Disaggregation of the Statistics on final energy consumption in the industry sector in the Netherlands

Final report

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1. Introduction

This report describes the outcome of the exploration on the possible disaggregation of the statistics on final energy consumption in the industry sector in the Netherlands. This research is the result of the grant for the *disaggregation of the statistics on final energy consumption (FEC) in the industry sector in the Netherlands* provided by Eurostat.

1.1 Background of the grant

The European Energy Statistics Regulation (ESR - Regulation (EC) No. 1099/2008 […] on energy statistics) provides the mandatory framework for EU Member States and other reporting countries to transmit energy quantities related data on a regular basis to Eurostat. This data collection concerns both the supply and consumption side.

The application of ESR required a detailed breakdown of the existing aggregates and statistics in order to better follow energy consumption trends with a higher degree of accuracy. The need to satisfy the ESR requirements was enhanced by the increasing demand for more detailed information about energy efficiency, Greenhouse gas (GHG) emissions linked to energy consumption and production, renewable energy, the cost of energy, energy dependence, and economic competitiveness.

As a result the Energy Statistics Working Group decided in 2008 to start with the disaggregation of the residential/households sector. This resulted in the implementation of the obligation to report detailed final energy consumption in households by type of end use in the ESR (Commission Regulation (EU) No 431/2014 of 24 April 2014). As this sector is now covered[1], the next sector to be explored is the 'industrial sector (NACE C - Manufacturing)[2]'.

Manufacturing is an important and big consumer of energy. The EU Strategy for *Heating and Cooling* and the *Energy Efficiency Directive* reinforced the demand for more detailed data, in order to be able to monitor existing consumption patterns for the development of new measures and policies supporting energy efficiency, contributing to the increase of renewable energy use and decreasing the energy intensity[3].

In 2016 and 2017 there was a task force (TF) on the *disaggregation of statistics on final energy consumption in the Industry sector* that provided recommendations for the most adequate breakdown keys which could be applied. While the discussions on the new data collection based recommendations by the TF are still going on, Eurostat allocated grants for the Member States that wished to update their data collection system in order to be able to provide the requested level of disaggregation or who wanted to explore to possibility to provide even more data. Accordingly, Statistics Netherlands took this opportunity to explore the possibility of publishing data on the proposed disaggregation of the statistics on final energy consumption in the industrial sector in the Netherlands.

[1] See https://ec.europa.eu/eurostat/web/energy/data

[2] NACE is the statistical classification of economic activities in the European Union.

[3] Measure of energy efficiency of an industrial sector: units of energy (consumed) per unit of value added or physical output.

1.2 Description of this research

The proposed disaggregation in this research is based on a multiple layer approach, which was developed by the Task Force "Further disaggregation of the statistics on final energy consumption in the industrial sector" of the Eurostat Working Group on energy statistics.

The following disaggregation layers are explored:

1. *Layer 1: NACE-based disaggregation on a 2-digit level*.

   Refining and complementing the existing methodology, developing guidelines and requirements for such a disaggregation, spotting the difficulties and discussing the quality of it.

2. *Layer 2: Product based disaggregation for at least NACE 17, 20, 23 and 24*[4].

   Exploring the possibility of such a disaggregation, by economic activity disaggregation on 3- or 4-digit level and by analyzing existing data on physical production to assess the representation of these NACE subsectors for the main products in these subsectors.

3. *Layer 3: Energy-end use based disaggregation and disaggregation high temperature vs. low temperature heat production.*

   As this data is not yet available, new sources and/or questionnaires had to be developed. The focus is on NACE 10 (Manufacture of food products), 20 (Manufacture of chemicals and chemical products) and 24 (Manufacture of basic metals), as these are the industries where the energy consumption or the energy intensity is particularly high in the Netherlands[5].

The structure of this report is as follows. Chapter two describes the methods applied to collect and estimate the proposed disaggregated data for the various layers. Chapter three presents the results and related discussions, and the recommendations are laid out in chapter four.

[4]NACE 17 - Manufacture of paper and paper products, NACE 20 - Manufacture of chemicals and chemical products, NACE 23 - Manufacture of other non-metallic mineral products, NACE 24 - Manufacture of basic metals.

[5]https://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=83989ENG&D1=18&D2=a&D3=7%2c11%2c24%2c29%2c32%2c43-44%2c51%2c55-58%2c60-63&D4=l&LA=EN&HDR=G3%2cG2%2cG1&STB=T&VW=T

2. Methods

In this research we try to further disaggregate the figures on final energy consumption in the industry sector. However, when comparing Dutch national data on final energy consumption with Dutch data reported to and by Eurostat and IEA (International Energy Agency), it is important to realise that there is a difference in definition for final energy consumption related to unsold combined heat and power (CHP). Hence, we first look at the definition and the existing reporting differences.

2.1 Definition of final energy consumption

Final energy consumption is the total energy consumed by end users, such as households, industry and agriculture. The energy that is used by the energy or transformation sector itself is excluded.

In the Dutch system, unsold heat from CHP-systems in the sectors that produce and consume this heat is included in the figures on production and final energy consumption of heat. In industry and greenhouse-agriculture unsold CHP heat (mostly from natural gas) provides a substantial part of energy for heating purposes. Therefore, to understand and predict the energy balance of these sectors, it is import to explicitly quantify the unsold CHP production at the sectoral level.

When reporting to Eurostat and IEA, unsold heat from CHP has to be excluded in order to fulfil the requirements of international energy statistics. Instead of reporting unsold CHP heat, the fuel input of the CHP-installations producing unsold heat has to be broken down into two fractions. The first fraction is allocated to electricity and sold CHP heat and the second fraction is allocated to unsold CHP heat. The fraction allocated to unsold heat should be reported as final energy consumption. Eurostat and IEA do not prescribe an allocation method, but suggest to use allocation based on energy output of the CHP-plants (IEA and Eurostat, 2004). Many allocation methods are possible and defendable, but in order to contribute to harmonisation of international energy statistics we follow the suggestion from Eurostat and IEA.

The result of the chosen allocation method is that efficiency of autoproducer[6] CHP electricity production is high (about 80 percent) and the difference in total final energy consumption between the national and international method is limited. The main difference in final energy consumption between national and international reporting is a shift from final consumption of heat (national) to final consumption of natural gas (international).

In this report we use data re-calculated according to the international definition (as in the Joint Annual Questionnaires submitted to Eurostat) of final energy consumption. Consequently, data will differ from national publications.

[6] Producers are classified according to the purpose of production. *Autoproducer* undertakings generate electricity and/or heat, wholly or partly for their own use as an activity which supports their primary activity. They may be privately or publicly owned.

2.2 Layer 1 and 2: disaggregated data based on existing data collection

For layer 1 and layer 2 we use the same method, making additional break downs using existing data and assessing the resulting accuracy. Therefore, we first describe the existing data collection and subsequently the way we calculate the sampling margin.

2.2.1 Description of existing data collection for final energy consumption industrial sector

The Dutch data collection for energy statistics on the industrial sector is mostly based on a set of surveys[7].

Several major companies in the industrial sector do not only have final energy consumption, but also play a major role in the transformations (blast furnace, cokes oven, petrochemical industry, electricity production) or non-energy consumption, whose output is often subject to monthly reporting obligations. About 50 major companies receive a monthly survey that covers the complete energy balance of these companies. These 50 companies cover already about half of the total final energy consumption in industry. For about 100 other companies that play a smaller, but not negligible, role in transformations or non-energy consumption we used a quarterly survey. This has been changed into an annual survey from 2018 onwards.

Part of the industrial companies that have no transformations and non-energy consumption only receive a simple annual survey on final energy consumption. This annual survey on final energy consumption is send to about 2000 companies in the industry sector. All companies with more than 200 workers are subject to this survey, just as the companies that use very specific energy commodities for the Netherland (like coal) or are very energy-intensive (like aluminium melting). Intermediate companies are part of a sample survey and small companies (less than 50 workers) are estimated based on the average energy consumption per worker of intermediate companies with 50-200 workers in the same subsector. The sample size and allocation is chosen is using the so-called Neyman allocation method, which results in a minimal sampling error for total final energy consumption in industry. Consequently, sectors with a large final energy consumption have a larger sampling fraction than sectors with a small final energy consumption. The application of the Neymann method for final energy consumption in industry is described by van Laar (2011).

Aggregates from samples are calculated by subsector and size-class using the number of workers as auxiliary variable.

Response rate for surveys send that are send to companies that are not part of a sample (i.e. important companies) is almost 100 percent at the time that data are used for annual reporting, though sometimes data are missing despite several reminders. In these cases, often is possible to estimate the data from administrative sources (client files grid operators or environmental reports). In case this is not possible we use data of the previous year.

Response rate for the annual survey on industrial final energy consumption is about 90 percent. Missing data for companies of the non-sample part of the survey are estimated (as described above), missing data for companies of the sample part are not estimated individually but accounted for in the statistical calculations to calculate aggregates from the sample.

[7] https://www.cbs.nl/en-gb/our-services/methods/surveys/korte-onderzoeksbeschrijvingen/dutch-energy-balance-sheet

Final consumption of wood is concentrated in a large number of smaller companies in the wood and furniture industry. This, relatively small, amount of energy is covered with a survey on sales of wood boilers and estimate on average equivalent full load hours.
For the construction sector no survey but other sources are used for compiling existing statistics: client files from grid operators for electricity and natural gas and model calculation for gasoil use in mobile machines. The model calculations for gasoil in mobile machines are carried out by a private company. We asked whether they could provide a break down by subsector in construction. They responded that this may be possible with a combination of research and expert knowledge (one to two days work). No subcontracting was foreseen in this project and administrative cost would be relatively high. Therefore, we did not continue this path.

2.2.2 Calculating sample margins

For the census-surveys the sampling error is zero. For the sampling survey the reliability margin is calculated by first calculating the variance estimate for each cell (defined by subsector and size class) and subsequently adding the variance estimators to the desired publication level. Subsequently, the accuracy with (95% reliability level) is calculated as 1,96 times the square root of the variance.

We calculate the margins for final energy consumption aggregated for all energy products, to focus the discussion on the main variable. For individual products the relative margins will probably be higher, because many products are used by only a limited number of companies. However, the most important products, natural gas and electricity are used by almost all companies and for important other products (like refinery gas) the companies that use this product are part of census survey.

Relative margins are calculated by dividing the accuracy by total final energy consumption of the sector considered.

2.2.3 Analysing data from the Prodcom on the production in subsectors

To put the energy production data in perspective it is relevant to know which products are produced. We analyzed the data collected for the PRODCOM 2016 statistics[8] for the subsectors at the 3 and 4 digit-level to asses to what extent energy production data could be connected to production of single products.

It was difficult to know beforehand what exactly could be expected from this analysis. Therefore, for this project we restricted ourselves to an overview of the available data for a few, energy intensive, subsectors. See paragraph 3.2.3 for this overview.

2.3 Layer 3: breakdown of final energy consumption by type of end-use

For the breakdown of final energy consumption by type of end-use, we focus on:

- NACE 10 - Manufacture of food products
- NACE 20 – Manufacture of chemicals and chemical products

[8] Prodcom provides statistics on the production of manufactured goods.

- NACE 24 – Manufacture of basic metals

These are the industries where the energy consumption or the energy intensity is particularly high in the Netherlands. The three sectors together cover about 75% of the final energy consumption in the industry.

In contrast with layer 1 and layer 2, the basic data for this type of disaggregation (type of end-use) are currently not available at Statistics Netherlands. Therefore, a new data collection method had to be developed. According to the Dutch national data collection policy, we have to make maximum use of existing administrative data in order to keep the administrative burden limited. It is likely that this will be the case for more EU Member States.

Therefore, we have first collected information from experts outside our institute (e.g. the Ministry of Economic Affairs and Climate Policy (EZK), the Netherlands Enterprise Agency (RVO.nl), Energy Research Centre of the Netherlands (ECN part of TNO), and industrial associations) to find out which data is already available elsewhere. It appeared to be the case that there is no coherent data available on this yet.

RVO.nl does has access to the Energy Efficiency Plans (EEP's) of businesses that are part of the MJA3/MEE-covenant (Voluntary agreements between industry and government on energy saving). However, there are no rules on the format/structure of these plans and some businesses may describe some of the end-uses, but this is only a small part and the information and it is not specific enough. In the subsectors of the food-industry there are several medium-sized companies which made their EEPs using the same consultancy company, which may result in some standardization of the information. Also RVO.nl made a summary of the energy situation in some of the subsectors ('quick scans'). Unfortunately, these plans and quick scans are not public. We tried to get access to this information by contacting RVO and the industrial association of the food sector, but we did not succeed in getting access to the information.

Due to the lack of available data, we opted for a pilot survey to collect the desired information. During the interviews we asked what kind of delineation of categories might be relevant for the specific industry. The relevance of the following categories were tested:

- Energy used for heat production (including vapour / steam production).
- Energy used for cold production (refrigeration)
- Electrochemical use of energy
- Mechanical energy use (engines)
- Energy used for space heating and cooling (air conditioning) and for water heating in office buildings
- Energy used for lighting and electrical appliances (including ICT-related)
- Non-specified energy uses.

At the national level there is also a special interest in making a break-down in low and high temperature heat. This because an important report describing the long term Dutch energy policy (EZK, 2016) divides energy use into four main functional groups, of which high and low temperature heat are two of them. Therefore, we included the difference between high- and low temperature heat in our pilot-questionnaire.

The pilot-questionnaire is included in annex 1.The following delineation of end-use categories has been chosen, based on the interviews and the categories suggested by Eurostat in the grant specification:

- Process heating
    - <200 degrees Celsius
    - 200 – 500 degrees Celsius
    - 500 – 1000 degrees Celsius
    - >1000 degrees Celsius
- Process and product cooling
- Electrochemical use of energy
- Mechanical energy use (engines)
- Energy used for space heating and cooling (air conditioning)
- Energy used for lighting and electrical appliances (including ICT-related)

Accordingly, businesses were asked to allocate their energy use per energy carrier to the various end-use categories. In addition we asked them how long it took them to fill in the questionnaire. This gave us an idea of the administrative burden.

Based on the results of the pilot-questionnaire, the shares per energy carrier for each end-use category could be calculated. These shares were applied to the total final energy consumption per energy carrier as known from the standard energy balance sheet. Consequently the new estimates per energy carrier and end-use were summed up in order to estimate the weighted shares that can be applied to the total final energy consumption per energy carrier of the specific industry sector.

2.3.1 Manufacture of basic metals

For manufacture of basic metals, there was a very useful cooperation with the industrial association of basic metals *VNMI (Vereniging Nederlandse Metallurgische Industrie)*[9]. Most of the ten biggest energy-consumers in the basic metal industry are part of VNMI, and they represent more than 75 percent of the total energy consumption in this sector. The association promoted the pilot-questionnaire and they helped to review the questionnaire and delineations of end-use categories.

Electrochemical use of energy appeared to be rather difficult to interpret. We have asked Eurostat to clarify this point and they responded that as there is no harmonized / commonly agreed definition of what should be included under the 'Electrochemical use of energy' (in this context), that this should mostly relate to electricity used for Electrolysis or Electro-synthesis in some industrial processes, but that this should exclude heat production from electricity.

2.3.2 Manufacture of food products

Unlike manufacture of basic metals, energy consumption of industries in manufacture of food products is not concentrated in a few businesses. The ten biggest energy consumers in NACE 10 only account for about 40 percent of the energy consumption in this sector. Nevertheless, we conducted a pilot-questionnaire among the ten biggest consumers to get at least a first impression of the type of energy use in this sector and to test a survey on the type of end use. The response rate was 90 percent, despite the fact that the industrial association of the food industry was less eager to cooperate.

[9] https://www.basismetaal.nl/

2.3.3 Manufacture of chemicals and chemical products

Manufacture of chemicals and chemical products in the Netherlands consumes a lot of energy and this energy consumption is concentrated in a few very large companies in the organic and inorganic base chemistry, fertiliser industry and industrial gases industry. We talked to the Dutch industrial association of the chemical industry (VNCI). They showed a high interest in issues relating to energy consumption, but they consider data collection as a responsibility of individual companies. They doubted whether the proposed data collection would be really useful for the current debate. This because more detailed data at the individual company level are needed for a realistic and meaningful analysis of future possibilities of energy supply and consumption in their sector.

Nevertheless we originally intended to carry out a pilot survey among the top 10 energy consuming companies in the chemical industry, like it has been done for the manufacture of food products and basic metals, to obtain a breakdown by type of end-use at the sector level. However, during 2018 several serious data issues occurred in the existing energy statistics which led to a revision of energy- and CO2-data for the chemical industry (CBS, 2018). These revisions, which were incorporated in revised data submission to Eurostat and IEA in January 2019, shed a light on the urgent need to ensure data quality for the main companies in the chemical industry. Moreover, a few important chemical companies have recently bought the neighbouring joint-venture CHP plant (supplying electricity and heat) leading to additional complications in data collection, both at the side of statistics Netherlands and at the side of the industry. These two factors, which we did not know at the time of starting the project, lead us to the conclusion that at this moment the benefits of an additional questionnaire for the chemical industry would not outweigh the disadvantages of interfering with the existing energy statistics. Therefore, we decided not to send the additional questionnaire to the chemical industry.

Instead we asked whether some expert estimate on break-downs by type of end-use is available at the major national institutes involved in energy modelling (PBL and TNO.ECN). They informed us that experts estimates are not available. However, there is currently a large ambitious project to obtain a lot of information on energy flows within major industrial companies at the individual level. This project is called *MIDDEN-project (Manufacturing Industry Decarbonisation Data Exchange Network)* (PBL, 2019). *MIDDEN* gathers up-to-date information on Dutch industrial locations, processes, and products, along with a wide variety of decarbonisation options for those processes. Several publications on subsectors and sites of the chemical industry are planned (PBL, 2019). Recently, the first two publications have been published for the aluminium and zinc industry (Kortes and van Dril, 2019ab). One of the future possibilities in the MIDDEN project is to investigate whether it is possible to derive meaningful detailed information at the level of groups of companies .

We also performed two additional efforts not directly involving final energy consumption of the chemical industry. First, we added a detailed sectoral break down of final non-energy consumption, which is substantial in the Netherlands (section 3.4) and secondly we distinguished four temperature levels of final energy consumption for heat instead of two (section 3.3).

3. Results and discussion

3.1 Layer 1: break down by 2-digit level

3.1.1 Total final energy consumption

Table 3.1. Final energy consumption at the 2 digit NACE level according to definitions of Eurostat/IEA energy statistics

NACE (2-digit)	Company units (in 2017)		Final energy consumption		sampling error			
	population	observed						
	2017	2017	2016	2017	2016	2017	2016	2017
	number		PJ		PJ		%	
Total industry	4,761	2,261	576.8	579.8	3.1	3.4	1	1
08 Mining and quarrying (no oil and gas)	19	19	4.9	5.0	0,0	0.0	0	0
09 Mining-support service activities	18	15	0.1	0.1	0.0	0.0	9	11
10 Manufacture of food products	770	501	84.0	85.3	1.9	1.8	2	2
11 Manufacture of beverages	33	30	4.1	4.4	0.3	0.1	6	1
12 Manufacture of tobacco products	6	6	0.4	0.4	0.0	0.0	0	0
13 Manufacture of textiles	96	45	3.4	3.6	0.5	0.4	15	10
14 Manufacture of wearing apparel	11	6	0.2	0.2	0.1	0.0	61	26
15 Manufacture of leather and footwear	13	13	0.5	0.3	0.0	0.0	0	0
16 Manufacture of wood products	141	21	3.1	2.2	0.5	0.2	17	9
17 Manufacture of paper	131	81	22.1	23.2	0.6	0.6	3	2
18 Printing and reproduction	179	57	3.3	2.9	0.6	0.3	17	12
20 Manufacture of chemicals	275	238	304.1	302.9	0.7	1.1	0	0
21 Manufacture of pharmaceuticals	45	38	4.1	4.0	0.1	0.1	3	2
22 Manufacture rubber, plastic products	313	210	9.9	10.0	0.6	0.7	6	7
23 Manufacture of building materials	158	124	25.7	25.2	0.6	0.5	2	2
24 Manufacture of basic metals[1]	94	74	51.7	52.1	0.4	0.9	1	2
25 Manufacture of metal products	956	319	11.2	12.2	1.6	1.6	14	13
26 Manufacture of electronic products	184	103	1.7	1.7	0.1	0.1	6	7
27 Manufacture of electric equipment	127	54	3.5	3.3	0.3	0.2	9	5
28 Manufacture of machinery n.e.c.	705	103	5.3	5.7	0.6	1.4	11	25
29 Manufacture of cars and trailers	121	31	3.0	2.9	0.3	0.2	10	8
30 Manufacture of other transport	100	56	1.6	1.5	0.1	0.1	9	9
31 Manufacture of furniture	157	54	2.0	1.9	0.4	0.3	18	18
32 Manufacture of other products	108	62	1.0	1.0	0.2	0.2	23	17
F Construction			25.3	26.8				
NACE Unknown			0.8	0.9				

[1] In the current joint annual questionnaires this sector is already broken down. Section 3.2. includes this breakdown.

Not applicable (empty cell)

Table 3.1 provides the breakdown of the final energy consumption in industry at the 2-digit level and the sampling errors. About half of all final energy consumption is in one subsector: the chemical industry. Many subsectors cover only a very small part of final energy consumption.

We checked the calculated sampling errors with the errors that were calculated by van Laar (2011) using older data. Van Laar calculated the errors for total final consumption (including non-energy consumption). Sampling error in final non-energy consumption is zero, because all companies with non-energy consumption are not in the sample part of the survey. Therefore, the relative errors for total final consumption could be 'translated' to final energy consumption using the fraction of non-energy consumption in total final consumption. After this translation the

relative sampling error of van Laar (2011) was 0,5 % for total industry which was comparable with the 0,6% calculation for both 2016 and 2017 data presented in table 3.1. We also compared the sampling errors for the subsectors and the overall picture was comparable. The subsectors with a large sampling error are the food-industry and metal products industry. These are subsectors with a relatively large number companies with intermediate energy consumption. The effect of the Neymann allocation is visible in the table: subsectors with the largest uncertainty (in absolute terms) receive the largest number of surveys.

For several subsectors the relative sampling error is large, i.e. more than 10%. However, the sectors with a large *relative* sampling error contribute little to overall final energy consumption. It would be possible to reduce the sampling error for these subsectors by increasing the sample size or by shifting the sample to these sectors. The first option would result in an increased administrative burden and an increased work load for Statistics Netherlands while only gaining accuracy for subsectors which are not very relevant regarding final energy consumption. In the Dutch situation this is not acceptable. The second option would result in both a loss of accuracy in more important sectors and a loss of accuracy of final energy consumption for the whole industry. Hence, this option is even worse and not desirable.

Apart from the sampling error, also other errors may occur. For example, companies may misunderstand questionnaires or it may be hard to follow companies in case of bankruptcy. It is hard to completely avoid these type of errors and to quantify the magnitude. Carefully checking time series and additional plausibility checks with administrative sources internally available at Statistics Netherlands can reduce these type of errors, but this is also time consuming.. If publishing on a more detailed level, then more efforts would be needed to control these type of errors and to avoid large relative errors in published data. In the Dutch situation it is uncertain whether the resources will be available for increased data checking, especially for subsectors with relatively limited energy consumption.

Therefore, we can conclude that it is possible to provide data at the NACE 2-digit level. However, for many 2-digit sectors with limited energy consumption the results have a relatively low accuracy.

For the construction sector the subdivision to 2-digit level was not possible, because no underlying data is available at that level. It might however be possible to estimate the final energy consumption for gasoil at the 2-digit level, but this requires hiring a private company for one or two days.

3.1.2 Final energy consumption by energy product at NACE 2 level

The analysis in the section above is focused on total final energy consumption, i.e. the aggregate of all energy products. This analysis is sufficient to get an overview on the (im)possibilities for the breakdown by NACE 2-digit level. It is also relevant to know whether this analysis is valid for the individual energy products. Therefore, we made the same breakdown for the individual energy products. Doing so, we discovered that several energy products are only used by one or a very few companies at the NACE 2-digit level, leading to confidentiality issues. To reduce these issues we made new aggregates of energy products:

- Coal and oil
- Natural gas
- Electricity
- Heat

- Renewables

Table 3.2 provides data according to this aggregation.

Table 3.2. Final energy consumption at the 2 digit NACE level according to definitions of Eurostat/IEA energy statistics by energy product

NACE (2-digit)	Total	Of which				
		Coal and oil	Renewables	Natural gas	Electricity	Heat
	TJ					
Total industry	579,795	159,890	6,415	220,770	128,055	64,650
08 Mining and quarrying (no oil and gas)	5,020	315	5	2,005	985	1,710
09 Mining support service activities	65	0	0	30	35	-
10 Manufacture of food products	85,345	1,345	1,175	54,180	23,710	4,940
11 Manufacture of beverages	4,395	0	130	2,850	1,410	-
12 Manufacture of tobacco products	415	0	-	260	125	25
13 Manufacture of textiles	3,590	15	-	2,275	1,130	170
14 Manufacture of wearing apparel	180	-	-	130	50	-
15 Manufacture of leather and footwear	325	-	-	175	155	-
16 Manufacture of wood products	2,165	-	1,145	460	560	-
17 Manufacture of paper	23,170	30	1,525	12,795	7,030	1,770
18 Printing and reproduction	2,870	-	-	900	1,945	25
20 Manufacture of chemicals	302,925	116,450	235	87,535	44,055	54,645
21 Manufacture of pharmaceuticals	4,030	c	c	2,250	1,560	155
22 Manufacture rubber, plastic products	10,030	10	0	4,305	5,700	15
23 Manufacture of building materials	25,225	2,335	660	17,675	4,550	5
24 Manufacture of basic metals	52,080	20,300	5	14,215	16,485	1,070
25 Manufacture of metal products	12,245	105	0	6,000	6,115	20
26 Manufacture of electronic products	1,725	5	0	535	1,185	5
27 Manufacture of electric equipment	3,295	25	0	2,200	1,075	-
28 Manufacture of machinery n.e.c.	5,700	10	0	2,345	3,330	15
29 Manufacture of cars and trailers	2,890	185	5	1,335	1,365	-
30 Manufacture of other transport	1,540	20	0	760	755	5
31 Manufacture of furniture	1,880	-	200	965	710	-
32 Manufacture of other products	950	20	-	305	550	80
F Construction	26,835	17,980	1,275	4,270	3,310	-
NACE Unknown	895	720	-	-	175	-

Almost all industrial companies in the Netherlands use electricity and natural gas. Therefore, relative accuracy and confidentiality issues are comparable with the aggregate “all energy products”.

This is different for the other energy products. Coal is mainly used in *Manufacture of basic metals* with small amounts in other sectors. Oil for final energy consumption is mainly refinery gas in the chemical industry, with several other subsectors using small amounts of gasoil. All main users of refinery gas and coal are part of survey, so the absolute sampling error will be limited.

Heat is mainly used in the chemical industry, basic metal industry and food industry. In these sectors the number of involved companies is large enough to the show data. All main users are part of a survey, so the absolute sampling error will be limited. However, reporting of sold and bought steam is sometimes complicated, because not all exchanged steam is formally bought or sold.

Renewables (biogas and solid biomass) is mainly used on a small and intermediate scale. Total amount of energy involved is limited. Most data for renewables are based on reliable administrative data and sample error is small or absent.
Hence, due to confidentiality, not all individual energy products can be showed at the NACE 2-digit level. However, missing data relate to small amounts of energy. Data can be shown by aggregating the energy products to sub-aggregates for more NACE 2-digit industries.

3.2 Layer 2: break down by 3-digit or 4 digit level

A few energy intensive sectors are broken down at the 3- or 4-digit level. In the Eurostat terminology this is called the product based approach (second layer).

3.2.1 Sampling accuracy and confidentiality issues at 3- and 4-digit level accuracy for total final energy consumption

Table 3.3. Final energy consumption at the 3- (or 4-)digit NACE level according to definitions of Eurostat/IEA energy statistics

NACE (3- and 4-digit)	Company units in 2017		Final energy consumption		sampling error			
	population	observed						
	2017	2017	2016	2017	2016	2017	2016	2017
	number		PJ		PJ		%	
Chemical industry (NACE 20)								
201 Manufacture of basic chemicals	134	123	291.5	290.5	0.3	0.8	0	0
2011 Manufacture of industrial gases	11	10	21.6	18.1	0.0	0.0	0	0
2012 Manufacture of dyes and pigments	9	9	2.0	1.7	0.0	0.0	0	0
2013 Manufacture other inorganic basic chemic	12	12	29.3	31.2	0.0	0.0	0	0
2014 Manufacture organic basic chemicals	39	38	184.7	182.6	0.0	0.7	0	0
2015 Manufacture of fertilisers	10	10	29.7	29.3	0.0	0.0	0	0
2016-2017 Plastics and synthetic rubber industry	53	44	24.1	27.5	0.3	0.3	1	1
202-206 Other chemical industry	141	115	12.6	12.4	0.7	0.8	5	7
Building materials (NACE 23)								
231 Manufacture of glass	24	22	9.1	8.6	0.3	0.3	3	3
232 & 234 Refractory, other ceramic industry	6	6	0.1	0.1	0.0	0.0	0	0
233 Manufacture clay building materials	14	14	7.5	7.3	0.0	0.0	0	0
235 Manufacture of cement, lime, plaster	4	4	2.4	2.8				
236 Manufacture concrete etc. products	86	57	3.5	3.5	0.2	0.2	5	4
237 & 239 Stone dressing, other mineral products	24	21	3.0	3.0	0.5	0.4	16	12
Base metal industry (NACE 24)								
244 Manufacture of basic precious and other non-ferrous metals[1]	44	39	12.0	11.3	0.4	0.9	3	8
24420 Manufacture of aluminium	28	19	2.5	6.1				
24 Manufacture of basic metals, excl basic precious and other non-ferrous metals (NACE 244)[2]	50	35	39.7	40.7	0.1	0.1	0	0

[1]Corresponds to "Non-ferrous metals" in joint annual questionnaires

[2]Corresponds to "Iron and steel" in joint annual questionnaires

Not applicable (empty cell)

Table 3.3 shows that it is possible to provide a detailed breakdown of three selected NACE 2-digit sectors with a very low sampling error, indicating that all relevant companies of these subsectors are part of our survey.

The main companies of the aluminium industry are part our survey, but this subsector is separately distinguished in our aggregation scheme and therefore, the sampling error was not produced for this sector. Total amount of energy consumption of this subsector is relatively limited and therefore, we considered it not worth the effort to consult an expert for a dedicated sampling error calculation (if possible).

Apart from sampling errors also other errors are possible. For example errors due to estimates in case of non-responding companies or undetected errors in reported data. It is hard to quantify these type of errors. One way to detect these type of errors is to looking at changes between years. Data in table 3.3 show that the year to year changes of energy consumption seem plausible.

Because of the interest in the aluminium industry within this project we had a closer look at the data of a few important companies and detected an error, which was related to the repetitive financial problems and change of ownership of the melting plant. This error was repaired in autumn 2018 and already included in this research and in the joint annual questionnaires.

Within the framework of this project, it is not possible to have a closer look at most relevant companies for each publication cell. This implies that the users of the results should be careful and not use the sampling error as only indicator for accuracy. Users have to keep in mind that underling data for aggregates which represent a limited amount of energy are subject to limited data checking. For these aggregates the presented data provide a reasonable estimate of the energy consumption for this subsector, but the data are probably not always accurate enough to follow small developments over the years.

In our national data NACE 20.16 and 20.17 (plastic and rubber) is not divided, for historic reasons and the wish to have long consistent time series. Looking at data number of companies and employees and the products produced (see below) it is very likely that the energy consumption of the aggregate of NACE 20.16 and 20.17 mainly consists of companies part of NACE 20.16.

3.2.2 Final energy consumption by energy product at NACE 3- to 4-digit level

We repeated the same analysis as done for4 the NACE 2-digit level and compiled data for a list of (aggregated) energy products, the same as used above.

Table 3.4. Final energy consumption at the 3- (or 4-)digit NACE level according to definitions of Eurostat/IEA energy statistics by energy product, 2017

NACE (3- and 4-digit)	Total	Of which				
		Coal and oil	Renew-ables	Natural gas	Electric-ity	Heat
	TJ					
091 Support activities for petroleum and natural gas extraction	65	0	0	30	35	-
201 Manufacture of basic chemicals	290,510	116,430	0	81,855	40,175	52,050
2011 Manufacture of industrial gases	18,135	5,475	-	6,470	5,380	810
2012 Manufacture of dyes and pigments	1,745	0	0	825	355	560
2013 Manufacture other inorganic basic chemic	31,210	2,500	0	13,165	9,355	6,195
2014 Manufacture organic basic chemicals	182,585	108,320	0	27,025	13,055	34,180
2015 Manufacture of fertilisers	29,320	5	0	25,490	2,695	1,125

2016-2017 Plastics and synthetic rubber industry	27,515	130	0	8,875	9,330	9,180
202-206 Other chemical industry	12,415	20	235	5,685	3,885	2,595
231 Manufacture of glass	8,580	200	0	6,680	1,695	-
232 & 234 Refractory, other ceramic industry	50	-	-	30	25	-
233 Manufacture clay building materials	7,320	50	0	6,680	590	-
235 Manufacture of cement, lime, plaster	c	c	c	c	c	-
236 Manufacture concrete etc. products	3,455	260	10	2,390	800	-
237 & 239 Stone dressing, other mineral products	2,995	1,070	-	1,390	530	5
244 Manufacture of basic precious and other non-ferrous metals[1]	11,345	10	0	3,090	7,180	1,065
24 Manufacture of basic metals, excl basic precious and other non-ferrous metals (NACE 244)[2]	40,735	20,290	5	11,125	9,305	5

[1]Corresponds to "Non-ferrous metals" in joint annual questionnaires

[2]Corresponds to "Iron and steel" in joint annual questionnaires

zero or nihil (-)

confidentiality (c)

3.2.3 Homogeneity of products produced at the 3-digit or 4-digit level

For assessing energy consumption and efficiency it would be useful to relate energy consumption to specific activities or production of specific products.. For a few energy intensive sectors (Manufacture of chemicals, Manufacture of building materials, and Manufacture of basic metals) we investigated the type of products produced.

Manufacture of chemicals (NACE 20)

Subsection 20.1 of the chemical industry (Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms) is responsible for about 50 percent of all final energy consumption in the industry.

We considered Prodcom data at 6 or 8 digit product level, often leading to cells with one or two companies. To avoid confidentiality issues we have to restrict ourselves to a qualitative analysis (table 3.5 below).

- The main products of the subsection 20.11 Manufacture of industrial gases are all typical products for this subsection. Both hydrogen, oxygen and nitrogen are important products in terms of value and volume. However, the physical and chemical production processes for these gases differ considerably and therefore also the type of energy product and amount of energy needed.
- In section 20.13 (Manufacturing of other inorganic basic chemicals) many main products are produced by only one company.
- Sections 20.14 (Manufacturing of other organic basis chemicals) and 20.16 (Manufacturing of primary plastics) seem to have a relation with each other, because companies with the main activity in 20.14 also produce substantial amounts of products from 20.16 and the other way around.
- The fertiliser industry (section 20.15) is again rather homogeneous producing mostly nitrogen based fertilisers. In Prodcom the data are measured in terms of kg nitrogen which seems quite sensible as a measure for physical production. However, as the number of companies is limited we cannot show these data.

Table 3.5. Main products of manufacture of chemicals, 4-digit NACE

NACE	Description	Main products
20.11	Manufacture of industrial gases	Hydrogen, Oxygen, Nitrogen, Inorganic oxygen compounds of non metals, carbon dioxide
20.12	Manufacture of dyes and pigments	Products specific to 20.12, but also several products from other subsectors in chemical industry
20.13	Manufacture of other inorganic basic chemicals	Products specific to 20.13, but also several products from other sectors. Almost all products only produced by 1 company
20.14	Manufacture of other organic basic chemicals	Styrene and other products specific for 20.14 but in especially in terms value primary plastics are relevant as well
20.15	Manufacture of fertilisers and nitrogen compounds	Several types of mainly nitrogen based fertilisers. Number of companies is mostly 2.
20.16 and 20.17	Manufacture of primary plastics and synthetic rubbers	Mostly primary plastics but also organic base chemicals (20.14)

Manufacture of building materials (NACE 23)

Manufacture of building materials in the Netherlands consists of several subsectors. The glass industry (NACE 32.1) is quite heterogeneous, consisting of companies that produce bottles (often from recycled glass), windows and glass fibres. By contrast, the clay building materials (NACE 23.3) is more homogeneous producing about 60% bricks (in terms of production value).

Table 3.6. Main products of manufacture of building materials

NACE	Description	Main products
23.1	Manufacture of glass and glass products	Bottles for drinks, isolation glass for buildings and glass fibres
23.3	Manufacture of clay building materials	Bricks, clay roofing tiles and ceramic tiles and flags
23.6	Manufacture of articles of concrete, cement and plaster	Manufacture of concrete products for construction purposes and ready-mixed concrete

Manufacture of basic metals (NACE 24)

In terms of energy consumption the metal industry is dominated by the production of basic iron. However, there are several types of basic iron produced with dedicated processes after the blast furnace process. Aluminium is another important type of metal. In the Netherlands there is one company producing raw aluminium and there are several other companies part of NACE 24.42 using raw aluminium to produce other (half) products.

Table 3.7. Main products of manufacture of basic metals

NACE	Description	Main products
24 (excl. 24.4)	Manufacture of basic metals excl. 24.4	Several products specific for the basis iron industry mostly produced by one company
24.4	Manufacture of basic precious and other non-ferrous metals	Products of mostly aluminium and but also other non-ferro metals
of which 24.42	Aluminium production	Aluminium bars, rods and profiles and other alumunium products

3.3 Layer 3: break down by type of end-use

The preliminary results, allocation shares to type of end-use, presented in this section are based on the results of the pilot-questionnaire conducted among 10 companies in the industry *manufacture of basic metals (NACE 24)* and 10 companies in the industry *manufacture of food products (NACE 10).* The response rate was 90-100 percent.

3.3.1 Allocation shares to type of end-use

Within the industry *manufacture of basic metals* there is especially one big player active. Hence, developments in total final energy consumption is in the Netherlands dominated by one company. Therefore the allocation shares based on the results of the pilot-questionnaire should normally be considered as confidential. However, in agreement with the company we are allowed to present these figures in this paper.

Table 3.8 and 3.9 present the allocation shares for the corresponding industries. It shows per energy carrier the type of process where the energy is used for.

In the *manufacture of basic metals* most energy carriers (cokes oven gas, blast furnace gas and natural gas) are used for process heating with high temperatures (more than 500 degrees Celsius). Electricity, diesel and Steam (from CHP) are instead mainly used for mechanical processes. As expected, the energy used for space heating and cooling and lighting and electrical appliances is minor compared to the rest. Steam (from CHP) is also used for the lower heat processes. The most used energy carriers in *manufacture of basic metals* are cokes oven gas, electricity and natural gas.

Table 3.8. Manufacture of basic metals, allocation shares to type of end-use

Energy carrier	Process heating	of which				Process and product cooling	Electrochemical use of energy	Mechanical energy use (engines)	Energy used for space heating and cooling	Energy used for lighting and electrical appliances
	Total	<200 degrees Celsius	200 – 500 degrees Celsius	500 – 1000 degrees Celsius	>1000 degrees Celsius					
Cokes oven gas (not used in blast furnaces)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cokes oven gas	97%	2%	1%	12%	82%	0%	0%	3%	0%	0%
Blast furnace gas, incl. oxy gas	81%	16%	7%	0%	59%	0%	0%	18%	0%	0%
Natural gas	91%	2%	9%	33%	47%	0%	0%	3%	6%	0%
Electricity	4%	0%	0%	1%	3%	0%	27%	67%	0%	1%
Steam (from CHP)	34%	25%	9%	0%	0%	0%	0%	65%	1%	0%
Diesel	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%

Table 3.9. Manufacture of food products, allocation shares to type of end-use

Energy carrier	Process heating	of which				Process and product cooling	Electrochemical use of energy	Mechanical energy use (engines)	Energy used for space heating and cooling	Energy used for lighting and electrical appliances
	Total	<200 degrees Celsius	200 – 500 degrees Celsius	500 – 1000 degrees Celsius	>1000 degrees Celsius					
Natural gas	100%	45%	54%	0%	0%	0%	0%	0%	0%	0%
Electricity	0%	0%	0%	0%	0%	2%	0%	95%	0%	3%
Steam (from CHP)	100%	100%	0%	0%	0%	0%	0%	0%	0%	0%

In the *manufacture of food products*, process heating especially occurs at temperatures below 500 degrees Celsius. So, this is the opposite compared to the metal industry that uses mainly heat above 500 degrees. Mainly natural gas and some steam (from CHP) is used for providing heat. Electricity is used for the mechanical processes.

3.3.2 Reflections on the data collection and quality of the results

Although the allocation of total final energy consumption to type of end-use in NACE 24 is likely to be robust for the whole sector, as the ten participated companies are responsible for more

than 75 percent of the energy consumption in this sector, it is likely to not reflect the consumption patterns of the companies in this sector other than the major players. This because there is especially one big player with its own specialized production process (a blast furnace with postprocessing of produced steel) that dominates the underlying data where the allocation shares are based on. Other companies are dealing with different production processes.

For NACE 10 the average allocations shares are somehow less robust in the sense that they are based on 10 companies that represent only 40 percent of the total energy consumption in this industry. It is not possible to conclude that the results of the 10 surveyed companies are representative for the whole NACE 10 subsector, because the number is small and because at least a few of these companies are quite specific (sugar and dairy product factories).

The pilot-questionnaire included a control indicator regarding the total final energy consumption per energy carrier. This should be the same as the amount they filled in in the annual energy questionnaire. However, this was often not the case, but as the figures were around the same magnitude we did not pay much more attention to this for the purpose of this study. Though it does show the likeliness of errors occurring when collecting data from different questionnaires (interpretation errors). To improve consistency it may be help to integrate the survey with the additional break downs into the existing survey.

No particular other general problems were faced as the companies were able to fill in the questionnaire as requested. There was however a company that allocated all natural gas consumption to space heating and cooling. The total amount of final consumption of natural gas of this company was in the pilot-questionnaire much lower than that what had been filled in in the annual standard questionnaire. We have corrected this relatively high energy-use for space heating (which was obviously too high) and cooling downwards, in line with what other companies filled in.

The administrative burden of setting out such a questionnaire will be on average between 2.3 and 4.8 hours, depending on the industry (see table 3.10). Moreover, it is likely that it takes longer for companies with more complex production processes.

Table 3.10. Average time it took to fill in the questionnaire

Industry	Hours (mean)
NACE 10 - manufacture of food products	2.3
NACE 24 - manufacture of basic metals	4.8

It seems to be possible to get an idea of the end-use of the energy consumption based on a questionnaire. However it puts more administrative burden on the businesses. Hence, it is important to severely consider whether it is worth the effort to get such kind of figures given the administrative burden.

If this kind of information is considered to be of high importance regarding current policy questions, then it should be possible to include it in the standard questionnaire sent out for the energy balance (same kind of structure). However, we do not recommend such a survey on a yearly basis, as the picture will not change much over the years for individual companies. Moreover, by increasing the length of the questionnaire the focus on the more important

questions might decrease which influence the quality of the data collection for the energy balance. A compromise may be to have more detailed break down every three or five years.

3.4 Non-energy consumption by sector

In the Dutch industry, non-energy use of energy commodities is about as large as the use of energy commodities for energetic purposes. In the existing energy statistics, the sectoral breakdown of non-energy use is limited. At the national level we make a breakdown of the non-energy use at the same level of sectoral details as energy-use. In table 3.11 we show the results of this subdivision for which non-energy use exists.

Table 3.11 Non-energy consumption by sector in the Netherlands 2017, PJ

	Total	Of which		
		Coal	Oil	Gas
	PJ			
Total Industry	556	0	449	107
10 Manufacture of food products	0	0		
17 Manufacture of paper	1		1	
20 Manufacture of chemicals	547		440	107
201 Manufacture of basic chemicals	545		438	107
2011 Manufacture of industrial gases	24			24
2012 Manufacture of dyes and pigments				
2013 Manuf. other inorganic basic chemicals	31		31	
2014 Manufacture organic basic chemicals	418		405	13
2015 Manufacture of fertilisers	70			70
2016-2017 Plastics and synthetic rubber industry	2		2	
202-206 Other chemical industry	3		3	
Manufacturing unknown	2		2	
F Construction	6		6	

Not applicable (empty cell)

Most non-energy uses relates to oil in the petrochemical industry. This sector uses natural gas liquids (NGL), naphtha and LPG to produce basic-chemicals for further processing by other companies in the Netherlands and abroad.

Also non-energy consumption of natural gas is substantial, about half the consumption for energetic purposes. Most natural gas is used for (nitrogen) fertilizer production and the production of hydrogen by the sector manufacturing of industrial gases is also relevant.

All non-energy use is based on a census survey, hence sampling error is negligible. The most important inaccuracy is related to the data quality of the individual companies. It can be difficult to distinguish between energy-use and non-energy use or between raw material for petrochemical transformation and non-energy use.

4. Conclusion and recommendations

As outlined in the introduction there is a demand for more detailed data on energy consumption in the industrial sector. We investigated the possibilities, following the multiple layer approach as developed by the Eurostat task force on final energy consumption in industry.

First layer: NACE 2-digit-level
We investigated the possibilities for further breakdowns of final energy consumption in the industrial sector. With existing data it is possible to calculate breakdowns for almost all NACE 2-digit industries. Compared to the existing publication, this provides more detail for industries with relatively little energy consumption. Sampling error is however relatively large for these low final energy consumption industries. Hence, it is possible to publish on NACE 2-digit level, but, if indeed published, it is important to recognise the limited (relative) accuracy for the low final energy consumption industries in data checking procedures and it should be stressed in metadata linked to the dataset.

We have administrative data for electricity and natural gas deliveries from the grid operators at the grid connection level. However, it is not yet possible to fully connect these data to the business register. With additional research this may be possible, leading to more accurate statistics for subsectors with numerous small consumers. However, until now there is limited interest by the government at the national level for increased accuracy for the low final energy consumption industries, and therefore no financial resources available yet for such research.

Second layer: NACE 3- and 4-digit level for energy intensive sectors
With the existing data it also possible to provide details at NACE 3- and NACE 4-digit levels for a few energy intensive subsectors. All relevant companies are included in our data collection and consequently the sampling error is small for these energy intensive industries in the Netherlands. Therefore, it is possible to report on this more detailed level to Eurostat.

We analysed the PRODCOM-data for a few energy intensive subsectors. Many important products are only produced by a very limited number of companies. Therefore, it was not possible to publish data at the individual product level. Most companies produce products that are specific for their main-activity classification. Except for the production of organic basic chemicals and primary plastics which are often both produced by companies classified as “basic chemical producer” and as “primary plastic producer”.

Aggregating energy products for first and second layer approaches
The higher the level of detail, the more likely the occurrence of confidentiality issues. We discovered that by aggregating energy products, confidentiality issues are reduced. Therefore, we recommend to use less detailed energy product classifications when applying detailed NACE-level classifications.

Third layer: type of end-use
The type of end-use may be relevant to evaluate the options to decarbonise energy consumption and therefore there is an interest in this type of breakdown. Information on the type of end-use (e.g. heat, or mechanical energy) is not available in the current data collection of Statistics Netherlands. We investigated whether this information is somewhere available at the national

level by talking to research agencies and industrial associations. These discussions learned us that this type of information is only available to a limited extent and hard to access for us.

Therefore, we decided to carry out two pilot surveys with about 20 participating companies in *manufacture of basic metals (NACE 24)* and *manufacture of food products (NACE 10).* This exercise showed that it was possible to collect the desired information, but against the cost of an administrative burden of 3.5 hours on average per company.

Energy intensive companies in manufacture of chemicals and chemical products have a rather complicated energy-system. For this industry some complications already exists in the current compulsory energy statistics. Hence, we decided not to burden this industry with additional questions regarding their energy consumption. For these type of companies an intensive approach at the company level may be the optimal way to obtain information on decarbonisation options. Such an approach is mainly outside the scope of the energy statistics department at Statistics Netherlands. Currently, at the national level a project has been set up to follow this approach, but it is not clear yet when and what results will be achieved and whether these results can be feed into energy statistics.

To summarise, the second layer (more details at NACE 3- and 4-digit level for energy intensive sectors) is the most promising extension. It provides relevant additional information with limited additional effort. Even though the first layer approach (NACE 2-digit) is feasible as well, it provides less relevant additional insights. This because the added subsectors use a limited amount of energy and the sampling error is relatively high for some of these added subsectors. We also showed that it is possible to collect information on the third layer (type of end-use), but this involves costs in terms of administrative burden for companies and data collection by statisticians. It is a political decision whether these efforts outweigh the benefits.

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Abbreviations

CHP	Combined heat and power
ECN	Energy Research Centre of the Netherlands (now part of TNO)
ESR	Energy statistics regulations
EU	European Union
EZK	Ministry of Economic Affairs and Climate Policy
FEC	Final energy consumption
GHG	Greenhouse gasses
IEA	International Energy Agency
NACE	Statistical classification of economic activities in the European Community
TNO	Netherlands Organization for applied scientific research

Explanation of symbols

Empty cell	Not applicable
-	Zero or nihil
c	Confidentiality

Annex 1. Pilot questionnaire

Final energy consumption by type of end-use

Period: year 2017

Energy carrier	Unit	Total final energy consumption[2]	Process heating	of which				Process and product cooling	Electrochemical use of energy	Mechanical energy use (engines)	Energy used for space heating and cooling	Energy used for lighting and electrical appliances
			Total	<200 degrees Celsius	200 – 500 degrees Celsius	500 – 1000 degrees Celsius	>1000 degrees Celsius					
Cokes oven gas (not used in blast furnaces)	1000 kg											
Cokes oven gas	1000 m3 a.e.											
Blast furnace gas, incl. oxy gas	1000 m3 a.e.											
Natural gas	1000 m3											
Electricity	1000 kWh											
Steam (from CHP)[1]	1000 kg normal steam (100 °C, 1 bar)											
Diesel	1000 litre											

1) 1000 kg (1 ton) of this steam has a heat content of 2670 MJ.
2) Should be the same amount as already given by the companies that also fill in the yearly standard questionnaire on final energy consumption

Completion time of questionnaire (in hours)	