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Monitoring Energy Efficiency Indicators in The Netherlands in 2000

Dutch contribution to the project 'Cross country comparison on energy efficiency - Phase 6'

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Preface

This study has been carried out in the framework of the SAVE project 'Cross-country Comparison on Energy Efficiency Indicators - Phase 6'. This project is co-ordinated by the French agency ADEME. The project was financed to a large extent by the Dutch Ministry of Economic Affairs, together with the EU SAVE program under contract number 00 10 019. The ECN project number was 7.7306.

Abstract

The study uses energy efficiency indicators to present and review the energy efficiency situation in the Netherlands in the last decades. The indicators are calculated along a common methodology, using the ODYSSEE database and national data. Such analysis leads to a better understanding of national developments, because indicators allow for a structured decomposition of the different factors underlying energy efficiency trends, such as structural changes and human behaviour. In addition, indicators are very suitable for international comparison and benchmarking, because they translate absolute levels of energy demand to comparable proportions. On the Cardiff Summit in 1998, the European Commission has decided to use a selection of the ODYSSEE indicators for monitoring the progress of energy efficiency in the European Union.

In this report, indicators are used to monitor and analyse national developments with respect to energy efficiency and CO_2 emissions in all main economic sectors up till 1999.

In the period 1982-1999, total final energy demand has grown with 19%. In 1998 and 1999, a decrease in final energy consumption took place. This occurred mainly in the industry (chemical sector), the residential sector and the service sector. It is uncertain yet whether this is an incident or structural. The decrease in the residential and service sectors can partly be explained by the weather.

Over the same period, the final energy intensity decreased with 18%. Again, this is partly due to the -not yet statistically significant- decrease in final consumption in 1998-1999. Overall energy efficiency has improved most rapidly in the years 1982-1986, with an average annual decrease of the final energy intensity of 3.4%, when fuel prices were high due to the second oil shock, the economy was in a recession, and an active energy conservation policy was carried out. When the prices dropped and the economy recovered, the overall energy efficiency improvement slowed down to an average rate of 1.7% annually.

The CO_2 emissions of final consumers show a slightly increasing trend, except for 1998-1999. There are two explanations for this. First, more electricity is imported, of which the emissions are accounted for by the country where the generation takes place. Secondly, due to a change in definition, more emissions are accounted to non-energy use in industry. The CO_2 emission intensity shows a decreasing trend, similar to that of the final energy intensity. The CO_2 emissions per capita, on the other hand, are still increasing.

CONTENTS

1. INTRODUCTION

This national report for the Netherlands is one in a series of national reports for the SAVE project 'Cross-country Comparison on Energy Efficiency Indicators-Phase 6'. This project is co-ordinated by the French agency ADEME. The project was financed to a large extent by national contributions, together with the EU SAVE program. The aim of the project is to develop and analyse energy efficiency indicators for all EU countries, based on national data, which, harmonised to a common format, are stored in one database 'ODYSSEE'. Each year, the database is updated with the most recent information for the purpose of monitoring the latest developments, and new indicators are developed.

Why energy efficiency indicators?
Energy efficiency indicators are used for various purposes, such as:
- To support policy makers in answering different types of questions related to energy efficiency, for the evaluation of programmes and policies, for target monitoring, or for the definition of research programmes. Such analysis leads to a better understanding of national developments, because indicators allow for a structured decomposition of the different factors underlying energy efficiency trends, such as structural changes.
- To compare energy efficiency levels, both within a country through time (monitoring) and between countries. Indicators are very suitable for international comparison and benchmarking, because they translate absolute (and very different) levels of energy demand to comparable proportions.
- To provide a source of data for forecasting models.

The current project and related activities
In Phase 6 of the project, besides an update of the database to 1999, CO_2 emissions and indicators have been calculated for the first time. In addition, specific information on policies and measures in the residential and transport sector has been collected (see Annex B). In the spring of 2001 the project co-ordinator ADEME will publish the final project report consisting of:
- all 16 national reports,
- an assessment of energy efficiency in the EU,
- an overview of energy efficiency and environmental policy in the different EU countries.

ECN has previously contributed to Phase 3, 4 and 5 of the project, see respectively (Uyterlinde, 1997) and (Van Dril, 1999), (Uyterlinde, 2000). In Phase 3, setting up the data collection was a major task, while in Phase 4 the harmonisation of Dutch definitions, in particular in industry and for CHP, with international definitions required additional effort. Phase 5 incorporated the organisation of a conference 'Monitoring tools for energy efficiency', the proceedings of which have been published separately (ADEME, 2000).

On the Cardiff Summit in 1998, the European Commission has decided to use a selection of the ODYSSEE indicators for monitoring the progress of energy efficiency in the European Union. For this purpose, a process of 'officialisation' of the ODYSSEE indicators, supported by EUROSTAT, is in progress since 1999. Other institutes, such as the European Environmental Agency and EUROSTAT, will provide indicators focusing on environmental (emissions) and energy market developments. Since the IEA has also developed energy efficiency indicators, see for instance (IEA, 1999), a process of harmonising methodologies between ODYSSEE and IEA indicators is in progress.

Content of this report

This report uses energy efficiency indicators to present and review the energy efficiency development in the Netherlands in the last decades. First, Chapter 2 gives an overview of energy efficiency and environmental policy in the Netherlands in 2000. Next, Chapter 3 gives an overall assessment of energy efficiency trends on the national level. In Chapters 4 to 7 an analysis is made to determine energy efficiency and savings in the main end-use sectors. In Chapter 8, the general context with regard to data collection and definitions is described. Finally, conclusions are drawn in Chapter 9.

Unless indicated otherwise, the source of data for the figures and tables in this report is the ODYSSEE database, for the Netherlands mainly based on CBS data from the energy database EDN.

2. ENERGY EFFICIENCY POLICY IN THE YEAR 2000

Prices and taxes

In Table 2.1, recent energy price developments are stated for the Netherlands. Industry prices vary considerably, depending on demand size and pattern. For smaller industrial consumers tariffs are similar to household prices. For the largest consumers, costs may be 10% lower than the stated value.

Table 2.1 *Energy prices in the Netherlands, including energy taxes, excluding VAT. For households, VAT = 17.5% (EVN, several years, Energiemonitor CBS 2000-3, Tables 6.6, 6.7, VENW Journaal 5-6-2000)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Natural gas, households ct/m^3	43.2	49.0	49.3	45.4	47.2	46.6	47.0	54.6	56	54.8
Natural gas, industry ct/m^3	21.6	22.8	22.9	20.5	20.4	20.6	22.6	24.3	23.1	21.6
Electricity, households ct/kWh	19.5	19.4	19.1	19.7	20.1	20.3	22.7	23.0	23.2	24.5
Electricity, industry ct/kWh	10.1	9.9	9.8	10.1	10.0	10.4	10.9	11.1	11.1	11.1
Natural gas, electricity generators Dƒ/GJ	6.4	6.3	5.8	5.9	5.6	6.1	6.1	6.7	6.4	25.9
Oil, electricity generators Dƒ/GJ	5.6	5.8	7.1	7.8	7.2	5.9	5.9	6.1	6.5	8.7
Coal, electricity generators Dƒ/GJ	4.3	4.4	4.5	4.4	4.1	4.0	3.9	4.3	4	3.75

January 1st, 1996, the '*Energy Regulatory Tax*' (REB) was introduced. The tax is limited to small and medium users only, thus preventing undesirable effects on the international competitiveness of the Dutch manufacturing sector. The tax encourages renewable energy in the following way. Electricity produced from renewable sources (wind, solar, hydro, biomass) is levied when used, however, the proceeds are returned to the producer instead of the taxpayer. The tax is expected to lead to a 1.5% reduction of total CO_2 emissions.

Since the introduction in 1996, the REB rates have been raised significantly in several steps. For 2001 another increase is foreseen. The REB is regarded an instrument to counterbalance the undesired environmental effects of the expected price decrease in a liberalised market. The gains are returned to households via a reduction of the income tax and the tax on wages. As of 2000, the tax on natural gas has increased with 5 cents to 24 cents per m^3. The tax on the electricity price has increased with 3,5 cents to 10 cents.

Table 2.2 *Rates small user carbon/energy tax in the Netherlands in cents (excl. VAT) (Energiemonitor CBS 2000-3, Table 6.4)*

	1996	1997	1998	1999	2000
Electricity per kWh	2.95	2.95	2.95	4.95	8.20
Natural gas per m^3	3.20	6.40	9.53	15.98	20.85
Light fuel oil per litre	2.82	5.64	8.46	12.68	17.56
Heating oil per litre	2.84	5.68	8.53	12.785	17.43
LPG per kg	3.36	6.72	10.09	15.125	20.78

Efficiency Standards

The Energy Performance Standard (EPS) for new dwellings came into effect in December 1995 as part of the Building Act. The EPS does not only take into account the energy required for space heating, but also for hot water use, ventilation, and lighting. It is an integrated calculation, and the maximum value of 1.4 in 1996 is equivalent to a total energy use in new dwellings of 1400 m^3 natural gas equivalent. The standard has been tightened to 1.0 in the year 2000.

In the Memorandum on Energy Saving, the government announced an Energy Performance Advice (Energie Prestatie Advies, EPA) for existing buildings. This must lead to an efficiency improvement so that ultimately, for existing houses, the efficiency should equal the efficiency of newly built houses of 1985. As of 2000, for about 400 guilders, residents can have professional consultants execute the test. When they decide to respond to one or more recommendations, they will receive a refund of 350 guilders. As of 2001 an EPA for buildings in the service sector has been developed.

Financial Support

Co-generation of Heat and Power (CHP) is supported with numerous measures adding up to a sum of 230 million guilders. These measures include an increase to 55% (as of 2001) of the Energy Investment Allowance (EIA). Commercial companies may use the EIA, introduced in January 1997, to subtract the investments from their corporate tax.

To stimulate the use of PV-panels, the government introduced a support of 500-750 guilders on each panel. This cuts down the price of a panel by about 50 percent. On half of the new dwellings in the social housing sector, PV-panels should be installed. Until 2004, annually 60 million guilders is mobilised for this purpose.

3. OVERALL ASSESSMENT OF ENERGY EFFICIENCY TRENDS

3.1 Economic context

In 1999, GDP in the Netherlands has grown with 3.9%. Figure 3.1 presents the trends in the main macro-economic indicators between 1970 and 1999. From 1990 to date, the average growth is 3.4%. Economic development in the Netherlands is steady.

Between 1980 and 1983 there was a recession, which is visible in the value added in the industry as well as in the private consumption. The average growth in private consumption is almost equal to GDP growth. Industry is gradually decreasing its share of GDP while the contribution of the tertiary sector increases.

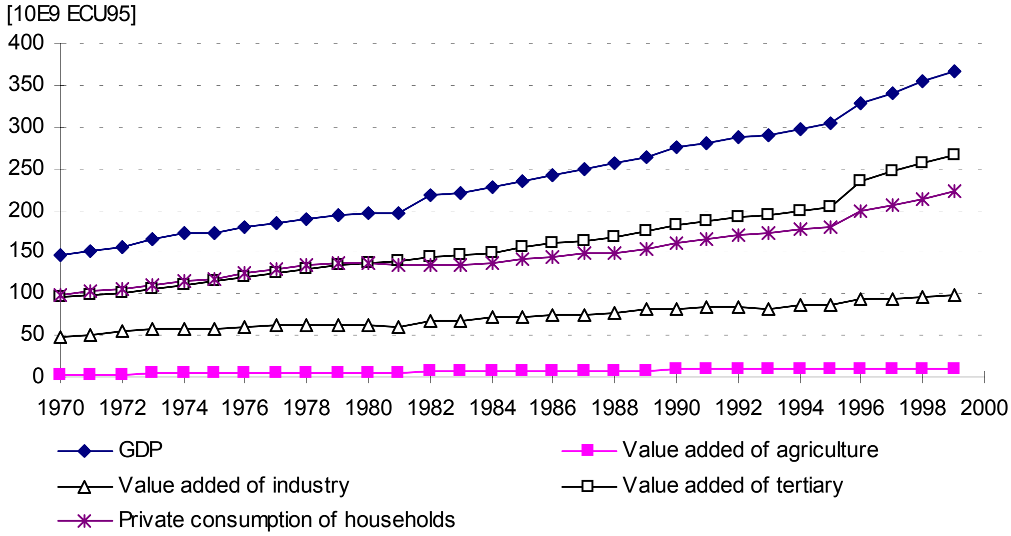

Figure 3.1 *Macro-economic developments in the Netherlands; in constant prices of the year 1995*

3.2 Final energy consumption trends

In this section, the focus is on final energy consumption, because energy efficiency is mainly calculated for end users. Total final energy demand has increased in the Netherlands with 19% between 1982 and 1999. In 1998 and 1999, a decrease in final energy consumption took place. This occurred mainly in the industry (chemical sector), the residential sector and the service sector. It is uncertain yet whether this is an incident or structural. The decrease in the residential and service sectors can partly be explained by climatic variations. The high value in 1996 is also due to climatic variations, see Section 3.4. In the period 1982-1990, total final consumption remained more or less stable at a level of around 43 Mtoe, after 1990 there was an increase to around 50 Mtoe.

In Figure 3.2 the final consumption by energy carrier is presented. The increase in electricity consumption is relatively large: 67% between 1982 and 1999. The consumption of natural gas is practically stable over these years. The fluctuations in gas consumption can partly be explained by climatic influences, because natural gas is the main fuel used for space heating in the Netherlands. Solid fuels are mainly used in the iron and steel industry as far as final consumption is concerned. Since 1984, this consumption is fluctuating around 1.5 Mtoe.

There have not been any remarkable shifts in the fuel mix recently. The fuel mix is dominated by natural gas, due to the domestic supply of this energy carrier, and oil products. In 1998, natural gas had a share of 43% in final demand, followed by crude oil and oil products (33%). The share of electricity is increasing, from 12% in 1982 to 16% in 1998. Compared to other EU countries, the electricity consumption is relatively low in the Netherlands. On the other hand, the share of heat supplied is relatively high in the Netherlands. This is due to the emergence of joint ventures that operate cogeneration plants and supply the industry.

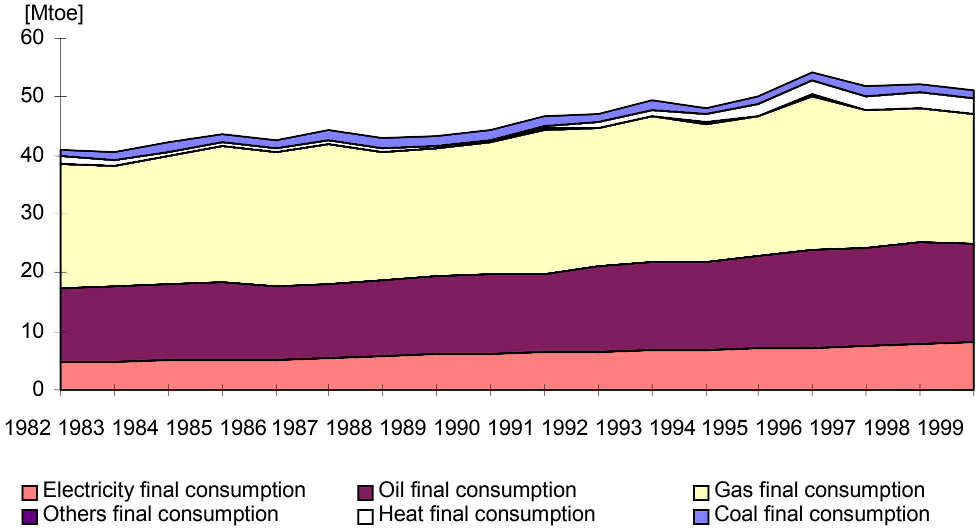

Figure 3.2 *Final energy consumption by energy carrier in the Netherlands (conventional equivalence, excluding non-energy uses)*

Figure 3.3 shows the final energy consumption by sector for the years 1982 and 1999. In this period, total final demand has increased with 19% from 42.9 Mtoe to 50.1 Mtoe (excluding non-energy uses). This increase was a result of growth of the energy consumption in all sectors. Concerning relative shares, transport gained at the expense of households. Energy demand in the transport sector has grown steadily. It mainly concerns road transport, and although there have been efficiency improvements, the annual distance travelled has increased. Energy demand in the agricultural sector has also grown significantly, greenhouse horticulture is the main energy consuming sector within agriculture (80% of final demand) and the increase is both due to growth of this subsector, and to the use of more energy intensive cultivation methods.

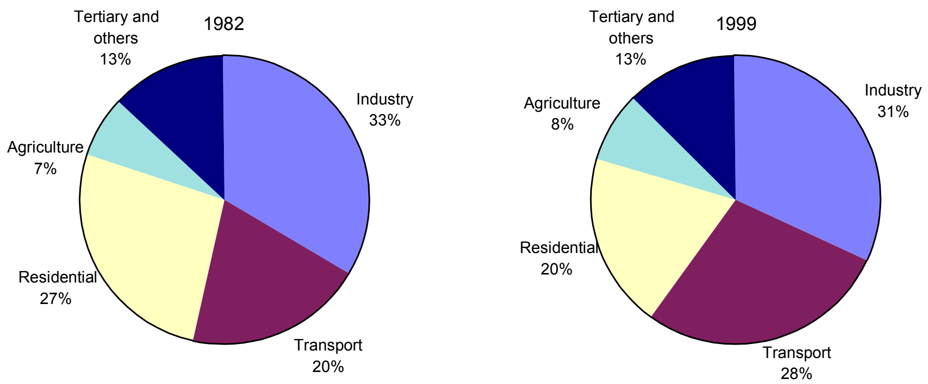

Figure 3.3 *Shares of sectors in final energy consumption in the Netherlands in 1982 and 1999*

The Netherlands has a large energy intensive industry, which accounts for about 30% of the total final consumption (excluding non-energy uses). Although the share of the sector has decreased (Figure 3.3), energy consumption has increased in absolute terms. Since 1982 the final energy consumption in the industry sector has grown with 16% partly as a result of growth of the energy intensive subsectors.

Final energy demand in the residential sector, mostly for space heating, fluctuates between 10 and 12 Mtoe, depending on temperature variations. 1996 was a relatively cold year, so natural gas consumption in household rose sharply with 17% compared to 1995.

3.3 Primary and final energy intensity

Three general indicators have been selected for characterising overall energy efficiency trends (Energy Efficiency Indicators, 1998). The first one is the primary energy intensity, which relates the total amount of energy used in a country to the GDP in constant prices. This indicator includes both efficiency changes in the energy transformation sector and efficiency changes at the level of final consumers, and various other effects.

The second indicator concentrates on final consumers only: the final energy intensity. This is the ratio of final energy consumption over GDP. Since energy efficiency policy often focuses on final consumers, this indicator is suitable for monitoring the overall development of end-use energy efficiency. It is also possible to use two separate indicators for this purpose: one related to fossil fuel use, and one related to electricity consumption. However, care must be taken in interpreting electricity-related indicators when electricity is substituted for fossil fuels.

The third indicator denotes the relation between the previous ones, and will be discussed further below.

In Figure 3.4 the trends in these indicators are presented. The improvement of the final energy intensity since 1982 was 30%. In the second half of the nineties, it shows a steady decrease. This is mainly due to the high level of economic growth. In 1999 it is a combination of high economic growth and a small decrease in energy consumption, however, it is not yet clear whether this is significant. Compared to other countries, the level of this indicator is high, mainly because of the energy intensive industry in the Netherlands. In the period 1982-1998, the overall energy productivity of the economy, as measured by the primary energy intensity, has improved by 24%.

The transformation share[1] indicates the difference between the primary energy intensity and the final intensity. It is the share of primary energy that is consumed in energy sectors, e.g. conversion losses for electricity generation and refineries, together with non-energy uses of fuels and bunkers. It is relatively large in the Netherlands, because of the large chemical industry and refinery sector (Uyterlinde, Koutstaal, 1998).

[1] This is equal to 1-ratio final/primary energy consumption.

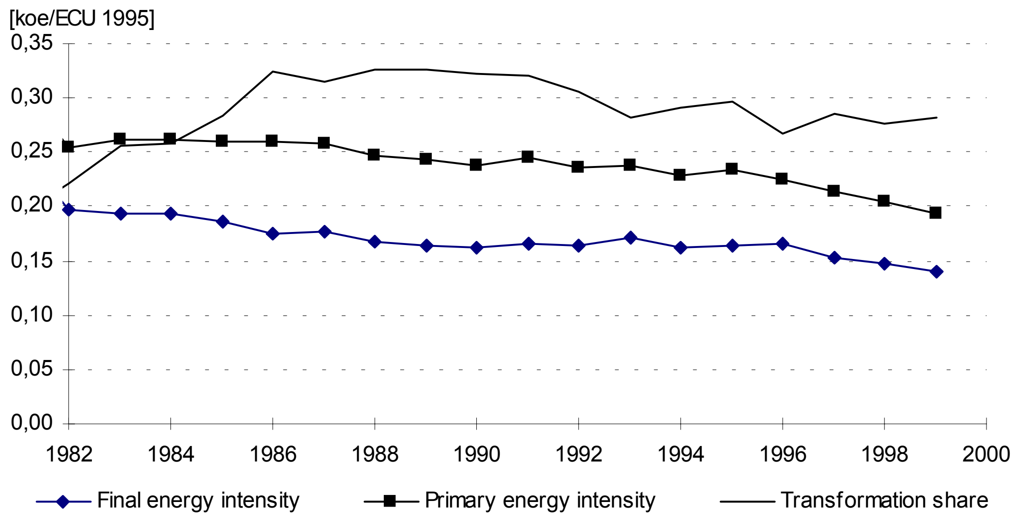

Figure 3.4 *Primary and final energy intensity in the Netherlands*

Naturally the trends in primary and final intensities are a result of many factors in the different economic sectors, which are analysed in more detail in the next chapters. The main factors that are supposed to influence the intensities at macro level are the fuel prices, the sectoral structure (influenced by economic growth), and the effort and funds devoted to energy conservation policy.

The difference between final and primary energy intensity gives an indication of the consumption and losses in the transformation sector, the role of non energy uses and bunkers for international transport that have been excluded from the final consumption.

The transformation share indicator is also presented in Figure 3.4. In the 1986-1991 period, it was relatively high at 0.32, compared to the other periods. This means that about 32% of the primary energy consumption is due to the transformation sector, non-energy uses and bunkers. This share is large, mainly because of the non-energy use in the large petrochemical industry sector and the bunkers used in main port Rotterdam. It could be consistent with the achieved capacity expansion of basic chemical industries and related non-energy consumption, compared to the modest growth of the economy as a whole.

The share of overall supply losses is not extremely large, compared to other countries, because the share of electricity in final demand is relatively low, and natural gas is used directly for space heating, causing almost no additional losses at the supply side. There is a downward trend in the transformation share since 1989. The increasing share of electricity in the final consumption would suggest a different trend. With regard to the transformation sector, there are a number of opposite effects. The efficiency of electricity generation has increased, almost 30% is nowadays combined with heat generation. More electricity is imported, for which there are no domestic conversion losses. However, the share of coal plants has increased, compared to more efficient gas plants. The energy consumption of refineries has increased too, due to higher upgrading of oil products. The consumption for gas production has increased because of depletion of the Groningen gas field (Boonekamp, 1998).

3.4 Interpretation of final energy intensity

Although the final energy intensity does give an indication of the energy efficiency in the Netherlands, it is influenced by many other factors as well. One of the most obvious factors is the weather. The severeness of winters has a significant impact on the consumption of natural gas, which is the main fuel used for space heating in the Netherlands. As natural gas accounts for about 44% of the final energy consumption in the Netherlands, the overall final intensity is also affected considerably.

Figure 3.5 gives an illustration of this relationship. It is clear that the cold winters of 1985-1987, 1991, 1993 and 1996 caused a peak in the consumption of natural gas in these years. The final consumption of other energy carriers is not significantly influenced by climatic variations (see Figure 3.2). The final energy intensity with climatic corrections is a better indicator of final energy efficiency, as it is corrected for these annual variations. This indicator is presented in Figure 3.6. It must be mentioned that the role of climatic variations is less important when looking at long periods, but it is useful for understanding the differences between individual years.

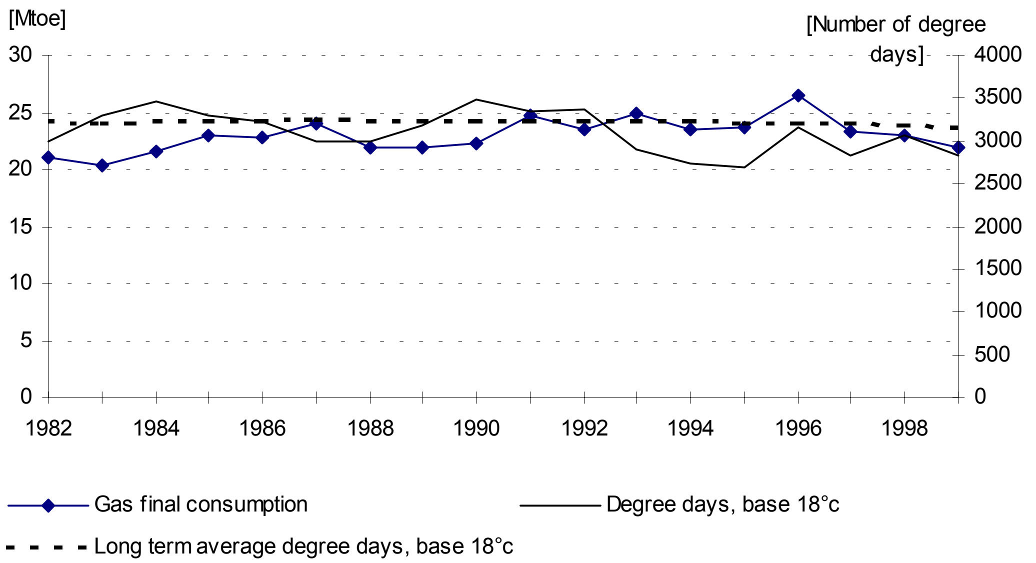

Figure 3.5 *Comparison between number of degree days and final consumption of natural gas in the Netherlands*

In Figure 3.6, the intensity with climate correction is fluctuating less than the uncorrected intensity. It is higher than the statistical final intensity after 1990, which is consistent with the relatively mild winters in that period.

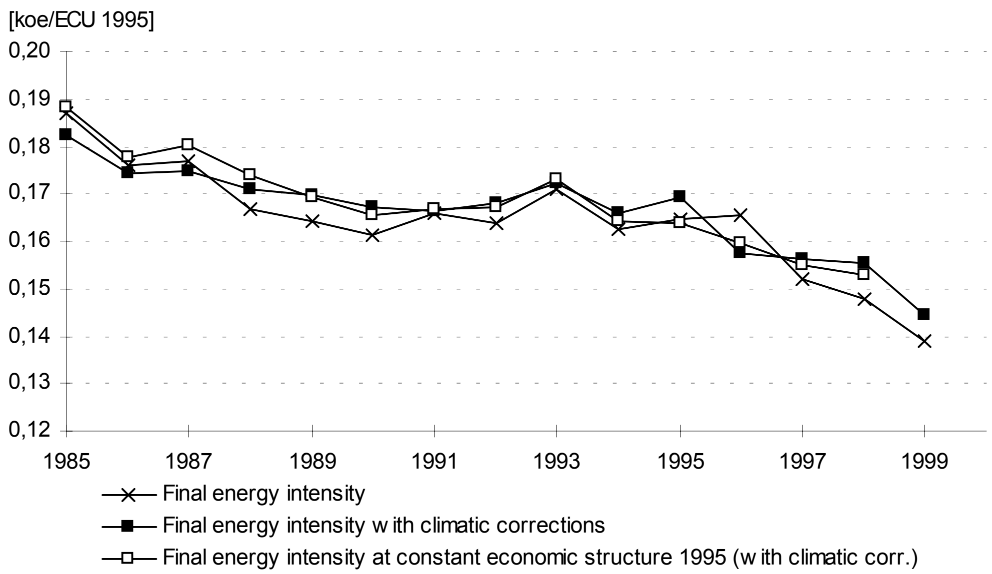

Figure 3.6 *Final energy intensity: role of climate and structural changes*

Another factor influencing variation in final energy intensities is the change in economic structure. A change in the GDP structure between sectors, for instance a decreasing contribution of energy intensive branches, will also result in a decrease of the final energy intensity. However, this decrease should not be regarded as a result of energy efficiency improvement efforts. Therefore another indicator is also presented in Figure 3.6, the final energy intensity at constant (main) structure. This indicator leaves out the influence of macro-economic structural changes, because sectoral intensities are calculated at the economic structure of 1995.

The final energy intensity at main economic structure is based on developments in agriculture, total industry and total services. Structural effects within industry are only available for a few years and are not determined here, but in Chapter 4. After 1993, the intensity at constant main structure is lower than the original intensity. This means that the structure of the economy has become slightly more energy intensive in recent years.

3.5 CO_2 emissions and indicators

CO_2 or carbon indicators are the natural extension of energy efficiency indicators, especially when considering the application of such indicators in the field of monitoring of international targets for the reduction of CO_2 emissions. At the moment, two types of carbon indicators are included in the ODYSSEE database:

1. Calculation of overall emissions (descriptive)
    - Overall CO_2 emissions (breakdown by fuels), see Figure 3.7.
    - Sector wise emissions: residential, industry, tertiary, transport (breakdown by fuels), reported in the next chapters.
2. Specific CO_2 emissions, e.g. per tonne of product, capita or value added, see Figure 3.9 and the next chapters.

Two calculations of emissions have been made for each sector:

- CO_2 emissions due to the combustion of fossil fuels only, by type of product (coal, lignite, heavy fuel oil, diesel…). The UNFCC emission factors have been used for all countries by type of product. So this presentation includes **direct** emissions from transformation activities and final energy consumption in each main sector.
- Total emissions: both due to combustion of fossil fuels and **indirect** emissions from electricity generation and district heating, using average national coefficients. The coefficients calculated for CO_2 emissions from electricity and heat production have been taken from the ENERDATA database.

Emissions from combustion of biomass, biofuels and wastes are not included, neither are CO_2 emissions from non-combustion related processes (non-energy uses). This is a major difference with the IPCC definition. For comparison, the emissions including non-energy uses are also shown in Figure 3.7.

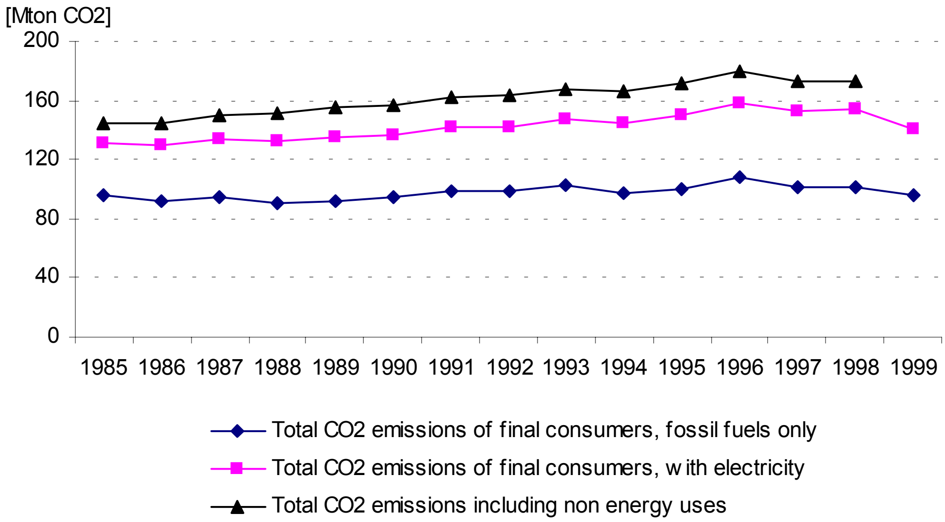

Figure 3.7 *CO_2 emissions of final consumers*

The Netherlands has agreed on a Kyoto target of 6% reduction of emissions of CO_2 and other greenhouse gases in 2008-2012, compared to 1990. In a high growth scenario, this corresponds to 50 Megatons of CO_2 equivalents (Ministry of Environment, 1999). In Figure 3.7 the CO_2 emissions of final consumers are presented. It shows a slightly increasing trend, except for 1998-1999. There are two explanations for this. First, more electricity is imported, of which the emissions are accounted to the country where the generation takes place. Secondly, due to a change in definition, more emissions are accounted to non-energy use in industry. The high level in 1996 is mainly due to the cold winter in that year.

Figure 3.8 presents a breakdown of the development of CO_2 emissions by sector, including indirect emissions assigned to electricity consumption per sector. Generally emissions are increasing in the transport, industry and tertiary sector, except in 1998-1999 as explained above. Emissions in the residential and tertiary sector show more annual fluctuations, because space heating accounts for a large share of the energy consumption in these sectors. Emissions in agriculture fluctuate around 10 Mton.

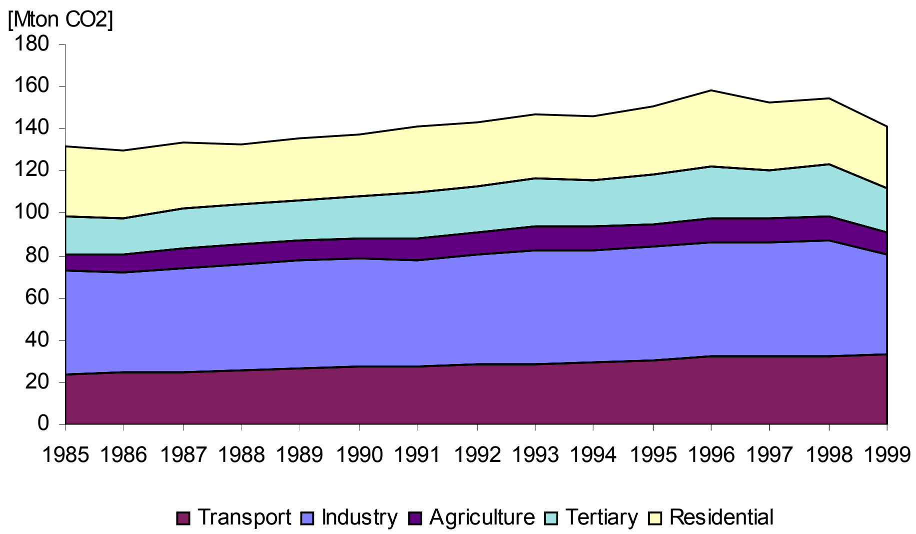

Figure 3.8 *Development of CO_2 emissions by sector; including indirect emissions due to electricity generation*

Figure 3.9 shows the trends in selected CO_2 indicators with climate correction. The CO_2 emission intensity shows a decreasing trend, similar to that of the final energy intensity. This means that the CO_2 emissions are increasing at a slower rate than GDP growth. The CO_2 emissions per capita, on the other hand, are still increasing.

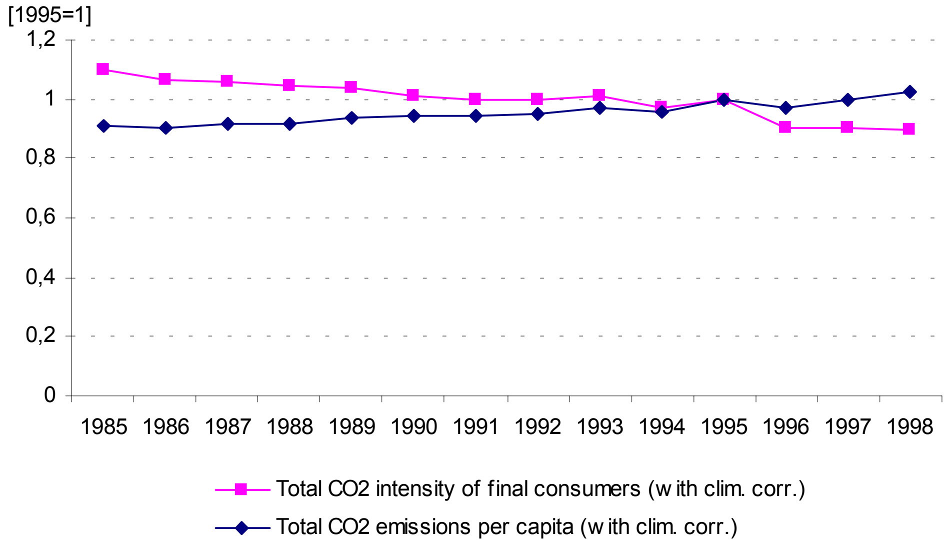

Figure 3.9 *CO_2 emission indicators of final consumers, including indirect emissions from electricity generation, with climate correction*

3.6 Conclusions

The trends in primary and final intensities are a result of many factors in the different economic sectors, which are analysed in more detail in the next chapters. The main factors that are supposed to influence the intensities at macro level are the fuel prices, the sectoral structure (influenced by economic growth), and the effort and funds devoted to energy conservation policy, summarised in Table 3.1.

Table 3.1 *Main factors influencing energy conservation in The Netherlands*

	Energy prices	Economy	Policy intensity	Annual average final intensity improvement[1]
1982-1986	High	Recession	Active	3.4%
1986-1991	Low	Recovery	Less active	0.9%
1991- 1999	Low + energy tax	Growth	Increase	1.7%

[1] Climate corrected

In the period 1982-1999, total final energy demand has grown with 19%. In 1998 and 1999, a decrease in final energy consumption took place. This occurred mainly in the industry (chemical sector) and the residential sector. It is uncertain yet whether this is an incident or structural. Over the same period, the final energy intensity decreased with 18%. Again, this is partly due to the - not yet statistically significant - decrease in final consumption in 1998-1999. Table 3.1 shows that the highest intensity decrease occurred in the first half of the eighties. In the nineties, the decrease slowed down due to structural effects, coupled with economic growth and low fuel prices.

- In the first period after the second oil shock the effect of high fuel prices can be seen in final consumption. In this period, old inefficient industrial capacity was scrapped and replaced. This period shows the highest annual energy efficiency improvement.

- After 1986, the economic growth picked up again and the intensity development reflects autonomous trends with few structural changes.
- After 1991, increased energy efficiency stimulated by policy efforts is offset by various intensifying trends, e.g. relative high growth of electricity consumption, more energy intensive industries, and larger cars. After 1993 the structure of the economy has become slightly more energy intensive. In 1997 and 1998, the improvement of the final intensity is mainly due to the high level of economic growth.
- Except for the first period, in which high-energy prices occurred in combination with economic recession, the influence of the level of energy prices and taxes on energy consumption seems to be very limited.
- In spite of an increasing policy intensity in the last decade, it seems difficult to achieve the ambition level of energy savings of 2% annually because of the high economic growth.

4. INDUSTRY

Data from this section are based on the sectoral energy balance sheets of the Netherlands Energy Statistics (CBS, NEH). Economic data are derived from National Accounts (CBS). It is in particular in the industry sector that the differences between the Dutch statistics and the international conventions become apparent (see Section 8.2).

4.1 Energy consumption by industrial branch

First, it is important to define the industry sector. This sector consists of

- the manufacturing industry, which is subdivided in several main branches, see Figure 4.2.
- construction,
- non-energy mining.

The oil industry (refineries) and coke factories are not included in the manufacturing sector, but in the transformation sector.

In Figure 4.1, the development of final energy consumption is depicted for the total industry sector as a whole and for the manufacturing sector separately. In Figure 4.2, shares of the different main industry branches are presented for 1999. In 1999, a substantial decline in industrial final energy consumption took place. This occurred mainly in the chemical sector. It is uncertain whether this decline is an incident or structural.

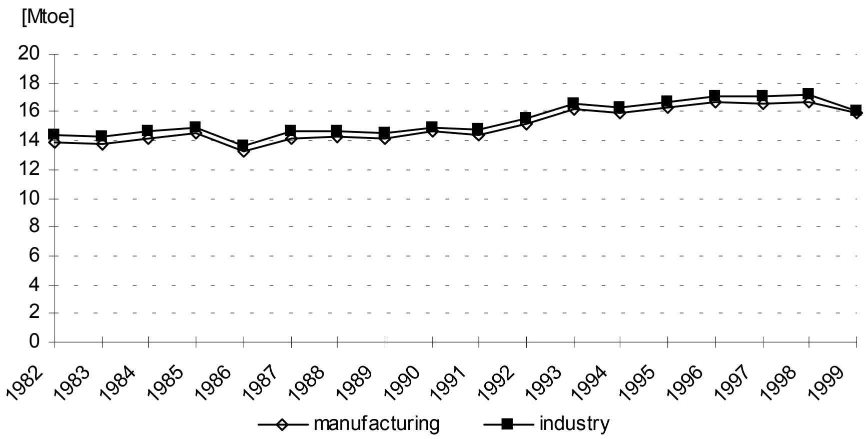

Figure 4.1 *Development of final energy consumption in industry and manufacturing*

The Dutch chemical sector is dominant with respect to energy consumption, and the growth of total industrial energy consumption reflects the activities in this sector. Basic metals (including foundries) is the second largest sector with respect to energy. Equipments refers to all other metal sectors, metal products, machinery; transport equipment and electro-technical equipment. The structure of energy consumption by sectors is relatively stable, but fluctuates with the cyclical movements of the chemical and basic metals sector.

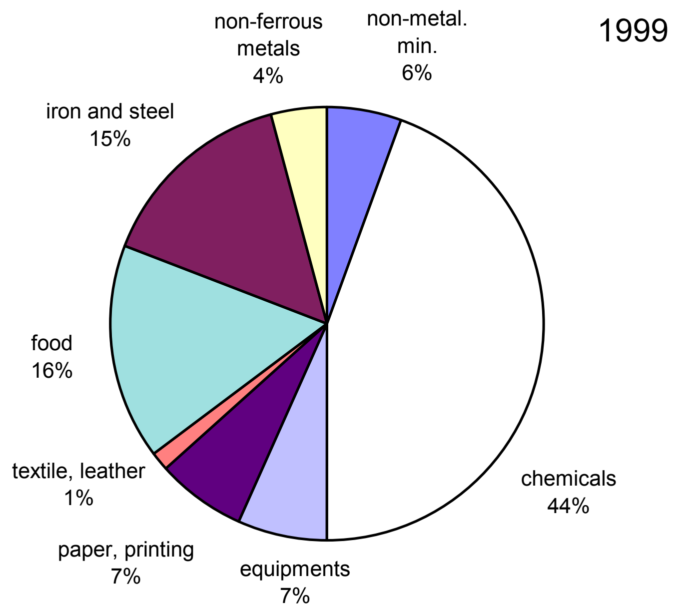

Figure 4.2 *Final energy consumption shares of main manufacturing industry branches*

4.2 Energy intensities by industrial branch

For the main branches of industry, final energy intensities are calculated, based on the added value from each branch. Figure 4.3 indicates energy intensity of industry and manufacturing respectively. The difference between the two indicates mainly the low energy consumption and considerable contribution to GDP of the construction sector. Figure 4.4 presents intensity developments within separate manufacturing branches.

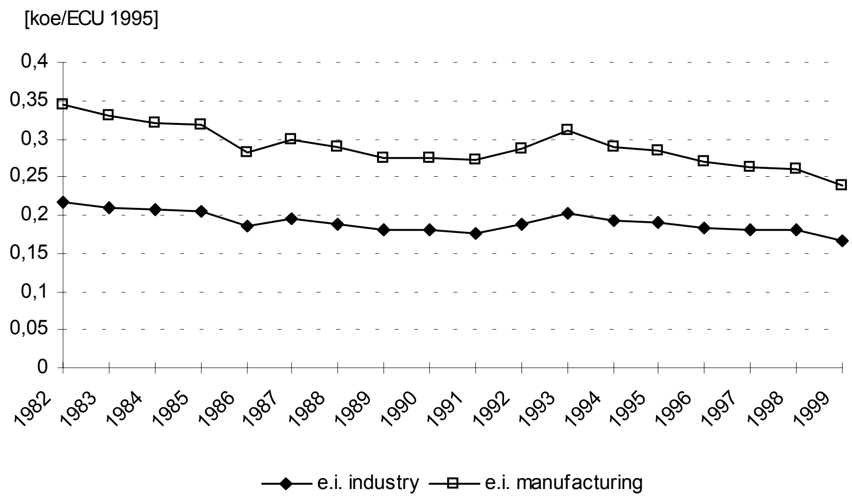

Figure 4.3 *Final energy intensity of industry and manufacturing*

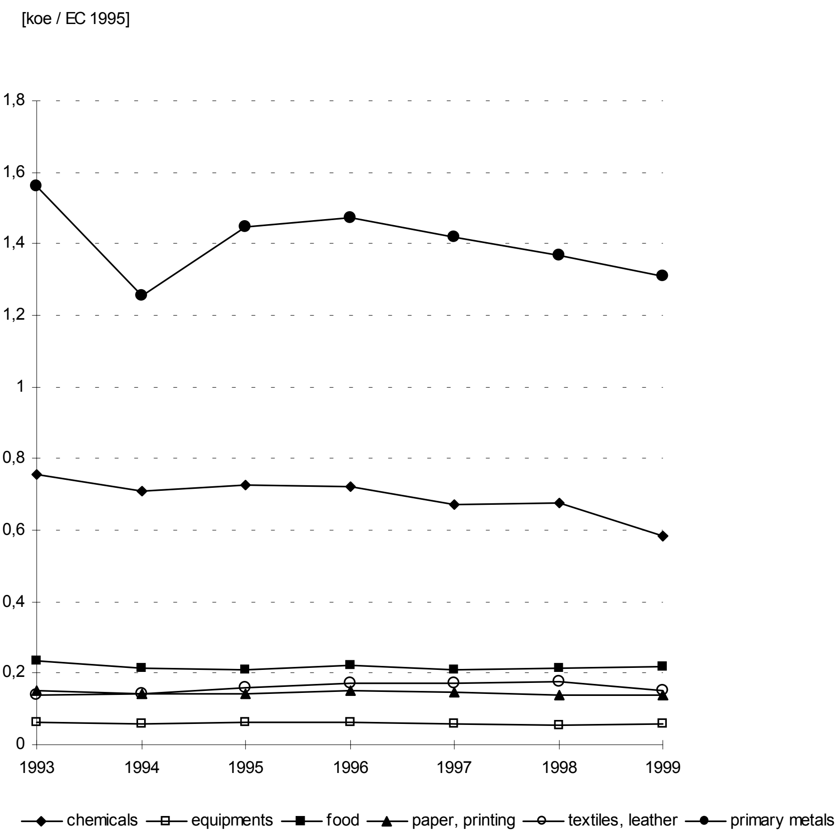

Figure 4.4 *Energy intensity of manufacturing branches*

The chemical industry is clearly energy intensive, as it includes a large basic chemicals production section. Primary metals is twice as energy intensive as chemicals, in basic metals all coal and coke inputs for iron production are included. Over the years where consistent time series are available, intensity has decreased by about 15 to 20% in chemicals and primary metals, the most energy intensive sectors. These two sectors represent almost two thirds of manufacturing energy consumption. Food industry is energy intensive as far as dairy, sugar and starch production is concerned. In food, paper and printing and equipments the intensity decrease was only 5-10%. These three sectors represent 30% of the energy and more than half of manufacturing value added in 1999. Textiles and leather had an increasing energy intensity. Value added decreased up to 1996 and rose again afterwards, but energy consumption grew steadily by 19% in 1998. In 1999 a sharp decline has occurred. The energy intensity of most branches has decreased in the eighties with about 2% annually. In the next section, underlying factors will be analysed. These include different sectoral growth and technical energy efficiency improvements.

4.3 The influence of the sectoral structure

In this section, the influence of structural effects on energy intensity is discerned. The effect of sectoral growth in manufacturing branches is separated from total energy intensity. In Figure 4.5, energy intensity development is depicted in two different ways. The first way is total manufacturing energy consumption divided by total manufacturing value added (at constant prices). The second way is the energy intensity development that would have occurred if value added growth was equal in all sectors (constant structure of 1993).

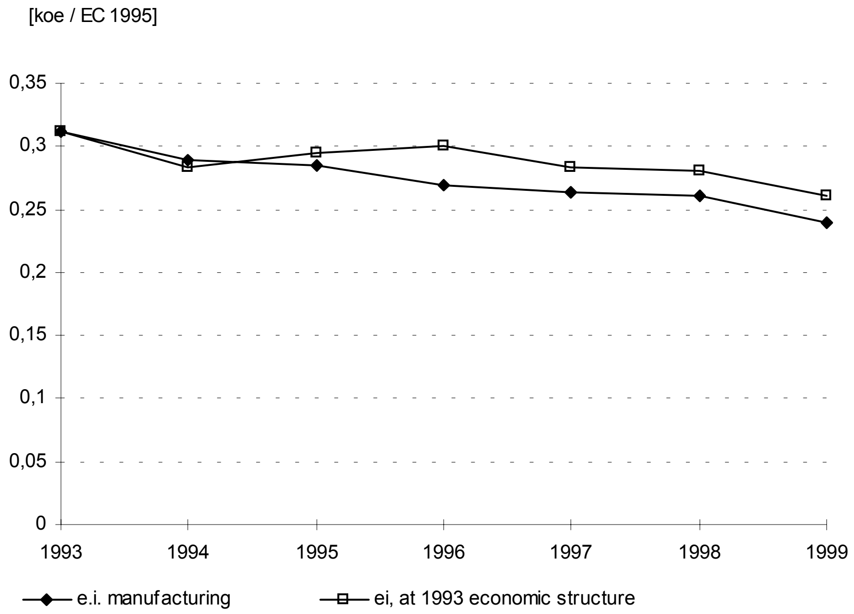

Figure 4.5 *Effect of economic structure on energy intensity in manufacturing*

Before 1993, the relatively large growth of value added of energy intensive industry, mainly chemicals, compared to total manufacturing, has made the structure of the economy more energy intensive (Uyterlinde, 1997). This effect is practically absent in recent years.

4.4 Energy efficiency

When energy consumption in some process or branch can be related to a meaningful physical indicator, energy efficiency can be calculated from a technological viewpoint, e.g. as specific consumption or unit consumption. In Dutch statistics, physical indicators are fragmentary. The most meaningful in terms of energy consumption would be olefins, ammonia, oxysteel, primary aluminium, paper, chlorine, carbon black, etc. Of these, only steel comes in a consistent time series up to 1996.

Energy efficiency policy for Dutch industry is largely built on Long Term Agreements (LTA's). From the monitoring of these agreements, a meaningful physical indicator is derived. It is based on a large array of products that are discerned in the monitoring process. Of these products, the required energy in 1989 is established as a reference. For the current year, the reference consumption is derived by multiplying product output growth figures with 1989 specific energy requirements. It is therefore equal to the energy requirement at frozen 1989 technology.

In Figure 4.6, LTA results are depicted, indexed on 1989 along with ODYSSEE indicators. LTA efficiency has improved with 21% until 1999, whereas final energy intensity has decreased only 14%. This is explained by a number of reasons.

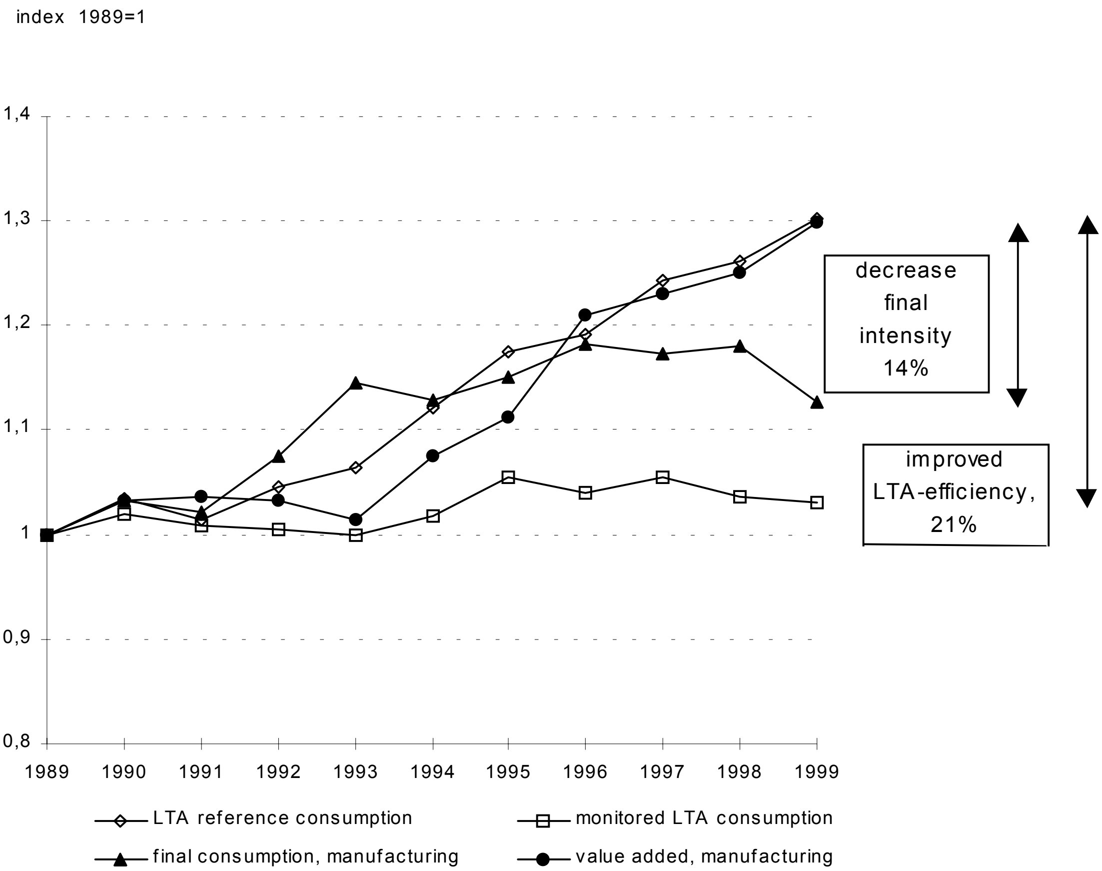

Figure 4.6 *Energy efficiency improvement based on LTA-monitoring (index 1989=1)*

First, physical production has increased more than value added, especially in 1992 and 1993, but lately value added gained again. This means in the observed period production output remained energy intensive. Second, final consumption (from statistical data) increased substantially more than monitored LTA consumption. This is caused by a number of reasons.

- CHP has been a dominant efficiency improvement option, this is not visible in the development of final energy consumption.
- Large unexplained observation differences between LTA monitoring and the data from the statistical office, mainly in chemicals.
- Coverage differences between LTA's and total manufacturing, these are relatively small.

Finally, using the LTA reference consumption as a representation of relevant physical output in manufacturing, final energy efficiency[2] has improved by 14%. It has recently improved considerably due to the decline in final consumption. The effect of CHP-accounting is a large factor in the difference between final consumption and monitored LTA-consumption. Hidden structural effects, like a large output growth of energy intensive products, are not specified in LTA-monitoring.

4.5 CO_2 emissions

In Figure 4.7 industrial CO_2 emissions are depicted, both with and without emissions from electricity production assigned to industrial consumption. The emissions exclude various process emissions from non-energy use which are not monitored. These are estimated to amount to about 10 Mton. As can be seen, CO_2 emissions in industry show a steady rise, in accordance

[2] Here defined as Final consumption manufacturing sector / LTA reference consumption.

with industrial energy consumption. CO_2 intensities also develop accordingly, with a steady decrease. The share of CO_2 emissions related to electricity consumption in industry is increasing.

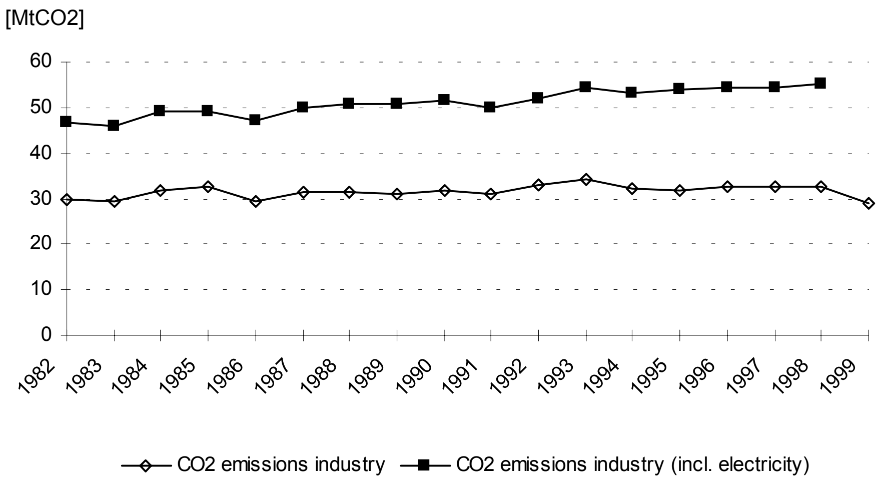

Figure 4.7 *CO_2 emissions of industry*

5. HOUSEHOLDS

5.1 Energy consumption by end-use

The share of space heating in total primary energy use is slowly decreasing from about 65% in 1980 to 54% in 1998. Water heating is growing in importance from 10% to 16% over the same period, as well as electrical appliances and lighting from 23 to 26% (‘specific uses of electricity’). The energy use for cooking is underestimated, since only the use of natural gas is considered in the calculation of the share of cooking in total energy consumption.

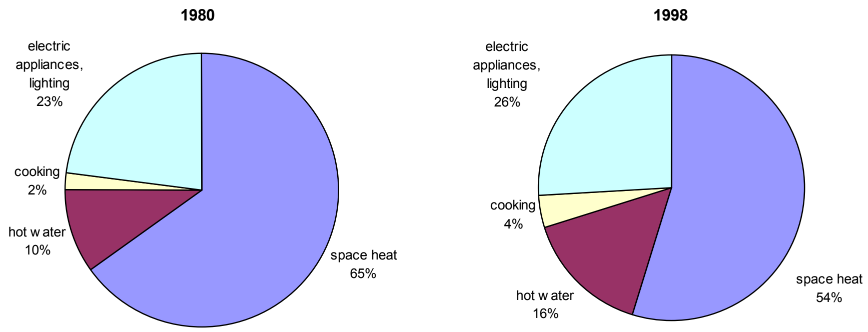

Figure 5.1 *The trends in primary energy consumption of households by end-users*

5.2 Unit consumption trends for households

Figure 5.2 shows the trends in the average consumption per household for all end-uses, for space heating and for specific uses of electricity.

The two first indicators are given with climatic corrections. Because of the dominant role of space heating, the total unit consumption is roughly following the trends of the unit consumption for space heating; with however a faster reduction for the latter one.

In the period 1980-1994, the average unit consumption per dwelling with climatic corrections is decreasing by 2.6%/year, from 2.55 to 1.76 toe/dwelling. In the years 1995 and 1996 the consumption was higher (respectively 1.80 and 1.79) but thereafter the consumption decreased until 1.72 toe/dwelling. For space heating, the reduction is about the same in the period 1980-1994 and the rise about 2.8%/year in the period 1994-1998. An explanation of this rise has to be found in behavioural aspects, such as the average indoor temperature and structural effects such as relatively more detached houses, larger houses etc. The unit consumption for specific uses of electricity (lighting, electrical appliances) has decreased regularly until 1988 at an average rate of 1.5%/year (1980-1988). After 1988, it rises with on average 1.9%/year (1988-1998).

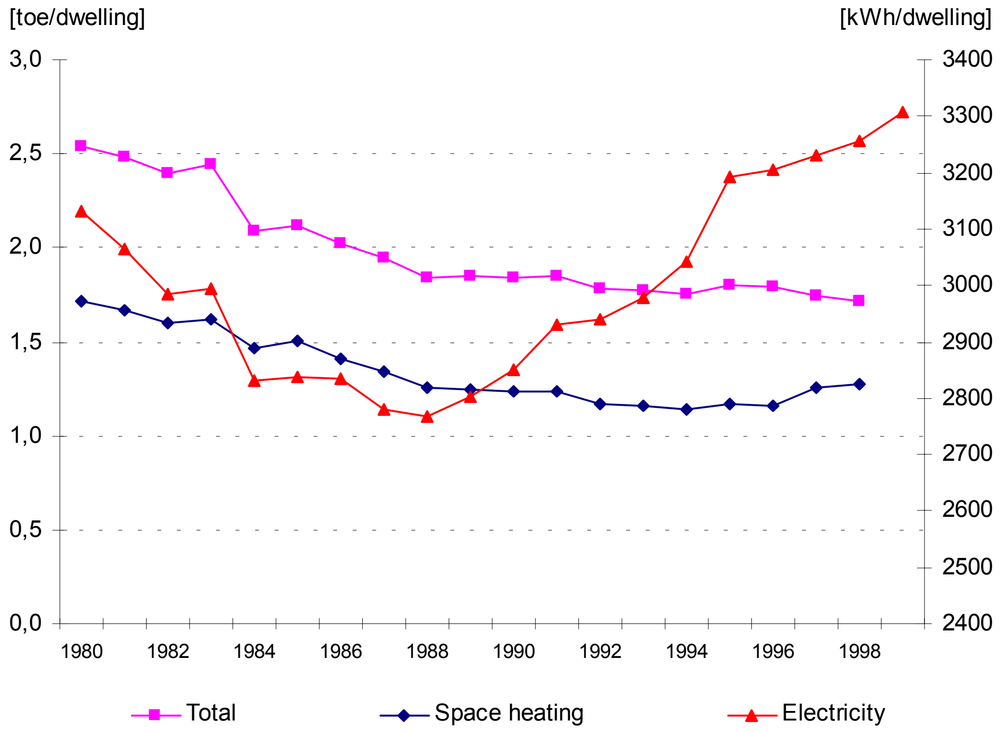

Figure 5.2 *Unit consumption of households total[(1)], space heating[(1)] and specific use of electricity*

[(1)] with climatic corrections.

5.3 Expenditures on energy

Between 1980 and 1986, energy prices were high. The electricity price reached the highest level of 28,7 cent/kWh in 1985, then decreased to 22,9 cent/kWh in 1986, on which level it stabilised for a number of years. Only recently, since 1996 the electricity price has been rising again to 25,8 cent / kWh in 1999, as a result of the newly introduced energy tax. Figure 5.3 shows the household expenditures on energy as a percentage of the disposable income. This figure clearly illustrates why, in the eighties, people were intrinsically motivated to change their behaviour to achieve energy savings. The economic recession added a sense of urgency to the need to save energy. After 1986, when prices decreased, the energy costs were no longer an incentive for energy efficient behaviour. Also in the current situation of economic growth, the impact of financial incentives (energy tax, discount on A-labelled appliances) is limited.

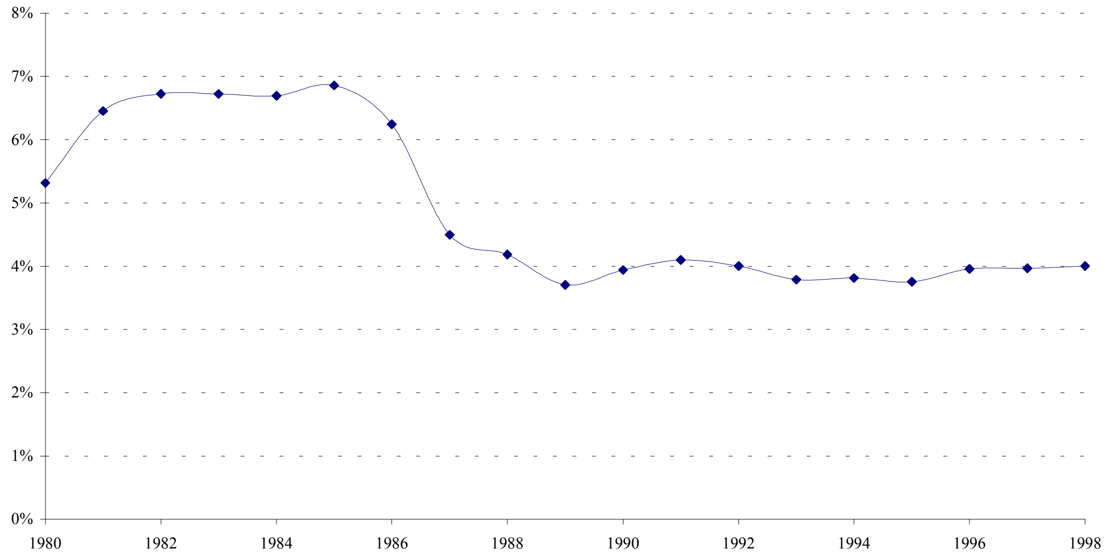

Figure 5.3 *Development of total household expenditures on energy as percentage of disposable income*

5.4 Electrical appliances

The trends in the specific consumption of electricity for the major household's appliances as refrigerators, freezers, washing machines and dishwashers reflect the influence of three components:

- *Energy efficiency*: changes in the average technical efficiency of appliances, either coming from general improvements in the electricity performance or from a consumer choice for more efficient new appliances.
- *Performance*: changes in the average appliance size, e.g. refrigerators or freezers with a larger capacity.
- *Behaviour*: changes in the use or conditions of use of appliances, e.g. increasing use of energy saving cycles for dish washers or washing machines.

The specific consumption of the most efficient electrical appliances on the market is compared to the average specific consumption. For washing machines and dishwashers, the best types consume less than 50% compared to the average. The best clothes dryer on the market consumes about 35% less energy compared to the average dryer (see Figure 5.4).

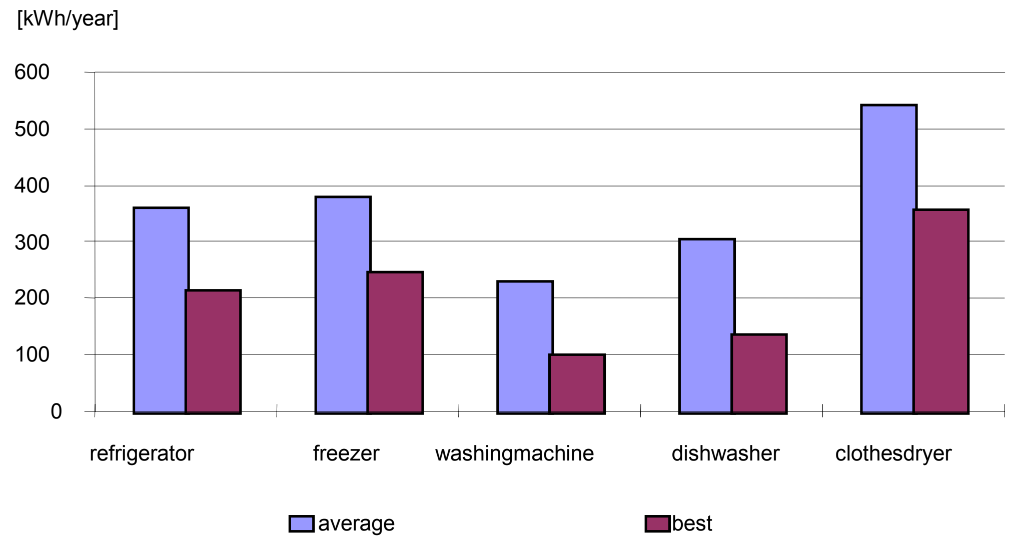

Figure 5.4 *Specific consumption of the most efficient household electrical appliances on the market compared to average appliances in 1998*

Penetration rates of appliances

The development of residential electricity consumption is closely related to the ownership and use of electrical appliances, which are in turn closely related to the lifestyle trends that influence consumer behaviour (Uyterlinde et al, 2000). In this section an overview is given of the trends in penetration of the major electrical appliances.

For most people, their disposable income has increased in the nineties. This results in an improvement in the quality of life. As shown before, the share of energy costs in their disposable income has not increased in recent years, so the size of the energy bill is no barrier for purchasing electrical appliances. A good example is the comprehensive built-in kitchen, in which the dishwasher and microwave are almost standard accessories (see Figures 5.5 and 5.6).

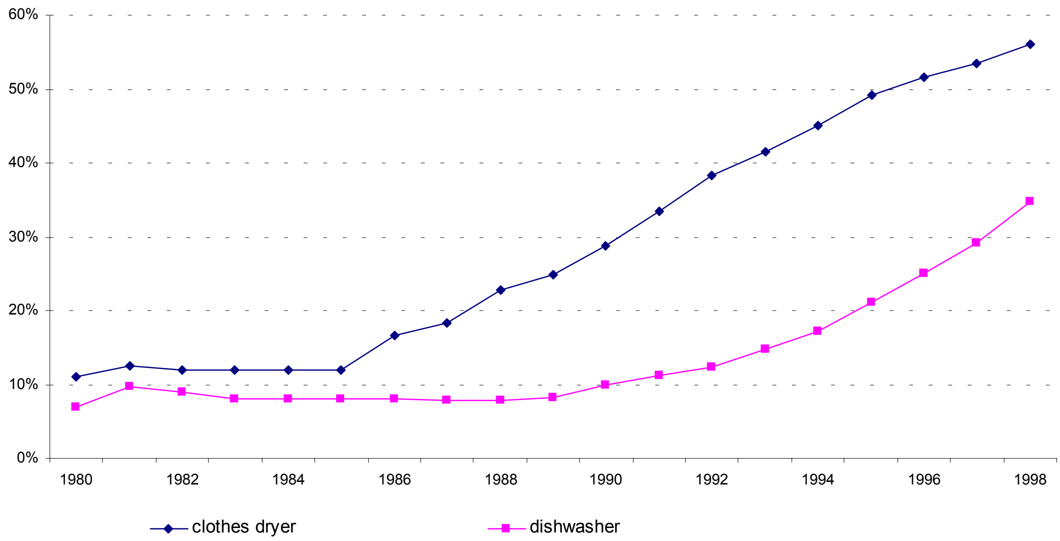

Figure 5.5 *Development of the penetration rate of clothes dryers and dishwashers*

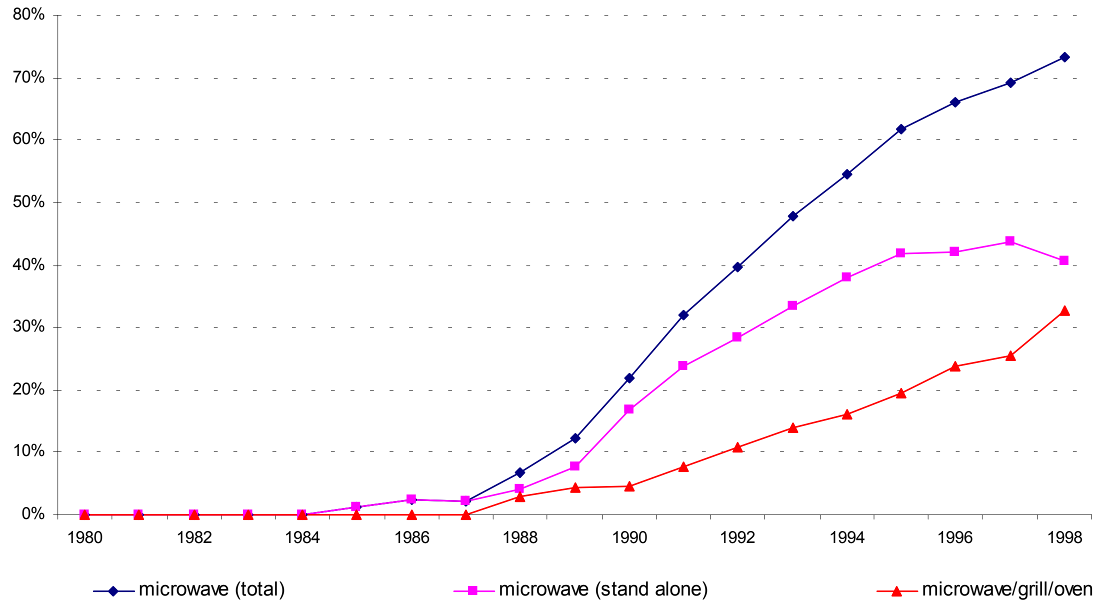

Figure 5.6 *Development of the penetration rate of microwaves*

Figure 5.7 shows that the use of large electric boilers (> 20 litres) decreases because they do not fit in a modern kitchen, and gas-fuelled boilers are more efficient. Small boilers are more and more used in kitchens and bathrooms supplementary to dish washers and hot water from the boiler. However, the electricity consumption of these small boilers is relatively high.

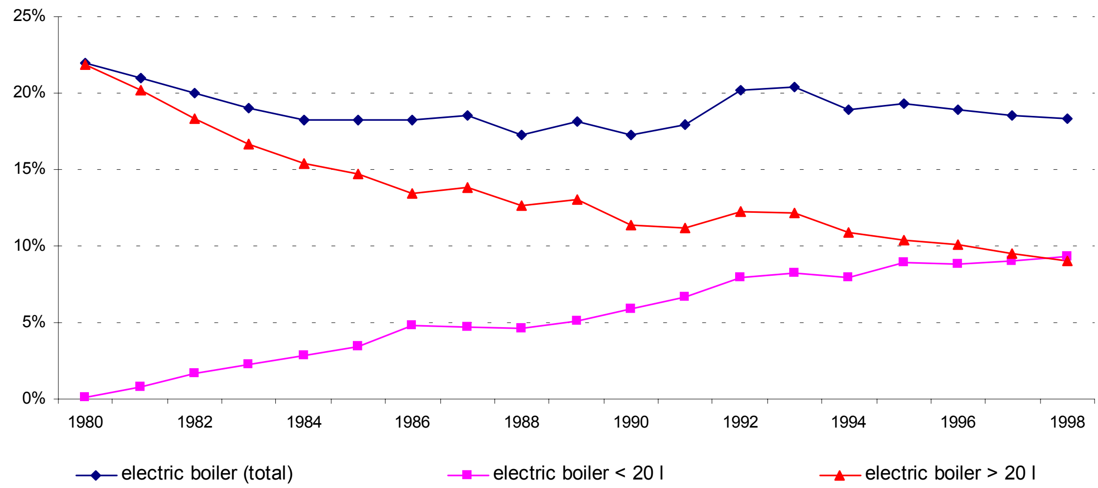

Figure 5.7 *Development of the penetration rate of electric boilers*

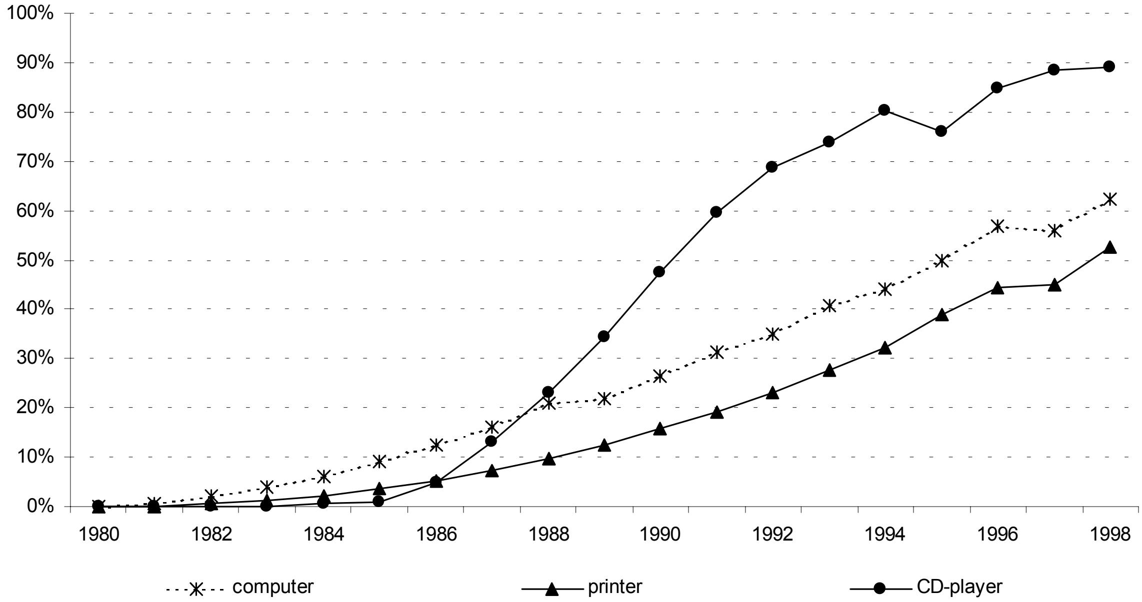

Figure 5.8 *Development of the penetration rate of computers, printers and CD players*

Scarcity of time arises from an increase in daily tasks and the decrease in the average number of persons per household, which is currently the trend in most EU countries. The decrease in available time can be compensated for by the purchase of appliances, such as a dishwasher, clothes dryer and microwave oven, which contribute to a more efficient performance of daily tasks. This trend can also explain the shift observed in Figure 5.9 from conventional fridges with only a small freezing compartment to larger fridge-freezers with a separate (and larger) freezing compartment. After all, a freezer reduces the shopping frequency and thus saves time. Since two-door fridge freezers consume more energy than the one-door models, this trend towards larger refrigeration equipment contributes to an increase in electricity consumption[3].

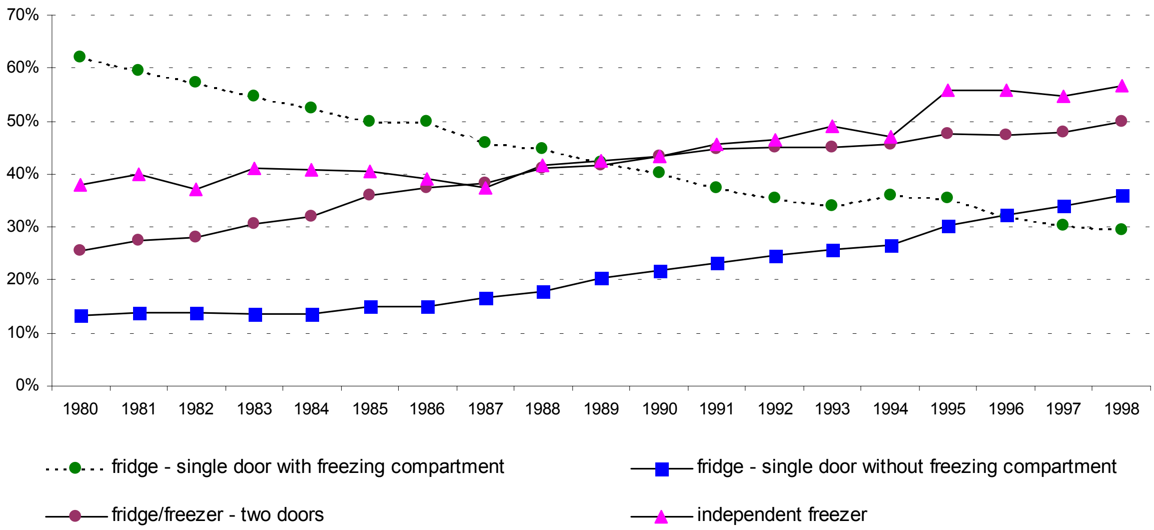

Figure 5.9 *Development of the penetration rate of refrigerators and freezers*

[3] It should be noted that the sudden increase of the penetration rate of the independent freezer after 1994 is probably incorrect. The penetration rates are obtained from annual surveys (EnergieNed, several years) and the increase is probably due to confused respondents who count their two-door fridge freezer also as a separate freezer.

Individualisation or a decrease in the average number of persons per household leads to a loss in economies of scale. After all, every household, despite its size, will have a need for lighting, cooling and heating. In addition, other equipment is shared by a fewer number of family members. Therefore, a decrease in the average number of persons per household will lead to an increase in energy use for a given population size. Individualisation of products occurs especially for electronic devices. An example is the increase in multiple ownership of televisions, as illustrated in Figure 5.10. The penetration rate of the television increases due to an increase in second (8% in 1980, 42% in 1998) and third TV-sets (1% in 1980, 16% in 1996). It should be mentioned that the stand-by energy consumption of appliances such as televisions and VCR's accounts for a 10-15% of annual residential energy consumption.

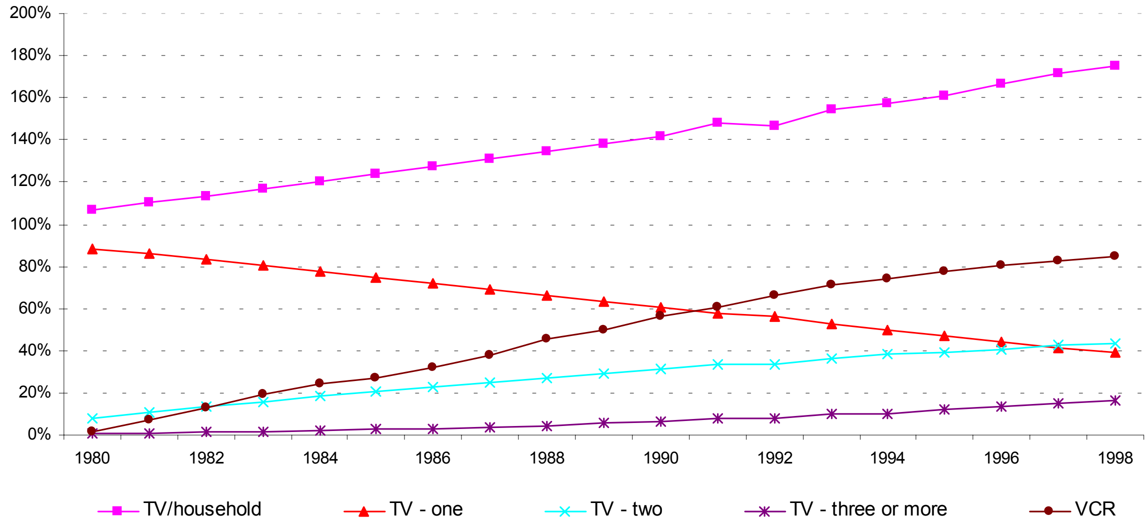

Figure 5.10 *Development of the number of TV sets per household and penetration rate of the VCR*

5.5 CO_2 emissions per dwelling

The emissions from fuels decrease from 5 tons of CO_2 per dwelling to 3.3 tons per dwelling. But this decrease is compensated by the increase of electricity use so that the total CO_2 emission per dwelling stabilises on 5.1 tons per dwelling. More than 33% is caused by electricity consumption.

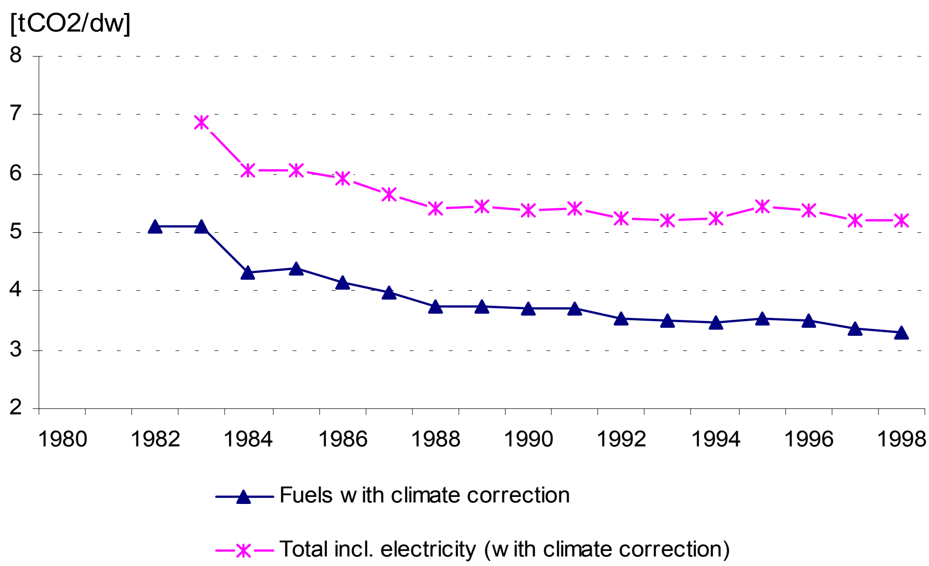

Figure 5.11 *Total CO_2 emissions due to space heating per dwelling*

The total CO_2 emissions per dwelling for space heating (incl. electric heating) is influenced by the climate, see Figure 5.12.

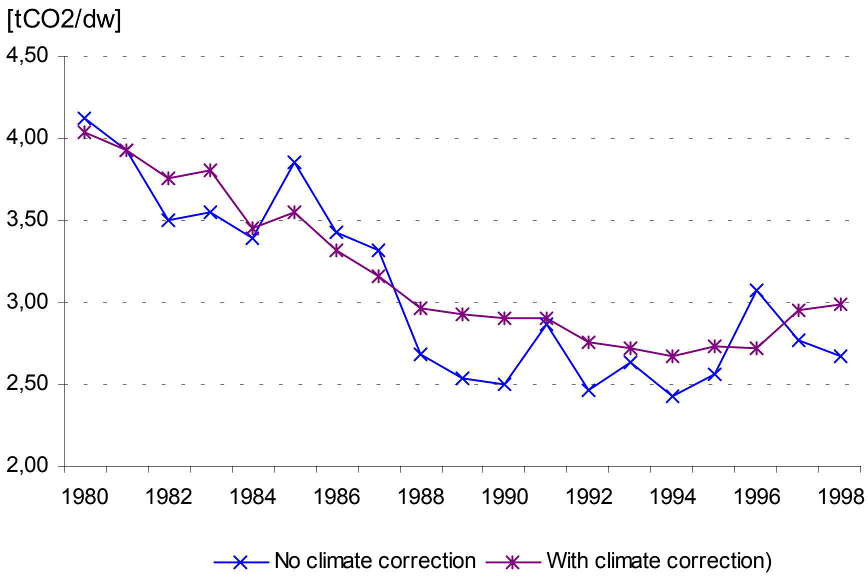

Figure 5.12 *Total CO_2 emissions due to space heating per dwelling*

6. TRANSPORT

Energy consumption in transport, as described in this chapter, refers by definition to energy consumption on public territory. Only when explicitly stated, it includes the use of fuels for international transport (bunkers).

6.1 Characteristics and policy of Dutch transport sector

Transportation is strongly related to the characteristics of the country. The Netherlands is a prosperous but small country (16 million inhabitants) with a high population density. It has three large European rivers including the Rhine, one large harbour in Rotterdam and an international airport, Schiphol, located near Amsterdam. The Netherlands has an important domestic energy source, natural gas, and has five oil refineries (LPG available). It has no mountains, it is a flat country.

These characteristics have major implications for the Dutch transport sector. The economic situation results in a high level of income and enough money for mobility and ownership of passenger cars. The high population density results in good possibilities for public transport (city busses, train) but also in traffic congestion. The flatness of the country makes bicycles an option for short distance travelling. The harbours and the Rhine make the Netherlands a good place for heavy industry (refining, petrochemicals, and steal) and for goods transport between Rotterdam harbour and Germany. The three main rivers and several canals allow for inland navigation as an important transportation option in the Netherlands. The refineries and the gas production make LPG available as non oil transportation fuel, the use of which is stimulated by the government.

The main policy issues in transportation are safety and traffic congestion. Against congestion an experiment with road pricing is starting and more roads are being built. However, space is scarce and already being used. Further issues are the cost and quality of public transport (privatisation) and the noise and risk of aeroplanes, because the Schiphol airport is growing fast. Politicians prefer to increase the fuel tax, from tax on ownership to tax for car use, but in such a small country there are too many border effects. Two years ago the government started to return a part of the fuel tax (increase) to owners of fuel stations near the borders with Germany and Belgium, but the European Commission stopped this. Energy efficiency is not a main policy issue in the transportation sector; for more efficient or cleaner cars the Netherlands is depending on EU-policy.

There are important changes in infrastructure, which will modestly affect the modal split. The Betuwe railroad (freight railroad from Rotterdam to Germany) is being built. This will result in a small change in the modal split: from road to rail. A rail connection for the high-speed train will be built. The TGV will connect Amsterdam (and Schiphol airport) to Brussels and France (modal split change from plane to rail). Furthermore there are private initiatives on regular inland shipping with containers (modal split change from road to water).

6.2 Transport consumption by mode

Since 1980 the energy consumption in the transport sector has increased with 62%. Between 1997 and 1998 energy consumption increased with 2,8%, of which 1,3% is caused by road transport and 1,3% is caused by (domestic and international) air transport. The remaining 0.2% is caused by water and rail transport.

Figure 6.1 shows the energy consumption in the transport sector for the different modes. Air transport includes the consumption for domestic and also international traffic. The energy consumption for domestic air travel in the Netherlands is rather low (0.1 Mtoe). The figure on navigation is based on the energy consumption of inland vessels in the Netherlands (Annema, 1997, 1999) (Brink, 2000)[4]. It includes estimations of the energy consumption of foreign vessels and it excludes the energy consumption of Dutch vessels in other countries. The figure contains no data on the energy consumption of sea going vessels. Also the small amount of electricity consumption by trams, metro's and trolleys (0.015 Mtoe) is not included (Kalverda, 1997).

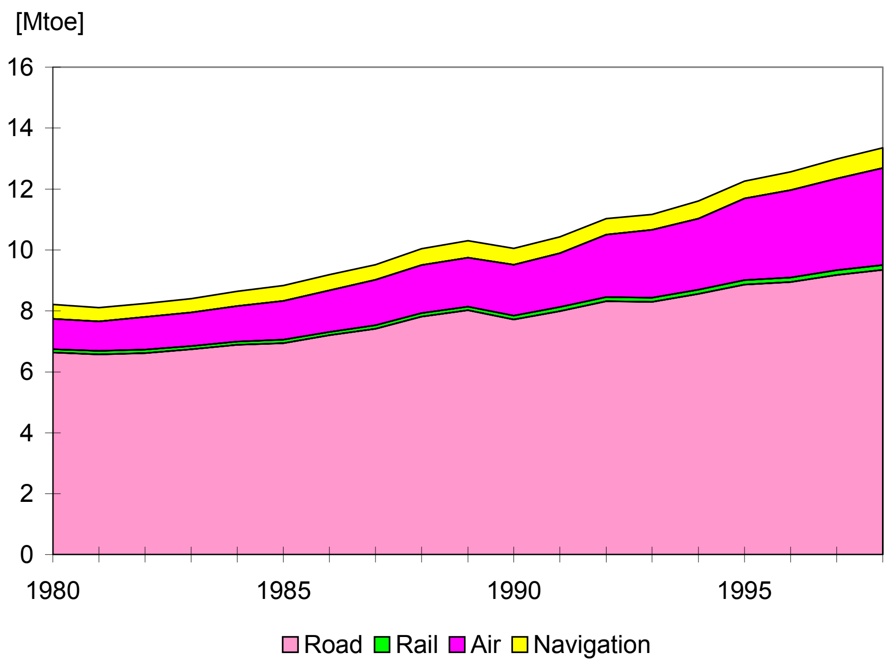

Figure 6.1 *Transport energy consumption by mode*

Between 1980 and 1998 the energy consumption for road transport increased with 41%. Only air transport increased much faster (219%). Navigation increased with 39% and rail transport with 37%. A special aspect of rail transport is the switch from diesel to electricity[5]. In 1980 43% of the energy consumption by trains was diesel; in 1997 only 21%. In electricity consumption of rail transport is not translated into primary energy.

In 1980 the shares of the different modes in energy consumption were 81% road; 12% air, 5% navigation, and 1% rail. In 1997 these shares have changed to 70% road, 24% air, 5% navigation, and still 1% rail.

Figure 6.2 presents the relationships between economic growth and transport demand (excluding international air transport). The general upward trend is related to the economic growth, which was relatively high in the late eighties. From 1993 onward, high growth is continued. The economic growth has its effect on passenger transport and freight transport. The number of vehicles has increased, and also the yearly performance of the vehicles (distance travelled per year). The development of the person kilometres shows a high growth rate (Annema, 1997; Brink 2000). Economic growth, passenger transport and freight transport are

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[4] CBS collects data on the total consumption of Dutch vessels and the amount of diesel sold for inland shipping (incl. international traffic). Due to price differences with other countries and an unclear market (many oil is sold via intermediate trade) the latter figure varies much in time. So model calculations are the only source of oil consumption for inland shipping in the Netherlands.

[5] The figures for 1980-1992 are based on data published by the Dutch Railway Company (NS). NS has stopped publishing these data, so for recent years CBS data on electricity consumption for the total sector are used, corrected by ECN for other energy users.

still strongly related. Between 1994 and 1998 growth in passenger transport in the Netherlands slowed down. International air transport did grow very fast in this period, but is not included in this figure.

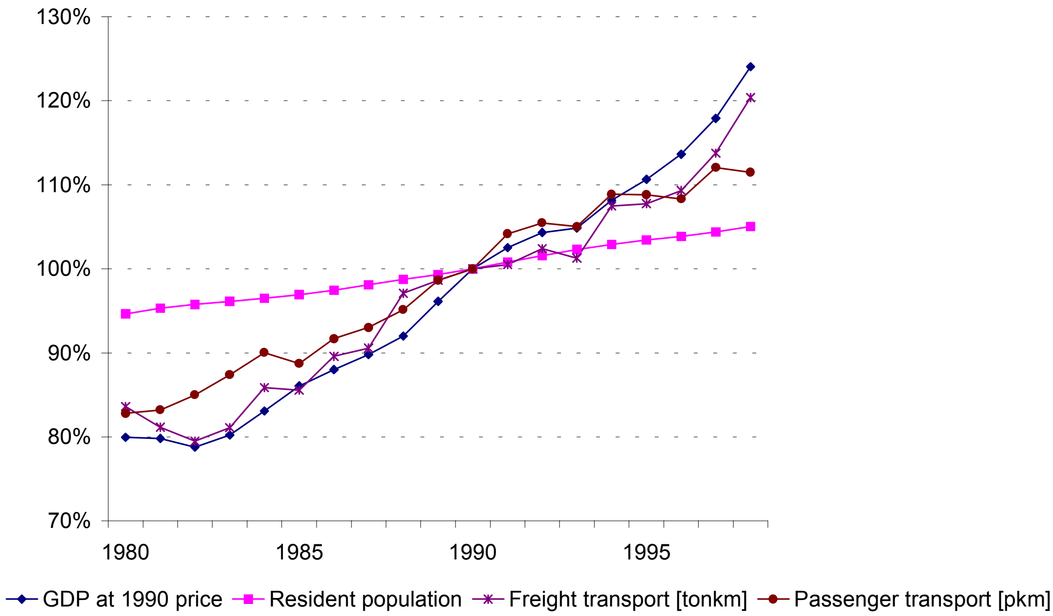

Figure 6.2 *Main economic and transport demand growth figures, excluding air transport (1990=100%)*

Figure 6.3 shows the relationship between the growth of energy consumption in the transport sector and economic growth. The decline in Figure 6.3 in energy consumption between 1989 and 1990 is based on a statistical correction of the years 1990 tot 1998 (see also 6.4.1).

Despite an increase in vehicle efficiency, the energy consumption shows an upward trend for transport. Until 1985 the energy consumption shows a low growth rate. The high growth rate between 1985 and 1989 is probably caused by the lower fuel prices. In 1985 the prices of motor fuels dropped drastically by 20%. If international air traffic is taken into account, the energy consumption of transport is growing even faster than the economy.

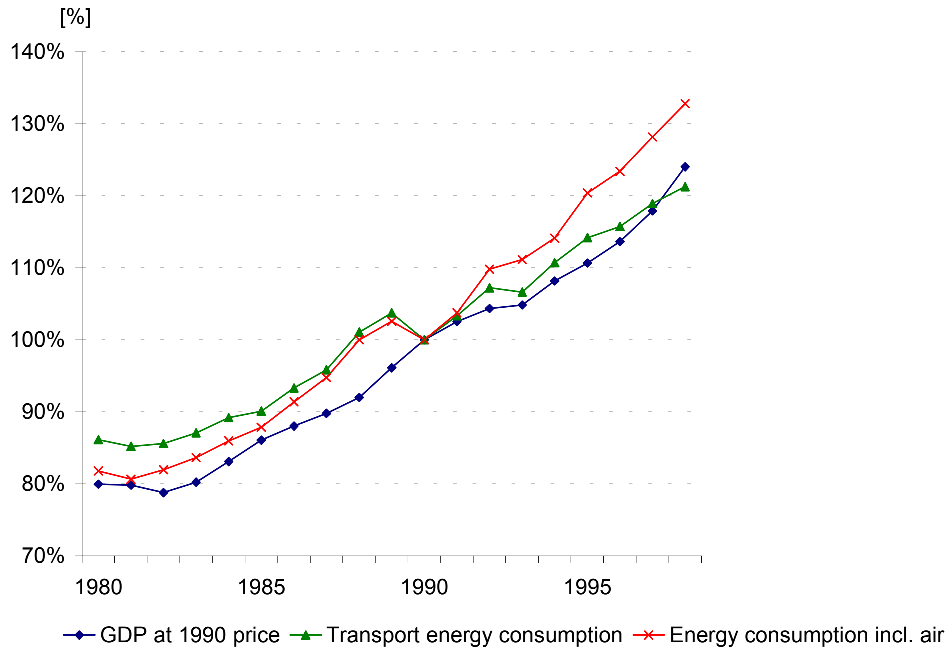

Figure 6.3 *Main economic and transport energy consumption growth, including air transport (1990=100%)*

Figure 6.4 presents the total energy consumption by service; passenger transport and freight transport. In this figure, compared to, air transport is excluded. For road transport also special vehicles (e.g. fire engines, ambulances, cranes) and light vehicles (vans) are excluded[6]. The energy consumption of rail transport was broken up by ECN in passenger and goods transport[7]. Again the general upward trend is related to the economic growth and the resulting income development.

For freight transport the total energy consumption increases, while the energy consumption per vehicle decreases because of an improved efficiency. The growth in the total energy consumption is the result of an increase in the number of vehicles and the vehicle performance. The slight decrease around 1983 is caused by a decrease in transport demand, related to an economic decline. The decline in 1990 has statistical reasons and is discussed in 6.4.1.

The energy consumption for passenger transport increases mainly because of the developments with private cars (see also Figure 6.5). In 1990 en 1993 energy demand decreased. In 1990 this was caused by a strong environmental concern in the Dutch population and government. In 1993 the economic growth slowed down, and people waited to see what would happen with the economy. Car sales decreased dramatically in that year. As a result, the growth of private car mobility stagnated in 1993. The figures of 1998 show a slower increase of energy consumption, but this is not rather significant yet.

The ratio of energy consumption between freight and passenger transport is with 30:70 almost constant in time. Only in the period 1981-1985 freight transport stagnated and the ratio became 27:73 (1983).

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[6] In the Netherlands a still growing number of ‘vans’ is used as a passenger car for private transport. Those private vans account for about 7% in 1980 and 20% in 1996 of the energy demand of vans.

[7] The division of energy use of rail transport between goods en passengers is not published in the statistics. ECN made a division based on figures for one year of several studies.

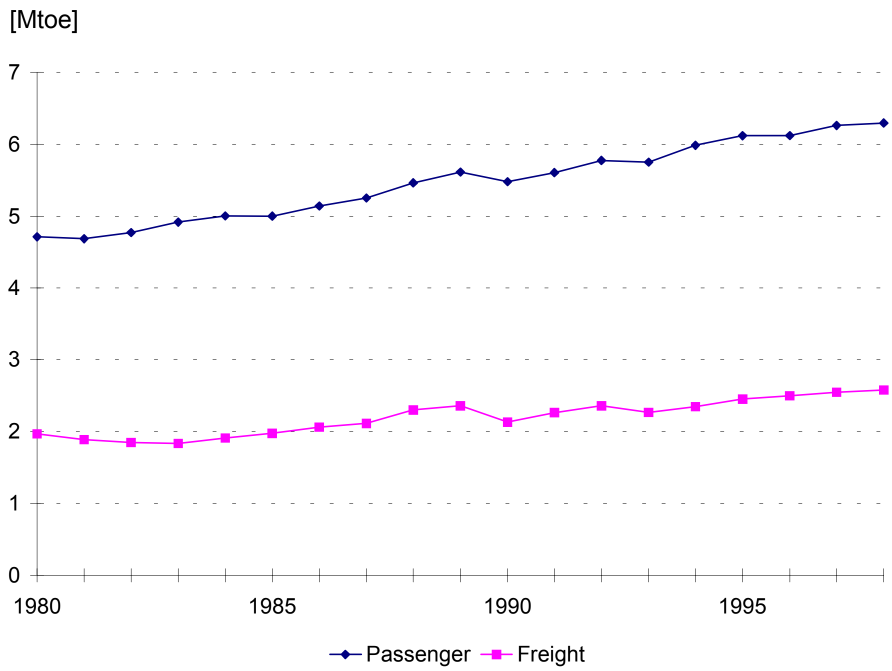

Figure 6.4 *Transport energy consumption by service: passenger and freight*

The road transport energy consumption by type of vehicle is given in Figure 6.5. The total energy consumption has risen with 41% between 1980 and 1998. Private cars dominate this energy consumption, followed by trucks and light vehicles (vans). Busses and motorcycles both only have a small share in the energy consumption by type of vehicle. The energy consumption of buses and motorcycles remains more or less constant. Thus the increasing energy consumption for passenger transport (see Figure 6.4) is mainly a result of the increase in energy consumption for private cars. The total energy consumption for private cars has increased from 1980 to 1998 with 35%. The energy consumption of trucks (44% corrected for the change in statistics) and vans (205%) has increased even more. The (small) energy consumption of special vehicles declined with almost 40% over time.

The share of energy consumption for the different vehicles has changed between 1980 and 1998. The share of private cars, trucks and vans has changed from 66%, 22% and 6% respectively in 1980 into 63%, 20%, and 13% in 1998. The growth rate for trucks is higher than for private cars. This seems contradictory with the conclusions from Figure 6.4 (passenger and goods transport have the same growth rate). It appears that the higher growth rate for trucks is compensated with a lower growth rate for inland shipping and rail transport.

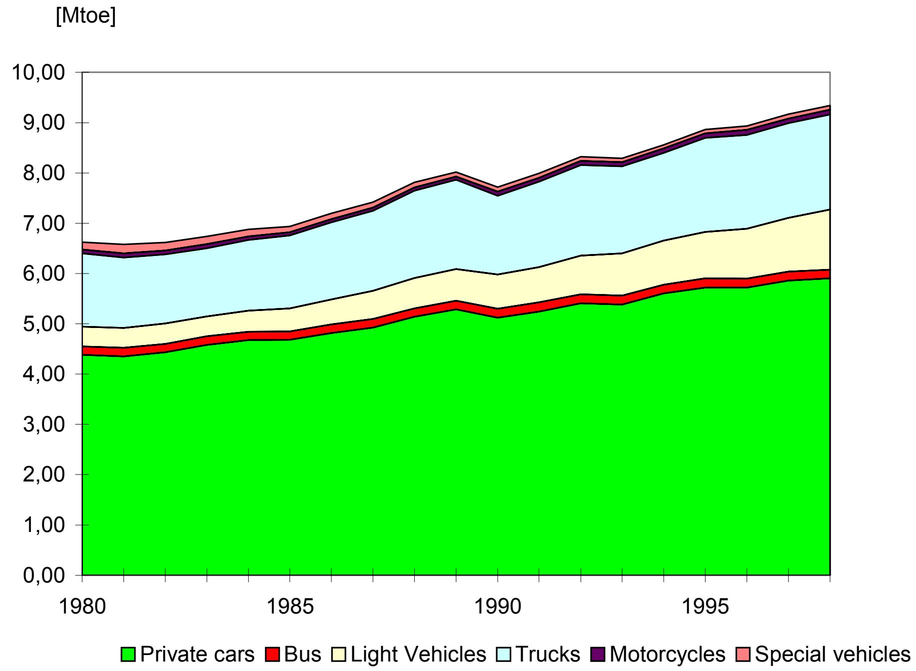

Figure 6.5 *Road transport energy consumption by type of vehicle*

6.3 Cars

6.3.1 Specific consumption

For road vehicles the overall efficiency can be monitored with the average specific consumption, expressed in litres/100 km (CBS, 1999; CBS, 2000). For cars, the average specific consumption is calculated from the total energy consumption of Dutch cars, the stock of cars (active fleet) and the average yearly performance of Dutch cars in the Netherlands. Figure 6.6 shows the specific energy consumption of cars. The average consumption and consumption of new cars are presented in litre gasoline equivalent per 100 km.

Until 1990 the specific consumption of cars decreases. This trend is partly due to a general efficiency improvement and to a shift in the fuel mix.

- In the year 1978 an agreement was reached between the European Union and the car manufacturers on a higher efficiency of private cars. In 1985, new cars should be 10% more efficient compared to 1978 cars. This goal has been more than achieved, actually in 1985 new cars were 14% more efficient.
- During the years the share of diesel cars has grown. Diesel cars are more efficient than gasoline cars and as a result, the total specific energy consumption has decreased.
- The introduction of the APK (obligatory general periodic inspection) in 1988 had a positive effect on the energy consumption of cars, because of scrapping of old, inefficient cars.

From 1990 on, the specific consumption of cars more or less stabilises, at least for gasoline and diesel cars. This stabilisation is caused by the increasing vehicle weight. More extra parts and equipment were built in the vehicles for a higher level of comfort and safety. In Figure 6.6 again efficiency improvement takes place after 1997. Diesel cars, gasoline cars and new cars are reported to be more efficient in 1998, but the average value, which is based on a different methodology (calculated instead of surveyed), does not change yet. So the efficiency improvement is not statistically clear.

Another important development is the increase in energy consumption because of environmental legislation. The introduction of the controlled three-way catalyst for passenger cars and light vans resulted in a 3% increase in energy consumption.

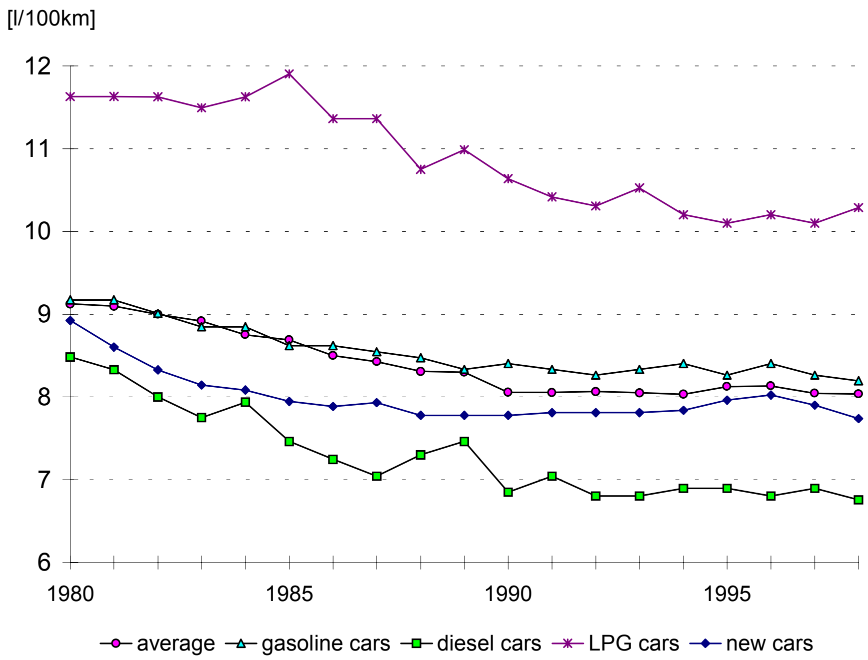

Figure 6.6 *Specific consumption of passenger cars*

The vehicle weight of new cars is shown in Figure 6.7. After a decline between 1980 and 1983 vehicle weight is rising again from 1984. In 1998, new cars are 24% heavier than in 1984 (CBS 2000; Annema, 1999). The increase in weight results in 1995 in a significant increase in specific consumption of new cars. Specific fuel consumption of new cars is almost equal to the average consumption of all the passenger cars (Figure 6.6). As a result of this, the decrease of fuel consumption caused by substitution of old cars by more efficient new cars will, if nothing else is done, slow down in the near future.

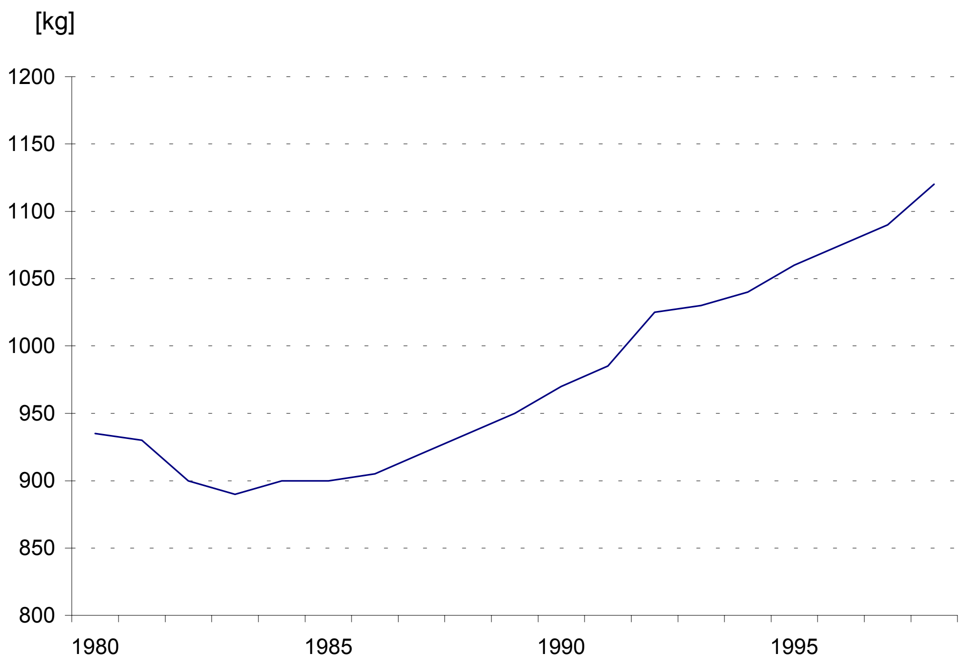

Figure 6.7 *Mean weight of new passenger cars (CBS, 2000*

However, consumption of new cars might decline in the next years. Dutch government has plans on lowering taxes for efficient cars in a certain category and increasing them for less efficient cars in the same category. Each category is specified by certain floor areas (length multiplied by width). A system of fuel efficiency labels for new cars is implemented in January 2001, based on the same categories. The energy label, which was already in use in the Netherlands for refrigerators, washing machines, and dryers, shows the buyer immediately how efficient the car is compared to others. Although fuel consumption and CO_2 emissions are on the label too, the colour of the label (from green = good to red = bad) refers only to the consumption of the passenger car compared to other cars in the same category. This is a big difference with label systems in other European countries. Finally, there is an EU policy, based on agreements with car producers on lowering fuel consumption of new passenger cars.

Figure 6.8 *Fuel efficiency label*

6.3.2 Unit consumption

The unit consumption of cars (toe/vehicle) depends on the average specific consumption of cars (l/100 km) and the average distance travelled per year. The distances driven in other countries by Dutch cars are substantial. In 1980 an average Dutch passenger car drove 15,180 km of which 1300 in other countries. In 1997 those figures are 16,550 km (+9%) respectively 1270 (-2%). Combined with the energy improvement of passenger cars in the same period (12%), the unit consumption of passenger cars (toe/vehicle) changes less than 2%. In other words the efficiency improvement is almost completely compensated by driving more km with the car. The growth of energy use of Dutch passenger cars in the Netherlands almost equals the growth of the number of cars.

6.3.3 Passenger transport

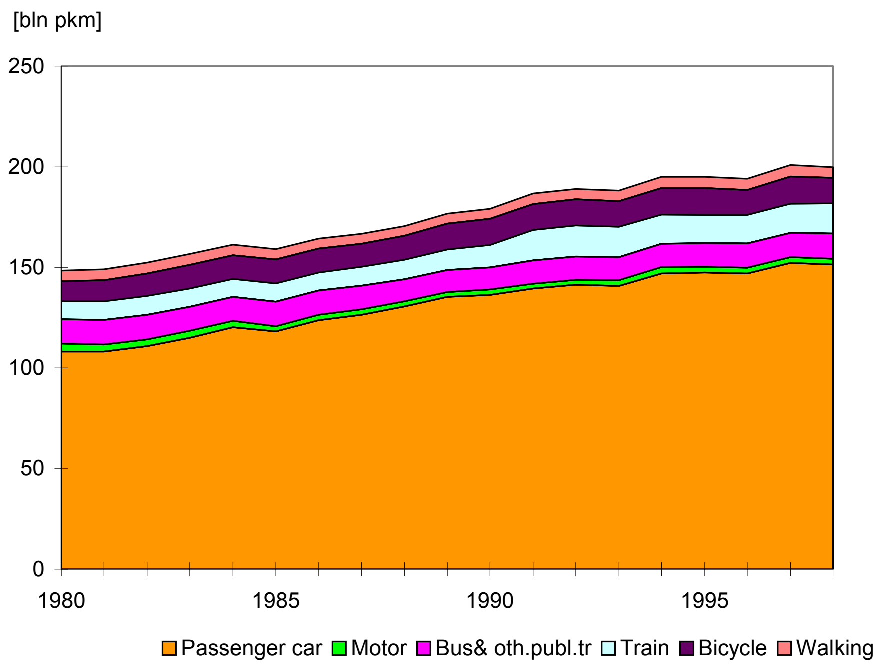

Figure 6.9 *Modal split passenger transport*

Figure 6.9 presents the modal split in passenger transport. The development of the energy efficiency of passenger transport is presented in Figure 6.10 (total includes walking and bicycles). The biggest change takes place with the motorcycles ('motor' in the graph). First, the energy use of motorcycles (and mopeds) per km increases. Second, mopeds use less energy per km, but the market share of mopeds declines in favour of a rising share of motorcycles. In 1991 students did get a pass for free travel by public transport resulting in 37% more passenger km by train (and very crowded trains) because almost no extra trains where available. This resulted also in a lower energy consumption per passenger km by train. As can be seen in Figure 6.9 and Figure 6.10, the changes in efficiency of the passenger car are the main factor for the specific consumption of passenger transport as a whole.

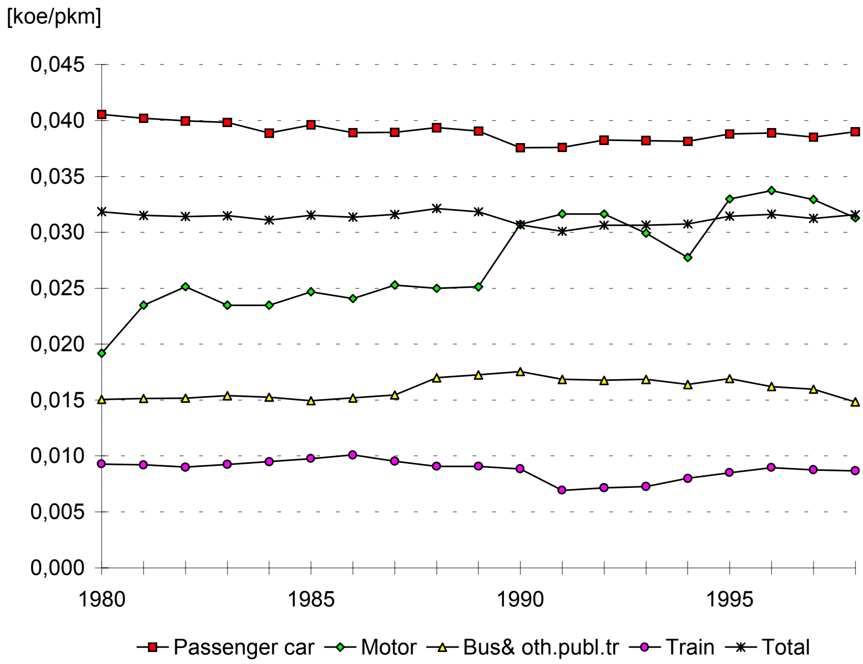

Figure 6.10 *Specific consumption passenger transport*

6.4 Trucks

6.4.1 Specific consumption

The specific consumption of trucks in litres/100 km can be considered as an indicator of the vehicle efficiency.

Figure 6.11 shows data for the Netherlands. It was concluded that transport performance in ton km was not in line with road performance in vehicle km, so a new calculation was made for the period 1990-1998 (Brink, 2000). Comparing the figures for 1990, road performance is 13% lower according to the new calculation, resulting in a disruption in the statistical data between 1989 (old figures) and 1990 (new figures). Correcting for the disruption, there is a decline between 1989 and 1990 of 4%.

Taking this into account, road transport became 20% more efficient over the years, but some factors resulted in stabilisation of the specific consumption of trucks between 1980 and 1998. First of all, trucks became heavier. From 1981 to 1989 the average vehicle weight increased with 12% (Bureau Goudappel Coffeng, 1994). Secondly, the weight of the load increased over the years. The specific consumption of trucks also increased because of the environmental legislation. The introduction of the EURO 3 emission norm for trucks resulted in an increase in the energy consumption of 0.5%-4% (Dings, 1996).

The improved efficiency of the trucks together with an increase in the weight of the vehicle/load and the introduction of emission norms result in a stabilisation of the specific consumption/vehicle km.

6.4.2 Efficiency

The efficiency of freight transport by trucks can be monitored with the unit consumption per ton-kilometre. Changes in the unit consumption per ton-km depend on:

- Energy efficiency of vehicles: variation in the specific consumption of trucks (per vehicle kilometre), which is an indicator of vehicle efficiency.
- Tonne capacity per vehicle: in the Netherlands there is a change from lorries to tractors (bigger loads possible per vehicle), so even a higher consumption per vehicle can result in an efficiency improvement.
- Load factor or fleet management: efficiency of transport services provided by the vehicles, this is expressed in a variation of the ratio ton-km performed per vehicle-km.

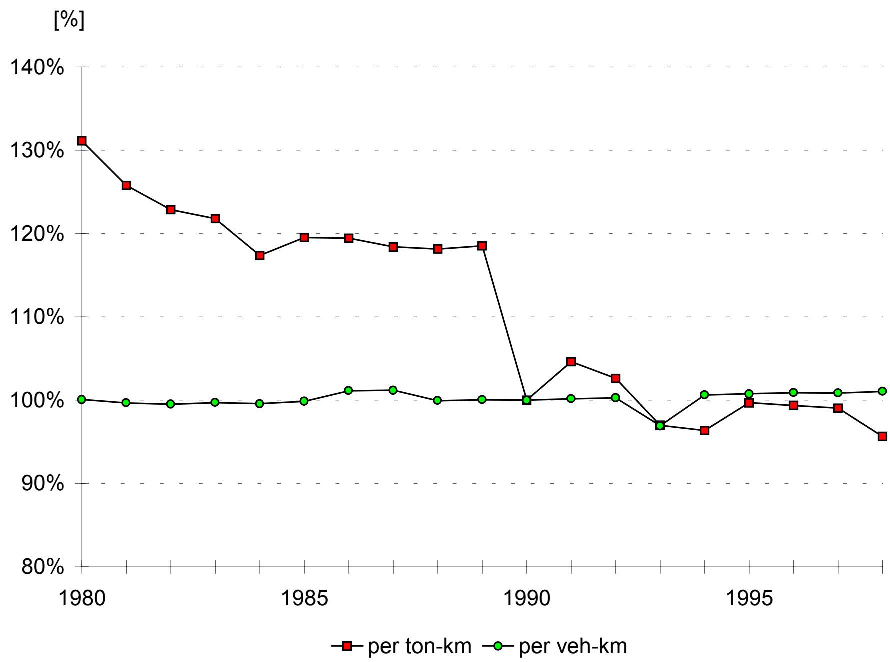

Figure 6.11 *Energy consumption of trucks (1990=100%)*

Figure 6.11 presents the energy consumption of trucks per ton-km and per vehicle-km. There are two reasons for the different slopes in the curves for specific consumption of trucks and unit consumption per ton-km. First there is a shift towards bigger trucks, with a higher load capacity. Secondly, the load factor is increasing. Both effects are the consequence of better fleet management and result in a decreasing unit consumption per ton-km. The two effects increase the specific consumption per vehicle but, because of the efficiency improvements of the trucks, the overall specific consumption decreases. It is not clear why energy consumption is rising after 1994. Probably it is caused by a trend to smaller loads for trucks, due to 'just in time delivery', and a rising market share of inland navigation, in the container transport market. The recent decline in 1998 is not statistical proven yet, so it is too early to draw conclusions.

6.5 Energy savings for road transport

The energy savings for road transport, presented in Figure 6.12, are calculated in ODYSSEE from the technical and the behavioural/management savings for cars and trucks.

Energy savings for cars:

- Technical savings; these are based on the variation in the theoretical (test) value of the specific consumption of new cars.

- Behavioural savings; the difference between the theoretical and the actual specific consumption.

Energy savings for trucks:
- Technical savings; these are related to the actual specific consumption.
- Management savings; the variation of the load factor.

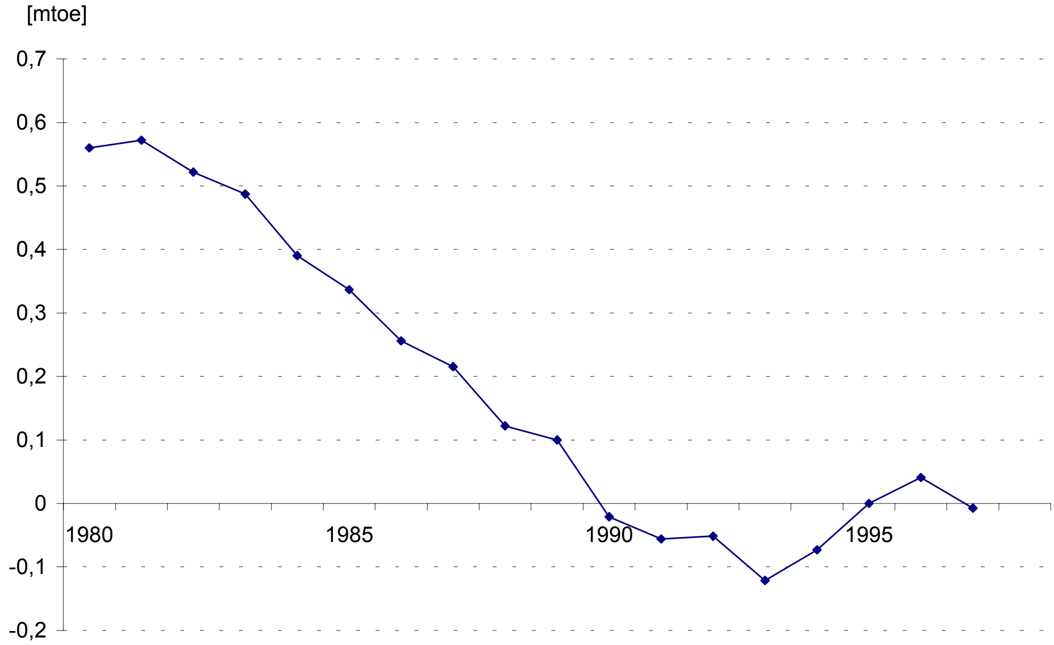

Figure 6.12 *Energy savings for cars and trucks*

The reference year for the energy savings is 1995. Before 1990 there where substantial savings. Between 1990-1997 there are almost no energy savings with both cars and trucks. Since road transport is the most energy intensive per ton-km, for the complete freight transport sector a growth in energy demand between 1980 and 1998 (by the growing amount of ton-km) and specific energy demand (by the growing market share of road transport) can be expected.

In Figure 6.13 the impact of the modal shift on the specific energy consumption can be seen. Between 1989-1990 the already described disruption in statistical data for trucks can be seen. The specific consumption of rail transport decreased with almost 23% (1980-1998) due to electrification and energy improvements. In primary energy terms the decrease is lower. The specific energy consumption of navigation increased with 14%. There is no clear explanation for this; it might be an effect due to the model calculations of the energy consumption, but it can also be caused by an increase in speed. Finally the energy efficiency of truck transport declined 14% between 1980 and 1998 (corrected for the disruption). Between 1980 and 1993, modal split effects result in 19% more energy use, and efficiency improvements in 12% less energy use. Between 1993 and 1998 modal split results in 3% less energy use and efficiency improvements in 1% less energy use. Overall energy consumption per ton km rose with 1% mostly due to an increase between 1990 - 1995 and a decline in more recent years. Before 1990 the energy improvements compensated for the change in mode. After 1990 there were hardly any energy technology improvements, so changes in mode resulted directly into changes in overall energy intensity.

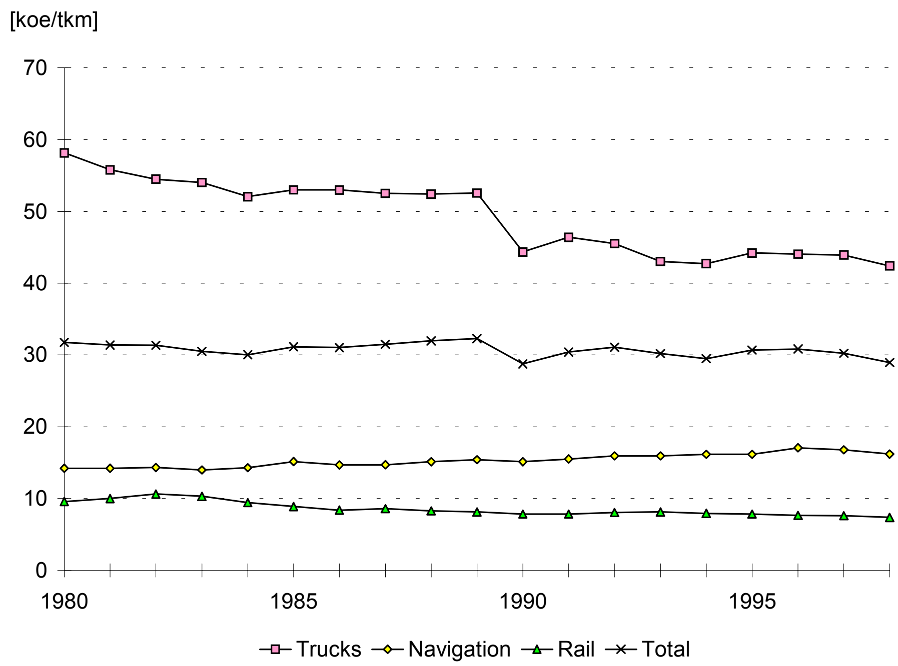

Figure 6.13 *Impact of modal shift on freight transport: energy consumption*

6.6 Water and rail transport

There are only limited data available on the energy efficiency of water and rail transport. For rail, in the statistics only combined data for passenger and freight transport are available. For navigation, models are used to calculate the energy consumption.

In Figure 6.14 freight transport is depicted by mode. In the period 1980-1998 road transport shows a steady increase with 77%. Rail transport declined with about 20% between 1980 and 1993 but restructuring of the sector and promotion resulted in a 43% increase! The restructuring included take over by the German Rail Company, less good stations, less piece goods and more containers. Navigation nearly stabilised between 1980 and 1993, but, similar to rail transport, it grew substantially after 1993 with 28% (total 22% increase between 1980 and 1998). Many containers are nowadays shipped from Rotterdam and Amsterdam to Germany (and back). Between 1993 and 1998, truck transport grew only 11%. The policy to move freight from trucks to train and inland shipping was very successful in the Netherlands. Infrastructural measures in the Rotterdam harbour, and other places in the Netherlands were necessary. A positive attention of the transport companies and increasing traffic jams around Rotterdam also encouraged freight transport by train and inland shipping.

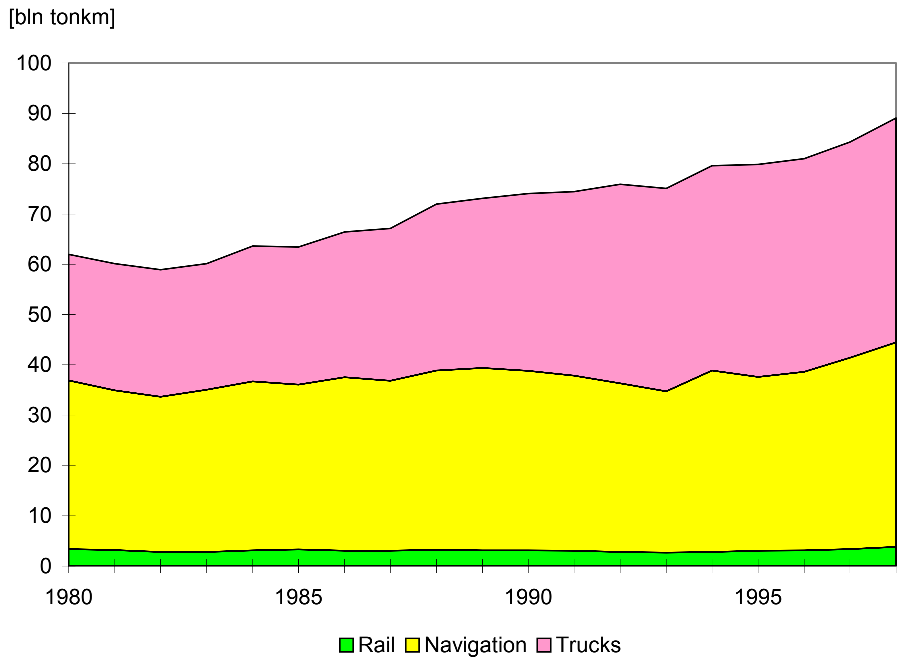

Figure 6.14 *Modal shift in freight transport; ton-km per mode*

6.7 CO_2 emissions

Figure 6.15 shows the development of some CO_2 indicators (1995 ≡ 100). The emission of CO_2 per passenger km has declined with 5% between 1980 and 1998. The increase between 1990 and 1998 is probably caused by the fast growth of international air traffic, of which the energy consumption is included. Smaller effects are the decline of LPG use in the Netherlands, a growth in motors and decline in mopeds. The decline of LPG use is related to emission limits. The investment cost of LPG installations has become higher because extra investments are needed for an extra control system of the air - fuel balance. To overcome this problem for some cars LPG installations are nowadays installed in the car factory, so one system controls both LPG and gasoline use.

The CO_2 emission per car km has about the same pattern as in Figure 6.5. The CO_2 emission per car has an extra factor in it, namely the yearly road performance per car. The increasing road performance almost compensates the effect of more efficient cars.

The CO_2 emission of goods traffic looks similar to that of Figure 6.11 although Figure 6.15 includes also vans. And the use of vans has strongly increased with 25% between 1995 and 1998. Its is not clear whether this is caused only by industry and service activities. It might also be an increase of vans used by households. There is less tax on vans compared to passenger cars in the Netherlands. And the number of households with two incomes, and two cars for commuting, has increased in recent years. So a number of households has one family car and one cheaper van. There is also an increasing market in the Netherlands for new or second hand vans with an extra bench in it. With 6 seats, and a lot of cargo space, this is also an interesting alternative for the usual family car.

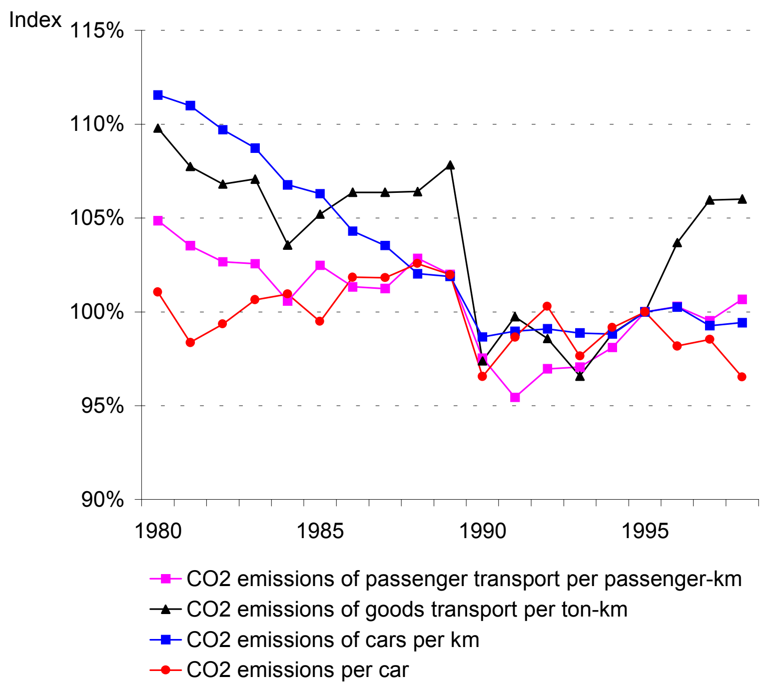

Figure 6.15 *Index of several CO_2 transport data (1995=100)*

6.8 Conclusions

Since 1980 the energy consumption in the transport sector has increased with 62%. Between 1997 and 1998 energy consumption increased with 2,8%, of which 1,3% is caused by road transport and 1,3% is caused by air transport. Between 1980 and 1998 the energy consumption for road transport increased with 41%. Only air transport increased much faster (219%). Navigation increased with 39% and rail transport with 37%.

Economic growth, passenger transport and freight transport are still strongly related. Between 1994 and 1998 growth in passenger transport in the Netherlands slowed down. This is at least partly compensated by international air transport, which did grow very fast in this period.

The energy consumption for passenger transport increases mainly because of the developments with private cars. In 1990 en 1993 energy demand decreased. In 1990 this was caused by a fast rising and strong environmental concern in the Dutch population and government. In 1993 the economic growth slowed down, and people waited to see what would happen with the economy. Car sales decreased dramatically in that year. As a result of less new cars, the growing of private car mobility stagnated in 1993. The figures of 1998 show a slight decrease, but this is not rather significant yet.

From 1990 on, the specific consumption of cars more or less stabilises, at least for gasoline and diesel cars. This stabilisation is due to two counterbalancing trends, an increase of the engine efficiency with 10%, and an increase of the average vehicle weight. More extra parts and equipment were built in the vehicles for a higher level of comfort and safety.

The specific consumption of good transport by rail decreased with almost 23% (1980-1998) due to electrification and energy improvements. The specific energy consumption of navigation (in MJ/tonkm) increased with 14%. There is no clear explanation for this; it might be an effect due to the model calculations of the energy consumption, but it can also be caused by an increase in speed. Finally the energy efficiency of truck transport declined 14% between 1980 and 1998.

Between 1980 and 1993, modal split effects result in 19% more energy use (more freight by truck) and efficiency improvements result in 12% less energy use. Between 1993 and 1998 modal split results in 3% less energy use and efficiency improvements in 1% less energy use. Overall energy consumption per ton km rose with 1%, mostly due to an increase between 1990 - 1995 and a decline in more recent years. Before 1990 the energy improvements compensated for the change in mode. After 1990 there were hardly any energy technology improvements, so changes in mode resulted directly into changes in overall energy efficiency. After 1993, the policy to move freight from trucks to train and inland shipping was very successful in the Netherlands. Infrastructural measures in the Rotterdam harbour, and other places in the Netherlands were necessary. A positive attention of the transport companies and increasing traffic jams around Rotterdam also encouraged freight transport by train and inland shipping.

Before 1990 there where substantial savings for cars and trucks, but between 1990-1997 there are almost no energy savings in road transport.

7. SERVICE SECTOR

The service sector is one of the most diverse economic sectors, which means that data is not always readily available. However, its importance for energy efficiency is still growing, because of the increasing contribution of the service sector to GDP, as well as its increasing electricity consumption.

7.1 Use of gas and electricity per end use

The use of gas and electricity for the different energy functions in de service sector has been estimated[8]. In figure 7.1 the percentages of the primary energy use are given.

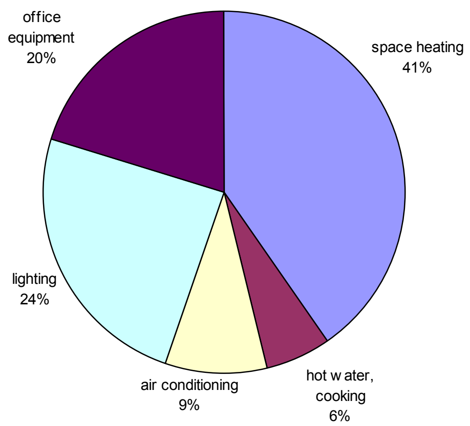

Figure 7.1 *Use of primary energy in the service sector in 1997*

7.2 Overall energy performance

The following types of energy indicators are considered for the service sector:
- energy intensity,
- unit consumption per employee.

Figure 7.2 shows the variation of the total and electricity intensities.

[8] ECN-C--99-084: Energieverbruik van gebouwgebonden energiefuncties in woningen en utiliteitsgebouwen.

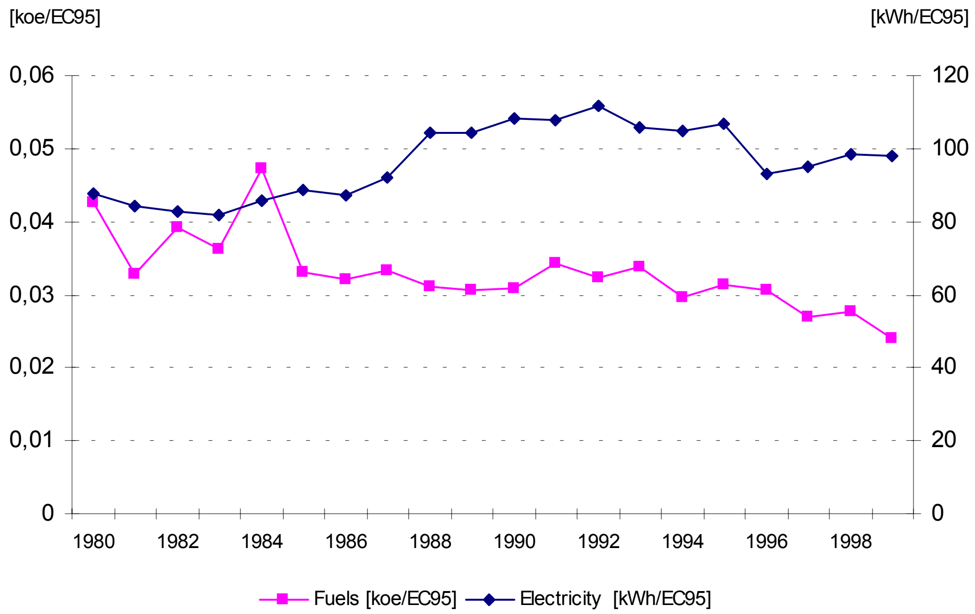

Figure 7.2 *Energy intensity in the service sector*

In the period 1984-1999, the overall energy intensity decreases from 0.04 koe/EC95 until 0.025 (about 2.5% per year). For electricity, the general trend is an increasing intensity of 1.7%/year on average between 1980 and 1999. Part of the increasing use of electricity is due to penetration of equipment for office automation and climate control. The extreme value in 1984 cannot be explained, the table from Statistics Netherlands shows extreme use of LPG.

The unit consumption per employee increases slightly (0.6% per year) in the period 1985-1999. The unit consumption of electricity increases in the same period by nearly 1.9%. Especially in the period 1985-1992 the growth was relatively high namely more than 4%. After 1992 the use of electricity per employee more or less stabilises.

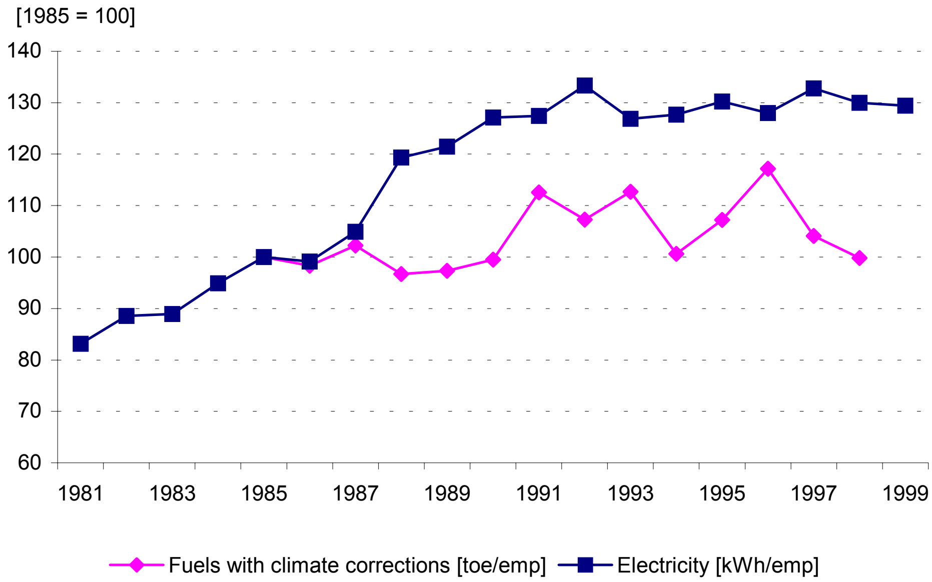

Figure 7.3 *Unit consumption per employee in the service sector*

In the period 1985-1999 the unit consumption per employee increases about 5%. The unit consumption per EC95 remains more or less stable. The labour productivity has increased with 20%.

7.3 CO_2 indicators

The CO_2 intensity of the service sector decreased especially in the period 1982 - 1986, thereafter there was a slight increase, but after 1995 the intensity decreases again. In 1998 60% of the intensity was due to the use of electricity.

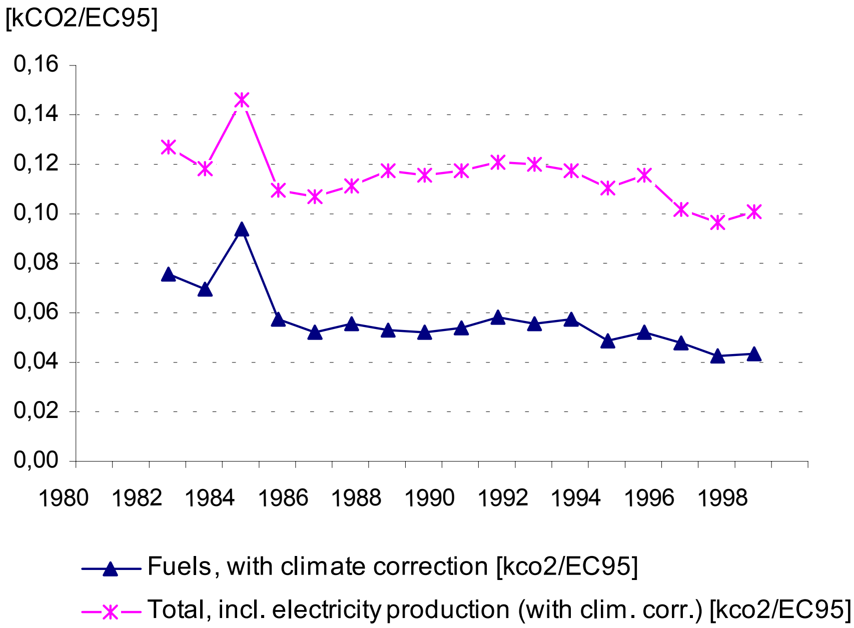

Figure 7.4 *CO_2 intensity of services sector*

The emissions per employee from fuels show a stable level after 1984. The emissions from electricity generation increase with nearly 1% per year (Figure 7.5).

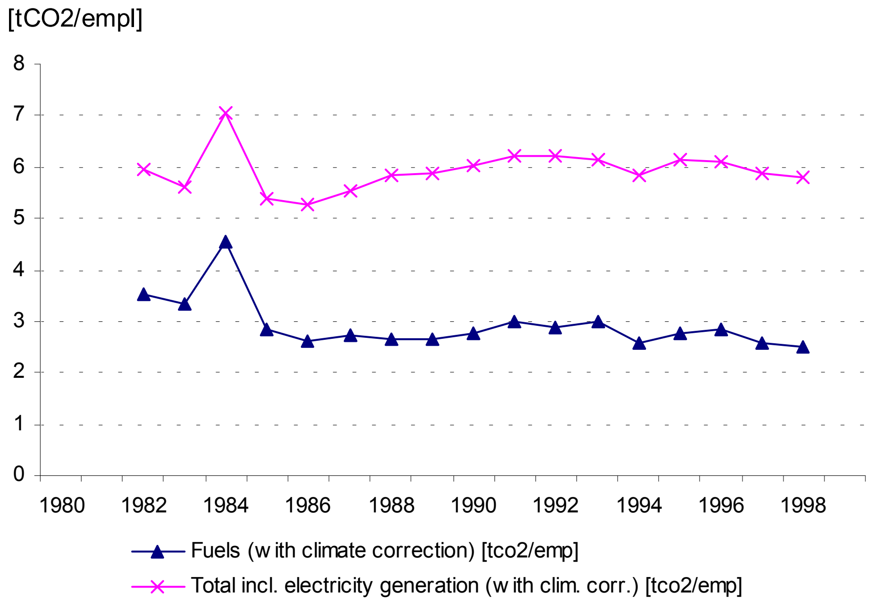

Figure 7.5 *CO_2 emissions of services sector per employee*

7.4 Indicators by branch

Five activities are considered in the service sector:

- commerce: wholesale and retail trade,
- hotels and restaurants,
- education,
- hospitals,
- government.

Other important branches, e.g. communication and transportation companies are not shown because of data problems. Their share in total energy use of the service sector is about 25%.

The activities correspond to economic branches, which means that the value added and employment are available, and energy intensities and unit consumption can be calculated.

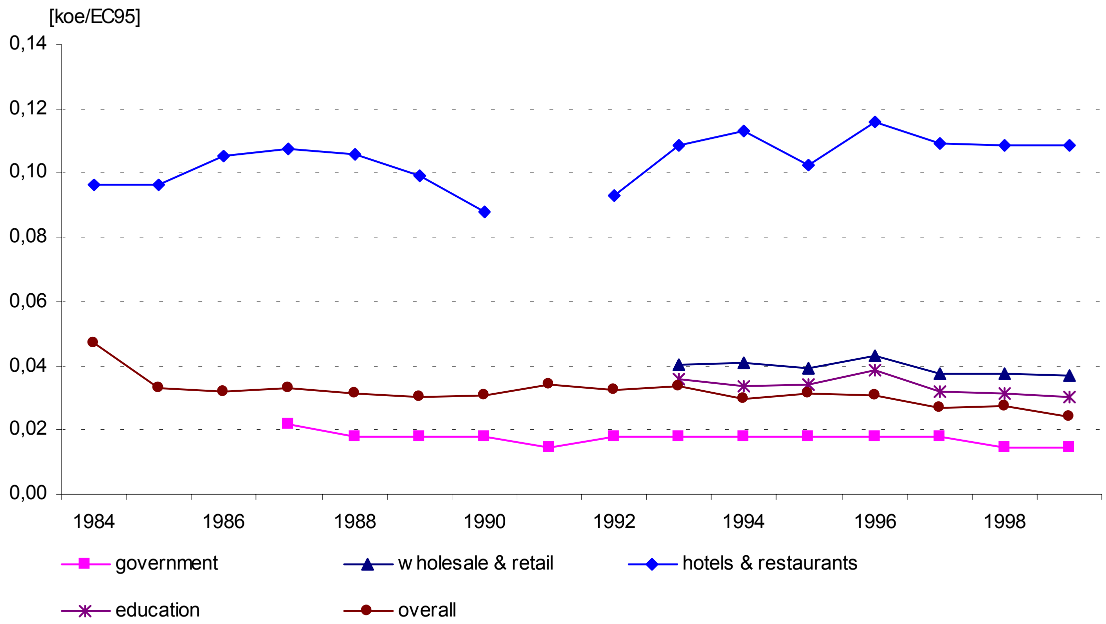

Figure 7.6 *Energy intensity by branch*

The hotels and restaurants branch turns out to be more than three times as energy intensive as commerce and the average of the sector (see Figure 7.6). On average, the intensity of the hotel and restaurant branch and commerce increased a little in the period 1993-1999, trade and education decreased a little. The intensity for government is small[9] perhaps due to the fact that many employees such as policemen (45.000), defence (70.000), environmental cleaning etc. do not use offices or workplaces. It is approximated that nearly 20% of the employees works in the field. Not all the branches of the service sector have been shown, so the overall mean value cannot be connected to the lines shown.

[9] Intensities by government have been recalculated by ECN.

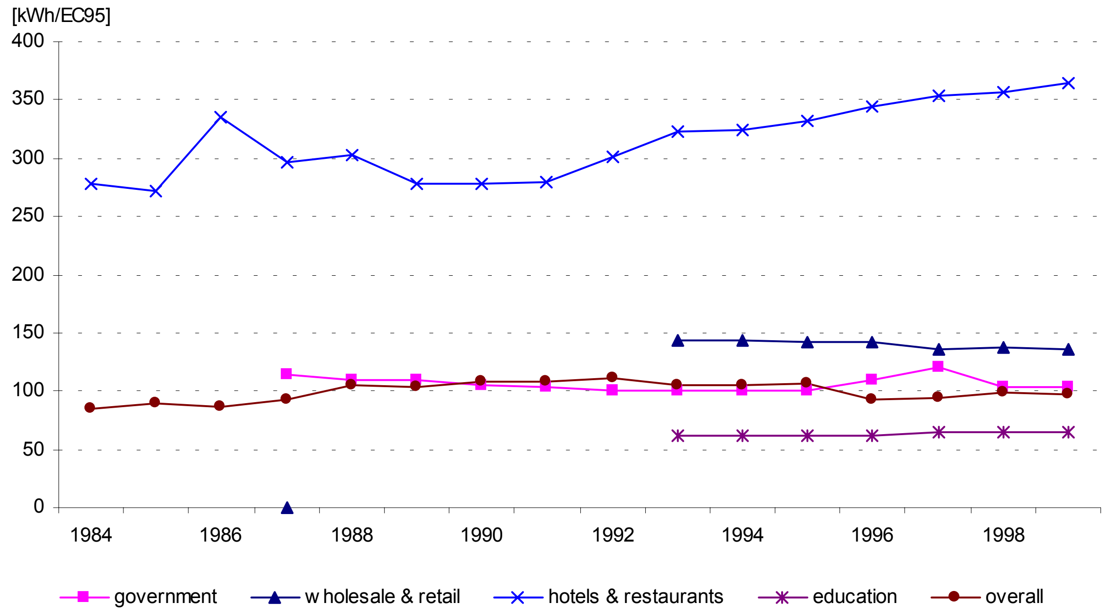

Figure 7.7 *Electricity intensity by branch*

Figure 7.7 shows the development of the intensity of use of electricity per activity. Again hotels and restaurants are the most energy intensive branches within the sector. The increase of electricity intensity for the hotels & restaurants is remarkable. Here, again, only a few branches of the service sector have been shown.

7.5 Useful square meters per branch

The square meters in the different branches are known for the year 1995. The total amount for the distinguished branches is 153 millions of m^2. In figure 7.8 the partition over the branches is given.

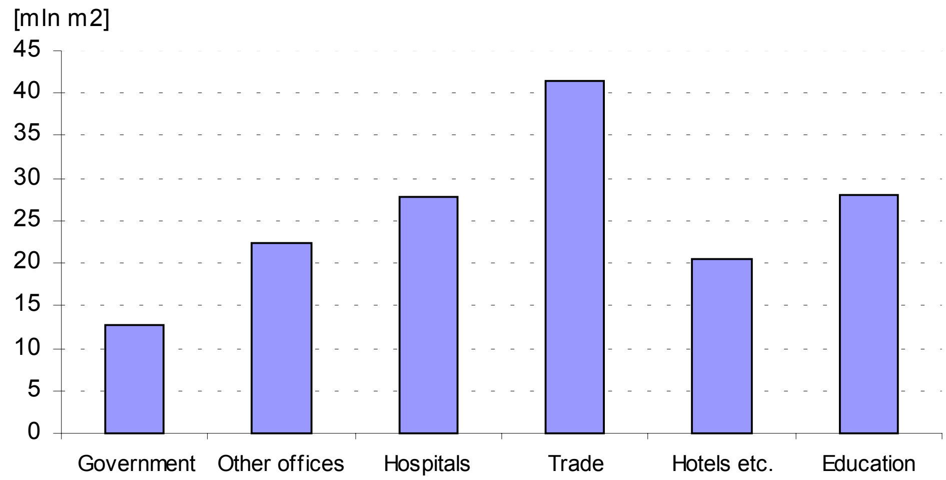

Figure 7.8 *Millions of square meters per branch (1995)*

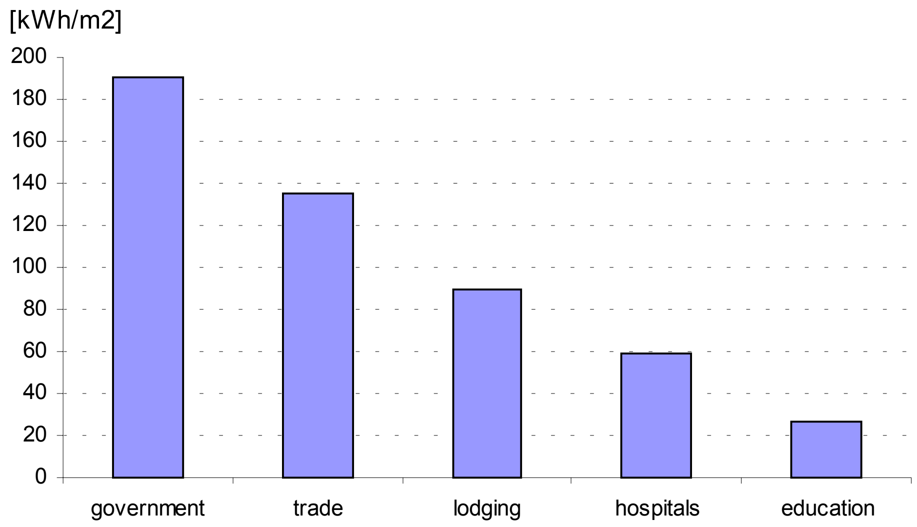

Figure 7.9 *Electricity use per m² (1995)*

Figure 7.10 *Use of fossil fuels per m² (1995)*

In Figure 7.9 and 7.10 the energy use (electricity and fuels) per square meter given for 5 branches of the service sector.

7.6 Energy intensity of agriculture

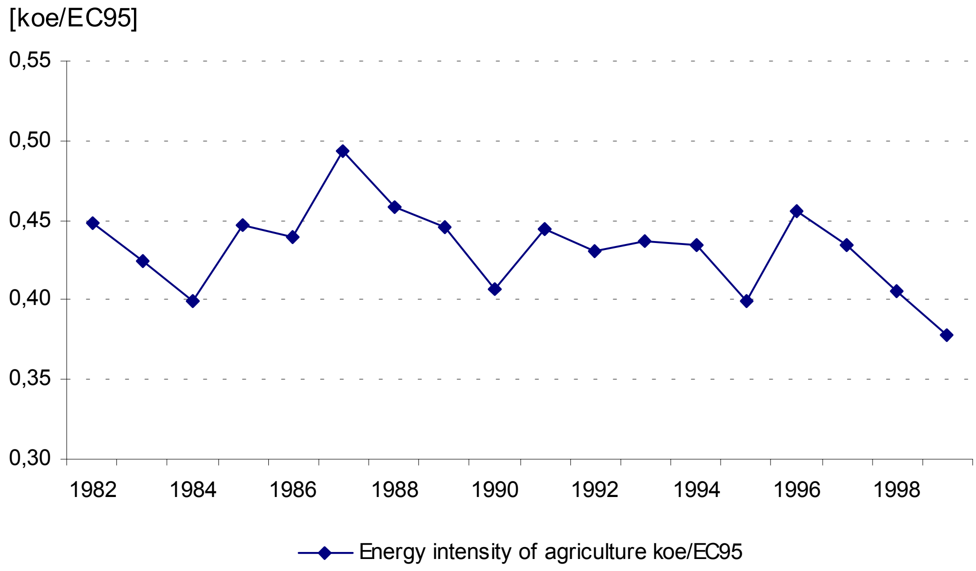

Figure 7.11 *Final energy intensity of agriculture*

After 1982 the energy intensity of agriculture fluctuates. The different definitions for energy use as well as value added in the periods of 1980 until 1987, of 1988 until 1993 and the next years have caused part of it. Greenhouse horticulture is the main energy consuming sector within agriculture (80% of final demand) and the increase in energy consumption is both due to growth of this subsector, and to the use of more energy intensive cultivation methods.

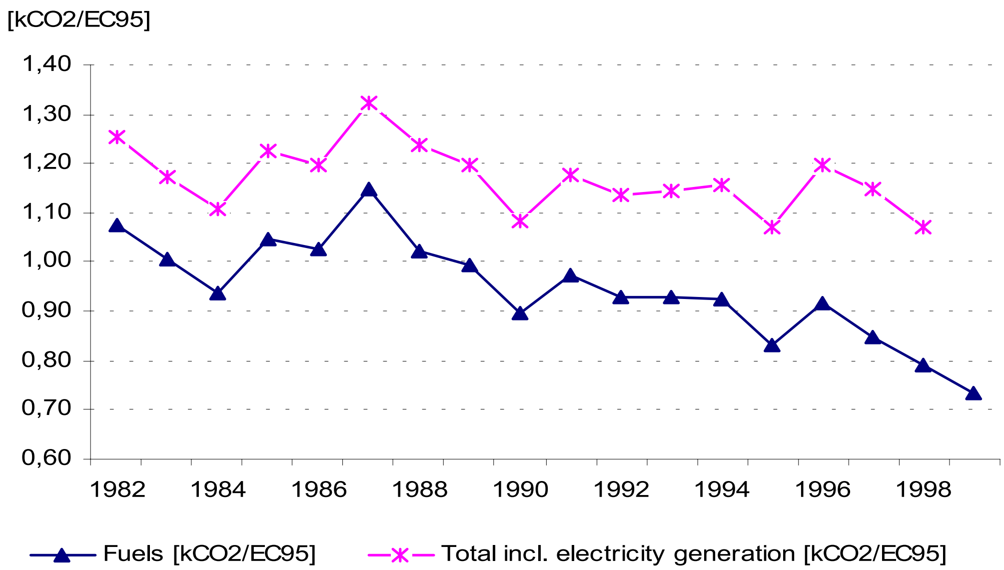

Figure 7.12 *CO_2 intensity of agriculture*

As can be seen in Figure 7.12 the CO_2 intensity of the agricultural sector shows a slightly decreasing trend. The share of electricity increases from nearly 14% in 1982 till about 28% in 1998.

8. REVIEW OF DATA COLLECTION

This chapter provides an overview of data sources and obstacles encountered in the collection of the data submitted to the ODYSSEE database.

8.1 Sources of energy data in The Netherlands

One of the most important sources of energy data for the Netherlands is the Dutch energy database EDN (see also Blok et al., 1997). EDN can be found at *www.ecn.nl/unit_bs/edn/*. This database has been set up with the aim of providing a consistent framework for collecting data with regard to energy consumption and energy conservation. EDN contains both energy data and sectoral economical data. Important sources of data are the Dutch Energy Statistics (*Nederlandse Energie Huishouding* - NEH), and the Production Statistics. Other publications of Statistics Netherlands are also used regularly. At the moment, data are generally available for the years 1983-1999, and updates are carried out each year.

EDN contains data for the main end-use sectors, i.e. households, industry, transport, other energy consumers, and for the transformation sectors. In the industry sector, a further desaggregation into branches is supported. For each industrial branch or main sector from Table 8.1 and for each energy carrier, final consumption (for energy and non-energy purposes), purchased energy, fuel input for cogeneration and other transformations are available. For most of these sectors/branches the value of production, value added and number of employees is also covered in EDN. On a more detailed level, economic production statistics are available that include apparent energy consumption of natural gas, electricity and a category ‘other’. These observations can differ from the energy statistics.

One major problem with regard to the data collection is the disruption in Dutch statistics as a result of the adoption of the NACE code since 1993. Although in principle this should improve the comparability with other countries, it is a major undertaking to achieve consistency with the years before 1993. In the years 1993-1994, data are available along both classifications. In this report the new system of classification is used. As data according to the new system are not available for years before 1993, some time series are still short. Table 8.1 gives an overview of corresponding sectors in both classifications. An important difference, not visible in the table, is that in the SBI-’74 classification all companies employing less than 10 persons were included in the category ‘Other energy consumers’, whereas these companies have been included in their respective branches in the SBI-’93 classification.

Economic data concerning value added are derived from National Accounts which is a consistent framework covering all sectors.

Table 8.1 *Sector classifications for energy statistics in the Netherlands compared, before and after 1993 (Blok et al., 1997)*

Former classification 'SBI-'74'	Code [10]	New classification 'SBI-'93'	Code
Food, beverages and tobacco	20, 21	Food, beverages and tobacco	15, 16
Textile	22	Textile, clothes, leather and leather products	17, 18, 19
Paper	26	Paper, paper products, publishing and printing	21, 22
Fertilisers	29.1	Fertilisers	2415
Other chemical industry	29.1-9, 30	Organically chemical industry	24141, 24142
		Inorganic chemical industry	2413
		Other basic chemical industry	rest 241, 247
		Chemical products	rest 24
Building materials, ceramics and glass industry	32	Building materials	26
Basic metal industry	33	Basic metal - iron and steel	271-273 (partly), 2751, 2752
		Basic metal - non-ferrous	274, 2753, 2754
Other metal industry	34, 35, 36 37	Metal products industry	28-32, 34-36
Other industry	23, 24, 25 31, 38, 39	Rubber and plastic products, instruments, other industry	20, 25, 33, 37
Transport	-	Transport	-
Households	-	Households	-
Other energy consumers (agriculture, services and government, construction and non-energy mining, small companies)	0, 1, 5, 6 7, 8, 9	Other energy consumers (agriculture, services and government, construction and non-energy mining)	01-05, 14, 45, 5, 6, 7, 8, 9 (partly)

To derive results for the required industry sectors for ODYSSEE, sometimes adjustments have been made based on production statistics. For instance, to calculate the chemical sector, energy statistics for sector 24 are combined with production statistics for sector 25, etc. A complete overview is presented in Annex A.

The services and government sector includes:

- trade, repairs, lodging and catering,
- transportation (excluding fuels for transport), warehousing, telecommunication,
- financial services,
- private services,
- public administration,
- education,
- health care,
- culture, recreation.

These sectors have limited data on energy consumption. For all sectors, the consumption of motor fuels for transport has been accounted for in the transportation section.

Apart from EDN, other sources from which data for ODYSSEE were collected are the Dutch monitoring tool MONIT (Boonekamp, 1998) and various publications from Statistics Netherlands and the Dutch utilities (Basisonderzoek Elektriciteitsverbruik, Basisonderzoek Aardgasverbruik, 1997).

[10] In this report, the SBI-'93 classification has been used.

8.2 Definitions in the ODYSSEE database

A short overview is given of the definitions used in ODYSSEE and in this report. For CHP, the conventions used for the Netherlands are different from the international accounting method. In ODYSSEE, the final consumption corresponds to the energy used by final consumers for energy purposes, including non conventional fuels (ADEME/Enerdata, 1998). Excluded from the final consumption are:

- non energy uses of fuels,
- fuels used for electricity generation (auto-producers),
- the energy consumption of energy industries, including gas and oil piping,
- the oil products used for international maritime transport (bunkers) and international air transport.

With regard to the accounting of self-generation, the conventions in IEA/EUROSTAT statistics are followed in ODYSSEE. This means that, as stated above, the fuel inputs for self-generation of electricity appear in the transformation sector. For CHP, only the part corresponding to the electricity generation is included in transformations. In Dutch statistics, CHP inputs and outputs are observed, therefore heat output is directly registered as final consumption. To get conformity with IEA/EUROSTAT, instead of heat output a calculated part of fuel inputs is assigned to final consumption (see Appendix).

Whenever temperature corrections have been imposed on the final consumption data, it is explicitly stated (see also Section 3.4). Temperature corrections are made only for fuel use for space heating in the residential and tertiary sectors.

Final consumption (by definition) does not occur in energy mining, refineries or any other energy company. This is to some extent different in Dutch Statistics, adjustments have been made for the ODYSSEE database.

Non-energy use only applies to fuels, not to electricity. Non-energy use of electricity in Dutch Statistics (e.g. chlorine production and primary aluminium) is assigned to final energy for the ODYSSEE database.

8.3 Data supply problems in 2000

Compared to Phase 5 of the project (Uyterlinde et al., 2000), considerable progress has been made regarding the data collection in the transport and tertiary sectors. The remaining problems, to be solved in the next phases of the project, are described in this section.

Macro

- In 1999, new values for value added after 1994 have been published according to new (international) definitions. To obtain longer time series than that, the values for 1995-1998 have been estimated using the values for 1995 combined with growth figures based on later years.
- All data at market prices instead of factor costs are only available in time series 1995-1999. For the years 1982-1994, these have been estimated based on the growth rates of factor costs.
- Final consumption by sector and energy carrier: in the industry sector, this needed estimation of consumption of oil products in the construction and non energy mining subsectors, and subsequent adaptation of the programme currently used for automatic conversion of Dutch statistics to the conventions used in ODYSSEE. For the service sector, these data has been aggregated from individual branches.
- Production indices have been recalculated as a result of changing definitions at the Statistical Office.

Industry
Data on final consumption and transformations are available from 1982 on. In 1993 the sectoral classification was altered, which caused disruptions. In this report, data are based on the new classification, some time series are thus only available from 1993 on.

Manufacturing sectors are observed in energy surveys and production surveys. Both surveys include energy consumption data, but these are not based on the same observations, and differ to some extent, both in quantities and method.

Final consumption of manufacturing sub-branches, e.g. paper and glass are not observed separately in the energy surveys. Adjustments between both surveys have to be made to comply with Odyssee requirements.

Deflated value added data are derived from National accounts, that have consistent time series from 1986 on, but do not cover the same sector classification as the energy survey nor the production survey. For instance, non-metallic minerals, iron and steel, non-ferrous metals are not available. Estimates had to be made for the years after 1995 similar to the description for 'macro'.

Data for energy intensive products are limited: only steel and aluminium production are published in a useful way.

Value added at constant prices is not available for non-metallic minerals after 1994. Since 1994 this sector is part of "Other industry".

Production of key energy intensive products (cement, glass, paper) has been included. Consumption of cement, glass has been updated until 1997. Consumption of paper and printing product (ppp) is provided from 1993-98, and paper and pulp (pap) is provided up to 1994. This disruption exists in Dutch statistics.

Tertiary
Service sector: general problem of data availability: most data is not monitored each year.

Energy consumption data in most tertiary sub-sectors is now available in more or less complete time series since 1986. Value added is available for all sub-sectors except hospitals. Surface areas are available for 1995; annual construction of new buildings for 1996-1998.

Households
There are no data on specific energy consumption of appliances. There are no data on behaviour components regarding energy consumption.

The main source of data for residential gas and electricity consumption, (Basisonderzoek Elektriciteitsverbruik, Basisonderzoek Aardgasverbruik, several years) was not published in time for updating the data to the year 1999. For electricity consumption, the report over 1998 is the most recent one.

Transport
As a result of reorganisations at Statistics Netherlands, most data will not be available for 1999, only 1998 (in particular those delivered by RIVM).

Stock and annual sales of new cars by power class (cylinder size) is not available in recent years. No subdivision of rail passenger and freight transport into fuels. Most data are only available up to 1997.

Air traffic is not available (domestic and total). There are data (from RIVM), but it is not clear if it only concerns inland flights. Domestic air traffic plays a marginal role in The Netherlands, and for this reason statistics are hardly available.

Agriculture

There is a disruption in the data for energy consumption in the agricultural sector in 1994, due to a change of data source (CBS to LEI).

9. CONCLUSIONS

Why is the overall energy efficiency improvement in The Netherlands slowing down since 1986?

Overall energy efficiency has improved most rapidly in the years 1982-1986, with an average annual decrease of the final energy intensity of 2.4%, when fuel prices were high due to the second oil shock, the economy was in a recession, and an active energy conservation policy was carried out. When the prices dropped and the economy recovered, the overall energy intensity improvement slowed down to an average rate of 0.7% annually.

In the period 1982-1998, total final demand has increased with 25%. In 1998 and 1999, a decrease in final energy consumption took place. This occurred mainly in the industry (chemical sector) the residential sector, and the service sector. It is uncertain yet whether this is an incident or structural. The decrease in the residential and service sectors can partly be explained by climatic variations. No remarkable shifts in the fuel mix occurred. The improvement of the final energy intensity since 1982 was 18% (corrected for average outside temperature). The influence of the level of energy prices and taxes on energy consumption appears to be very limited, while the recent high level of GDP growth induces energy consumption growth and counterbalances the increased efforts devoted to energy efficiency and climate policy. It will therefore be difficult to achieve the ambition level of energy savings of 2% annually.

What are the trends in CO_2 emissions?

Total CO_2 emissions of final consumers show a slightly increasing trend, except for 1998-1999. There are two explanations for this. First, more electricity is imported, of which the emissions are accounted to the country where the generation takes place. Secondly, due to a change in definition, more emissions are accounted to non-energy use in industry.

The CO_2 emission intensity shows a decreasing trend, which means that the CO_2 emissions are increasing at a slower rate than GDP growth. The CO_2 emissions per capita, on the other hand, are still increasing. The highest growth in emissions is found in the transport, industry and tertiary sector, except in 1998-1999 as explained above. Emissions in the residential and tertiary sector show more annual fluctuations because space heating accounts for a large share of the energy consumption in these sectors.

Why are the LTA results in industry more favourable than the intensity decrease?

For the manufacturing sector, the results of monitoring Long Term Agreements show an efficiency improvement of 21% up to 1999, whereas final energy intensity has decreased only 14%. This is explained by a number of reasons.

- Physical production has increased more than value added, especially in 1992 and 1993. This means that production output became more energy intensive.
- Final consumption rose substantially compared to monitored LTA consumption. This is mainly caused by the contribution of CHP as a dominant efficiency improvement option, which is not visible in the development of final consumption. Other, less important factors are unexplained observation differences, mainly in chemicals, and coverage differences between LTA's and total manufacturing.

In 1999, a substantial decline in industrial final energy consumption took place. This occurred mainly in the chemical sector. It is uncertain whether this decline is an incident or structural.

What can be done to stabilise the increasing residential electricity consumption?

In the residential sector, the rise in electricity consumption per household and the stabilisation of the consumption of natural gas per dwelling have led to an overall decrease in energy efficiency after 1990. The electricity consumption per dwelling in The Netherlands has been growing at a rate of 1.9% annually since 1988.

- In a period of economic growth as The Netherlands is currently experiencing, the influence of *energy prices* is limited. Expressed as a share of disposable income, the energy costs do not impose a heavy burden on household budgets. Therefore the impact of financial incentives such as the energy tax is limited, in particular given the fact that most customers are hardly aware of the existence and height of the tax. Proper feedback on their energy consumption and a clearer presentation of the energy bill could improve on this situation.
- The purchase and ownership of appliances is closely related to lifestyle trends such as social recognition, individualisation and scarcity of spare time. *Energy labels* can and do influence purchasing decisions. Offering *subsidies* (the 'Energy Rebates') on the most efficient models can stimulate the choice of an efficient appliance, although care must be taken that the subsidy signal is not interpreted as an 'approval' of buying appliances. After all, no (electric) clothes dryer is still the most energy efficient option.
- Not only the penetration rate of domestic appliances is a determining factor in the development of electricity consumption, but also the *use* (hours of usage) and changes in *performance* are of importance. These factors are greatly determined by lifestyle trends and customer behaviour, and not easily influenced.

What makes it difficult to achieve energy efficiency improvement in the transport sector?

Economic growth, passenger transport and freight transport are still strongly related. Between 1994 and 1998 growth in passenger transport in the Netherlands slowed down. This is at least partly compensated by international air transport, which did grow very fast in this period. Since 1980 the energy consumption in the transport sector has increased with 62%. Between 1980 and 1998 the energy consumption for road transport increased with 41%. Only air transport increased much faster (219%). Navigation increased with 39% and rail transport with 37%.

Despite an increase in vehicle efficiency, the energy consumption for road transport keeps growing. Before 1990 there where substantial savings for cars and trucks but between 1990-1997 there are almost no energy savings in road transport.

- The increase of energy consumption of *private cars* is caused by a combined effect of an increasing number of private cars and a higher yearly performance (km driven) of the cars, although the efficiency of the cars has improved.
- In addition, the increase in weight results in a significant increase in specific consumption of *new cars* in recent years. The motor industry succeeded in increasing the engine efficiency with 10%, but the average engine power increased during the past years due to an increase in vehicle weight. More extra parts and equipment were built in the vehicles for a higher level of comfort and safety.
- Specific fuel consumption of new cars is almost equal to the average consumption of all passenger cars. As a result of this, the decrease of fuel consumption caused by substitution of old cars by more efficient new cars will, if nothing else is done, slow down in the near future.
- The upward trend in the energy consumption of *trucks* is also the result of decreasing energy consumption per vehicle kilometre together with a growing performance of the trucks and a growing number of trucks.

Between 1993 and 1998, *modal split effects* result in 3% less energy use, and efficiency improvements in 1% less energy use. Before 1990 the energy efficiency improvements compensated for the change in mode. After 1990 there were hardly any energy technology improvements, so changes in mode resulted directly into changes in overall energy intensity.

After 1993, the policy stimulating a modal shift from trucks to train and inland shipping was very successful in the Netherlands.

The specific consumption of *good transport* by rail decreased with almost 23% (1980-1998) due to electrification and energy improvements. The specific energy consumption of navigation (in MJ/tonkm) increased with 14%. There is no clear explanation for this; it might be an effect due to the model calculations of the energy consumption, but it can also be caused by an increase in speed. Finally the energy efficiency of truck transport declined 14% between 1980 and 1998.

What are the main trends with respect to energy intensity in the service sector?
The total energy intensity in the service sector has remained more or less stable after 1984. The electricity intensity however has doubled in the same period, probably due to growth in office equipment and climate control. In 1985-1999 the unit consumption per employee increases about 5%, while the unit consumption per EC95 remains more or less stable. The labour productivity has increased with 20%. The hotels and restaurants branch turns out to be more than three times as energy intensive as the average of the sector.

After 1982 the energy intensity of agriculture fluctuates due to the use of different statistical definitions. Greenhouse horticulture is the main energy consuming sector within agriculture (80% of final demand) and the increase in energy consumption is both due to growth of this subsector, and to the use of more energy intensive cultivation methods.

What is the status of data collection?
Data collection according to ODYSSEE requirements has considerably improved in particular in the transport and tertiary sectors. Matters still to be dealt with are:

- The lacking data for industry sectors before 1993 due to changes in classification.
- Finding meaningful (physical) output time series for calculating energy savings in industry, agriculture and services.
- Establishing the energy efficiency of the transformation sector.
- The use of standardised technological data for appliances.

REFERENCES

ADEME (2001): *Cross country comparison on energy efficiency indicators, Phase 6, Final Report to the EU (SAVE), volume 1-4,* Paris, 2001.

ADEME (2000): *Monitoring tools for Energy Efficiency.* Proceedings of the conference in Brussels, February 7-8, Paris, 2000.

Annema, J.A., R.M.M. van den Brink (1997): *Verkeer en vervoer in de Milieubalans 1997.* (in Dutch), RIVM-rapport 251701033, Bilthoven, RIVM, December 1997.

Annema, J.A., R.M.M. van den Brink (1999): *Verkeer en vervoer in de milieubalans 1998*, (in Dutch) RIVM-rapport 251701036, RIVM, Bilthoven, February 1999.

Basisonderzoek Aardgasverbruik Kleinverbruikers. Arnhem, EnergieNed (in Dutch), several years.

Basisonderzoek Elektriciteitsverbruik Kleinverbruikers. Arnhem, EnergieNed (in Dutch), several years.

Blok, K., K. Burges, J.M. Bais, A.W.N. van Dril (1997): *De NEEDIS Structuur - Versie 1997.* (in Dutch), Petten, April 1997.

Boonekamp, P.G.M. et al. (1998): *Monitoring Energieverbruik 1982-1996.* (in Dutch), ECN Policy Studies, ECN-C--98-046, Petten, December 1998.

Brink, R.M.M. van den.: Verkeer en vervoer in de Milieubalans 1999. RIVM-rapport 251701 042, Bilthoven, RIVM, March 2000

CBS (Dutch Statistical Bureau), internet site: http://statline.cbs.nl/, 1999

CBS: Transport data from Internet site. Dutch Statistical Bureau (WWW.CBS.NL) 2000

Dings, J. (1996): *Kosten en milieueffecten van technische maatregelen in het verkeer.* (in Dutch) Delft, CE, 1996.

Dril, A.W.N. van, W.G. van Arkel, P.G. Dougle, H. Jeeninga, P. Kroon, M. A. Uyterlinde (1999): *Energy Efficiency Indicators in The Netherlands. Dutch contribution to the project Cross country comparison on energy efficiency Phase 4.* ECN-C--99-038, 1999.

Energiegebruik en milieubelasting in verkeer en vervoer 1980-1993. (in Dutch) Deventer, Bureau Goudappel Coffeng B.V, 1994.

EnergieNed (1998): *MAP - resultaten Milieu Actie Plan energiedistributiesector 1997*, (in Dutch) Arnhem, 1998.

EnergieNed (1999): *Vergelijking verkoopprijzen op basis van standaard verbuikssituaties (Comparison of tariffs based on standard consumption classes.* (in Dutch) 1e halfjaar 1998, 1e halfjaar 1999, Arnhem, 1999.

Energy efficiency and human activity, Paris, International Energy Agency, 1999.

Energy Efficiency Indicators: The European Experience. Paris, ADEME/Enerdata, 1998.

Energy Policies of IEA Countries, 1997 Review. Paris, International Energy Agency, 1997.

Energy Policies of IEA Countries: the Netherlands 1996 Review. Paris, International Energy Agency, 1996.

EVN- Energie Verslag Nederland (Annual Energy Report for the Netherlands, in Dutch). Petten, ECN Policy Studies, several years.

Jeeninga H. (1998): *Domestic Appliances and Life Style. Consequences for domestic electricity consumption in 2010*. Novem, Sittard, the Netherlands, 1998.

Kalverda, M. (1997): *SAVE-transport overige vervoerswijzen personenvervoer; Modellering van energieverbruiksontwikkelingen in het personenvervoer*. (in Dutch) ECN-I--97-007; Petten, ECN, June 1997.

Ministry of Economic Affairs (1999): *Action Programme Energy Conservation 1999-2002*, Den Haag, June 1999.

Ministry of Environment (1999): *Climate Policy Implementation Plan, Part One*, Den Haag, June 1999.

ODYSSEE database of energy efficiency indicators, December 2000.

Uyterlinde, M.A. et al. (1997): *Energy efficiency in the Netherlands;* ECN-C--98-007, Petten, December 1997.

Uyterlinde, M.A., H. Jeeninga (2000): *Live life to the max! Or why can more efficient appliances not decrease the electricity consumption of Dutch households?* Proceedings of the conference 'Monitoring tools for energy efficiency in Europe', Brussels, February 7-8, 2000.

Uyterlinde, M.A. et al. (2000): *Monitoring Energy efficiency indicators in the Netherlands in 1999;* ECN-C--00-053, Petten, May 2000.

Uyterlinde, M.A., P.R. Koutstaal (1998): *Landenvergelijking Energieverbruik en -Beleid; Achtergronddocument bij het rapport Monitoring Nederlands Energieverbruik en -beleid* (in Dutch). ECN-I--97-051, Petten, 1998.

Waide P. (1998): *Monitoring of energy efficiency trends of European domestic refrigeration appliances: final report*. Manchester, United Kingdom, 1998.

Winward J., P. Schiellerup, B. Boardman (1998): *Cool labels, The first three years of the European Energy Label.* Oxford, Environmental Change Unit, University of Oxford, 1998.

ANNEX A ON CONVERSION OF DUTCH NATIONAL STATISTICS TO THE ODYSSEE DATABASE

A.1 Energy data

From Dutch statistics (NEH) are used:
- Sectored Energy balances (Table series 1- 4 NEH Part 1), final consumption data.
- In case balances are not available: additional data (Table series 5-10 NEH Part 2) from other observations, apparent consumption is interpreted as being final, and if necessary added to the most plausible fuel categories of the balances.

Table numbers refer to NEH 1993.

A.2 Calculation of final consumption

The following adjustments are made to final consumption data:
- Final consumption in sectors SBI 23 (refineries and coke factories) Table 2.2.2 and 2.2.1; SBI 11 (energy mining) Table 2.1; and SBI 40/41 Tables 2.2.3, 2.2.4 and 2.2.5 is not added to final consumption of industry, but regarded as transformation energy.
- Final non-energetic electricity consumption in NEH is added to final consumption of electricity, other non-energetic consumption is not added.
- Final energy consumption of heat/hot water is not used, instead only purchased (verbruikssaldo) heat/hot water is used. Furthermore, inputs for cogeneration are added to final consumption of the respective fuels, as far as production of heat/hot water is concerned, not when electricity generation is concerned. For each fuel input for cogeneration, a part is calculated to be added to final consumption. This part is for all fuels: (heat/hot water output in PJ) / (total cogeneration output in PJ). This is in conformity with Eurostat practice, and usually leads to an increase of total final consumption compared to Dutch statistics.

For example:
NEH:
natural gas: purchased 20; input cogen 10; final consumption 10
oil: purchased 3; input cogen 2; final consumption 1
electricity: purchased 5; produced by cogen 3; final consumption 8
heat/hot water: purchased 1; produced by cogen 5; final consumption 6
total final consumption = 25
cogen efficiency (3+5) / (10+2) = 2/3; conversion loss cogen = 4

EUROSTAT:
cogen heat/hot water output share = 5 / (5+3)
natural gas: final consumption = 10 + (5/8) × 10 = 16.25
oil: final consumption = 1 + (5/8) × 2 = 2.25
electricity: final consumption = 8.
heat/hot water: final consumption = 1
total final consumption = 27.5
conversion loss electricity = (3/8) × (10+2) - 3 = 1.5

A.3 Fuel types

GNA = natural gas (aardgas)
GAD = manufactured gas (cokesovengas en hoogovengas)
GAZ = natural + manufactured gas

GZL = diesel (gas-, diesel-, stookolie < 15 cSt)
HOL = heating fuel oil (leeg)
FOL = heavy fuel oil (zware stookolie ≥ 15 cSt)
PDV = other petrol (raffinaderijgas, chemisch restgas, nafta's, aardolie-aromaten, petroleum, overige lichte oliën, smeeroliën en vetten, bitumen, overige aardolieproducten)
PET = total petroleum products (totaal aardolieproducten)

ESS = gasoline (motorbenzine)
GPL = LPG (LPG, propaan, butaan)
ESA = aviation gasoline (vliegtuigbenzine)
CAR = jet fuel (zowel op basis van benzine als van petroleum)

CHA = hard coal (steenkool en bruinkool)
LIG = brown coal (-)
COK = cokes (steenkoolcokes)
OSF = other solid fuel (overige steenkoolderivaten)
CMS = hard coal + brown coal + cokes + other solid fuel

ELE = electricity (electriciteit)
VAP = steam, heat (stoom en/of warm water)
OTH = other energy (fermentatiegas)
ENC = other energy including organic waste (fermentatiegas en organisch afval)

A.4 Sector divisions

Table A.1 gives an overview of the matching of Dutch statistics to the ODYSSEE industry sector. Table A.2 does the same for the branches within the manufacturing sector.

Table A.1 *Matching Dutch (NEH) statistics to the industry sector in ODYSSEE*

ODYSSEE	NEH
Manufacturing industry - Nace 15-35, excluding Nace 23 (oil industry, coke factories)	Industrie, SBI 15-37 excluding 23, Table 3.1.x
The energy sector - Nace 23 and Nace 40+41 electricity, heat, water production and distribution	Omzettingsbedrijven (conversion) • raffinaderijen en cokesfabrieken (refineries and coke factories), SBI 23 + 27(part); Tables 2.2.1 and 2.2.2 • elektriciteit- en warmteproducerende bedrijven centraal en decentraal (electricity and heat generation), SBI 40 (part); Tables 2.2.3 and 2.2.4 • vuilverbrandingsinstallaties, SBI 90 (part); Table 2.2.5 Distributiebedrijven (distribution and trade) • handelaren in vaste brandstoffen, SBI 51 (part); Table 2.3.1. • aardolieproductenhandel + -opslagbedrijven, SBI 51(part); Table 2.3.2. • distributiebedrijven voor gas, elektriciteit en warmte (energy distribution and trade) SBI 40 (part); Table 2.3.3 • winning en distributie van water, SBI 41; Table 2.3.3.
Construction - Nace 45	Bouw (construction), • SBI 45, Table 5.16, in case of non-energy final consumption: bitumen from Table 3.4.
Mining - Nace 10-14	Winningsbedrijven (mining) • (energy mining) SBI 11, Table 2.: oil and gas mining, coal mining is non existent, • overige delfstoffenwinning (other mining and quarrying) SBI 14, Table 5.14; All final energy consumption in this sector is put to zero.

Table A.2 *Matching Dutch (NEH) statistics to the manufacturing sector in ODYSSEE*

ODYSSEE	NEH
1. Food IAA, (Nace 15+16)	1. Voedings- en genotmiddelenindustrie (food and tobacco), Table 3.1.1 for all years
2. Textile TEX, (Nace 17+18+19)	2. Textiel, kleding en leerindustrie (textile, clothing, leather), Table 3.1.2 for all years
3. Paper and printing PPP, (Nace 21+22) • paper and board PAP, (Nace 21)	3. Papier en grafische industrie (paper and printing) SBI 21+22, Table 3.1.3 after 1992 • papier (paper and board) SBI 21, Table 3.1.3. before 1995
4. Chemical industry CHI, (Nace 24+25) • basic chemicals CHB, (Nace 24.1) • other chemicals and pharmacy CMP, (Nace 24 + 25 - 24.1) • rubber and plastics PHA, (Nace 25)	4. Chemie, 5 sectoren (chemical industry) SBI 24, Tables 3.1.4 to 3.1.8 *plus* kunststof- en rubberverwerkende industrie (plastic and rubber processing industry) Table 9.5.2 • basic chemicals, Tables 3.1.4 -> 3.1.7 • other chemicals and pharmacy, Table 3.1.8 • rubber and plastics, Table 9.5.2.
5. Non-metallic minerals NMM, (Nace 26) • glass VER, (Nace 26.1) • cement CIM, (Nace 26.51 or 26.5)	5. Bouwmaterialen, aardewerk en glasindustrie (building materials, pottery and glass) SBI 26, Table 3.1.9 • Glass, Table 9.5.2 companies with more than 20 employees.
6. Primary metals PRM, (Nace 27) • steel industry SID, (Nace 27.1->27.3, 27.5) • non ferrous MNF, (Nace 27.4) • aluminium ALU, (Nace 27.42) • ferro alloys FAL, (Nace …)	6. Basismetaalindustrie, 2 sectoren (basic metals industry) SBI 27, total of Tables 3.1.10 and 3.1.11 • Basismetaal ijzer en staal SBI 27.1-27.3(ged.), 27.51,27.52, Table 3.1.10 • Basismetaal non ferro SBI 27.4, 27.53, 27.54, Table 3.1.11
7. Equipment EQP, (Nace 28-35)	7. Overige metaalindustrie, (metal processing industry) SBI 28-32 and 34-36, Table 3.1.12
8. Other industry IDV, (Nace 20, 37)	8. Kunststoffen, rubber en overige industrie (plastic, rubber and other industry) SBI 20+25+33+37 , Table 3.1.13 *minus* kunststof- en rubberverwerkende industrie (plastic, rubber and other industry) SBI 25 Table 9.5.2.

ANNEX B QUESTIONNAIRE ON POLICIES AND MEASURES

B.1 Thermal energy efficiency standards for new buildings

	Year	Status	Name	% Saving[11]
Dwellings	1995	M	EPN	The standard is tightened every couple of years. However, the aim of the standard itself was not to enlarge energy saving, when compared to the previous standard, but to enhance the flexibility and minimise costs.
Buildings (services)	1995	M	EPN	

Status : **N** = no standards, **M** = mandatory, **V** = voluntary, **P** = planned

Is there a monitoring of the implementation of the standard? ✗ Yes ❒ No

If yes what is monitored ?

✗ degree of conformity
❒ actual specific consumption
❒ …

What are the results ?

- 100 % of new dwellings following the standards

B.2 Labelling, efficiency standards and target values for household electrical appliances

Labelling

Appliances	Year	Status	Name[12]
- Refrigerators	1996	V	92/2/EC (21/01/94)
- Freezers	1996	V	92/2/EC (21/01/94)
- Washing machines	1996	V	95/12/EC (23/05/95)
- Dish washer	1/8/1999	V	97/17/EC (16/04/97)
- Dryers	1996	V	96/60/EC (19/09/96)
- Air conditioners		N	
- Lamps	1/1/2001	P	(01/98)

Status: **N** = none, **M** = mandatory, **V** = voluntary, **P** = planned

Is there an evaluation of the impact of the labels? ✗ Yes ❒ No

For impact of the labels: see the report by PW Consulting (report distributed by Ademe last year)
Recently, ECN has evaluated the effects of a subsidy on A-labelled appliances. This concerns the effects of the subsidy rather than the effects of the labelling, although some remarks are made with respect to the need for revision of the standards.

[11] % Saving: saving compared to situation before the standard.
[12] e.g. EU Directive.

Moreover, the retailers are visited in order to check whether labels are attached to the appliances and if the energy class corresponds to the type of appliance shown in the shops. In addition, tests are done in order to determine the energy efficiency of the appliances and see whether the values on the labels as specified by the manufacturers are correct.

What are the results and conclusions?

- Refrigerators: PW Consulting, ECN report about the effects of a subsidy.
- Freezers: PW Consulting, ECN report about the effects of a subsidy.
- Washing machines: ECN report about the effects of a subsidy.
- Dish-washers: ECN report about the effects of a subsidy.
- Dryers: ECN report about the effects of a subsidy.
- Lamps: none.
- Air conditioner: none.

Standards or target values

Appliances	Year[13]	Status	Name[14]	% Saving[15]
- Refrigerators	1999	M	Max specific consumption in kWh/day dependent on type of refrigerator; consistent with EU legislation (EN-153)	
- Freezers	1999	M	Max specific consumption in kWh/day dependent on type of refrigerator; consistent with EU legislation (EN-153)	
- Washing machines		N		
- Dish washers		N		
- Dryers		N		
- Air conditioners		N		
- Lamps		N		

The standards mentioned here are included in a framework law, the Energy Saving Appliances Act (Wet Energiebesparing Toestellen), established in 1986 and consistent with EU standards. The actual regulations are laid down in supplements.

Status: **N** = none, **M** = mandatory**,** **V** = voluntary, **P** = planned

Is there an evaluation of the impact of the standards ? ❒ Yes ❒ No
It’s likely this is done on a European level, but not specifically for the Netherlands

[13] Year of implementation (standard) or target year for target values.
[14]e.g. EU Directive.
[15] % Saving: saving compared to situation before the standard.

B.3 Fiscal measures on passenger cars

Measures	Status	Value[16] [Euro]	Value[17] [%]	Year[18]	Foot-note[19]
Car purchase tax[20]					
Difference by engine size or weight?	N		45.2	1 may 2000	1
Difference by fuel type?	Y	Gasoline/LPG: 1540.13 Diesel: +327.63 or -216.91 (if 2005 level)		1 may 2000	2
Annual registration tax					
Difference by engine size or weight?	Weight	379 gasoline; 757 diesel; 819 LPG (499 clean LPG)		1 may 2000	3
Difference by age					
- increase with age?	N				
- decrease with age?	N				
- suppression for old cars?	Y	no tax if older than 24 year			4
Motor fuels tax (average %)[21]					
- motor gasoline	Y	0.791	71.1	2000 1e quarter	5
- diesel	Y	0.491	61.8	2000 1e quarter	5
- LPG	Y	0.140	32.0	2000 1e quarter	5
- CNG	N	energy tax			
Subsidies for scrapping old cars	N				
Subsidies for *clean* and *efficient cars*					
Electric cars	Y	no annual tax			6
CNG	N	see LPG			

Status: **N** = no, **Y** = yes, **P** = planned

Footnotes : comment on the impacts of the measures (change observed on the market, problems encountered,…)

1) The BPM is 45.2 % of the netto car price excluding 17.5% VAT. The tax paid as BPM is not a subject of VAT. The consumer pays: (net car price * (1 + 0.452 +0.165) + BPM fuel correction). BPM=tax of personal cars en motors. The mean consumer price in 1997 was 18,000 euro. If an older car is imported to the Netherlands, there is a certain lifetime correction on the BPM.

   Sources:
   http://www.belastingdienst.nl
   http://www.autorai.nl
2) The BPM has an environmental correction. For other than diesel cars BPM is lowered with -1540.13 euro. Diesel cars pay 327.63 euro more, but if their emissions are already within the 2005 limits they pay 216.91 euro less.

[16] If there is a difference by category of cars give the average value for 2 categories at least: small cars and medium cars ; if there is a difference by fuel give the values for the different fuels.
[17] The values should be given in % of car price.
[18] Reference year for values given (e.g. 2000).
[19] Give a footnote number and give comments below.
[20] Excluding VAT.
[21] Ratio total taxes including VAT over average price; for motor gasoline and diesel will be taken from IEA statistics (“Energy Prices and Taxes”) if not provided.

3) The annual registration tax (MRB) depends on fuel type, weight class, and province
Gasoline:
1051-1150 kg Zuid Holland: 379.36 euro/y (range for other provinces 361-393)
Other weight for instance in Zuid Holland: 951-1050 kg : 309 euro and 1151-1250 kg: 451 euro
Diesel:
1051-1150 kg Zuid Holland: 756.91 euro/y (range for other provinces 739-771)
Other weight for instance in Zuid Holland: 951-1050 kg : 651 euro and 1151-1250 kg: 860 euro
Other excluding electricity (mainly LPG):
1051-1150 kg Zuid Holland: 818.62 euro/y (range for other provinces 800-833)
Other weight for instance in Zuid Holland: 951-1050 kg : 708 euro and 1151-1250 kg: 929 euro
G3 gas installation (clean LPG):
1051-1150 kg Zuid Holland: 499.16 euro/y (range for other provinces 481-514)
Other weight for instance in Zuid Holland: 951-1050 kg : 388 euro and 1151-1250 kg: 612 euro

Source: Centraal bureau motorrijtuigenbelasting*: Uittreksel tarieven motorrijtuigenbelasting ingaande 1 mei 2000*, Apeldoorn, CBR, 2000

Electric cars pay no MRB. MRB=motor vehicle tax. The mean weight of new cars in the Netherlands is between 1051 and 1150 kg (1997).

4) Cars of 25 years and older pay no annual tax. They are seen as collectors items (old timers) and not as daily used cars.
Source: http://www.autorai.nl

5) In euro /litre. The taxes per 1 januari 2000 excluding 17.5% VAT are 0.5968 (gasoline); 0.3518 (diesel); 0.0632 (LPG). Taxes are normaly raised with inflation level per 1 january of each year.

Sources:
International Energy Agency: *Energy Prices & Taxes; quarterly Statistics; First quarter 2000*. ISBN 92-64-17494-x, IEA Publications, Paris, IEA/OECD, 2000
Centraal Bureau voor de Statistiek: Energiemonitor 2000-2. ISSN 1386-5730, Voorburg/Heerlen, CBS, 2000

There is no special fuel tax for CNG of electricity used in the transportation sector. The Netherlands has an energy tax depending on the yearly amount of electricity or natural gas used by the energy consumer at a certain location. The energy tax does not change if a part of this is used for transportation. The use of CNG and electricity (excluding public transport) in the Netherlands for transportation is very limited.

6) No annual registration tax

ANNEX C UNITS

1 koe (kilo oil equivalent)	=	41,868	MJ
1 toe	=	41,868	GJ
1 Mtoe	=	41,868	PJ
1 EC95	=	1 ECU in 1995 prices	