of motor vehicles.

Step 1: assessing use of motor fuels by households and industries

Traffic statistics, which are based on register information, include information whether the vehicles are owned by households or businesses. Accordingly, by combining the information from the traffic statistics on total distance travelled with data from this same source on the specific use by vehicle type and fuel type, the physical use of motor fuel by households and industries can be determined. In the Netherlands, households use approximately 57 percent of all motor fuels for road transport.

Step 2: imputing information for some specific industries

Information on the use of motor fuels from the production statistics can be used to assess the monetary value of the motor fuels for some specific industries. This applies industries where these costs are very relevant, namely:

a) Wholesale and retail trade and repair of motor vehicles and motorcycles (ISIC 45)

b) Other land transport (ISIC 492-494), including freight transport, public transport and taxi services

c) Warehousing and support activities for transportation (ISIC 52)

d) Postal and courier activities (ISIC 53)

e) Rental and leasing activities (ISIC 77)

Although the number of industries for which information is available is limited, these are industries that are very relevant with respect to the total amount of motor fuels that has to be allocated in total, namely 26 percent of total motor fuel use. The physical use can be determined using price information.

Step 3: using a key variable for the industries that are left

To allocate the remaining motor fuel use to industries, which is 16 percent for 2009, a key variable was used, namely the capital stock of motor vehicles. It is thus assumed that the use of motor fuels is proportional to the total stock of motor vehicles owned by the different industries. For diesel the total stock of motor vehicles for road transport was used, for petrol and LPG the capital stock of private cars was used. In the near future, traffic statistics may also yield information on industries, which will greatly improve the allocation of motor fuels.

Natural gas and electricity

Natural gas and electricity are energy products that are used by almost all industries in the Netherlands. For most industries in the service sector, they also constitute the most important form of energy use. In addition, combustion of natural gas is also the prime source of CO_2-emissions for most industries. Therefore, it is very important to get the allocation of these energy products right. Below, we describe how we have allocated the use of natural gas and electricity.

A) Agriculture

In agriculture, most natural gas and electricity is used in horticulture. Production and use of energy by horticulture is monitored in the Netherlands by LEI (Landbouw-Economisch Instituut; Agricultural Economics Institute Foundation). For the other industries within agriculture, data is available from our energy statistics which are also based on LEI data.

B) Mining, manufacturing, electricity and water supply and environmental services
For these industries, the energy balance provides detailed information on a NACE 2-digit level and sometimes even a 3-digit level. When more disaggregation was needed, production statistics were used (total energy use in monetary terms).

C) Building and service industries
A number of different data sources was used to disaggregate the use of natural gas and electricity to the different industries within the building and service industries. A recent new data source are the registers from energy companies that can be used to allocate the use of natural gas and electricity to industry at letter level. Further disaggregation was done using monetary information from the production statistics (total energy use). If no production statistics were available (for example for the financial sector) the number of employees was used to make the final disaggregation.

3.3 Compiling table for own use

According to the guidelines of SEEA, the (gross) physical supply and use tables include own account production / use of energy products. Own account activities consist of the production and use of goods and services within an establishment or household. With respect of energy, these are energy products that are produced and consumed within the same company, for example refinery gasses that produced by refineries and used as an energy source to sustain to the refinery process, or electricity produced in horticulture that is directly used in the greenhouses. It is not sold on markets and therefore most likely not recorded in monetary accounts.

Own account production / use can be calculated from the data provided by the energy balances:

Total production of energy plus indigenous production of energy – total deliveries – stock changes

Subsequently, own account production / use can be subtracted from the respectively total production and total intermediate consumption. These tables are now fully consistent with the SNA supply and use tables and can be used to calculate monetary supply and use tables.

3.4 Compiling the table for emission relevant energy use

The gross use table includes all energy products used for economic activities. Emission-relevant use of energy denotes the use of energy carriers resulting in physical flows of gaseous or particulate materials to the atmosphere, such as CO_2, CH_4, NOx, SO_2, PM10 etc. The majority of emission-relevant energy use relates to the combustion (i.e. oxidation) of energy carriers resulting in emissions. Emission relevant energy use may also relate to venting, e.g. of methane in the mining industry. Emission relevant energy use is also related to certain industrial production processes for instance in the refinery and chemical industry.

It is important to note that emission relevant energy use cannot be directly obtained from PEFA tables B (use table). Some energy products are used for non energetic purposes (which cannot always be deducted by the nature of the energy commodity). Also, some use for energy transformation does not always lead to emissions.

Emission relevant energy use can be obtained from the energy balances:

Total final energy consumption for energetic purposes + electricity and CHP transformation input.

However, this excludes emissions from a) venting and flaring and b) process related emissions (other than the conversion into electricity and heat). This last group are some very specific industrial processes with also some very specific emission coefficients. They are best added separately and therefore excluded from the table as currently compiled.

The compilation for this table is the same as for the use table B (see par. 3.2). The main difference is that in step 1 not total final use plus transformation input from the EB are inserted in blocks E and F, but only total final energy consumption for energetic purposes + electricity and CHP transformation input.

4. Results

4.1 Overview of the compiled tables

The following tables have been compiled:

PEFA Table A (Supply) for 1995-2011

PEFA Table B (Use) for 1995-2011

PEFA Table C (emission relevant use) for 1995-2011

Examples of these tables (with aggregated industry classification) can be found in Annex II

4.2 Comparison with previous net domestic energy use data

In Table 4.1.1 we made a comparison between the results obtained from the old and new methodology for net domestic energy use. Total net domestic energy use is 0,9 percent lower then the previous estimate for 2011. For the different industries absolute and relative changes vary. The new structure of the supply and use table, from which net energy use is deducted certainly is the cause for some of the differences. However, the most important reason for the differences are some new data sources that have been used:

- For the allocation of electricity, natural gas and motorfuels new source data was used (see par. 3.2.3), which resulted in large shifts between industries (particularly in the service industries).
- Total use of motorfuels is now based on traffic statistics (and not on the energy balance). This was done because traffic statistics provide a good data source on the use of motorfuels (based on comprehensive register data) which is also used for the calculation of the air emissions. For diesel use by road traffic this resulted in a large difference.
- For sea shipping and inland shipping a new data source (production statistics) was used.
- For agriculture some additional data sources were used

4.1.1 Net energy use according to the new and old data

Industry	2011 New PJ	2011 Old PJ	Abs, change PJ
A Agriculture, forestry and fishing	154,0	151,5	2,5
B Mining and quarrying	49,6	49,2	0,4
C Manufacturing	1303,5	1309,8	-6,3
10-12 Manufacture of food and beverages	84,8	88,7	-4,0
13-15 Man. of textile-, leatherproducts	4,7	5,3	-0,6
16 Manufacture of wood products	3,9	3,5	0,3
17-18 Manufacture of paper, printing	30,1	29,4	0,7
19 Manufacture of coke and petroleum	189,6	191,8	-2,3
20 Manufacture of chemicals	749,0	751,4	-2,3
21 Manufacture of pharmaceuticals	5,4	5,6	-0,2
22 Manufacture rubber, plastic products	9,7	7,1	2,6
23 Manufacture of building materials	29,2	29,1	0,1
24 Manufacture of basic metals	136,3	135,8	0,5
25 Manufacture of metal products	10,7	17,8	-7,1
26-27 Elektrical and electron. Industry	8,6	6,1	2,4
28 Manufacture of machinery n.e.c.	27,7	26,7	1,0
29-30 Transport equipment	4,3	4,9	-0,5
31-33 Other manufacturing and repair	9,6	6,6	3,1
D Electricity and gas supply	340,4	340,1	0,3
E Water supply and waste management	83,4	72,5	10,9
F Construction	56,6	42,5	14,1
G+I Trade, hotels, restaurants, bars	126,4	139,0	-12,7
H+J Transport, ICT	441,0	432,8	8,2
K-L Financial services and real estate	41,7	28,3	13,4
M-N Business services	60,1	75,2	-15,1
O-U Noncommercial services	145,0	174,3	-29,3
Total private households	664,3	682,8	-18,5
Total economic activities	3466,1	3498,0	-31,9

5. Applications of the Energy flow accounts

Energy flow accounts provide the opportunity for many different uses and applications. In this chapter we will focus on two aspects. First, a comprehensive overview will be provided and discussed of the useful aggregates and indicators that can be derived from the energy flow accounts. Next, as an example of a more in-depth analysis, the results of a structural decomposition analyses for energy will be presented.

5.1 Indicators

Indicators are quantitative parameters that can be used to illustrate and communicate complex phenomena in a simple way. They make it possible to quantify the development and progress of the phenomenon over time, and if the necessary data is available, between countries. They are often aggregates which provide summary measures for the developments in question. This makes them very useful to communicate broad developments to wider audiences.

Several important aggregates and indicators can be directly derived from the energy flow accounts. In addition, integration of energy accounts with other sources of information is important and can provide greater insights for policy makers, researchers, and other users of the energy accounts (SEEA-E 7.1). Chapter 7 of SEEA-E (uses of the energy accounts) highlights some key applications of the energy accounts, but does not provide an overview of the most important indicators that can be derived from the framework. The draft PEFA manual by Eurostat (so far) only mentions two important indicators, namely Gross energy input and Net domestic energy use. In this section we will describe in detail all possible aggregates that can be derived from PEFA tables A and B, describe indicators that can be derived by combining aggregates, and describe indicators that are obtained when combining the physical information with monetary data. As a result, we will present a list of some key energy indicators.

5.1.1 Aggregates from PEFA tables A and B

As a first step, we have identified all possible aggregates by looking at the structure of Tables A and B (Figure 2.1.1). For each block these can be the row totals, column totals or the block total. Furthermore, there are the totals of the columns and the rows of the tables. Figure 5.1.1 provides and overview of the aggregates in Tables A and B, Table 5.1.2 provides a complete list of all aggregates plus a description.

5.1.1. Different aggregates in Table A and B

SUPPLY	Industries		Households	Accumulation		ROW		Environment	TOTAL
Natural inputs								A	TSNI1
								A2	TSNI
Products	C	C1				D	D1		TSP1
	C2	Ct				D2	Dt		TSP
Waste				K					
				K2					TSRw
Losses	I	I1	J						TSR1
	I2	It	J2						TSR
TOTAL	TSI		TSH	=K2		=D2		=A2	

USE	Industries		Households	Accumulation		ROW		Environment	TOTAL
Natural inputs	B				B1				TUNI1
	B2				Bt				TUNI
Products	E	E1	F	G	EFG1	H	H1		TUP1
	E2	Et	F2	G2	EFGt	H2	Ht		TUP
Waste	N		Nh						
	N2				Nt				TURw
Losses				O				Q	TUR1
				O2				Q2	TUR
TOTAL	TUI		TUH	=G2+O2		=H2		=Q2	

5.1.2 Overview of all aggregates in PEFA tables A and B

Aggregate	Equal to other aggregates	Double counting	Description
SUPPLY TABLE			
Natural inputs			
TSNI1	A; B1; TUNI1		Total extraction of individual natural energy inputs by economic activities
A2	TSNI; Bt; TUNI		Total energy inputs from the environment. This is the total amount of energy extracted by (national) economic activities
TSNI	A2; Bt; TUNI		Total energy inputs from the environment. This is the total amount of energy extracted by (national) economic activities
Energy products			
C1			Total domestic production of individual energy products by economic activities (includes production from extraction)
C2		(X)	Total energy production for individual industries (includes production from extraction)
CTt		X	Total domestic energy production by economic activities (Includes production from extraction)
D1			Total imports for individual energy products
D2			Imports by different categories (direct imports, imports via fuels by transport activities)
Dt			Total imports of energy products. The total amount of energy products imported
TSP1	TUP1		Total supply of individual energy products (i.e. total amounts of energy products available for use)
TSP	TUP	X	Total supply of energy products (i.e. total amounts of energy products available for use)
Waste			
K2	K; TURw; TSRw		Total supply of waste used for energetic purposes
TSRw	K; K2; TURw		Total supply of waste used for energetic purposes
Losses			
I1			Total energy losses generated by production activities by different 'loss' categories
I2			Total energy losses generated by individual industries. This is the net domestic energy use for individual industries.
It			Total energy losses generated by industries. This is the net domestic energy use by production activities.
J2			Total energy losses generated by households. This is the net domestic energy use by household consumption activities.
TSR1	TUR1		Total energy losses generated by economic activities by different 'loss' categories
TSR	TUR		Total energy losses generated by economic activites. Total net domestic use of energy by economic activities.
TOTALS			
TSI	TUI	(X)	Total energy input/output for individual industries. This is the total energy requirement of individual industries,
TSH	TUH	(X)	Total energy input/output for households
USE TABLE			
Natural inputs			
B1	TUNI1; TSNI1; A		Total extraction of individual natural energy inputs by economic activities
B2			Total extraction of natural energy inputs by individual industries
Bt	TUNI; A2; TSNI		Total energy inputs from the environment. This is the total amount of energy extracted by (national) economic activities
TUNI1	B1; A; TSNI1		Total extraction of individual natural energy inputs by economic activities
TUNI	A2. Bt; TSNI		Total energy inputs from the environment. This is the total amount of energy extracted by (national) economic activities
Energy products			
E1			Total intermediate consumption of individual energy products
E2		(X)	Total intermediate consumption of energy products for individual industries
Et		X	Total intermediate consumption of energy products (gross use)
F2			Total household consumption of energy products
G2			Total net inventory changes
EFG1			Total use of individual energy products by economic activities
EFGt		X	Total use of energy products by economic activities (gross use)
H1			Total exports for individual energy products
H2			Exports by different categories (direct exports, exports via fuels by transport activities)
Ht			Total exports of energy. The total amount of energy products exported
TUP1			Total use of individual energy products (i.e. total amounts of energy products available from supply)
TUP	TSP	X	Total use of energy products
Waste			
N2			Total use of waste for energetic purposes by individual industries
Nt	K2; TURw; TSRw		Total waste used for energetic purposes
Losses			
O2			Total energy incorparated in products
Q2			Total flow of energy related residuals to the environment
TUR1	TSR1		Total energy losses generated by economic activities by different 'loss' categories
TUR	TSR		Total energy losses generated by economic activites. Total net domestic use of energy by economic activities.
TOTALS			
TUI	TSI	(X)	Total energy input/output for individual industries
TUH	TSH	(X)	Total energy input/output for households

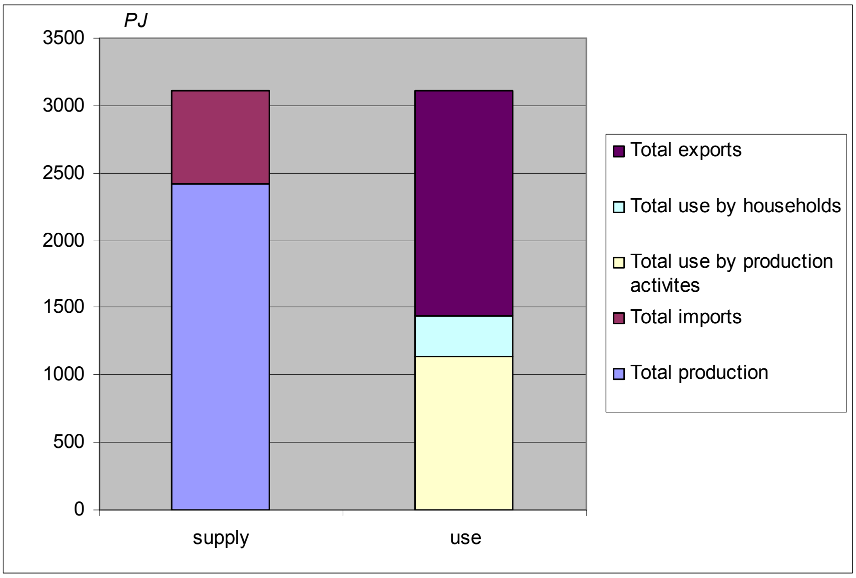
Next, this long list can be shortened. First, a lot of aggregates are equal to others (because of input-output and the supply-use identities). Secondly, some aggregates are subject to double counting, making them less useful. We can now rearrange the remaining aggregates into four categories, namely whether they provide information on individual energy carriers (energy mix), for (individual) industries and households, for the economy as a whole, and an 'other category.

1) Indicators for individual energy commodities (energy mix)

1	TSNI1; A; B1; TUNI1	Total extraction by economic activities
2	C1	Total production by economic activities
3	D1	Total imports
4	TSP1; TUP1	Total supply / use
5	E1	Total intermediate consumption
6	EFG1	Total use by economic activities
7	H1	Total exports

These indicators primarily describe the supply-use relationship for energy products: Total production plus total imports equals total use by production activities plus total use by households plus total exports (see 5.1.3 as an example for natural gas). Indicator 6 (total use by economic activities) equals intermediate use plus household consumption plus net inventory changes. Indicator 1 is related to natural energy inputs.

5.1.3 Supply and use of natural gas (2011)



2) Indicators for individual industries and households

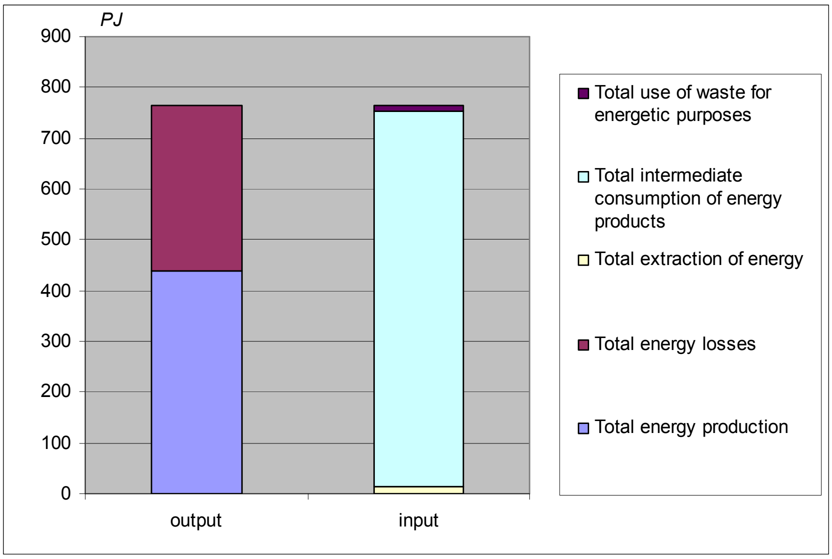
1 J2	Net domestic energy use by household consumption activities
2 F2	Total household consumption of energy products
3 C2	Total energy production
4 I2	Total energy losses (net domestic energy use)
5 B2	Total extraction of natural energy inputs
6 E2	Total intermediate consumption of energy products
7 N2	Total use of waste for energetic purposes
8 TSI; TUI	Total energy input/output (energy requirement)

Most of these indicators are part of the input-output identity for individual economic activities, namely total energy production plus total energy losses (net use) equals Total extraction of energy plus Total intermediate consumption of energy products plus total use of waste for energetic purposes(see 5.1.4 as an example NACE 35).

Total production (C), total use (E) and thus also total energy input/output (TSI, TUR) includes own account production /use and thus double counting. This can be corrected by subtracting own account use / production.

Note that the two indictors for households are almost the same as households produce only small amounts of energy (usually for own use only).

5.1.4 Input and output of energy for NACE 35 (electricity producers)



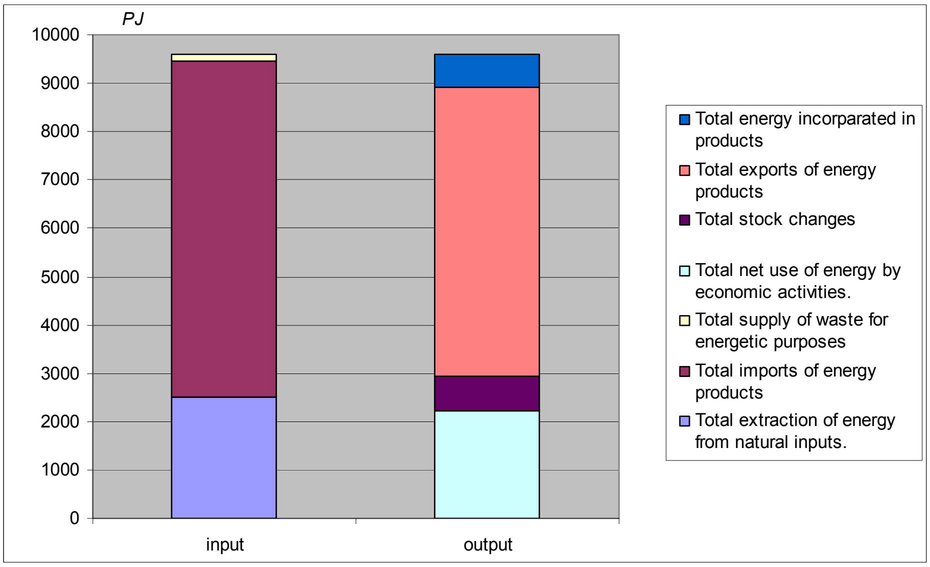
3) Indicator for the economy as a whole

1	A2; TSNI; Bt; TUNI	Total energy inputs from the environment.
2	Dt	Total imports of energy products
3	K2; Nt; TURw; TSRw	Total supply of waste for energetic purposes
4	IT	Total net domestic energy use by production activities.
5	TSR; TUR	Total net domestic energy use by economic activities.
6	G2	Total net inventory changes
7	Ht	Total exports of energy products
8	O2	Total energy incorparated in products
9	Q2	Total flow of energy related residuals to the environment

Most of these indicators are part of the input-output relationship for the economy as a whole, namely that domestic energy inputs plus imports plus waste inputs use for energetic purposes must equal net use of energy (energy losses) plus exports plus energy incorporated in products plus stock changes. Figure 5.1.5 shows how these aggregates relate to each other. Indicator 4 (energy losses by production activities) is part of total net energy use by economic activities. Energy incorporated by products plus total energy losses by economic activities make up total net energy use by economic activities.

Finally, the **Gross energy input** is an aggregate which can now easily obtained as this is equal to the total input (or output) to /from the economy (i.e. domestic energy inputs plus imports plus waste inputs use for energetic purposes).

5.1.5 Total input and output of energy for the Dutch economy (2011)



Other indicators

1 D2	Imports by different categories
2 H2:	Exports by different categories
3 I1	Total energy losses from production activities by different 'loss' categories
4 TSR1	Total energy losses by economicactivities by different 'loss' categories

These 'other' indicators provide information on the nature of imports / exports (i.e. the imports associated with respectively the use of energy by residents abroad and non residents) and the nature of the different energy losses (i.e. extraction, distribution and storage, transformation and residual heat losses).

5.1.2 Indicators obtained from combining aggregates

Beside the direct aggregates that can be obtained from the energy PSUT, also a number of important indicators can be obtained by combining different aggregates. Below we describe five of these cases.

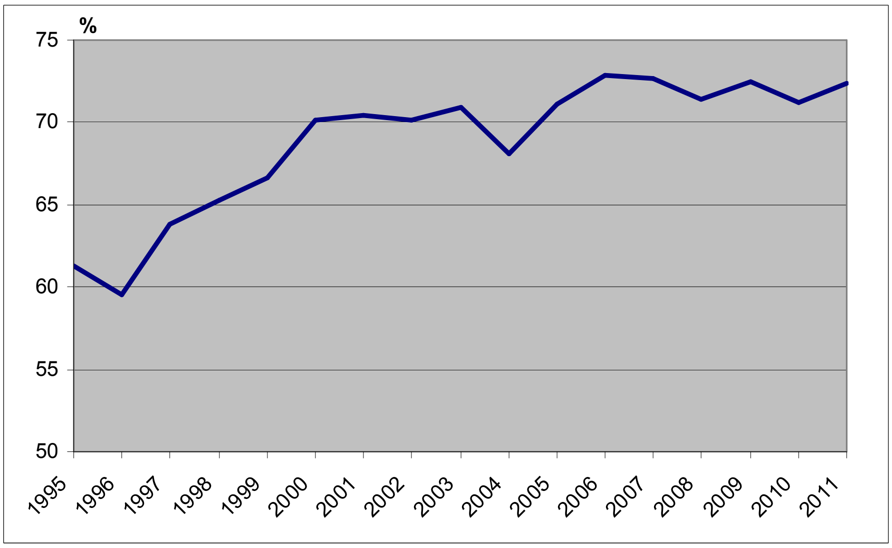
1) Energy dependence

Energy dependency, i.e. how dependant are we from imports for our energy use, is an important policy issues. There are several ways to construct an indicator for energy dependence. The most straightforward indicator is:

Total energy imports (D) / total primary inputs (A+D+TURw)

The energy dependency as defined above can also be calculated for individual energy carriers.

5.1.6 Energy dependence on imports



As primary inputs include energy for re-exports, this may somewhat obscure the energy dependency on imports that is needed to satisfy domestic energy use. For the Netherlands for example, where a lot of oil products and also natural gas is directly re-exported, the calculated energy dependency may look rather high. Another, more difficult method, is to calculate how much of the net energy use was obtained from imports. This has been done for the Netherlands and results in a lower rate of dependence of 56 percent in 2011 (Statistics Netherlands, 2012).

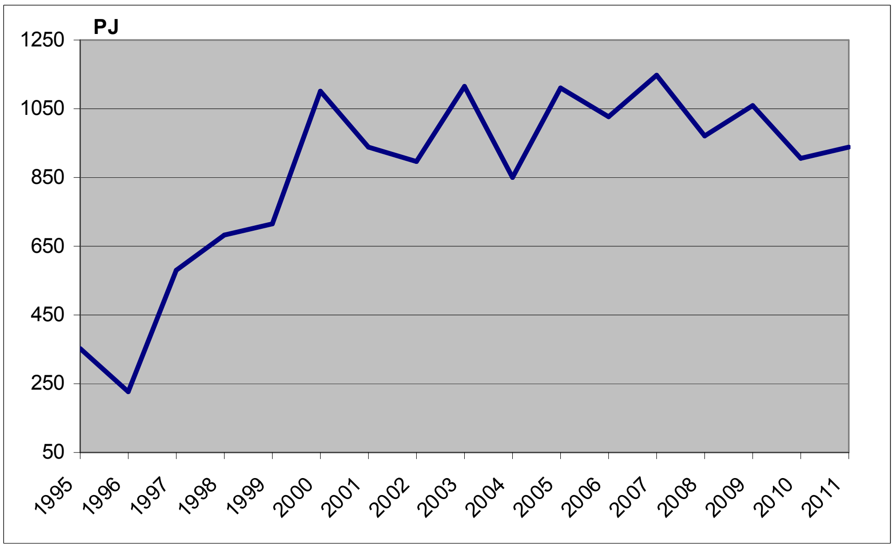
According to the definition used by Eurostat (which is based on the energy balances) the energy dependency rate is equal to the proportion of energy that an economy must import. It is defined as net energy imports divided by gross inland energy consumption plus fuel supplied to international marine bunkers, expressed as a percentage. A negative dependency rate indicates a net exporter of energy while a dependency rate in excess of 100 % indicates that energy products have been stocked. This indicator seems more difficult to interpret. For the Netherlands, the energy dependence would be around 31 percent (2010) according to this definition.

Clearly, these different approaches result in very different figures, surveying very different messages.

2) Net imports

Related to energy dependency (but not the same) is the indicator for the energy trade balance (net imports). This can simply be calculated as imports (D) minus exports (H). This indicator will show if an economy is a net importer of net exporter of energy and how this changes in time. This indicator can also be calculated for individual energy carriers.

5.1.7 Net imports

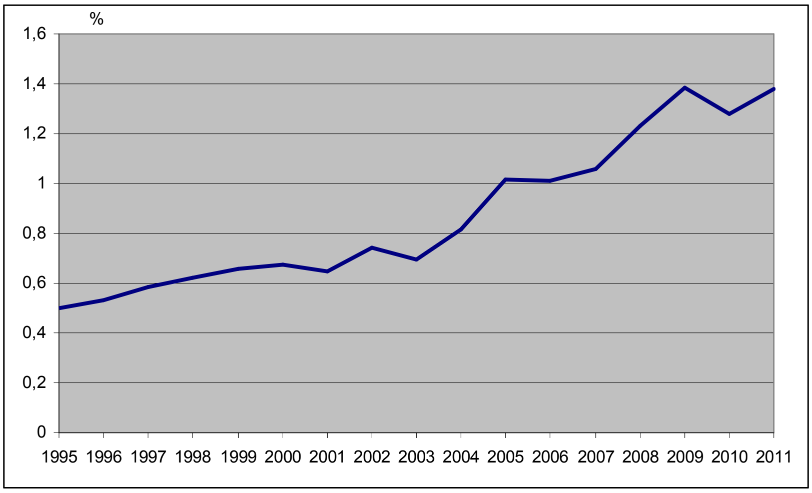


3) Share of renewables

The share of renewables for the economy as a whole can be calculated as share of renewables in total primary inputs:

Renewables in primary energy inputs (A) plus renewables in imports[3] (D) plus renewables in waste inputs (TURw) / total primary inputs (A+D+TURw)

5.1.8 Share of renewables in total primary inputs



The share of renewables for individual economic activities can be calculated as share of renewables in total primary inputs (equals total output):

Use of renewables in energy inputs (B) plus use of renewables in products[4] (E) plus renewables in waste inputs (N) / total primary inputs

The most commonly used indicator (based on the energy balances) is the share of gross final consumption of renewables in total energetic final consumption. The

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[3] This includes biomass but not electricity generated from renewable sources.

[4] This includes biomass but not electricity generated from renewable sources.

gross final consumption of renewable energy follows the definition from the EU directive for renewable energy from 2009. It is calculated as the sum of three parts:

1. Gross production of electricity from renewable sources
2. Gross production of sold heat from renewable sources
3. Final consumption of energy from the earth, outdoor air, the sun and biomass.

This indicator is thus calculated by dividing production by consumption. Accordingly, the share may theoretically be higher than 100 % (when the renewable energy in excess is exported). It is thus implicitly assumed that all domestic production of electricity and heat from renewable sources is for domestic uses only.

4) Share of primary energy in total input

Primary energy commodities are energy commodities from the environment and made available by indigenous production, e.g. hard coal, crude oil, natural gas, biomass and waste. Wind, solar and hydro energy is seen as a separate primary energy commodity which, after extraction, is transformed into electricity with a yield of 100 percent. Secondary energy commodities, e.g. motor fuels, electricity and hot water, are energy commodities obtained by transformation of primary energy commodities.

The share of primary energy in total input can be calculated as:

Primary energy commodities in energy inputs (A) plus Primary energy commodities in imports[5] (D) / total primary inputs (A+D+TURw)

5) Transformation efficiency

The transformation efficiency may be calculated for industries that are active in the production of energy:

Production of energy products / (production of energy products plus transformation losses)

5.1.3 Ratio indicators: combining physical and monetary data

Since the environmental accounts are consistent with the national accounting system, various so called ratio indicators can be calculated. Combining the information in the accounts with supplementary demographic and economic information makes it possible to calculate energy use per capita or per unit of GDP for example (SEEA-E 7.6). A lot of possible combinations are possible, below the describe only the most important ones:

1. *Decoupling indicators*

   Physical energy use data combined with value added or GDP provides the energy intensity (or energy productivity). Most common indicator is net domestic energy use divided by GDP or value added.

2. *Per capita indictors*

   Energy use data can also be divided by the total number of the population to provide per capita numbers.

[5] This includes biomass but not electricity generated from renewable sources.

3. *Average energy prices*

   By dividing the physical use or production of energy products by the monetary data on energy use from the supply and use tables (National accounts), average energy prices can be calculated. This is particularly relevant for individual energy commodities, but also for individual industries.

5.1.4 Summary

Table 5.1.9 provides an overview of the most important aggregates / indicators that can be obtained from PEFA Tables A and B.

Table 5.1.9

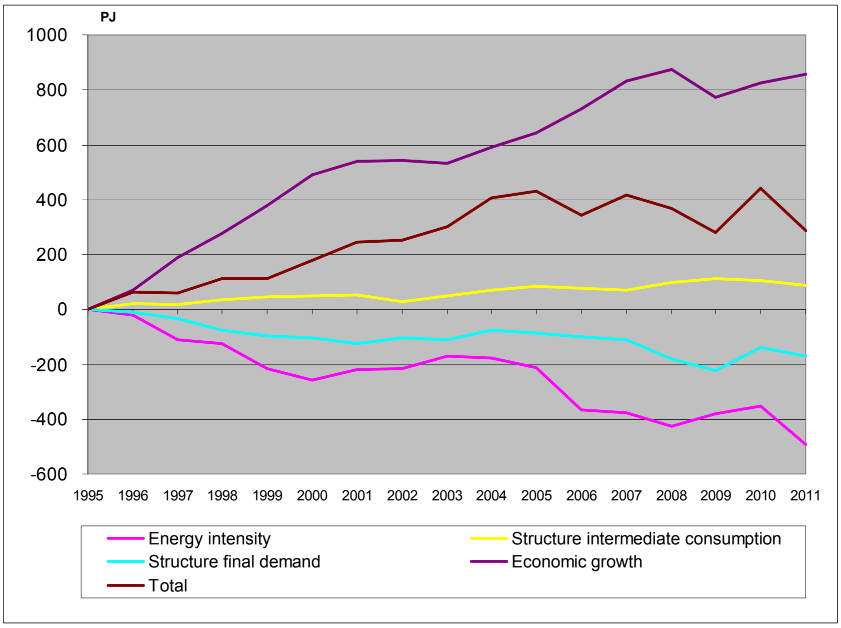
Physical indicators	Ratio indicators
Total economy	
Gross energy input	energy intensity/productivity
Total net domestic energy use by economic activities	
of which by production activities	energy intensity/productivity
of which by consumption activities	
Total energy inputs from the environment.	
Total use of waste for energetic purposes	
Net imports	
Energy dependance on imports	
Share of renewables	
Individual Industries	
Total energy requirement	energy intensity/productivity
of which energy products (intermediate consumption)	average price energy use
Total energy production	average price energy production
Total net domestic energy use	energy intensity/productivity
Transformation efficiency	
Households	
Total net domestic energy use	net domestic energy use per capita
Individual energy commodities	
Total extraction	
Total production	average price
Total imports	average price
Total exports	average price
Total use by economic activites	average price

5.2 Decomposition analyses

Decomposition analysis can be used to obtain a better understanding of the interactions between economic activities on the one hand, and environmental impacts on the other. Decomposition analysis is a tool by which the particular driving forces influencing changes in environmental impacts are separately quantified. Here we will not go into the theory behind decomposition analysis (see for example SEEA 3 for this), but focus on the results.

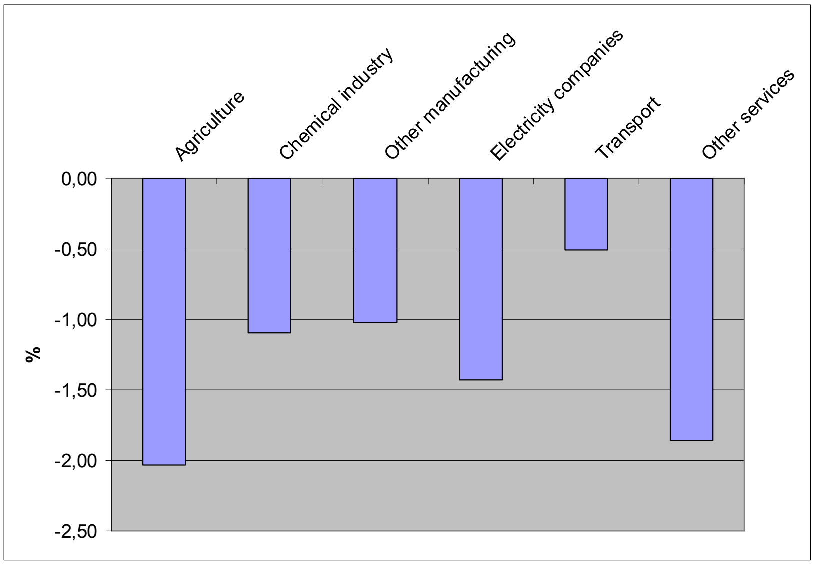
Using decomposition analysis, the change in the level of net energy use by economic activities in a certain period can be explained by different factors. First of all, economic growth may have led to more energy use. The economic structure may have changed, for example due to a change in the input-output relations of the intermediate use, or a change in composition of the final demand for products and services. Finally, energy-efficiency improvements of the production process may have decreased energy use. Structural decomposition analysis allows us to account in detail for the factors underlying the changes in emissions.

5.2.1 Structural decomposition analysis for net domestic energy use



Economic growth clearly has been the driving force behind the increase in net energy use, which were only partially negated by an increase in efficiency. Energy use in 2011 would have been about 34 percent higher than in 1995 if there had been no change in efficiency and structure. The improvement of the energy intensity (energy saving) has reduced the increase in net energy use. Structural changes in the economy had less effect on the total change in emissions. On average, using this methodology, the energy savings rate for all economic activities was equal to 1.2 percent per year. The average energy savings rate could be an important indicator for policy makers.

5.2.2. Average energy savings rate for industries



The decomposition analysis can also be done for different industries. Accordingly it is possible to calculate the average energy savings rate (1995-2011). As can be seen in figure 5.2.2, the energy savings rate was highest in agriculture and other services and lowest in transport. In manufacturing, the energy savings rate was equal to 1.0 percent per year.

6. Conclusions and recommendations

Compilation of the PEFA tables

The framework for the PEFA tables, as described in SEEA-CF and SEEA-E, is very comprehensive. Compiling these tables according to the classifications for energy products and industries as proposed by Eurostat is indeed a challenge. However, the experience gained during this project shows that it feasible to construct PEFA tables A, B and C. However, it should be remarked that there were some conditions in the Netherlands that made the task relatively easy:

- The Dutch energy balances provide an excellent basis to start the compilation of the energy accounts as they provide a high level of detail and do not contain a 'statistical discrepancy'.
- Part of the data in de energy balances is already allocated to ISIC (namely manufacturing).
- The corrections needed for the National accounts concepts (energy use by residents abroad an energy use by non residents) are already available as these also have to be known for the compilation of the air emission accounts.
- Several additional data sources are available, such as traffic and transport statistics and monetary production statistics which have been used to improve the energy flow accounts.
- Previous experience with the compilation of the net energy accounts.

The main compilation challenge is the allocation of energy use and supply to the service industries. The quality of this data is very dependent on the source data that is available to do this allocation.

Recommendations for further improvement of the Dutch PEFA tables

The Dutch PEFA tables should be further improved:

- Bridge table E should still be compiled, but all basic data is available to do this.
- The allocation of energy consumption to NACE should be further improved. In the current project, only an allocation key for natural gas, electricity and motor fuels was made for one year. In 2012, the first results were published by the energy statistics department on the use of natural gas and electricity by the service industries in the Netherlands, using the results of customer registers. Investigated will be whether register data can be used as a source for this allocation.
- The recording of biomass can be improved. Now, it is assumed that (almost) all biomass used for energetic purposes originates from waste. It should be investigated if this really is the case.

- It should be investigated if in the source data of the energy statistics some more information is available to compile data for some extra energy commodities.
- The energy balance and traffic statistics provide very different data for the use of diesel. This should be further investigated.
- Emission relevant energy use should be compared with data used by the environmental statistics department to compile air emission statistics, but also to the air emission accounts that are already being compiled.
- The time series could be further extended to 1990.

Recommendations for Eurostat

- Eurostat is currently developing the so called PEFA builder, which is a tool that will generate energy supply and use tables using data from the Eurostat/OECD joint questionnaire. The results of PEFA builder, which should be ready in 2013, could be compared with the results published in this study. This will help to improve both the PEFA builder and the Dutch energy accounts, but will also be of interest to other countries and Eurostat.
- The current proposal for the number of energy commodities is to large. At least for the Netherlands it would never be possible to fill in all categories as these are not observed in our source data. As most of these energy commodities are not very relevant, it would be better to focus on a smaller group of energy products including categories as 'other oil products' and 'other coal products', which still is comprehensive (i.e. includes all energy commodities).
- PEFA table C on emission relevant energy use provides some additional analytical possibilities. However, when air emission accounts are already being compiled based on other sources (as in the case for the Netherlands where the national emission inventory is used), the value added of this table is limited.
- Several important indicators can be derived from the energy flow accounts. Table 5.1.9 provides an overview of the key indicators that have been identified in this study. This list may serve as an input for the PEFA compilation guide.

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Annex 1: Classification of energy commodities used for the Dutch PEFA tables

Energy from natural inputs	
	Natural gas
	Crude oil
	Natural gas liquids
	Solid and liquid biomass
	Hydro power
	Wind energy
	Solar energy
	Geothermal, deep
Energy products	
	Primary coals
	Coke-oven cokes
	Coke oven gas
	Other coal products
	Nuclear energy
	Natural gas
	Crude oil
	Natural gas liquids
	Other hydrocarbons
	Residual gas
	Naphtha
	Lpg
	Motor gasoline
	Gas/diesel oil
	Fuel oil
	Kerosene
	Lubricants
	Bitumen
	Other petroleum products
	Blast furnace gas
	Electricity
	Heat
	Bio gas
	Solid and liquid biomass
	Biogenic municipal waste
	Waste and other energy commodities
Energy residuals	
	Waste residuals
	Other losses
	Energy incorporated in products
	Transformation losses
	Residual heat losses

Annex II: Table A Supply table (2011)

	Production (including household production on own-account); Generation of residuals							Accumulation	Flows from the Rest of the world	Flows from the environment	TOTAL SUPPLY
	Agriculture, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, steam supply, environmental services	Transportation and storage	Other industries	Households		Imports		
Energy from natural inputs											
Natural gas										2413	2413
Crude oil										45	45
Natural gas liquids										17	17
Solid and liquid biomass										0	0
Hydro power										0	0
Wind energy										13	13
Solar energy										1	1
Geothermal, deep										1	1
Energy products											
Primary coals	0	0	0	0	0	0	0	0	628		623
Coke oven cokes	0	0	57	0	0	0	0	0	5		62
Coke oven gas	0	0	16	0	0	0	0	0	0		15
Other coal products	0	0	4	0	0	0	0	0	4		3
Nuclear energy	0	0	0	0	0	0	0	0	40		40
Natural gas	0	2419	0	4	0	0	0	0	690		3113
Crude oil	0	47	2	0	0	0	0	0	2042		2001
Natural gas liquids	0	17	2	0	0	1	0	0	343		363
Other hydrocarbons	0	0	15	0	0	0	0	0	201		213
Residual gas	0	0	197	0	0	0	0	0	0		197
Naphtha	0	0	370	0	0	12	0	0	417		800
Lpg	0	0	74	0	0	0	0	0	120		104
Motor gasoline	0	0	252	0	0	144	0	0	415		811
Gas/diesel oil	0	0	879	0	0	124	0	0	717		1720
Fuel oil	0	0	348	0	0	86	0	0	880		1314
Kerosene	0	0	324	0	0	1	0	0	206		531
Lubricants	0	0	27	0	0	1	0	0	42		71
Bitumen	0	0	10	0	0	0	0	0	11		21
Other petroleum products	0	0	95	0	0	4	0	0	96		195
Blast furnace gas	0	0	37	0	0	0	0	0	0		37
Electricity	49	0	23	333	0	2	0	0	74		485
Heat	53	2	70	124	0	0	0	0	0		252
Bio gas	4	0	1	7	0	0	0	0	0		12
Solid and liquid biomass	1	0	10	13	0	3	9	0	22		63
Energy residuals											
Waste residuals								143			143
Other losses	0	2	0	17	0	0	0				13
Energy incorporated in products	0	0	641	0	2	14	2				659
Transformation losses	23	0	60	367	0	1	0				471
Residual heat losses	131	48	664	41	430	423	663				2399
Total	262	2535	4238	914	433	790	674	143	6943	2502	

Table B Use table (2011)

	Intermediate consumption; Use of energy resources; Receipt of energy residuals						Final consumption	Accumulation	Flows to the Rest of the world	Flows to the environment	TOTAL USE
	Agriculture, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, steam supply, environmental services	Transportation and storage	Other industries	Households		Exports		
Energy from natural inputs											
Natural gas	0	2419	0	0	0	0	0	0			2419
Crude oil	0	40	0	0	0	0	0	0			40
Natural gas liquids	0	17	0	0	0	0	0	0			17
Solid and liquid biomass	0	0	0	0	0	0	0	0			0
Hydro power	0	0	0	0	0	0	0	0			0
Wind energy	4	0	0	13	0	1	0	0			18
Solar energy	0	0	0	0	0	0	1	0			1
Geothermal, deep	0	0	0	0	0	0	0	0			0
Energy products											
Primary coals	0	0	123	182	0	0	0	178	144		628
Coke oven cokes	0	0	62	0	0	0	0	1	1		62
Coke oven gas	0	0	15	2	0	0	0	0	0		16
Other coal products	0	0	5	0	0	3	0	0	0		8
Nuclear energy	0	0	0	40	0	0	0	0	0		40
Natural gas	134	32	382	422	9	163	295	0	1676		3113
Crude oil	0	0	2148	0	0	3	0	-78	17		2001
Natural gas liquids	0	1	369	0	0	4	0	-10	0		363
Other hydrocarbons	0	0	17	0	0	10	0	-3	191		216
Residual gas	0	0	183	14	0	0	0	0	0		197
Naphtha	0	0	327	0	0	92	0	1	382		800
Lpg	2	0	101	0	0	11	11	0	70		194
Motor gasoline	0	0	2	0	1	20	187	8	593		811
Gas/diesel oil	22	2	32	5	138	194	61	-43	1278		1720
Fuel oil	2	0	73	0	58	94	0	-16	1103		1314
Kerosene	0	0	4	0	175	14	1	4	341		531
Lubricants	0	0	0	0	2	2	2	3	60		71
Bitumen	0	0	0	0	0	9	0	0	12		21
Other petroleum products	0	0	68	0	0	31	0	2	93		195
Blast furnace gas	0	0	12	25	0	0	0	0	0		37
Electricity	30	11	146	35	17	117	87	0	42		486
Heat	58	6	142	21	1	14	10	0	0		252
Bio gas	4	0	1	7	0	0	0	0	0		12
Solid and liquid biomass	1	0	10	40	0	3	9	0	0		63
Energy residuals											
Waste residuals	5	0	16	107	0	3	11				143
Other losses										19	19
Energy incorporated in products								659			659
Transformation losses										471	471
Residual heat losses										2399	2399
Total	262	2535	4238	914	433	790	674	635	6004	2889	

Table C emission relevant use table (2011)

	Intermediate consumption						Final consumption	TOTAL USE
	Agriculture, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, steam supply environmental services	Transportation and storage	Other industries	Households	
Energy products								
Primary coals	0	0	1	182	0	0	0	183
Coke-oven cokes	0	0	2	0	0	0	0	2
Coke oven gas	0	0	8	2	0	0	0	10
Other coal products	0	0	0	0	0	0	0	0
Nuclear energy	0	0	0	0	0	0	0	0
Natural gas	134	32	270	418	9	161	295	1320
Crude oil	0	0	0	0	0	0	0	0
Natural gas liquids	0	0	0	0	0	0	0	0
Other hydrocarbons	0	0	0	0	0	0	0	0
Residual gas	0	0	179	6	0	0	0	185
Naphtha	0	0	0	0	0	0	0	0
Lpg	2	0	1	0	0	4	11	17
Motor gasoline	0	0	1	0	1	18	187	208
Gas/diesel oil	22	2	9	6	130	104	61	371
Fuel oil	2	0	1	0	58	2	0	63
Kerosene	0	0	0	0	175	2	1	178
Lubricants	0	0	0	0	0	0	0	0
Bitumen	0	0	0	0	0	0	0	0
Other petroleum products	0	0	10	0	0	0	0	10
Blast furnace gas	0	0	12	25	0	0	0	36
Electricity	0	0	0	0	0	0	0	0
Heat	0	0	0	0	0	0	0	0
Bio gas	4	0	1	7	0	0	0	12
Solid and liquid biomass	1	0	4	40	0	0	9	54
Energy residuals								
Waste residuals	0	0	3	76	0	2	0	81
Total	164	35	503	762	412	294	564	2733