

**Physical indicators as a basis for  
estimating energy efficiency developments  
in the Dutch industry – update 2005**

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# 1 Introduction

In 2004, a method was developed for calculating energy efficiency developments in the Dutch manufacturing industry using physical indicators of production. The method and its application to calculate energy efficiency developments in the Dutch manufacturing industry for the time period 1993-2001 is described in a report by Neelis et al. (2004). The method is used as part of the yearly calculation of energy savings in the Netherlands according to the Protocol Monitoring Energy Savings performed by the Platform Monitoring Energy Savings (e.g. Boonekamp et al., 2004). On request of this platform, the calculations done in 2004 are updated and extended by two additional years (2002 and 2003) for which production statistics have, in the meantime, become available.

In this report, we give the results of the extended calculations for the years 1993-2003. In Chapter 2 of this report, we summarise the additional data sources used compared to the analysis done in 2004. The results are given in Chapter 3.

It should be emphasised that in this report, we do not give any background on the method applied for which we refer to the 2004 report. Furthermore, we focus in this report on presenting the results of the calculations and only give minor attention to analysing, explaining and interpreting the results found.



## 2 Additional data sources compared to the 2004 analysis

### 2.1 Production statistics

The main source for production statistics are the production statistics collected by Statistics Netherlands according to the PRODCOM 8-digit product classification. Two databases have been used:

- The PRODCOM database for 1993-2003 at the level of PRODCOM numbers.
- The PRODCOM database for 1993-2003 containing production values at the level of individual companies.

Both databases are confidential and are accessed via the CEREM (Centre for Research of Economic Microdata) framework at Statistics Netherlands. The spreadsheet tool with results is stored at Statistics Netherlands for future use. For some products, production data other than the PRODCOM databases is used. The data sources for 2002 and 2003, the additional years of this analysis compared to the analysis of last year are summarised in Table 2.1.

**Table 2-1 Non-PRODCOM production statistics used in the calculations**

	Year	Source
<b>Iron and steel, basic metals industry</b>		
All products	2002 2003	Eurostat (2003) <sup>1</sup> IISI (2004) <sup>2</sup>
<b>Food, beverages and tobacco industry</b>		
Meat statistics	2002 2003	FAO (2005)
Dairies	2002 2003	PZ (2003) PZ (2004)
Sugar beet	2002 2003	FAO (2005)
Cocoa beans	2002 2003	UN (2005)
<b>Paper, printing and publishing industry</b>		
All products	2002 2003	VNP (2003) VNP (2004)
<b>Building materials industry</b>		
Clinker	2002 2003	Mergelsberg (2004) Mergelsberg (2005)
Glass	2002 2003	Beerkens (2004) Beerkens (2005)
Bricks & Paving bricks	2002 2003	KNB (2003) KNB (2004)
<b>Non-ferro basic metals industry</b>		
Anode production at Pechiney, Vlissingen	2002 2003	Pechiney (2003) Alcan (2004) <sup>3</sup>

<sup>1</sup> The yearly iron and steel statistics were published by Eurostat for the last time in 2003. Therefore, we use another source for 2003 data.

<sup>2</sup> The production of cold rolled products is not reported in the IISI statistical yearbook. For 2003, we therefore assumed the same ratio of cold rolled products vs. hot rolled products as in 2002.

<sup>3</sup> Since 2004, Pechiney is part of the Alcan group.

## **2.2 Energy statistics**

The energy statistics for 1995-2002 and for 2003 were collected via a personal communications with Statistics Netherlands (2003 and 2004 respectively).



## 3 Results, discussion and conclusions

### 3.1 Changes compared to the calculations done in 2004 and status of 2003 results

While processing the PRODCOM statistics for 2002 and 2003, some changes in the PRODCOM data for 1993-2001 were discovered when comparing to the database used in the 2004 report. These changes could not be explained by Statistics Netherlands (Statistics Netherlands, 2005). In addition, some minor errors (typing errors and inaccurate rounding) have been corrected in the spreadsheet model. The changes are in all cases marginal. The largest change is 0.04 in the indexed reference electricity use for the chemical industry in 2001 (from 1.11 to 1.07), all other changes are smaller. The sectors and years for which the results for 1993-2001 presented in this chapter differ from the 2004 report are:

- Chemical industry for all years.
- Fertiliser industry for 2001.
- Iron and steel basic metals industry for 2002<sup>1</sup>
- Building Materials industry for 1993.
- Food, beverages and tobacco industry for all years.

The results for the non-ferro basic metals industry and for the paper, printing and publishing industry are not changed if compared to the 2004 analysis. In addition, some inaccuracies were discovered in two tables for the 2004 report for the food, beverages and tobacco industry (Chapter 7 and Appendix 5 in Neelis et al., 2004). In Appendix 1, we give a short explanation and the corrected tables.

The results for 2003 should be regarded as preliminary, because the PRODCOM statistics for 2003 are not yet official<sup>2</sup>. The PRODCOM statistics for a given year (in this case 2003) are always checked and sometimes corrected based on production data for the following year (in this case 2004). In addition to this standard practice, a project was recently started at Statistics Netherlands to improve the quality of the physical quantities in the PRODCOM database from 2004 onwards. As a result of this project, physical production data for 2003 might also further be improved (Statistics Netherlands, 2005).

### 3.2 Overall results, discussion and conclusions

On the next pages, we will summarise the results of our calculations. In Table 3.1 we give an overview of numerical values of the development of the reference energy use in the seven industrial sectors analysed, using 1995 as the base year of analysis (reference energy use = 1). The reference energy use is the development of the energy use assuming frozen energy efficiency. In Table 3.2, we summarise the development of the Energy Efficiency Indicator (EEI) for each sector. This indicator is calculated by dividing the realised energy use (from energy statistics) by the reference energy use, assuming frozen energy efficiency. An EEI below 1 indicates that an industry has become more energy efficient compared to 1995 level; an EEI above 1 indicates that an industry has become less energy efficient compared to 1995 levels. In Table 3.3, we summarise the results for the total of the industries analysed.

In Figures 3.1 to 3.32, we give a graphical representation of the results showing for each industry:

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<sup>1</sup> For the iron and steel basic metals industry, we included in the 2004 study already results for 2002, based on monthly production data until October 2002, which were extrapolated to yearly data. In this analysis, we use the real production for the whole of 2002, resulting in small changes compared to last year.

<sup>2</sup> This does not hold for the results for the iron and steel, basic metals industry and for the paper, printing and publishing industry, which are based on production statistics other than the PRODCOM statistics.

- The development of reference energy use, realised energy use and EEI for non-energy use.
- The development of reference energy use, realised energy use and EEI for fuels/heat use.
- The development of reference energy use, realised energy use and EEI for electricity use.
- The development of reference energy use, realised energy use and EEI for primary energy use (static primary units)<sup>3</sup>, excluding non-energy use.<sup>4</sup>
- The development of reference energy use, realised energy use and EEI for total primary energy use (static primary units).

As stated in the introduction, the focus of this report is on presenting the results of our calculations, rather than on analysing, interpreting and explaining the results. We will therefore only very general discuss the main trends in the results. For the sum of all sectors, the overall reduction in the EEI for total primary energy use between 1995-2003 is 7% (Table 3-3), excluding the chemical industry for which results are very uncertain. This is exactly the same number as the value calculated for the period 1995-2001 in the 2004 report, indicating zero energy efficiency improvement between 2001 and 2003 for the Dutch manufacturing industry. Including, the chemical industry, we calculate a reduction in EEI of 5% for the 1995-2003 period (2% for the period 1995-2001 in the 2004 report). At the level of individual sectors, we can conclude, that for the period 2001-2003, the EEI for total primary energy use went down for all sectors (between 3% and 6%), except for the fertiliser industry (EEI went up by 9%) and the food, beverages and tobacco industry (EEI up by 1%).

If we take into account the calculated uncertainty ranges, we can very generally conclude from the results that in 2002 and 2003, the overall trend for the period 1993-2001 shown in the 2004 report is continued. In none of the seven sectors, major trend breaks can be identified given the calculated uncertainty ranges, with the exception of the fertiliser industry (EEI went substantially down from 1993-2001 and substantially up in 2002 and 2003),

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<sup>3</sup> Final energy use is converted to primary energy use using static conversion factors of 2.5 for electricity and 1 for fuels/heat and non-energy use. We refer to Neelis et al., 2004 for details regarding the methodology.

<sup>4</sup> For the food, beverages and tobacco industry and for the paper, printing and publishing industry, the results for primary energy use, excluding non-energy use are not given, because non-energy use is negligible (food, beverages and tobacco industry) or non-existing (paper, printing and publishing) in those industries.

**Table 3-1 Overview of development reference energy use**

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<b>Chemical industry</b>											
Reference use, electricity	0.94	0.99	1.00	1.01	1.09	1.12	1.12	1.16	1.07	1.20	1.27
95% confidence interval, +/-	6.0%	4.5%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Reference use, fuels/heat	0.85	0.91	1.00	0.93	0.97	0.97	1.04	1.06	1.08	1.13	1.21
95% confidence interval, +/-	12.0%	10.0%	0.0%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%
Reference use, non-energy use	0.84	0.88	1.00	0.91	0.92	0.91	0.97	0.99	0.99	1.09	1.23
95% confidence interval, +/-	15.0%	12.0%	0.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%
Reference use, total primary, excl. non-energy use	0.88	0.93	1.00	0.95	1.01	1.02	1.06	1.09	1.08	1.15	1.22
95% confidence interval, +/-	9.0%	7.5%	0.0%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
Reference use, total primary	0.86	0.91	1.00	0.94	0.97	0.97	1.03	1.05	1.04	1.13	1.23
95% confidence interval, +/-	11.0%	9.0%	0.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%
<b>Fertiliser industry</b>											
Reference use, electricity	0.93	0.94	1.00	0.95	1.02	1.02	0.97	1.04	0.99	0.85	0.90
95% confidence interval, +/-	8.0%	8.0%	0.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Reference use, fuels/heat	1.01	0.97	1.00	0.95	1.01	1.03	1.02	1.06	0.93	0.88	0.82
95% confidence interval, +/-	7.5%	0.0%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
Reference use, non-energy use	0.96	0.99	1.00	0.99	1.04	1.04	1.03	1.06	0.94	0.89	0.84
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
Reference use, total primary, excl. non-energy use	0.99	0.96	1.00	0.95	1.02	1.02	1.01	1.05	0.94	0.87	0.84
95% confidence interval, +/-	6.5%	6.5%	0.0%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
Reference use, total primary	0.97	0.98	1.00	0.98	1.03	1.04	1.02	1.06	0.94	0.88	0.84
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
<b>Iron and Steel, basic metal industry</b>											
Reference use, electricity	0.91	0.96	1.00	0.98	1.05	1.00	0.96	0.99	1.04	1.08	1.16
95% confidence interval, +/-	3.0%	3.0%	0.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Reference use, fuels/heat	0.94	0.97	1.00	1.00	1.07	1.02	0.98	0.97	1.04	1.06	1.15
95% confidence interval, +/-	4.0%	4.0%	0.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Reference use, non-energy use	0.98	0.98	1.00	1.00	1.05	1.01	0.96	0.90	0.96	0.97	1.06
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
Reference use, total primary, excl. non-energy use	0.93	0.97	1.00	0.99	1.06	1.02	0.97	0.98	1.04	1.07	1.15
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Reference use, total primary	0.95	0.98	1.00	1.00	1.06	1.01	0.97	0.94	1.00	1.02	1.10
95% confidence interval, +/-	4.5%	4.5%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
<b>Food, beverages and tobacco industry <sup>1,2</sup></b>											
Reference use, electricity	0.97	1.00	1.00	1.01	1.03	1.06	1.07	1.09	1.06	1.03	1.00
95% confidence interval, +/-	4.0%	4.0%	0.0%	2.5%	3.0%	3.0%	3.5%	3.0%	5.5%	7.0%	7.5%
Reference use, fuels/heat	1.00	1.02	1.00	1.00	1.06	1.08	1.09	1.12	1.14	1.18	1.16
95% confidence interval, +/-	3.5%	3.5%	0.0%	2.5%	3.0%	3.5%	4.0%	3.0%	6.0%	6.0%	6.0%
Reference use, non-energy use	1.35	1.12	1.17	1.16	1.00	1.00	1.33	1.22	1.08	1.13	1.18
95% confidence interval, +/-	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
Reference use, total primary, excl. non-energy use	0.99	1.01	1.00	1.00	1.04	1.07	1.09	1.10	1.11	1.11	1.09
95% confidence interval, +/-	3.0%	3.0%	0.0%	2.0%	2.5%	2.5%	3.0%	2.5%	4.0%	5.0%	5.5%
Reference use, total primary	0.99	1.01	1.00	1.00	1.04	1.07	1.09	1.10	1.10	1.11	1.09
95% confidence interval, +/-	3.0%	3.0%	0.0%	2.0%	2.5%	2.5%	3.0%	2.5%	4.0%	5.0%	5.5%

<sup>1</sup> Since non-energy use in the food, beverages and tobacco sector is less than 1% of the primary energy use, the results for total primary reference energy use excluding non-energy use are almost identical to the results including non-energy use.

<sup>2</sup> Non-energy use figures are relative to 1997 (see chapter 7 of Neelis et al., 2004)

**Table 3-1 Overview of development reference energy use (continued)**

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<b>Paper, printing and publishing industry</b>											
Reference use, electricity	0.96	1.02	1.00	1.00	1.07	1.05	1.08	1.12	1.07	1.10	1.13
95% confidence interval, +/-	2.5%	2.5%	0.0%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Reference use, fuels/heat	0.96	1.02	1.00	1.01	1.07	1.07	1.10	1.13	1.07	1.12	1.13
95% confidence interval, +/-	2.5%	2.5%	0.0%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Reference use, non-energy use	-	-	-	-	-	-	-	-	-	-	-
95% confidence interval, +/-	-	-	-	-	-	-	-	-	-	-	-
Reference use, total primary, excl. non-energy use	-	-	-	-	-	-	-	-	-	-	-
95% confidence interval, +/-	-	-	-	-	-	-	-	-	-	-	-
Reference use, total primary	0.96	1.02	1.00	1.01	1.07	1.06	1.09	1.12	1.07	1.11	1.13
95% confidence interval, +/-	2.5%	2.5%	0.0%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
<b>Building materials industry</b>											
Reference use, electricity	0.95	0.99	1.00	1.00	1.05	1.10	1.16	1.14	1.11	1.07	1.05
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Reference use, fuels/heat	0.94	0.99	1.00	0.98	1.02	1.06	1.08	1.08	1.07	1.01	0.99
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Reference use, non-energy use	1.07	1.08	1.00	0.74	0.88	1.01	1.21	1.10	1.12	1.14	1.01
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
Reference use, total primary, excl. non-energy use	0.94	0.99	1.00	0.98	1.03	1.07	1.11	1.10	1.08	1.03	1.01
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Reference use, total primary	0.95	0.99	1.00	0.97	1.02	1.07	1.11	1.10	1.08	1.03	1.01
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
<b>Non-ferro basic metals industry</b>											
Reference use, electricity	1.04	1.05	1.00	1.04	1.07	1.23	1.28	1.30	1.30	1.41	1.39
95% confidence interval, +/-	5.5%	5.5%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Reference use, fuels/heat	0.89	0.95	1.00	0.93	0.98	1.09	1.14	1.19	1.17	1.18	1.20
95% confidence interval, +/-	8.5%	8.5%	0.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Reference use, non-energy use	0.75	0.81	1.00	0.84	0.86	0.99	1.08	1.09	1.09	1.12	1.04
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
Reference use, total primary, excl. non-energy use	1.02	1.04	1.00	1.03	1.05	1.22	1.26	1.28	1.29	1.38	1.37
95% confidence interval, +/-	5.5%	5.5%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Reference use, total primary	1.01	1.02	1.00	1.02	1.04	1.20	1.25	1.27	1.28	1.37	1.35
95% confidence interval, +/-	5.0%	5.0%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

**Table 3-2 Overview of development energy efficiency indicator**

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<b>Chemical industry</b>											
EEL, electricity	0.92	0.99	1.00	0.96	0.91	0.89	0.86	0.82	0.89	0.82	0.78
95% confidence interval, +/-	6.0%	4.5%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
EEL, fuels/heat	0.96	0.97	1.00	1.03	0.98	0.95	0.85	0.82	0.80	0.82	0.79
95% confidence interval, +/-	12.0%	10.0%	0.0%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%
EEL, non-energy use	1.21	1.16	1.00	1.03	1.14	1.11	1.17	1.32	1.37	1.25	1.25
95% confidence interval, +/-	15.0%	12.0%	0.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%
EEL, total primary, excl. non-energy use	0.95	0.97	1.00	1.01	0.96	0.93	0.86	0.82	0.82	0.82	0.79
95% confidence interval, +/-	9.0%	7.5%	0.0%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
EEL, total primary	1.05	1.05	1.00	1.02	1.03	1.00	0.97	1.00	1.03	0.98	0.97
95% confidence interval, +/-	11.0%	9.0%	0.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%
<b>Fertiliser industry</b>											
EEL, electricity	1.04	1.06	1.00	1.11	0.92	1.00	0.95	0.84	0.76	0.93	0.85
95% confidence interval, +/-	8.0%	8.0%	0.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
EEL, fuels/heat	1.15	1.03	1.00	0.99	0.91	0.94	0.90	0.78	0.72	0.78	0.86
95% confidence interval, +/-	7.5%	0.0%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
EEL, non-energy use	1.01	1.02	1.00	0.96	0.96	0.97	0.97	0.89	0.86	0.96	0.96
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
EEL, total primary, excl. non-energy use	1.13	1.04	1.00	1.01	0.91	0.95	0.91	0.79	0.73	0.82	0.86
95% confidence interval, +/-	6.5%	6.5%	0.0%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
EEL, total primary	1.05	1.02	1.00	0.98	0.94	0.96	0.95	0.86	0.81	0.91	0.93
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
<b>Iron and Steel, basic metal industry</b>											
EEL, electricity	0.99	0.99	1.00	0.98	0.95	0.98	1.01	1.14	1.08	1.02	0.99
95% confidence interval, +/-	3.0%	3.0%	0.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
EEL, fuels/heat	0.98	0.93	1.00	1.00	0.94	0.89	0.86	0.88	0.84	0.83	0.79
95% confidence interval, +/-	4.0%	4.0%	0.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
EEL, non-energy use	0.95	0.99	1.00	0.99	1.01	1.03	1.02	1.00	1.00	1.01	1.00
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
EEL, total primary, excl. non-energy use	0.98	0.95	1.00	0.99	0.95	0.93	0.92	0.98	0.93	0.90	0.86
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
EEL, total primary	0.97	0.97	1.00	0.99	0.98	0.97	0.97	0.99	0.96	0.95	0.93
95% confidence interval, +/-	4.5%	4.5%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
<b>Food, beverages and tobacco industry <sup>1,2</sup></b>											
EEL, electricity	1.10	0.99	1.00	1.08	1.05	1.04	1.01	1.00	1.10	1.11	1.13
95% confidence interval, +/-	3.5%	3.5%	0.0%	2.5%	3.0%	4.0%	4.5%	3.5%	6.0%	6.5%	6.5%
EEL, fuels/heat	1.01	0.97	1.00	1.07	0.96	0.96	1.00	0.93	0.87	0.85	0.84
95% confidence interval, +/-	4.0%	3.5%	0.0%	2.5%	3.0%	3.5%	3.5%	3.0%	6.0%	7.5%	8.0%
EEL, non-energy use	0.91	0.64	0.40	0.88	1.00	0.86	0.81	0.84	0.82	0.57	0.81
95% confidence interval, +/-	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
EEL, total primary, excl. non-energy use	1.05	0.97	1.00	1.08	1.00	0.99	1.01	0.96	0.96	0.95	0.96
95% confidence interval, +/-	3.0%	3.0%	0.0%	2.0%	2.5%	2.5%	3.0%	2.5%	4.0%	5.0%	5.5%
EEL, total primary	1.05	0.98	1.00	1.08	1.00	1.00	1.01	0.96	0.96	0.96	0.96
95% confidence interval, +/-	3.0%	3.0%	0.0%	2.0%	2.5%	2.5%	3.0%	2.5%	4.0%	5.0%	5.5%

<sup>1)</sup> Since non-energy use in the food, beverages and tobacco sector is less than 1% of the primary energy use, the results for total primary reference energy use excluding non-energy use are almost identical to the results including non-energy use.

<sup>2)</sup> Non-energy use figures are relative to 1997 (see chapter 7 of Neelis et al., 2004)

**Table 3-2 Overview of development energy efficiency indicator (continued)**

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
<b>Paper industry, printing and publishing</b>											
EEL, electricity	1.01	0.96	1.00	1.01	1.02	1.05	1.05	1.05	1.04	1.05	1.00
95% confidence interval, +/-	2.5%	2.5%	0.0%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
EEL, fuels/heat	1.03	0.94	1.00	1.10	1.04	1.01	0.99	0.96	0.95	0.92	0.90
95% confidence interval, +/-	2.5%	2.5%	0.0%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
EEL, non-energy use	-	-	-	-	-	-	-	-	-	-	-
95% confidence interval, +/-	-	-	-	-	-	-	-	-	-	-	-
EEL, total primary, excl. non-energy use	-	-	-	-	-	-	-	-	-	-	-
95% confidence interval, +/-	-	-	-	-	-	-	-	-	-	-	-
EEL, total primary	1.02	0.95	1.00	1.05	1.03	1.03	1.02	1.01	1.00	0.99	0.95
95% confidence interval, +/-	2.5%	2.5%	0.0%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
<b>Building materials industry</b>											
EEL, electricity	1.14	1.06	1.00	1.07	1.09	1.00	0.98	1.08	1.06	1.05	1.02
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
EEL, fuels/heat	1.24	1.16	1.00	1.10	1.05	0.96	0.95	0.97	0.96	0.87	0.89
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
EEL, non-energy use	1.02	1.15	1.00	0.85	0.74	0.45	0.31	0.38	0.29	0.25	0.20
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
EEL, total primary, excl. non-energy use	1.21	1.13	1.00	1.09	1.06	0.97	0.96	1.00	0.99	0.93	0.93
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
EEL, total primary	1.20	1.13	1.00	1.08	1.05	0.95	0.93	0.97	0.96	0.89	0.90
95% confidence interval, +/-	3.5%	3.5%	0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
<b>Non-ferro basic metals industry</b>											
EEL, electricity	0.99	0.95	1.00	1.00	1.00	0.96	0.97	1.00	0.97	0.89	0.91
95% confidence interval, +/-	5.5%	5.5%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
EEL, fuels/heat	1.01	0.99	1.00	1.00	1.03	0.91	0.80	0.84	0.73	0.76	0.73
95% confidence interval, +/-	8.5%	8.5%	0.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
EEL, non-energy use	0.85	1.12	1.00	1.01	0.91	0.88	1.08	1.08	1.11	1.19	0.97
95% confidence interval, +/-	5.5%	5.5%	0.0%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
EEL, total primary, excl. non-energy use	0.99	0.96	1.00	1.00	1.01	0.96	0.95	0.98	0.94	0.87	0.89
95% confidence interval, +/-	5.5%	5.5%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
EEL, total primary	0.98	0.96	1.00	1.00	1.00	0.95	0.96	0.98	0.95	0.89	0.89
95% confidence interval, +/-	5.0%	5.0%	0.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%

**Table 3-3 Energy efficiency indicator in 2003 for the sum of sectors analysed**

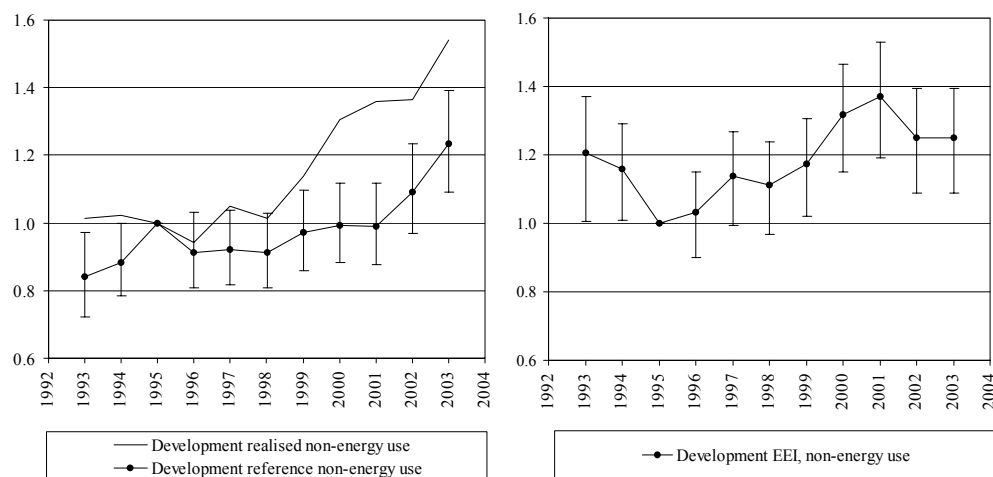
	Electricity			Fuels/Heat			Non-energy use			Total primary energy use (excl. non-energy use)			Total primary energy use		
	Reference energy use, 2003 (this study)	Realised energy use, 2003 (NEH)	EEL, 2003	Reference energy use, 2003 (this study)	Realised energy use, 2003 (NEH)	EEL, 2003	Reference energy use, 2003 (this study)	Realised energy use, 2003 (NEH)	EEL, 2003	Reference energy use, 2003 (this study)	Realised energy use, 2003 (NEH)	EEL, 2003	Reference energy use, 2003 (this study)	Realised energy use, 2003 (NEH)	EEL, 2003
	[PJ]	[PJ]		[PJ]	[PJ]		[PJ]	[PJ]		[PJ]	[PJ]		[PJ]	[PJ]	
Chemical industry	51.4	40.1	0.78	300.5	236.6	0.79	282.2	352.8	1.25	429.0	336.9	0.79	711.1	689.6	0.97
Fertiliser industry	3.3	2.8	0.85	25.9	22.3	0.86	63.4	61.0	0.96	34.3	29.3	0.86	97.6	90.3	0.93
Iron and steel basic metals industry	9.7	9.6	0.99	41.6	32.7	0.79	59.7	59.7	1.00	65.9	56.6	0.86	125.6	116.3	0.93
Food, beverages and tobacco industry <sup>1</sup>	20.9	23.7	1.13	83.1	70.0	0.84	0.5	0.4	0.81	135.1	129.4	0.96	135.6	129.7	0.96
Paper, printing and publishing industry	13.3	13.3	1.00	29.9	27.0	0.90	-	-	-	63.1	60.2	0.95	63.1	60.2	0.95
Building materials industry	5.2	5.3	1.02	28.4	25.1	0.89	2.0	0.4	0.20	41.3	38.4	0.93	43.3	38.8	0.90
Non-ferro basic metals industry	23.0	21.0	0.91	6.9	5.0	0.73	3.1	3.0	0.97	64.5	57.5	0.89	67.6	60.5	0.89
<b>Total for all sectors</b>	<b>126.9</b>	<b>115.8</b>	<b>0.91</b>	<b>516.4</b>	<b>418.8</b>	<b>0.81</b>	<b>410.7</b>	<b>477.2</b>	<b>1.16</b>	<b>833.2</b>	<b>708.3</b>	<b>0.85</b>	<b>1243.9</b>	<b>1185.5</b>	<b>0.95</b>
<b>Total, excluding the chemical industry</b>	<b>75.5</b>	<b>75.7</b>	<b>1.00</b>	<b>215.8</b>	<b>182.1</b>	<b>0.84</b>	<b>128.5</b>	<b>124.5</b>	<b>0.97</b>	<b>404.2</b>	<b>371.4</b>	<b>0.92</b>	<b>532.8</b>	<b>495.9</b>	<b>0.93</b>

<sup>1</sup> The EEI for non-energy use in the food, beverages and tobacco industry is relative to the year 1997, see Chapter 7 of Neelis et al., 2004 for details

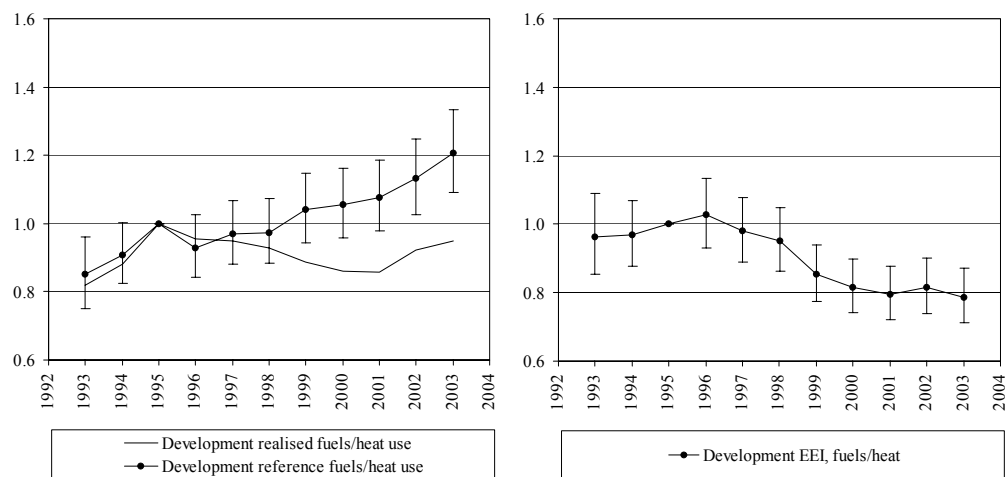




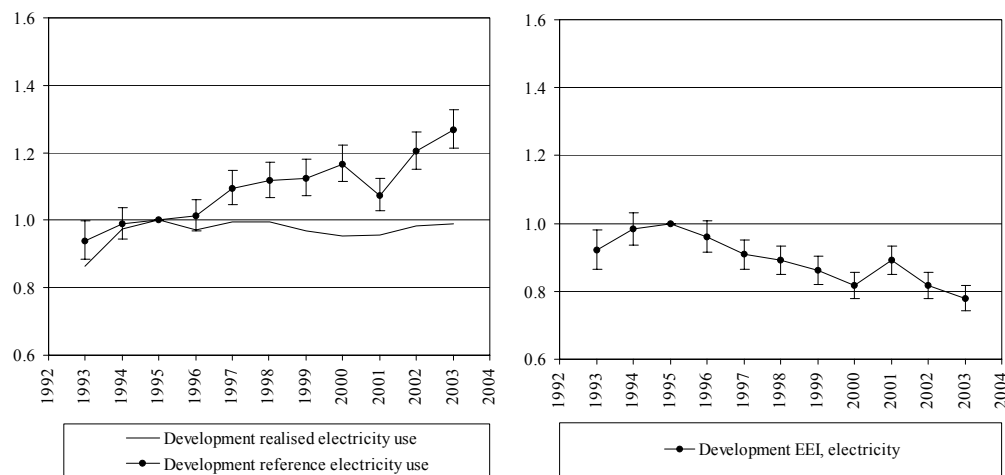
### 3.3 Chemical industry (excluding fertilisers)



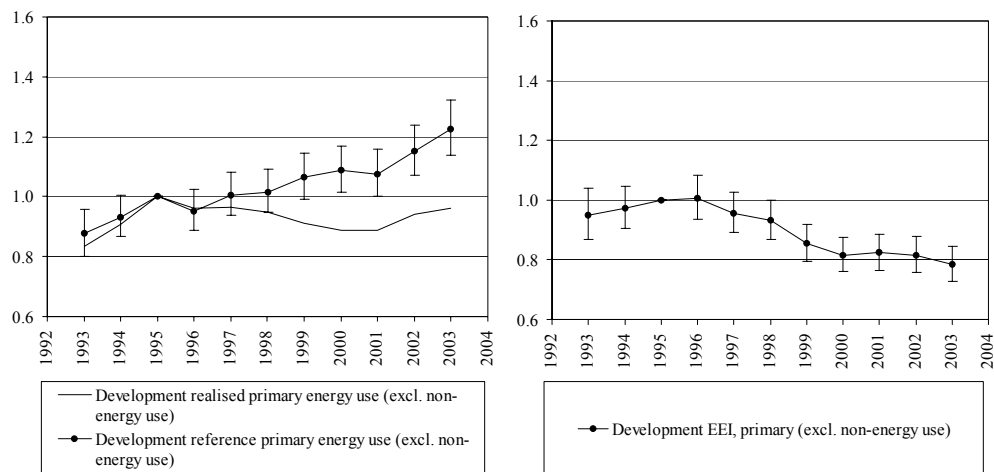
**Figure 3-1** Development of reference energy use, realised energy use and energy efficiency indicator for non-energy use in the chemical industry (uncertainty bars in realised use not shown)



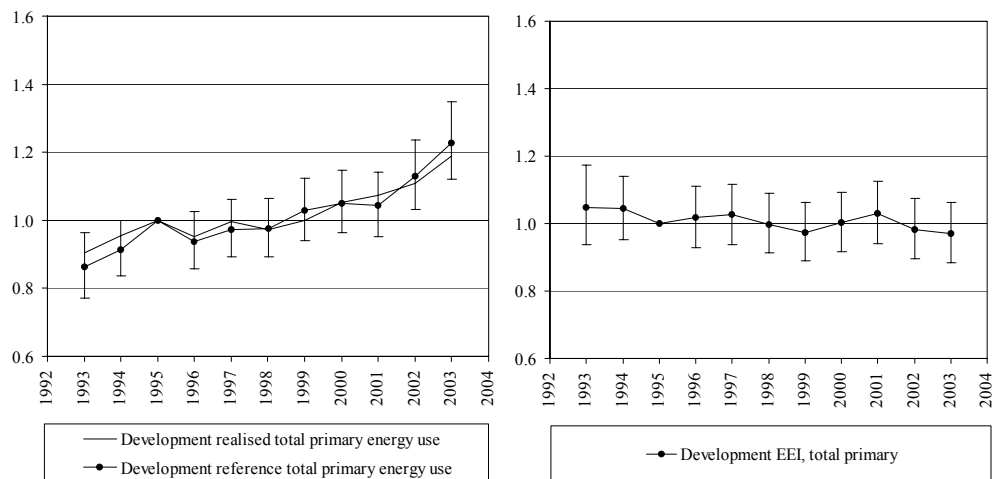
**Figure 3-2** Development of reference energy use, realised energy use and energy efficiency indicator for fuels/heat use in the chemical industry (uncertainty bars in realised use not shown)



**Figure 3-3** Development of reference energy use, realised energy use and energy efficiency indicator for electricity use in the chemical industry (uncertainty bars in realised use not shown)

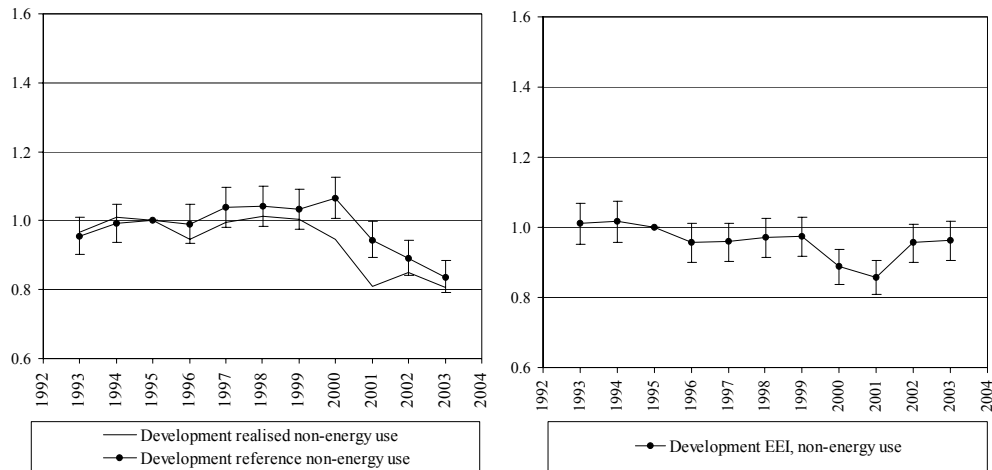


**Figure 3-4** Development of reference energy use, realised energy use and energy efficiency indicator for primary energy use (static primary units), excluding non-energy use in the chemical industry (uncertainty bars in realised use not shown)

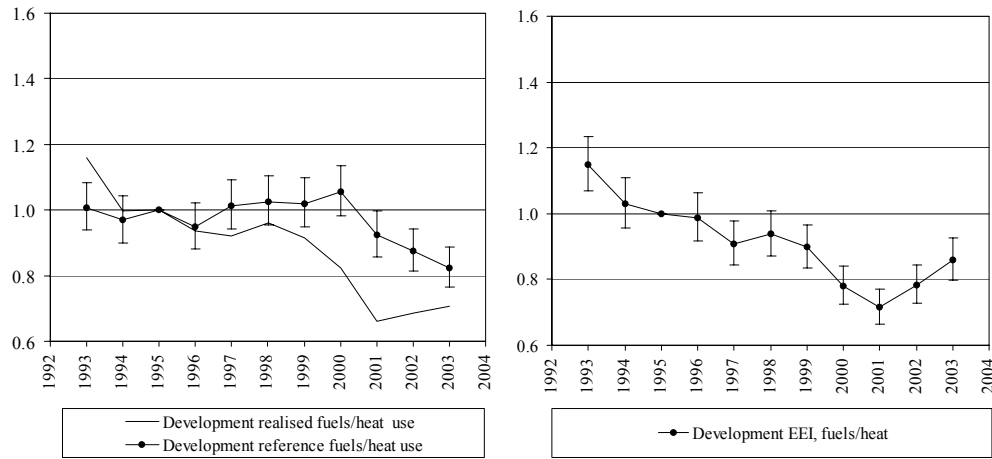


**Figure 3-5** Development of reference energy use, realised energy use and energy efficiency indicator for total primary energy use (static primary units) in the chemical industry (uncertainty bars in realised use not shown)

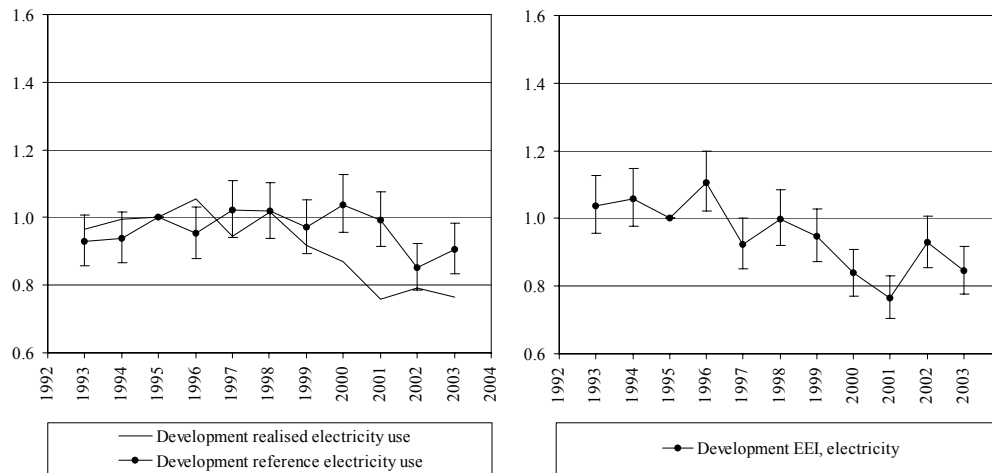
### 3.4 Fertiliser industry



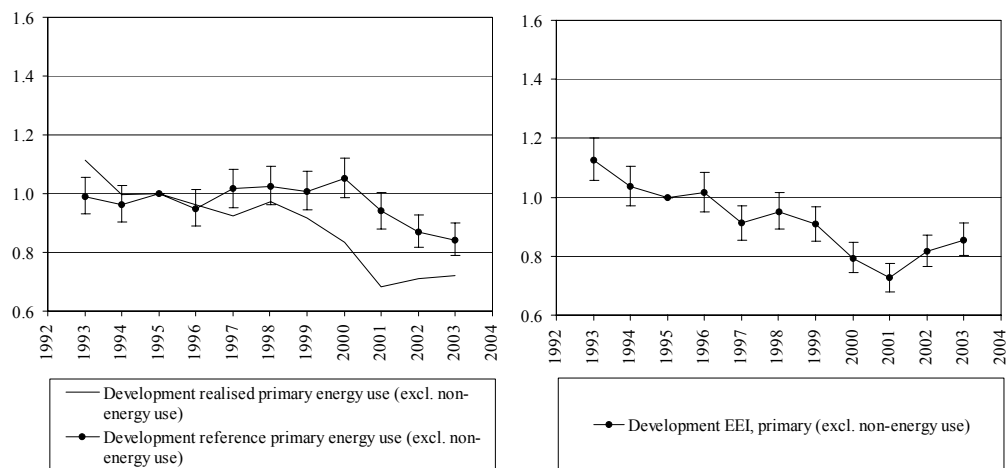
**Figure 3-6** Development of reference energy use, realised energy use and energy efficiency indicator for non-energy use in the fertiliser industry (uncertainty bars in realised use not shown)



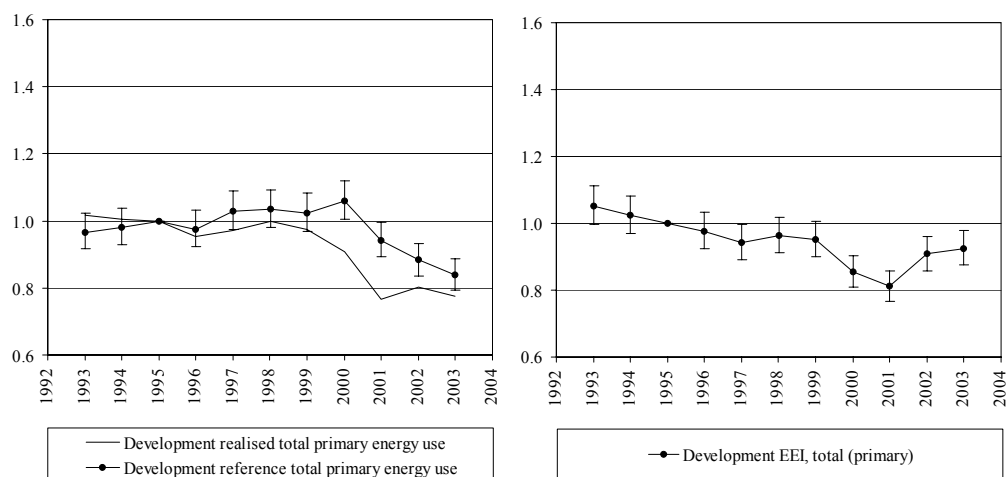
**Figure 3-7** Development of reference energy use, realised energy use and energy efficiency indicator for fuels/heat use in the fertiliser industry (uncertainty bars in realised use not shown)



**Figure 3-8** Development of reference energy use, realised energy use and energy efficiency indicator for electricity use in the fertiliser industry (uncertainty bars in realised use not shown)

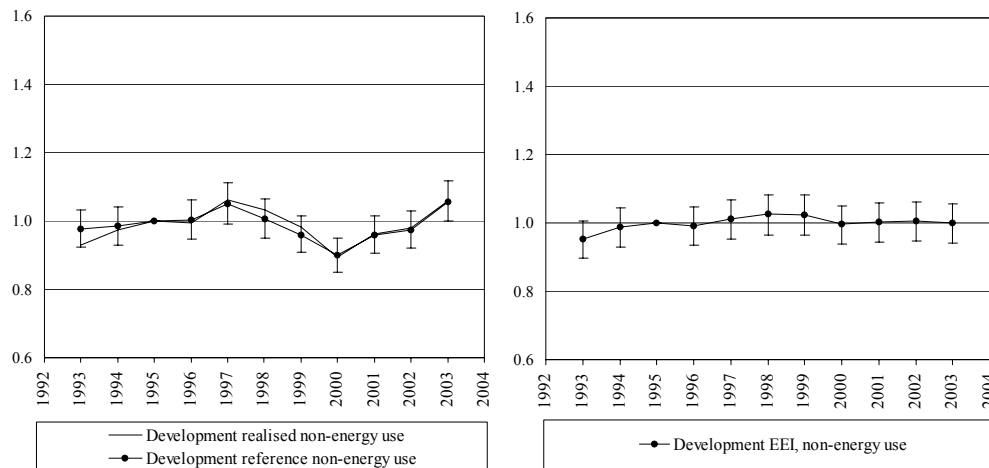


**Figure 3-9** Development of reference energy use, realised energy use and energy efficiency indicator for primary energy use (static primary units), excluding non-energy use in the fertiliser industry (uncertainty bars in realised use not shown)

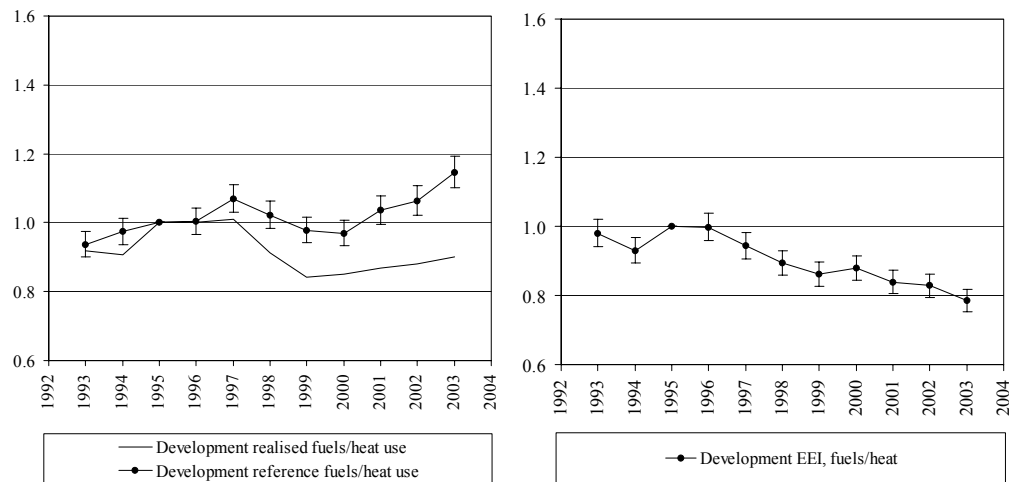


**Figure 3-10** Development of reference energy use, realised energy use and energy efficiency indicator for total primary energy use (static primary units) in the fertiliser industry (uncertainty bars in realised use not shown)

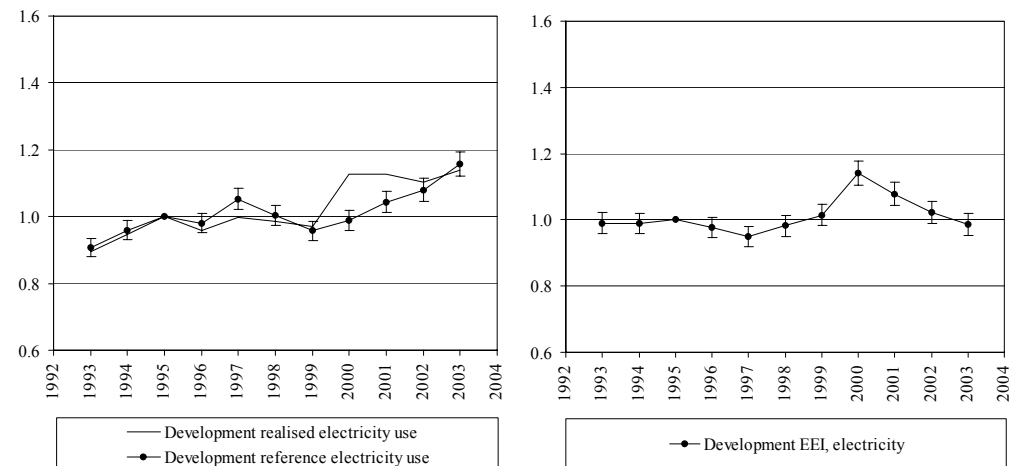
### 3.5 Iron and steel basic metals industry



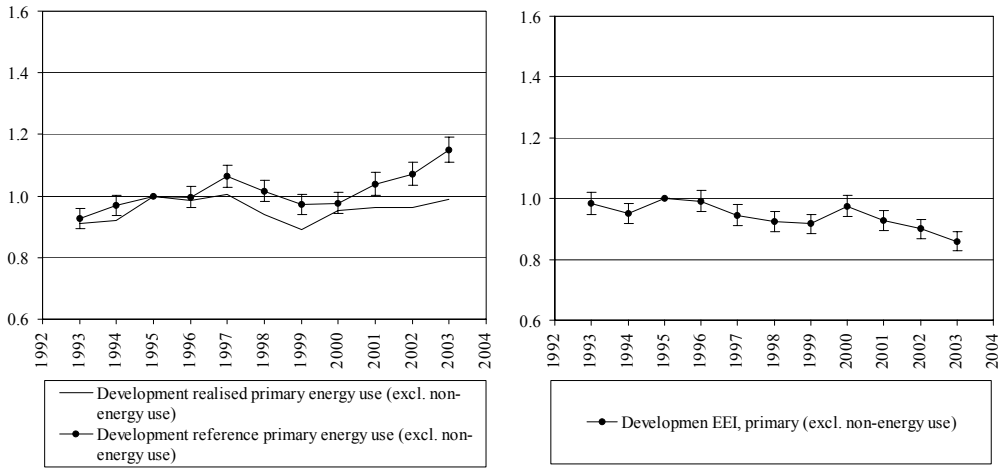
**Figure 3-11** Development of reference energy use, realised energy use and energy efficiency indicator for non-energy use in the iron and steel basic metals industry (uncertainty bars in realised use not shown)



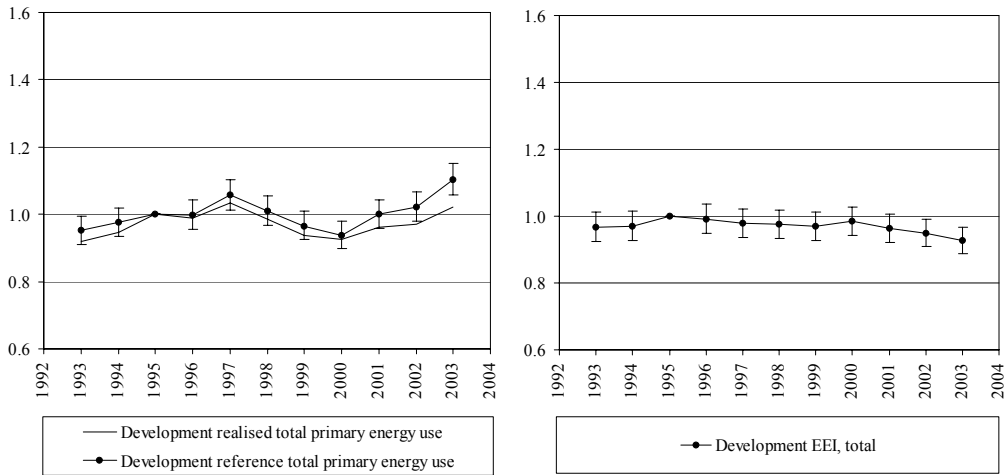
**Figure 3-12** Development of reference energy use, realised energy use and energy efficiency indicator for fuels/heat use in the iron and steel basic metals industry (uncertainty bars in realised use not shown)



**Figure 3-13** Development of reference energy use, realised energy use and energy efficiency indicator for electricity use in the iron and steel basic metals industry (uncertainty bars in realised use not shown)

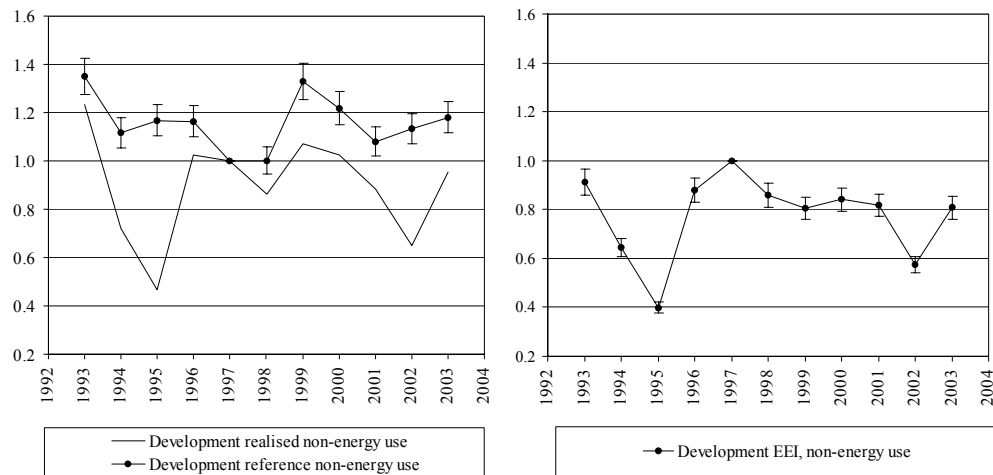


**Figure 3-14 Development of reference energy use, realised energy use and energy efficiency indicator for primary energy use (static primary units), excluding non-energy use in the iron and steel basic metals industry (uncertainty bars in realised use not shown)**

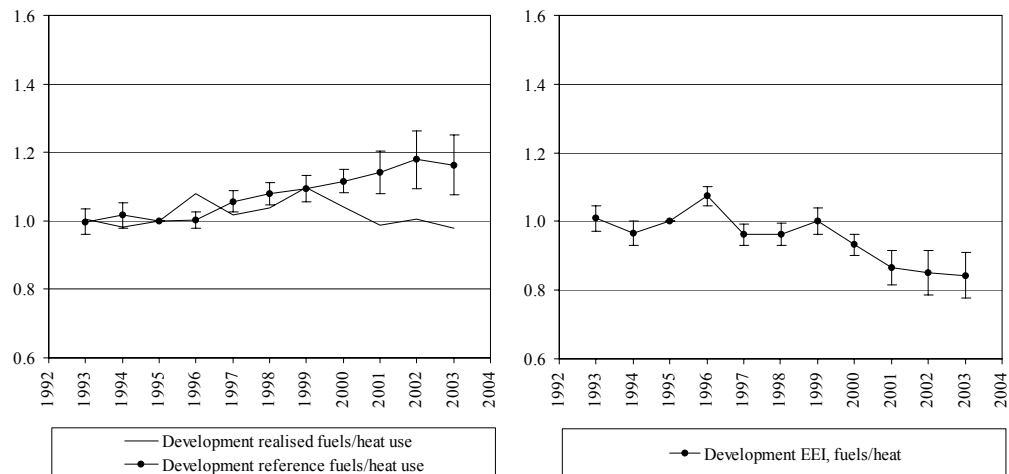


**Figure 3-15 Development of reference energy use, realised energy use and energy efficiency indicator for total primary energy use (static primary units) in the iron and steel basic metals industry (uncertainty bars in realised use not shown)**

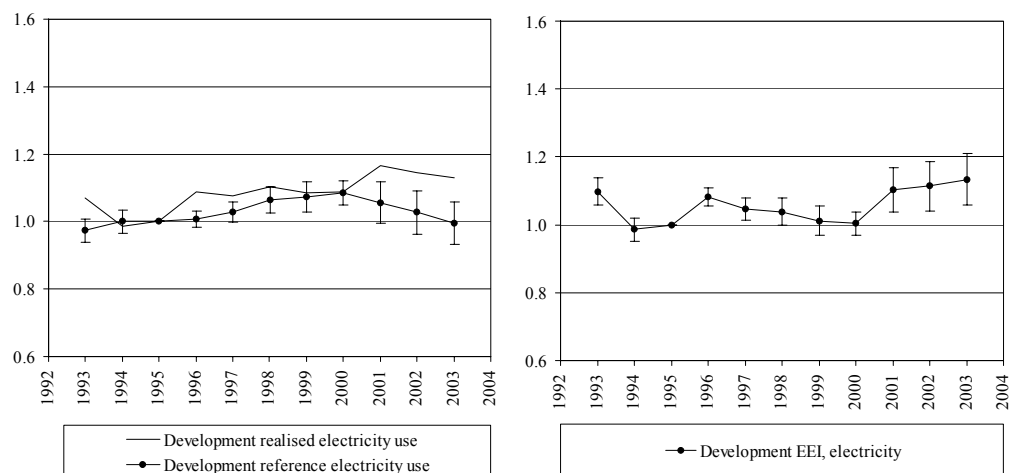
### 3.6 Food, beverages and tobacco industry



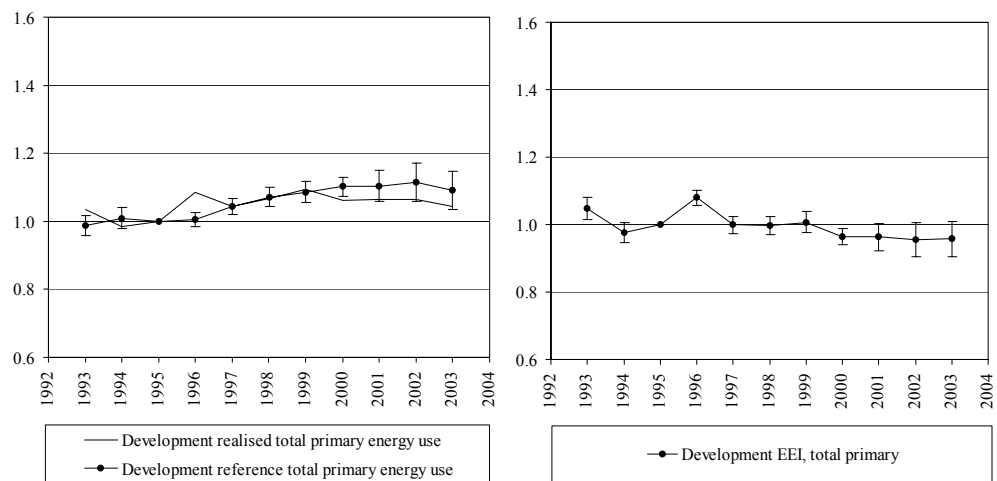
**Figure 3-16** Development of reference energy use, realised energy use and energy efficiency indicator for non-energy use in the food, beverages and tobacco industry (uncertainty bars in realised use not shown)



**Figure 3-17** Development of reference energy use, realised energy use and energy efficiency indicator for fuels/heat use in the food, beverages and tobacco industry (uncertainty bars in realised use not shown)



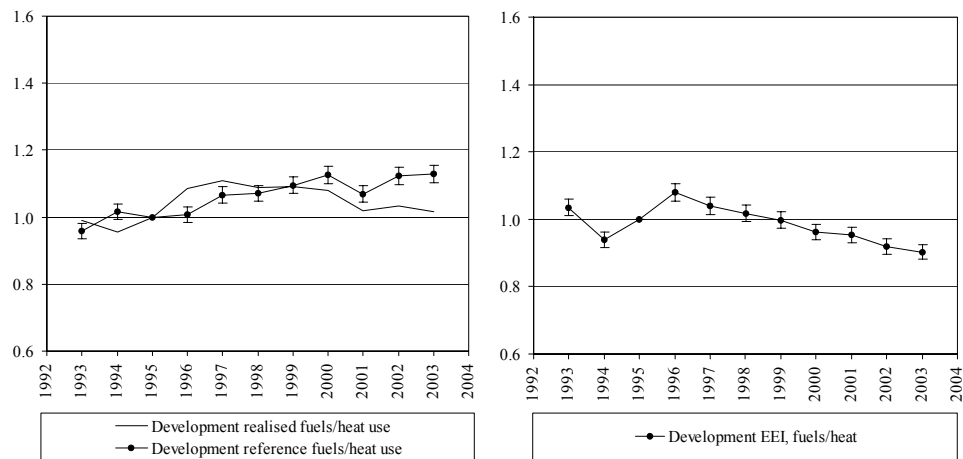
**Figure 3-18** Development of reference energy use, realised energy use and energy efficiency indicator for electricity use in the food, beverages and tobacco industry (uncertainty bars in realised use not shown)



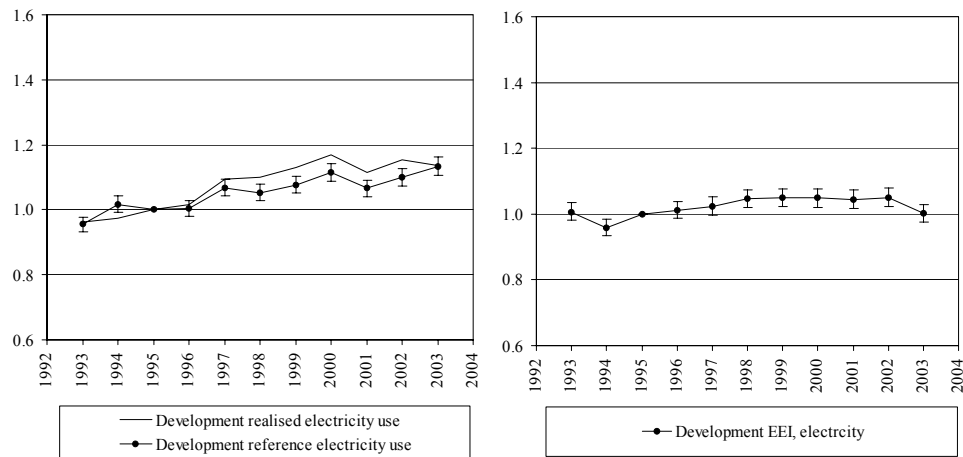
**Figure 3-19 Development of reference energy use, realised energy use and energy efficiency indicator for total primary energy use (static primary units) in the food, beverages and tobacco industry (uncertainty bars in realised use not shown)**



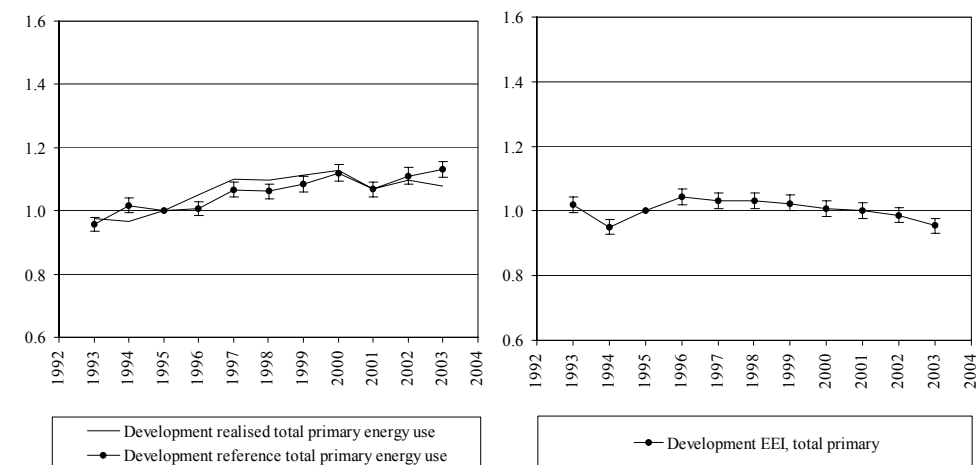
### 3.7 Paper, printing and publishing industry



**Figure 3-20** Development of reference energy use, realised energy use and energy efficiency indicator for fuels/heat use in the paper, printing and publishing industry (uncertainty bars in realised use not shown)



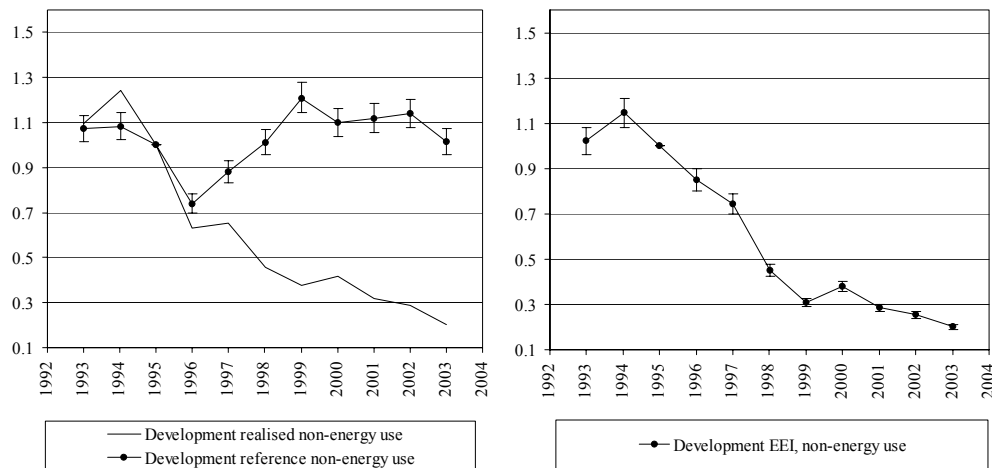
**Figure 3-21** Development of reference energy use, realised energy use and energy efficiency indicator for electricity use in the paper, printing and publishing industry (uncertainty bars in realised use not shown)



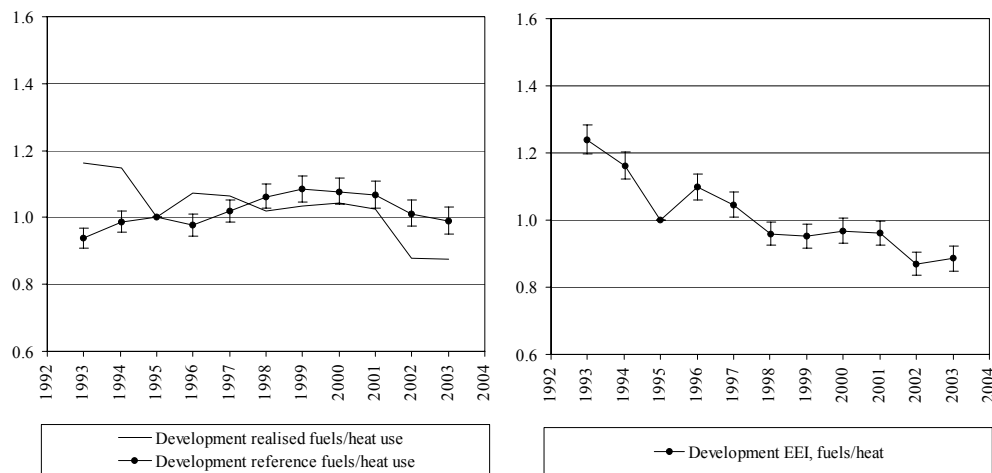
**Figure 3-22** Development of reference energy use, realised energy use and energy efficiency indicator for total primary energy use (static primary units) in the paper, printing and publishing industry (uncertainty bars in realised use not shown)



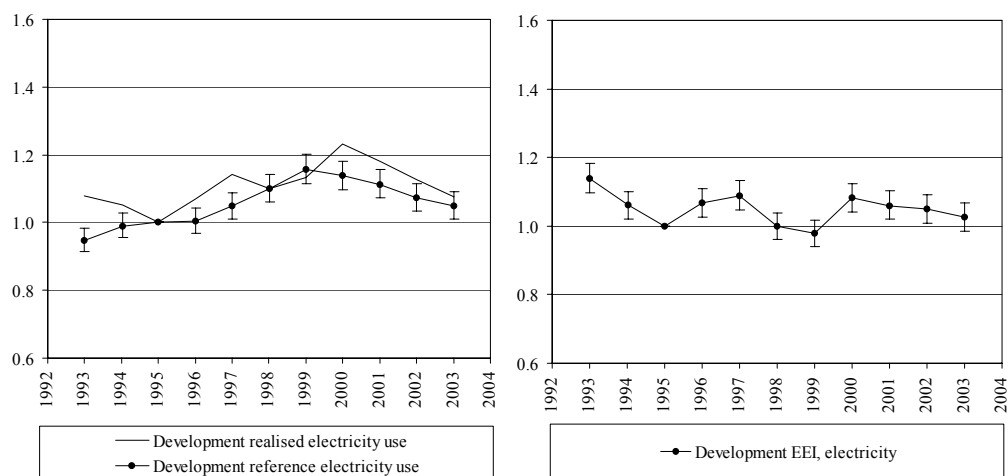
### 3.8 Building materials industry



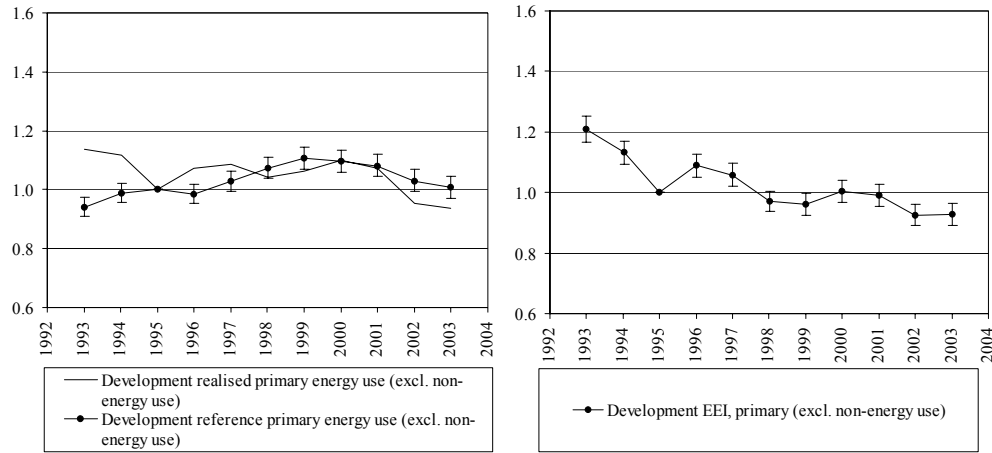
**Figure 3-23** Development of reference energy use, realised energy use and energy efficiency indicator for non-energy use in the building materials industry (uncertainty bars in realised use not shown)



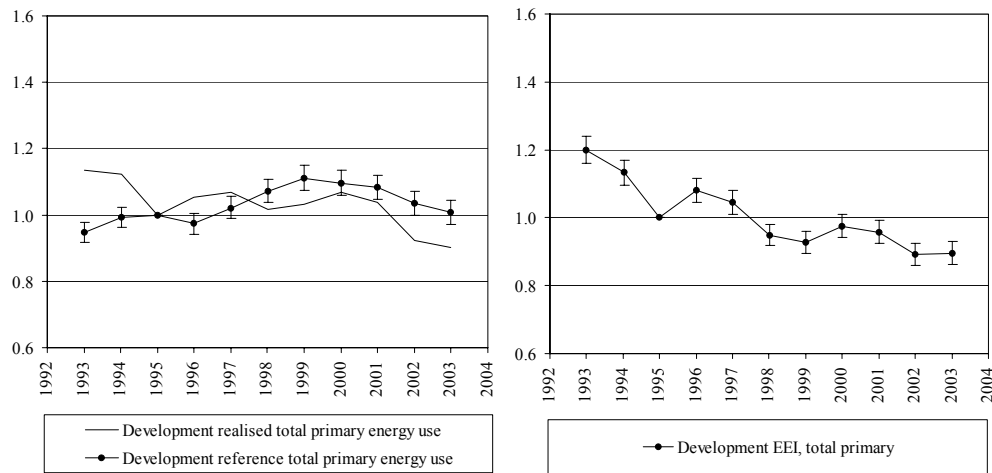
**Figure 3-24** Development of reference energy use, realised energy use and energy efficiency indicator for fuels/heat use in the building materials industry (uncertainty bars in realised use not shown)



**Figure 3-25** Development of reference energy use, realised energy use and energy efficiency indicator for electricity use in the building materials industry (uncertainty bars in realised use not shown)

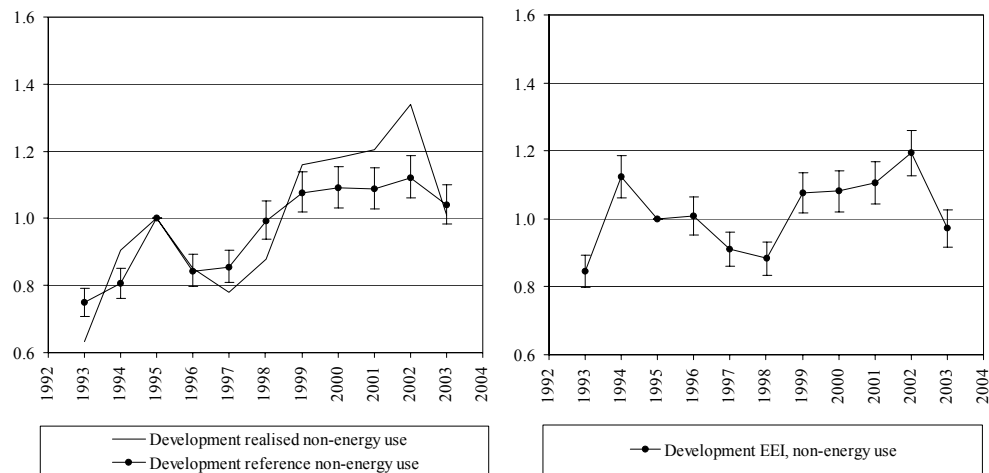


**Figure 3-26** Development of reference energy use, realised energy use and energy efficiency indicator for primary energy use (static primary units), excluding non-energy use in the building materials industry (uncertainty bars in realised use not shown)

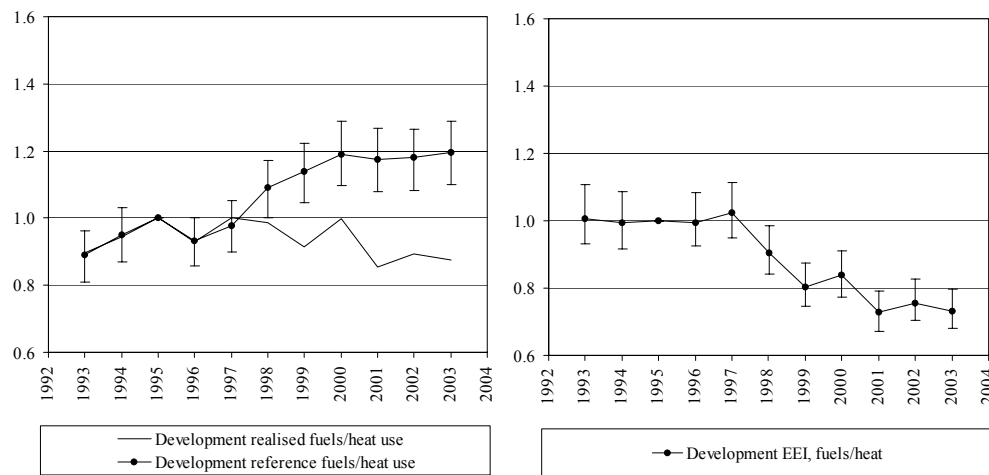


**Figure 3-27** Development of reference energy use, realised energy use and energy efficiency indicator for total primary energy use (static primary units) in the building materials industry (uncertainty bars in realised use not shown)

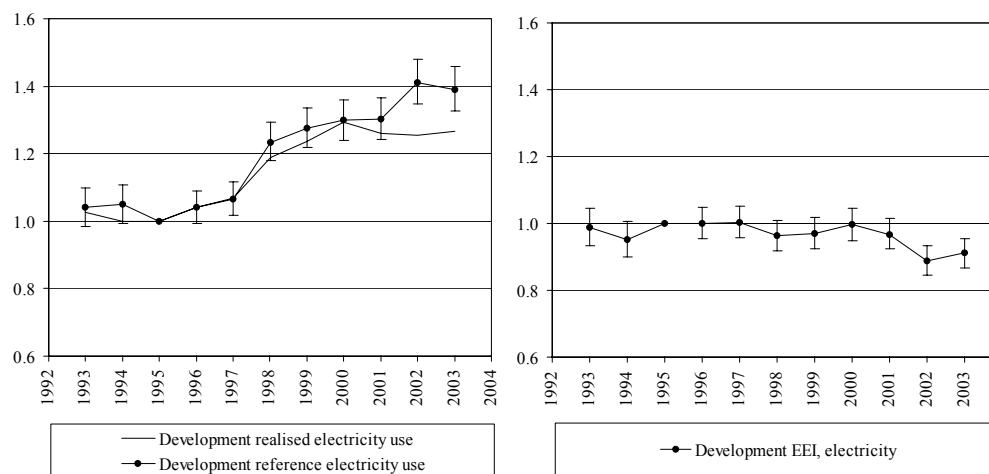
### 3.9 Non-ferro, basic metals industry



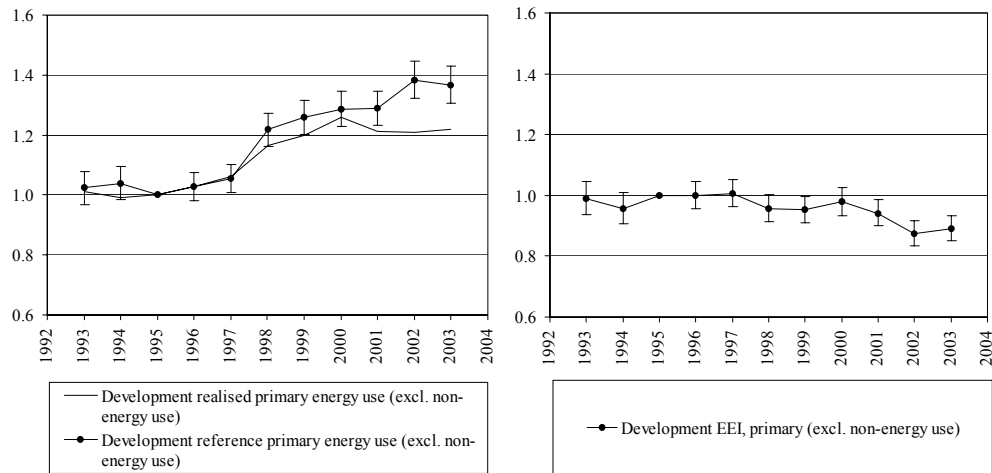
**Figure 3-28** Development of reference energy use, realised energy use and energy efficiency indicator for non-energy use in the non-ferro basic metals industry (uncertainty bars in realised use not shown)



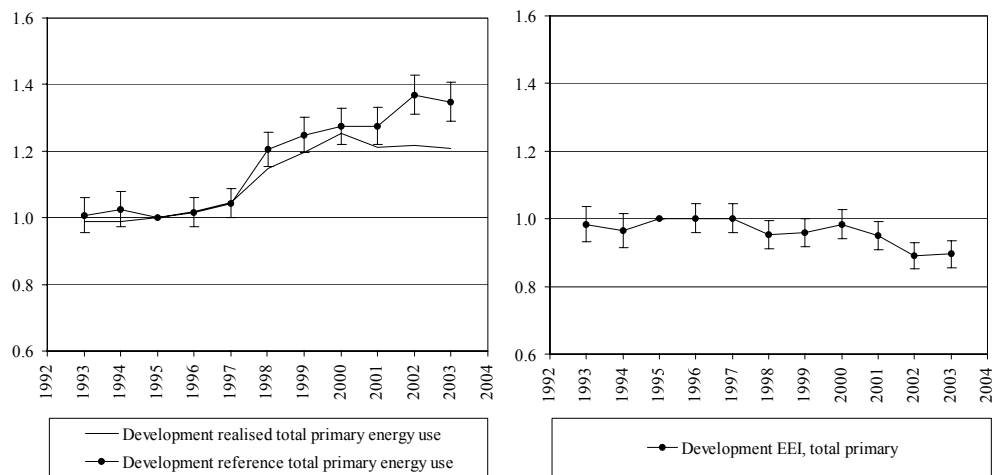
**Figure 3-29** Development of reference energy use, realised energy use and energy efficiency indicator for fuels/heat use in the non-ferro basic metals industry (uncertainty bars in realised use not shown)



**Figure 3-30** Development of reference energy use, realised energy use and energy efficiency indicator for electricity use in the non-ferro basic metals industry (uncertainty bars in realised use not shown)



**Figure 3-31 Development of reference energy use, realised energy use and energy efficiency indicator for primary energy use (static primary units), excluding non-energy use in the non-ferro basic metals industry (uncertainty bars in realised use not shown)**



**Figure 3-32 Development of reference energy use, realised energy use and energy efficiency indicator for total primary energy use (static primary units) in the non-ferro basic metals industry (uncertainty bars in realised use not shown)**

## 4 References

- Alcan (2004), *Milieujaarverslag 2003*, Alcan, Vlissingen
- Beerkens, R. (2004), *Personal communication on glass production in physical units*, TNO-TPD, Eindhoven, 9 february 2004
- Beerkens, R. (2005), *Personal communication on glass production in physical units*, TNO/TPD, Eindhoven, 17 february 2005
- Boonekamp, P.G.M., Gijsen, A. and Vreuls, H.H.J., *Gerealiseerde energiebesparing 1995-2002, conform Protocol Monitoring Energiebesparing*, Energy Research Centre of the Netherlands, Petten
- Carlsson-Kanyama A. and Faist, M. (2001), *Energy use in the food sector: a data survey*, Environmental strategies research group, Stockholm University, Stockholm
- Department of Environment (1997) *Cutting energy cost in the soft drink industry*. Energy consumption guide 65. Action Energy UK. Available online at: <http://www.actionenergy.org.uk>
- Eurostat (2003), *Iron and steel, yearly statistics, 2003 edition* Eurostat, Luxemburg
- FAO (2005), *FAOSTAT data*. Available online at: <http://faostat.fao.org/faostat>, accessed 26 April, 2005
- Gonsalves D. (1996), *Energy conservation opportunities at Tanzania Bottlers Dar es Salaam*, Msc Thesis, Eindhoven University of Technology, Faculty of Technology Management, Eindhoven
- Heineken (1999), *Environmental report 1998-1999*, Heineken, Amsterdam
- Hiddink J. (2004) *Personal communication*, Arcadis, Den Bosch
- Hulstotte, J.H.J. and Matthijsen, A.J.C.M. (1995). *Productie van suiker*, RIVM report 736301110, Bilthoven in: Ministerie van VROM, Ministerie van Verkeer en Waterstaat and RIVM (editors), *Samenwerkingsproject Procesbeschrijvingen Industrie Nederland (SPIN)*
- IISI (2004), *Iron and steel, statistical yearbook 2004*, International Iron and Steel Institute (IISI), Brussels
- IPTS (2003), *Draft reference document on best available technologies in the food, drink and milk industry*, European Commission, Joint Research Centre, Institute for Prospective Technological Studies, Seville, Draft, May 2003
- KNB (2003), *Jaarverslag 2002*, Koninklijk Verbond van Nederlandse Baksteenfabrikanten (KNB), de Steeg
- KNB (2004), *Jaarverslag 2003*, Koninklijk Verbond van Nederlandse Baksteenfabrikanten (KNB), de Steeg
- Loretzon K., Olsson O., Reiners V. and Stadig, M. (1997), *Uthållig livsmedelproduktion: en energi- och miljöstudie med inriktning not kyl, frys- och helkonservbehandling*, Swedish institute for food and bio-technology, Gothenberg, 1997.

- Mergelsberg, P. (2004), *Personal communication on clinker production*, ENCI Maastricht, 9 March 2004
- Mergelsberg, P. (2005), *Personal communication on clinker production*, ENCI Maastricht, 17 January 2005
- Molinari R., Gagliardi R., Drioli E., *Methodology for estimating savings of primary energy with membrane operation in industrial processes*, *Desalination* 1995 (100): 125-137
- Neelis, M., Ramirez, A. and Patel, M. (2004), *Physical indicators as a basis for estimating energy efficiency developments in the Dutch industry*, Report NW&S-E-2004-20 Department of Science, Technology and Society, Copernicus Institute for Sustainable Development and Innovation, Utrecht University, Utrecht, August 2004
- Nielsen P.H., Nielsen A.M., Weidema B.P., Dalgaard R. and Halberg N. (2003) *LCA food database* Available online at: <http://www.lcafood.dk/database> .
- Pechiney (2003), *Milieujaarverslag 2002*, Pechiney, Vlissingen
- Pontoppidan O., Hansen P. (2001). *Renere teknologi på svine-og kreaturslagterier*. Resume rapport (Cleaner technology in the poultry and cattle-slaughtering branch. Summary report). Environmental project No. 9, Danish EPA 2001 (in Danish). Available online at: <http://www.mst.dk/udgiv/publikationer/2000/87-7944-306-0/html/>
- PZ (2003), *Statistisch Jaaroverzicht 2002*, Productschap Zuivel, Zoetermeer
- PZ (2004), *Statistisch Jaaroverzicht 2003*, Productschap Zuivel, Zoetermeer
- Statistics Netherlands (2003), *De Nederlandse Energie Huishouding (NEH), jaarcijfers, 1993-2002*, obtained via a personal communication with W. Tinbergen, Statistics Netherlands, Voorburg, 15 september 2003
- Statistics Netherlands (2004), *De Nederlandse Energie Huishouding (NEH), jaarcijfers, 2003*, obtained via a personal communication with L. Pleijsier, Statistics Netherlands, Voorburg, 23 June 2004
- Statistics Netherlands (2005), *Personal communication by phone with H. van der Bosch*, Statistics Netherlands, Heerlen, 29 April 2005
- Suijkerbuijk, M.A.W., van Oosterhout C.J.M. and Hoogenkamp, A.W.H.M. (1995) *Slachterijen en vleeswaren industrie*, RIVM report 773006173, Bilthoven in: Ministerie van VROM, Ministerie van Verkeer en Waterstaat and RIVM (editors), Samenwerkingsproject Procesbeschrijvingen Industrie Nederland (SPIN)
- UN (2005), *United Nations Commodity Trade Statistics Database*. Available online at <http://unstats.un.org/unsd/comtrade/>, accessed 26 April, 2005
- VNP (2003), *Annual report 2002*, Vereniging van Nederlandse Papier- en Kartonfabrieken (VNP), Hoofddorp
- VNP (2004), *Annual report 2003*, Vereniging van Nederlandse Papier- en Kartonfabrieken (VNP), Hoofddorp



## **Appendix 1      Corrected tables for the food, beverages and tobacco industry**

In the section on the food, beverages and tobacco industry in the 2004 report (Chapter 7 and Appendix 5), we found some inaccuracies in the reporting of specific energy consumption (SEC) values and uncertainty ranges. In a number of cases the units given or rounding applied in the tables were inaccurate. These inaccuracies only occur in the report; all values appeared correct in the spreadsheet tool. In the two tables below, we give the correct tables. The changes compared to the 2003 are given in bold.

**Table A1-1 Specific energy consumption (SEC) values by product in the food, beverages and tobacco industry (Table 7.3 in Neelis et al., 2004).**

Product		Origin production data (Prodcum numbers)	SEC Electricity	SEC Fuels and heat	Unit	Source/ Comments
<b>Meat</b>						
Beef+ Sheep	A	PVE or FAO statistics	341	537	MJ/mt dress carcass weight	Pontoppidan and Hansen, 2001
Pig	A	PVE or FAO statistics	465	932	MJ/mt dress carcass weight	
Poultry	A	PVE or FAO statistics	1008	576	MJ/mt dress carcass weight	Pontoppidan and Hansen, 2000
Processed meat	PC	15131110+15131130+ 5131150+15131170+ 15131190+15131213+ 5131215+15131225+ 15131233+15131235+ 5131243+15131245+ 15131253+15131259+ 5131260+15131263+ 15131269	<b>754</b>	3950	MJ/mt product	Suijkerbuijk et al., 1995
Rendering	A	Calculated based on PVE or FAO statistics	327	1536	MJ/mt raw material	Rendac, 2002
<b>Fish</b>						
Fresh (fillets)	PC	15201190	129	6	MJ/mt product	Nielsen et al., 2003
Frozen fish	PC	15201210+15201230+15201270+15201290+1 5201530+15201553	<b>696</b>	6	MJ/mt product	
Prepared or preserved fish	PC	15201411+15201412+15201413+15201414+ 15201415+15201417+15201419+15201419+ 15201330+15201370+15201353+15201355+ 15201359+15201600	482	1062	MJ/mt product	
Smoked and dried fish	PC	15201353+15201355+15201359+15201370	<b>1200</b>	2077	MJ/mt product	Own calculation
Fish meal	PC	15201700	684	6200	MJ/mt product	Nielsen et al., 2003

Product		Origin production data	SEC Electricity	SEC Fuels and heat	Unit	Source
<b>Potatoes</b>						
Potatoes products	PC	15311230+15311250+15311100+15311210+15311270+15311290	5722 <sup>a</sup>		MJ/mt product	Own calculation
<b>Fruit and vegetables</b>						
Unconcentrated juice	PC	15321013+15321015+15321021+15321022+15321023+15321025+15321026+15321029+15321030+15321040	250	900	MJ/mt product	Loretzon et al., 1997
Tomato juice	PC	15321024	125	4789	MJ/mt product	Molinary et al., 1995
Frozen vegetables and fruits	PC	15331100+15331440+15331500+15332100	738	1800	MJ/mt product	Average figure based on confidential data VITO
Preserved mushrooms	PC	15331430	2898 <sup>a</sup>		MJ/mt product	Own calculation
Vegetables preserved by vinegar	PC	15331500	2178 <sup>a</sup>		MJ/mt product	Own calculation
Tomato ketchup	PC	15871230	380	1700	MJ/mt product	Carlsson-Kanyama and Faist, 2001
Jams and marmalade	PC	15332230+15332290+15881050	490	1500	MJ/mt product	
Dried vegetables and fruits	PC	15331330+15331350+15331390+15332520	1500	4500	MJ/mt product	
<b>Crude and refined oil</b>						
Crude oil +Refined oil	PC	15411210+15411240+15411260+15411350+15421110+15421120+15421140+15421150+15421160+15421210+15421220+15421230	672 <sup>a</sup>		MJ/mt product	Own calculation
<b>Dairies</b>						
Milk and fermented products	A	Prodzuivel statistics	241	524	MJ/mt product	Hiddink, 2004
Butter	A	Prodzuivel statistics	457	1285	MJ/mt product	
Milk powder	A	Prodzuivel statistics	1051	9385	MJ/mt product	
Condensed milk	A	Prodzuivel statistics	295	1936	MJ/mt product	

Product		Origin production data	SEC Electricity	SEC Fuels and heat	Unit	Source
Cheese	A	Prodzuivel statistics	1206	2113	MJ/mt product	Hiddink, 2004
Casein and Lactose	A	Prodzuivel statistics	918	<b>4119</b>	MJ/mt product	
Whey powder	A	Prodzuivel statistics	1138	9870	MJ/mt product	
<b>Starches and starch products</b>						
Wheat starch	PC	15622211	2960	8800	MJ/mt product	IPTS, 2003 Average values
Maize starch	PC	15622213	1000	2331	MJ/mt product	
Potato starch	PC	15622215	1425	3564	MJ/mt product	
<b>Prepared animal feeds</b>						
For farm animals	PC	15711003+15711005+15711007+15711009	475 <sup>a</sup>		MJ/mt product	Own calculation
For pets	PC	15721030+15721033+15721035	2306 <sup>a</sup>		MJ/mt product	Own calculation
<b>Sugar</b>						
Refined sugar	PC	15831230+15831290	<b>556</b>	5320	MJ/mt product	Hulskotte et al., 1995 NL; best 1990
Beet pulp	PC	15832000	5	1820	MJ/mt product	
<b>Cacao</b>						
Cacao beans	CBS	CBS data	6384 <sup>a</sup>		MJ/mt processed cacao beans	Own calculation
<b>Coffee</b>						
Non roasted	PC	15861130	141	<b>160</b>	MJ/mt product	IPTS, 2003
Roasted	PC	15861150+15861150	518	1997	MJ/mt product	IPTS, 2003 (Assuming 20% shrinkage in roasting)
Extracts of coffee solid form	PC		15675		MJ/mt product	Own calculation

Product		Origin production data	SEC Electricity	SEC Fuels and heat	Unit	Source
<b>Beer and malt</b>						
Beer	PC	15961000	20	153	MJ/hl product	Heineken, 1999 (Europe; 1997)
<b>Mineral waters and soft drinks</b>						
Mineral water and soft drinks	PC	15981130	133	199	MJ/1000 l product	Department of Environment, 1997
Unsweetened water and soft drinks	PC	15981150+15981230+15981255	120	360	MJ/1000 l product	Gonsalvez, 1996
<b>Tobacco and Others</b>						
Cigar	PC	160011130	66		MJ/1000 stucks	Own calculation
Cigarettes	PC	160011150	16		MJ/1000 stucks	Own calculation
Sweet Biscuits	PC	15811255	4581 <sup>a</sup>		MJ/mt product	Own calculation
Waffles and wafers	PC	15821259	3195 <sup>a</sup>		MJ/mt product	Own calculation
Flours	PC	156112100+15612200+15612400	420	30	MJ/mt product	Carlsson-Kanyama and Faist, 2001
Soup and broths	PC	15891100	7659 <sup>a</sup>		MJ/mt product	Own calculation
Pasta	PC	156113133+156113135+15613230	648	2	MJ/mt product	IPTS, 2003

*mt: tonne; a: due to confidentiality restrictions data is only shown as primary energy; PC: Prodcum number; A: Industrial associations*

Table A1-2 Assumptions uncertainty analysis food, beverages and tobacco industry (Appendix 5 in Neelis et al., 2004).

Parameter/product	PDF attributes	
	SEC fuels	SEC electricity
Beef+ Sheep	<b>Triangular [483-591]</b>	<b>Triangular [100-500]</b>
Pig	<b>Log normal <math>\sigma = 157</math></b>	<b>Log normal <math>\sigma = 65</math></b>
Poultry	<b>Log normal <math>\sigma = 218</math></b>	<b>Log normal <math>\sigma = 237</math></b>
Processed	<b>Triangular [2555-4345]</b>	Triangular [490-1017]
Rendering	Triangular [1674-3000]	Triangular [100-350]
Fresh (fillets)	Triangular [6-7]	<b>Triangular [90-168]</b>
Frozen	Triangular [6-7]	Triangular [520-810]
Prepared or preserved fish	<b>Triangular [906-1268]</b>	Triangular [337-627]
Smoked and dried	<b>Triangular [1869-2285]</b>	Triangular [840-1560]
Fish meal	Triangular [5580-6820]	Triangular [547-821]
Potatoes products	<b>Triangular [3220-3935]</b>	Triangular [621-932]
Unconcentrate Juice	Uniform [610-1100]	Uniform [200-400]
Tomato juice	<b>Triangular [3500-5268]</b>	Triangular [100-450]
Frozen vegetables and fruits	Triangular [1500-2000]	Triangular [371-1325]
Preserved mushrooms	Uniform [2198-3155]	Uniform [314-707]
Vegetables preserved by vinegar	Uniform [900-1503]	Uniform [275-590]
Tomato ketchup	<b>Triangular [1400-1900]</b>	Triangular [267-497]
Jams and marmalade	Uniform [750-2550]	Uniform [343-637]
Dried vegetables and fruits	Uniform [4050-6990]	Uniform [1350-1950]
Crude oil +Refined oil	<b>Triangular [3008-5332]</b>	Triangular [73-135]
Milk and fermented products	<b>Log normal <math>\sigma = 63</math></b>	<b>Log normal <math>\sigma = 63</math></b>
Butter	<b>Triangular [1157-1414]</b>	Triangular [411-563]
Milk powder	<b>Log normal <math>\sigma = 224</math></b>	<b>Log normal <math>\sigma = 224</math></b>
Condensed milk	Triangular [1742-2130]	Triangular [266-325]
Cheese	<b>Log normal <math>\sigma = 1820</math></b>	<b>Log normal <math>\sigma = 1820</math></b>
Casein and Lactose	<b>Log normal <math>\sigma = 412</math></b>	<b>Log normal <math>\sigma = 91.8</math></b>
Whey powder	Triangular [6910-12831]	<b>Triangular [800-1552]</b>
Wheat starch	Uniform [6768-10998]	Uniform [1692-4230]
Maize starch	Uniform [1332-3330]	Uniform [666-1332]
Potato starch	Uniform [1188-5940]	Uniform [950-1901]
Food for farm animals	<b>Log normal <math>\sigma = 608</math></b>	<b>Log normal <math>\sigma = 140</math></b>
Food for pets	Triangular [1144-2900]	Triangular [31-65]
Refined sugar	Triangular [5024-6699]	Triangular [202-824]
Cacao	<b>Triangular [3391-4152]</b>	<b>Triangular [947-1157]</b>
Non roasted coffee	<b>Triangular [130-193]</b>	Triangular [112-169]
Roasted coffee	<b>Triangular [1600-2416]</b>	Triangular [415-622]

<b>Parameter/product</b>	<b>PDF attributes</b>	
	<b>SEC fuels</b>	<b>SEC electricity</b>
Extracts of coffee solid form	Triangular [8910-14000]	<b>Triangular [1071-1301]</b>
Beer	<b>Triangular [138-169]</b>	<b>Triangular [18-22]</b>
Mineral water	<b>Triangular [179-219]</b>	Triangular [106-160]
Unsweetened water and soft drinks	<b>Triangular [290-436]</b>	<b>Triangular [97-144]</b>
Cigar	<b>Triangular [19-61]</b>	<b>Normal <math>\sigma =15</math></b>
Cigarettes	<b>Triangular [5-6]</b>	<b>Triangular [4-5]</b>
Sweet Biscuits	Triangular [2700-5300]	Triangular [660-760]
Waffles and wafers	Triangular [2700-3300]	<b>Triangular [63-84]</b>
Flours	<b>Triangular [200-430]</b>	Triangular [240-540]
Soup and broths	Uniform [2700-5300]	Uniform [1296- 2037]
Pasta	Triangular [2-3]	Triangular [504-940]