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Monitoring Energy Efficiency Indicators in The Netherlands in 1999

Dutch contribution to the project 'Cross country comparison on energy efficiency - Phase 5'

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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 5'. 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 99 10 023. The ECN project number was 7.7228.

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 in all main economic sectors up till 1998. Special attention is paid to the growth in residential electricity consumption in The Netherlands for which the effectiveness of policy instruments and the role of lifestyle trends are elaborated. In addition, an account is given of energy efficiency and environmental policy initiatives in the Netherlands since 1995.

In the period 1982-1998, total final demand has increased with 25%. The service sector doubled whereas households remained relatively stable. No remarkable shifts in the fuel mix occurred. The improvement of the final energy intensity since 1982 was 18% (corrected for average outside temperature). 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 efficiency improvement slowed down to an average rate of 0.7% annually.

In the residential sector, the rise in electricity consumption per household combined with the stabilisation of the consumption of natural gas per dwelling have led to an overall decrease in energy efficiency after 1990.

- 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.

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SUMMARY

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 (and very different) levels of energy demand to comparable proportions. Results of the international comparison are published separately. 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, has started in 1999.

In this report, indicators are used to monitor and analyse national developments with respect to energy efficiency in all main economic sectors up till 1998. Special attention is paid to the effectiveness of policy instruments and the role of lifestyle trends in explaining the growth in residential electricity consumption in The Netherlands. In addition, an account is given of energy efficiency and environmental policy initiatives in the Netherlands since 1995.

Overall assessment of energy efficiency in The Netherlands
The trends in primary and final intensities are a result of many factors in the different economic sectors. 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 S.1.

Table S.1 *Main factors influencing energy conservation in The Netherlands*

	Energy prices	Economy	Policy intensity	Annual average final intensity improvement (climate corrected)
1982-1986	High	Recession	Active	2.4%
1986-1991	Low	Recovery	Less active	0.9%
1991- present	Low + energy tax	Growth	Increase	0.7%

In the period 1982-1998, total final demand has increased with 25%. The service sector doubled whereas households remained relatively stable. No remarkable shifts in the fuel mix occurred. The improvement of the final energy intensity since 1982 was 18% (corrected for average outside temperature). However, Table S.1 shows that the highest efficiency improvement occurred in the eighties. In the nineties, the energy efficiency improvement rate slowed down due to structural effects, coupled with higher 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, 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 will be difficult to achieve the ambition level of energy savings of 2% annually, because of the high economic growth.

Energy efficiency policy
In recent years the policy intensity has increased, which is illustrated by the number of relevant policy documents published in 1999 in The Netherlands:
- Action Programme Energy Conservation 1999-2002, aiming at increasing the energy efficiency improvement from 1.6% to 2% annually. The Programme announces a budget increase for energy efficiency. More financial resources have been made available by the government, ranging from 690 million Dutch guilders in 1999 to 910 million in 2001. Compared to recent years, this means an ample doubling.
- Energy Efficiency Benchmarking Covenant, in which companies in the energy-intensive industry, refineries and electricity producers voluntarily commit themselves to become the most efficient companies amongst their global competitors, in 2012.
- Climate Policy Implementation Plan - Part one, in which domestic measures are outlined in order to reach 25 Mton CO_2 emission reduction in 2010 (half of the Dutch Kyoto target).
- Renewable Energy - Advancing Power, Review Report 1999, in which steps required to reach the goal of 10% renewable energy in 2020 are outlined.
- The Energy Report 1999 in which national energy policy is reviewed. Regarding liberalisation of the electricity and gas markets, the ministry has decided that it will investigate the possibility of a total liberalisation as soon as 2003. The government is investigating an even sooner date, 1-1-2001, for the market for renewables. To support this, a system of green certificates will come into force on the same date.

Since 1996, fuels and electricity are subject to the Energy Regulatory Tax (REB). As the objective of the tax is stimulating energy efficiency, it is supposed to be revenue neutral, and the revenues are returned through reduction of direct taxes paid by households and firms. As stated in the *Energy Report 1999*, the undesired environmental effects of the expected price decrease in a liberalised market will be counterbalanced by a substantial increase in the REB rates.

Manufacturing sector
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 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.

The energy intensity of most branches has decreased in the eighties with about 2% annually. After that the overall intensity has hardly decreased, though recent years show a decreasing trend. Primary metals is the most energy intensive branch. The intensity of primary metals has decreased by 10% since 1993. The chemical industry is also energy intensive, as it includes a large basic chemicals production section. Between 1993 and 1998, the intensity has decreased by about 15% in the chemicals, food and equipments sectors. These three sectors represent 70% of manufacturing value added in 1998. In paper and printing, intensity has decreased by about 5%. Food industry is energy intensive as far as dairy, sugar and starch production is concerned. The textiles and leather section had an increasing energy intensity. Value added decreased up to 1996 and rose again afterwards, but energy consumption grew steadily by 19%.

For the manufacturing sector, the results of monitoring Voluntary Agreements (also known as Long Term Agreements - LTA's) show an efficiency improvement of 19% up to 1997, whereas energy intensity has decreased only 1% and efficiency compared to final consumption only grew 5%. This is explained by a number of reasons. First, physical production has increased more than value added, especially in 1992 and 1993. This means that production output became more energy intensive. Second, final consumption rose substantially compared to monitored LTA consumption. This is caused by:

- The contribution of CHP as a dominant efficiency improvement option, which is not visible in the development of final consumption.
- Large unexplained observation differences, mainly in chemicals.
- Coverage differences between LTA's and total manufacturing, although these are relatively small.

Residential sector

In The Netherlands, the only energy carriers playing a significant role in households are natural gas and electricity. Natural gas is mainly used for space heating, hot water production and cooking, whereas electricity is used for appliances and lighting. Although the average gas consumption has been decreasing since 1980 and has stabilised in recent years, electricity consumption has, after a decrease, been increasing rapidly (1.9% annually) since 1988. Therefore the decrease in energy used for space heating was not sufficient to counterbalance the effect of the increase in energy used for domestic appliances. The analysis in this report has focused on the effectiveness of policy instruments and the role of lifestyle trends in explaining the electricity consumption growth in The Netherlands. The main conclusions are summarised below.

- 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. 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.
- *Energy labels* can and do influence purchasing decisions. The sales figures for different types of refrigerators and freezers by label class (1994-1996) suggest that labelling is an effective policy instrument. However, it should be noted that labelling became compulsory for refrigerators and freezers in The Netherlands only in 1996. This implies that in 1994-1995, buyers probably were unaware of the labels when buying cold appliances, although manufacturers were already obliged to distribute the labels with the appliances. In addition, the manufacturers were already anticipating the introduction of the energy labels by positioning new products just within the highest labelling category they could achieve. Therefore the number of appliances available in the more efficient classes was increasing, implying that the sales figures for efficient appliances would also tend to increase anyhow, compared to those for less efficient models.
- 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. A factor that can be influenced, by minimum efficiency standards and labelling, is the efficiency of the appliance itself, as well as its stand-by consumption. Policy efforts in this direction seem to have some effect. In addition, policy measures should focus on removing institutional and practical barriers for new highly efficient appliances (such as heatpump clothes dryers), and stimulation of the penetration of renewable sources of electricity such as photovoltaic energy and green electricity.

Transport sector

Energy demand in the transport sector has grown steadily, and has increased with 43% since 1982. It mainly concerns road transport, and although there have been efficiency improvements, the annual distance travelled has increased. The general upward trend is related to the economic growth, which has its effect on passenger transport and freight transport. If international air traffic is taken into account the energy consumption of transport is growing even faster than the economy. Although in 1995 and 1996 transport growth slowed down, in 1997 the economic growth level was picked up again. Between 1996 and 1997 energy consumption increased with 2,9%, of which 1,8% is caused by road transport and 1,1% is caused by air transport.

Despite an increase in vehicle efficiency, the energy consumption for road transport keeps growing. 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. The increase in weight results in a significant increase in specific consumption of new cars in recent years. 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.

In the period 1980-1996 road transport shows a steady increase. Rail transport declined with about 10% and navigation grew with about 5%. Because road transport is the most energy intensive per ton-km, for the complete freight transport sector a growth in energy demand (by the growing amount of ton-km) and specific energy demand (by the growing market share of road transport) can be expected. Between 1980 and 1997, modal split effects for freight transport result in 13% more energy use, while efficiency improvements result in 11% less energy use. Overall energy consumption per ton-km rose with 2%, mainly after 1990. 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 in changes in overall energy efficiency.

Service sector

In 1982-1998, the share of the services sector in total final energy demand increased from 9% to 14%. 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.

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. This is compensated by improvements in labour productivity and building insulation. The hotels and restaurants branch turns out to be more than three times as energy intensive as the average of the sector.

Data collection

Data collection according to ODYSSEE requirements has considerably improved but is still not optimal. Compared to Phase 4 of the project, 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 summarised below.

- The lacking data for industry sectors before 1993 due to changes in classification (adoption of the NACE code).
- 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 cars and appliances.

A complicating factor is that in the liberalising market, some data previously published by utilities now are regarded confidential. It concerns mainly natural gas and electricity consumption data for households.

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 5'. 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 5 of the project, besides an update of the database to 1998, new indicators were developed to assess the effectiveness of DSM policies, see Chapter 5 and Annex B of this report. Phase 5 also incorporated the organisation of a conference 'Monitoring tools for energy efficiency', the proceedings of which have been published separately (ADEME, 2000a). In the spring of 2000 the project co-ordinator ADEME will publish the final project report (ADEME, 2000b), 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 and Phase 4 of the project, see respectively (Uyterlinde, 1997) and (Van Dril, 1999). 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.

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, has started in 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 since 1995. 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 NEEDIS.

2. RECENT ENERGY EFFICIENCY AND ENVIRONMENTAL POLICY IN THE NETHERLANDS

This chapter gives an overview of energy and environmental policy in The Netherlands since 1995 (IEA, 1996, 1997; EVN, several years).

2.1 Energy policy framework

In the Netherlands, the national government has the main responsibility for energy matters, in particular the Directorate-General for Energy in the Ministry of Economic Affairs. The Ministry of Housing, Spatial Planning and the Environment also has an important influence, having the responsibility for climate policy and air quality.

2.1.1 Third White Paper on Energy Policy

There is no single energy efficiency law in the Netherlands. The energy policy framework has been formed since the first oil crisis in several White Papers and Environmental Policy Plans. The foundation for the current energy policy has been laid down in the Third White Paper on Energy Policy, submitted to Parliament in December 1995.

Most measures and targets identified in the Second Memorandum on Energy Conservation (1993), have been replaced by the energy policy as outlined in the Third White Paper. Only the target set in the National Environmental Policy Plan Plus of reducing emissions of CO_2 by 3-5% in the year 2000, relative to the level of 1989/1990, still holds. However, this will be overruled by the National target of -6% in 2010 compared to 1990, a result of the post-Kyoto negotiations.

In the Third White Paper on Energy Policy, the two general objectives of the Dutch energy policy are outlined. The first objective is to attain a *sustainable energy supply* by:
- Improving energy efficiency by one-third in the next 25 years, which means an improvement of 1.5% annually.
- Increasing the share of renewables in primary energy supply to 10% by 2020.

Secondly, the White Paper strives towards *market liberalisation* both with regard to electricity and natural gas.

For achieving a sustainable energy economy, a number of measures are proposed, some of which will be described more extensively in the next sections. Energy efficiency is to be improved by Long Term Agreements in industry, introduction of standards and an energy tax (preferably on EU-level), fiscal instruments, and efficiency improvements in the transportation sector. In March 1997, the 'Renewable Energy Action Plan' was sent to Parliament. This plan is a further elaboration of concrete measures to achieve the goal set in the White Paper of 10% renewables in the primary energy supply. The plan focuses on improvement of the price-performance ratio of renewables, stimulating market penetration and eliminating administrative barriers. To a large extent this has to be achieved by fiscal measures (see Section 2.6.3). A large share of the 10%-goal will be reached by the generation of electricity from renewable sources.

With regard to market liberalisation, the White Paper formulates a number of steps. Gradually, all customers will be enabled to select their own supplier of electricity and natural gas, starting with the largest (industrial) energy consumers. This will be made possible by further separation of management of the grid, the production and the distribution; non-discriminatory free access to the grid and independent supervision of the grid functions. The government will ensure protection of captive customers when the market is liberalised.

For implementation of the policy objectives, tasks have been given to municipalities, counties, agencies, and ‘target groups’. This illustrates that the Dutch energy policy is more based on co-operation than on regulation.

2.1.2 Memorandum on Energy Saving

The Dutch government published a Memorandum on Energy Saving (Energiebesparingsnota) in April 1998, containing proposals for extra energy saving policies till 2010, in order to reach 10 to 15 Mtons less CO_2 emissions. This means that the energy efficiency improvement rate has to rise from 1.6% to 2% per year. It was estimated that annually 3 to 4 billion guilders will have to be invested in energy efficiency, of which the government will have to pay 600 million guilders per year. The Memorandum did not aim at making decisions on measures and budgets. Because elections were at hand when the Memorandum was published, these decisions were left for the next government to take. However an energy tax raise is foreseen. Also measures in the built environment are considered, like an energy performance standard for new building locations (EPL) and an energy performance audit for existing houses (EPA). An action plan is to be published in the spring of 1999.

2.1.3 Electricity law

On 1 August 1998 a new electricity law, the Electricity Law 1998, partly came into force. The new law will liberalise the Dutch electricity market in three phases. From the start, the largest users are eligible customers. In 2002 also medium sized users will be free. Small users will follow in 2007. The Dutch law is in accordance with the European Directive on the internal electricity market, but the liberalisation is faster than the Directive demands. With respect to energy efficiency the Electricity Law contains an article that says that both producers and distributors of electricity (> 10 GWh) have the general task to strive for renewable energy and energy efficiency and have to report on this every two years. A directive has been included for the back supply to the electricity grid of renewably produced power. On the basis of the new law, the Minister of Economic Affairs can oblige the consumers of electricity to take a minimum share of renewable electricity, by means of a system of green certificates.

2.1.4 Gas law

A new Gas Law has been offered to Parliament in March 1999. The market is to be liberalised in three steps, analogous to the electricity market. As of January 2000, the customers with an annual consumption over 10 million m^3, such as power plants and large industries, will become eligible customers. . In 2002 also medium sized users will be free. Small users will follow in 2007. The Dutch law is in accordance with the European Directive on the internal market for natural gas. With respect to pipeline access, the Dutch law chooses the system of ‘negotiated third party access’.

2.2 New programmes in 1999

In 1999 the Dutch government has published a number of relevant policy programmes.

2.2.1 Action Programme Energy Conservation 1999-2002

This programme, published in June 1999, aims at increasing the energy efficiency improvement from 1.6% to 2% annually. It describes the contribution to energy conservation that the government expects from the various sectors of the public and target groups in the 1999-2002 period. The government also describes the policy instruments that will be deployed for this purpose. Actions to improve energy efficiency fall in three categories: actions that specifically address end-users, a clear allocation of responsibilities within the central government and a key role for intermediate organisations.

The government distinguishes eight groups of end users. For each of these groups, a limited set of core-instruments is proposed. For the energy-intensive sectors exposed to international competition, this means Benchmarking en Long Term Agreements by means of the covenant approach. Core-instruments for other sectors are levies such as the Energy Regulatory Tax, audits and advice such as the Energy Performance Advice for existing buildings, and efficiency standards such as the Energy Performance Standard. Regarding financial stimulation of investments in energy saving, fiscal instruments and subsidies are deployed.

2.2.2 Energy Efficiency Benchmarking Covenant

In this document, published in July 1999, companies in the energy-intensive industry, refineries and electricity producers voluntarily commit themselves to become the most efficient companies amongst their global competitors, in 2012. In return, the government will not impose specific energy or CO_2 emission reduction targets. This commitment is expected to result in a CO_2 emission reduction of 5 to 9 Megaton each year.

2.2.3 Climate Policy Implementation Plan - Part one

In order to reach the Kyoto target of 6% CO_2 emission reduction, additional policy is required. Therefore June 1999 saw the birth of the Climate Policy Implementation Plan ('Uitvoeringsnota Klimaatbeleid, deel 1'). In this first part domestic measures are set out. These measures should realise a reduction of 25 Megatons, 50% of the required 50 Megatons. The other half is to be realised abroad, for which in the beginning of 2000 a second Policy Plan is to be released.

The measures set out are chosen on the basis of cost-effectiveness and the even distribution among greenhouse gases and also among the target groups. Much attention is paid to CO_2, since among all greenhouse gases, CO_2 emissions are relatively difficult to reduce. The split between reductions in CO_2 emissions and reductions in emissions of other gases is roughly 70-30%.

The measures selected have been divided into three packages. The basic package contains measures to be taken now, which offer a reasonable degree of certainty. Additionally, a reserve package is set out in case it becomes clear that the basic package is not sufficient. Finally, a third package of measures has been adopted, containing initiatives intended to lead to innovation. It contains steps that will form the basis of further reduction after 2008-2012. In the basic package, a wide range of measures is involved, requiring a contribution of all target-groups. Large reductions in CO_2 emissions have to be realised through intensification of energy conservation policy and measures in coal-fired power plants. With regard to renewable energy, the Climate Policy Implementation Plan introduces a new target of 5% renewable energy in 2010.

Table 2.1 *Objectives of the Climate Policy Implementation Plan*

Sector	Emissions in 2010 in Mton CO_2 equivalents	Reduction in 2010 in Mton CO_2 equivalents
industry (incl. refineries)	89	10,0
energy companies	61	8,0
agriculture	28	2,0
traffic	40	3,0
households	23	2,3
trade, services, government	12	1,0
other	6	-

2.2.4 Renewable Energy - Advancing Power, Review Report 1999

In 1997, the Dutch government released the Action Programme Renewable Energy, a White Paper on renewable energy. It contained the steps required to reach the goal of 3% renewable energy in 2000 and of 10% in 2020. It set out three different policy lines: improvement of the price-performance ratio, stimulation of the market penetration and the removal of administrative bottlenecks.

In the Review Report of July 1999 ('Duurzame Energie in Opmars, Voortgangsrapportage 1999'), additional policy intensifications are outlined: an increase of the budget for renewable energy, a rise of the Regulatory Energy Tax, and a new Gas Law, with special provisions for renewable energy. Although the 3% target of the Action Programme is also mentioned in the Review Report, it is expected that in 2000 the contribution of renewables is only 1,3%. A new target of 5% in 2010 has been introduced in the Climate Policy Implementation Plan. The goal of 10% renewables in 2020 still stands.

2.2.5 The Energy Report 1999

The 1995 White Paper on Energy Policy states that the ministry of Economic Affairs shall bring forward an Energy Report ('Energierapport') every four years, in which policy is reviewed in the light of the latest developments in the field. In the first edition of November 1999, there are a number of issues that deserve attention. Regarding liberalisation of the electricity and gas markets, the ministry has decided that it will investigate the possibility of a total liberalisation as soon as 2003. The government is investigating an even sooner date, 1-1-2001, for the market for renewables. To support this, the system of green certificates will come into force on the same date.

The slow progress of wind energy is to a large extent due to problems regarding siting of turbines. The government is considering an obligation for municipalities to locate turbines. Studies have shown that the co-generation of heat and power comes under pressure because of low energy prices and the introduction of a new gas tariff system. Therefore CHP will receive additional support in the coming years.

2.3 Budget

After substantial cuts in the energy policy budget in 1994, the budget was increased again in 1996 as a result of the White Paper and within the framework of climate policy. Cuts were mainly made in investment subsidies for energy conservation, and also in specific R&D subsidies (nuclear, fuel cells). One of the measures compensating for the cuts in subsidies for energy conservation and pollution control is the 'Energy Regulatory Tax' discussed further below. The White Paper proposes increases in R&D budgets, demonstration and market introduction of technologies, and fiscal measures.

The *Action Programme Energy Conservation 1999-2002* announces a budget increase for energy efficiency. More financial resources have been made available by the government, ranging from 690 million Dutch guilders in 1999 to 910 million in 2001. Compared to recent years, this means an ample doubling.

Figure 2.1 gives an overview of the budgets for 1999 by programme, as specified in the Action Programme. In addition to the structural allocations for energy conservation from the Ministry's budget, a lump sum of NLG 145 million was added to the budget from the climate funds in 1999. The budget for fiscal measures will be further increased in the next few years, in particular for companies, from 258 million guilders in 1999 to 490 million in 2001. It concerns measures such as the VAMIL and EIA, described in Section 2.6.3.

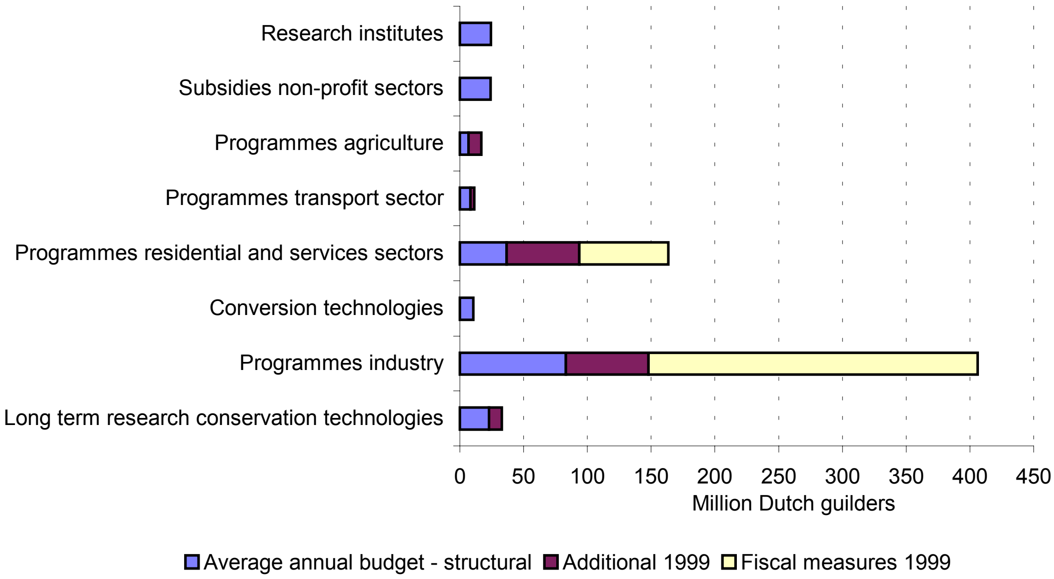

Figure 2.1 *Energy conservation allocations from the Ministry of Economic Affairs budget in millions of NLG on a commitment basis (EZ, 1999)*

Figure 2.1 does not show all items in the Ministry's budget that are relevant to energy conservation. Subsidy schemes that are not specifically aimed at energy conservation can still contribute towards it, directly or indirectly. An important incentive for energy conservation is provided by the funds that the Cabinet has made available for the CO_2 Reduction Plan in recent times (NLG 1 billion). In 1999, NLG 230 million of this was still available, more than half of which is allocated for energy conservation projects.

The above resources from the Ministry of Economic Affairs budget are not the only ones available. Other Ministries, local authorities, the EU and energy companies contribute directly or indirectly to energy conservation from budget items. The same applies for the climate funds managed by other Ministries.

2.4 Prices and taxes

In Table 2.2, 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 2.2 *Energy prices in the Netherlands, including energy taxes, excluding VAT. For households, VAT = 17.5% (EVN, several years)*

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

Since 1996, fuels and electricity are subject to the Energy Regulatory Tax (REB). As the objective of the tax is stimulating energy efficiency, it is supposed to be revenue neutral, and the revenues are returned through reduction of direct taxes paid by households and firms. Tax rates are based on the proposed EU directive for a carbon/energy tax, and are given in the table below.

In order to exempt the largest energy users from the tax, a ceiling applies of 1 million m^3/year of natural gas and 10 million kWh of electricity. In addition, consumption of the first 800 m^3/year of natural gas and 800 kWh of electricity is free of taxation, as a protection of low income groups.

As stated in the *Energy Report 1999*, the undesired environmental effects of the expected price decrease in a liberalised market will be counterbalanced by an increase in the REB rates. According to a tax revision plan launched by the government in 1999, the REB will be raised in three steps: 1999, 2000 en 2001. It is anticipated that this will generate 3,4 billion Dutch guilders every year. The extra gains will be returned to tax payers through a reduction of the income tax and the tax on wages.

Table 2.3 *Rates small user carbon/energy tax in the Netherlands in cents (excl. VAT)*

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

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 tax payer. The European Commission has approved this exemption. The tax is expected to lead to a 1.5% reduction of total CO_2 emissions.

2.5 Utilities

2.5.1 Environmental Action Plans

Since 1990, the Dutch energy distribution sector has been contributing to the national energy efficiency policy, by implementing Environmental Action Plans (MAPs). The utilities have agreed on a number of energy conservation and emission reduction goals with the national government. The measures used to achieve these goals are financed by a ‘MAP-levy’ on the tariffs for electricity and natural gas. Measures for end-users include subsidies for insulation in dwellings and energy efficient lighting. On the supply side, CHP and renewable energy supply is stimulated. In addition, the market introduction of technologies such as heat pumps, high efficiency boilers, and efficient lighting is supported.

The legal framework for these Environmental Action Plans has been improved in 1996, in the Energy Distribution Law. The law requires utilities to justify their expenditures for energy conservation on the basis of the revenues of the MAP-levy. It also prevents unfair competition by utilities that have started commercial activities in recent years, both in not energy-related activities such as cable TV or waste handling, and in offering energy services.

In January 1997, the utilities have established a fund based on revenues of the MAP-levy, that enables Small and Medium sized Enterprises to finance investments in energy efficiency with a reduced discount rate.

In the Energy Report, the government considers levies an inappropriate instrument in a liberalised market. Therefore, the MAP programme, which ends on 31-12-1999, will not be continued. Another reason for this is that in a liberalised market, the utilities do not act together as one party anymore.

Alternatives mentioned for the actions in the Environmental Action Plans are:

- Energy Rebates ('Energiepremies') for households, starting January 2000: buyers of efficient (A-class) appliances will receive a financial incentive. Subsidies are also available for insulation measures. This programme is similar to measures that were previously part of the MAP framework. The utilities will carry out the programme, the subsidies are paid from the revenues of the Regulatory Energy Tax (most of the revenues however are recycled back through income tax reductions).
- The recent increase of the Energy Investment Allowance (EIA) offers an alternative for companies. The EIA offers a lower corporate tax in the first year by deducting 40-52% of the investment sum from the profit in that year. The investment must concern technologies that satisfy general energy performance criteria. A similar programme is available for non-profit companies.

Another phenomenon is 'green electricity' supplied by utilities. Some consumers are willing to pay more (voluntarily) for electricity that is generated from renewable sources. The revenues are used for investments in renewable energy.

2.5.2 Green Labels

The Dutch association of energy distributors, EnergieNed, launched a trial for a Green Label System in January 1998. For the first two years the trade and creation of Green Labels will be recorded, but no binding targets have to be met. Creation of Green Labels is done by producing 10,000 kWh renewable electricity, and having this registered under a serial number at the nation-wide registration office. This office publishes information on the production and trade at the Green Label website, where also labels can be bought and sold.

The first binding target is set for the year 2000. In this year, the distribution companies together are to produce 1.7 billion kWh renewable electricity. The quota of renewable electricity that is allotted to each of the distributors will be based on the volume of past sales and will have to be met by handing over Green Labels, so it does not have to be produced by this distributor itself.

The Energy Report announces the introduction of a system of green certificates by the government in January 2001.

2.6 Measures

2.6.1 Efficiency standards

The Energy Performance Standard (EPS) for new dwellings came into effect in December 1995 as part of the Building Act. The EPS not only takes into account the energy required for space heating, but also for hot water use, ventilation, and lighting. The EPS is based on the design, materials and installations and standardised behaviour and electricity end use. It is an integrated calculation, and the maximum value of 1.2 is equivalent to a total energy use in the most common new dwelling of 1200 m^3 natural gas equivalents in 1996. The standard is to be tightened to 1 in 2000. A comparable standard is operational for new buildings in the tertiary sector, where cooling is also taken into account. A distinction in the tightness of the standard is being made along the type of building, e.g. offices, hospitals, schools, shops etc. An Energy Performance Standard for Locations (EPL) for new building areas takes into account the design of the local energy infrastructure. However, this standard only serves as a measure to compare ambitions between local governments. There are no obligations connected to it.

An EU directive on minimum efficiency standards for refrigerators and freezers was established in 1996, and included in the Dutch Energy Saving Appliances Act in 1997. On the basis of an EU directive, energy labels for washing machines and tumble dryers have been introduced in the Netherlands in April 1996. A similar label had already been implemented for refrigerators, freezers and hot water boilers in 1995 (see Annex B for a complete overview of implementation of labels and minimum efficiency requirements).

2.6.2 Long Term Agreements

In the Netherlands, covenants or Long Term Agreements (LTA's) are used as an alternative to imposing regulation to large industrial energy consumers. Environmental permits are regarded as a supplement for those firms not participating in LTA's, or a safety net for firms failing to meet their LTA-obligations.

Covenants containing energy efficiency targets are signed between the Minister of Economic Affairs, a sector organisation, and Novem, the government agency monitoring most long term agreements. The target is stated in terms of efficiency improvement (energy consumption by unit production), and has been formulated in a negotiation process preceding the agreement. Individual companies draw an 'energy savings plan' to implement the agreement. They receive support from Novem in identifying saving measures, and the requirements of the Environmental Protection Act are assumed to be met.

There are now 29 LTA's in the industrial sector, and 9 with other sectors, including health care, freight transport and greenhouse horticulture. Small and Medium-sized Enterprises are difficult to reach because of the lack of sector organisations. Some new LTA's were started in 1999 in sectors of minor importance.

In the period 1989-1998, the energy efficiency within the industrial sectors involved in an LTA has improved by 16.8%. This is equivalent to an absolute energy conservation of 155 PJ annually, or 8.7 million tons of CO_2 emission reduction annually. The Ministry of Economic Affairs expects the target of 20% efficiency improvement in 2000 to be reached.

Most LTA's will end in the year 2000. Negotiations on the 'next generation LTA's' have been started already. For the energy intensive branches, the Benchmarking Covenant has been introduced as an alternative, see Section 2.2.2.

2.6.3 Fiscal or economic incentives

Fiscal measures for energy conservation are increasingly important in the Netherlands, mainly replacing subsidies. Advantages of fiscal incentives are that they make better use of the market mechanism. However, for non-profit organisations adjustments had to be made.

- The *Accelerated Depreciation of Environmental Investments programme* (VAMIL), gives a corporate tax advantage to companies that invest in specific energy saving measures or environmentally friendly technologies. This measure only applies however, to those companies obliged to pay corporate taxes, excluding for instance hospitals.
- For the target group Small and Medium Sized Enterprises a program *Cleaner Producing* (Schoner Produceren) has been started, that also contains two subsidy measures: Information and screening and Energy efficiency and environmental advice.
- The *Energy Investment Allowance* offers a lower corporate tax in the first year by deducting 30-40% of the investment sum from the profit in that year. This is equivalent to a subsidy of 14-18%. The investment must concern energy saving technologies or renewables, and again only applies to those companies obliged to pay corporate taxes.
- The subsidy measure *Energy Investments for the Non Profit Sector* (EINP) was introduced in the course of 1997 to grant subsidies to the non-profit sector investments in energy efficiency. Commercial companies may use the Energy Investment Allowance (EIA), introduced in January 1997, to subtract the investments from their corporate tax. Since non-profit institutes do not pay this tax, they cannot use the EIA. The subsidy budget was 15 million guilders in 1997 and 20 million guilders in 1998. In 1998 the EINP was extended to wind energy for the agricultural sector. They do pay corporate tax, but the Inland Revenue do not consider the buying of a wind turbine an investment that may be subtracted. For wind energy 12,5 million guilders is reserved.
- The fiscal measure Green Investments ('Groen Beleggen') was introduced in 1995 to make investments in environmentally sound projects more profitable. By this measure interest and dividend that private investors receive from 'green investment funds' are free of income tax. The measure already applied among others to renewable energy projects and sustainable building projects, and offered the possibility of a 'green mortgage'. In October 1998 among other types of projects the energy efficient 'green label greenhouse' was added to the list of green investments. Also the measure was extended to projects in foreign countries on environmental technology, nature protection, biological agriculture and energy efficiency and to Joint Implementation of CO_2 emission reduction projects in Central and Eastern Europe. A similar measure was introduced in the Netherlands Antilles and Aruba.

3. OVERALL ASSESSMENT OF ENERGY EFFICIENCY TRENDS

3.1 Economic context

In 1998, GDP in the Netherlands has grown with 5.2%, which is a very high growth figure. Figure 3.1 presents the trends in the main macro-economic indicators between 1970 and 1998. The Dutch GDP has grown by 2.7% annually on average, with a recession in the beginning of the eighties. From 1990 to date, the average growth is 2.9%. 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. The average growth in value added in the industry sector is 1.9% per year over the period 1970-1998. Industry is gradually decreasing its share of GDP while the contribution of the tertiary sector increases.

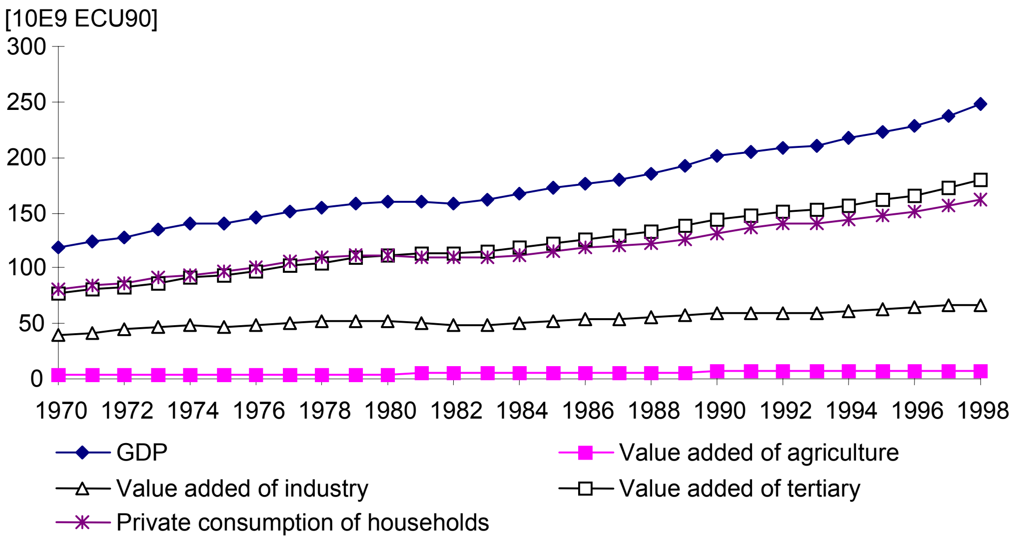

Figure 3.1 *Macro-economic developments in the Netherlands; in constant prices of the year 1990*

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 25% between 1982 and 1998. The high value in 1996 is partly due to climatic variations, see Section 3.4. In the period 1982-1990, total final consumption remained more or less stable around 40 Mtoe, after 1990 there was an increase to 45-50 Mtoe.

In Figure 3.2 the final consumption by energy carrier is presented. The increase in electricity consumption is relatively large; 63% between 1982 and 1998. 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 44% in final demand, followed by crude oil and oil products (34%). 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 purchased heat is relatively high in the Netherlands. This is due to the emergence of joint ventures that operate cogeneration plants and supply the industry.

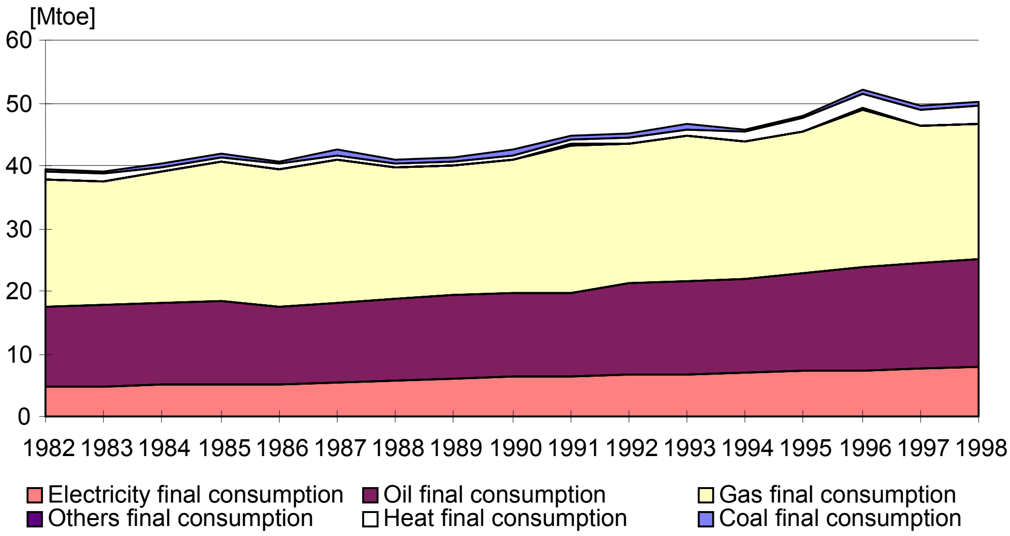

Figure 3.2 *Final energy consumption by energy carrier in the Netherlands (conventional equivalence, excluding non-energy uses)*

Figure 3.3 shows the final energy consumption by sector for the years 1982 and 1998. In this period, total final demand has increased with 27% from 39.3 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, services gained at the expense of households.

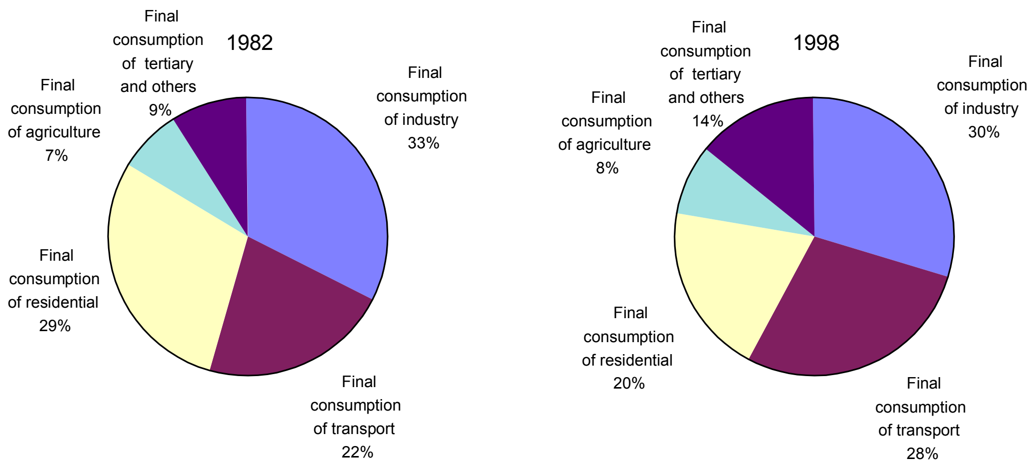

Figure 3.3 *Shares of sectors in final energy consumption in the Netherlands in 1982 and 1998*

Energy demand in the transport sector has grown steadily, and has increased with 43% since 1982. 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, from 2.9 to 4 Mtoe between 1982 and 1998. 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.

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. In 1997 and 1998, the energy consumption stabilised again.

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. 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 19%. In the nineties, it has remained slightly above 0.2 koe/ECU 1990. However, 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 17%.

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.

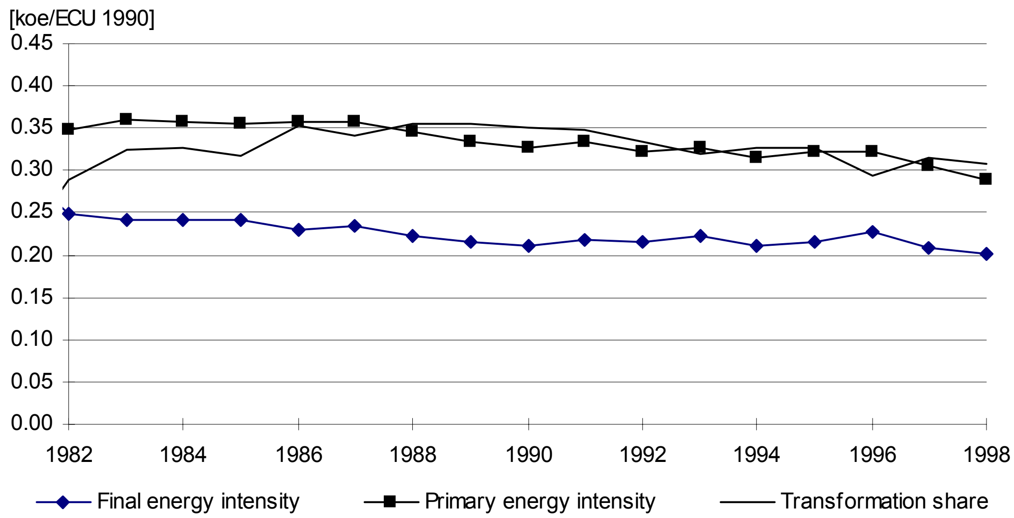

Figure 3.4 *Primary and final energy intensity in the Netherlands*

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. Three periods can be distinguished, based on developments with regard to these factors in the Netherlands (Boonekamp, 1998).

- 1982-1986: high fuel prices, economic recession, and active conservation policy,
- 1986-1991: low fuel prices, economic recovery, and less attention paid to energy conservation,
- 1991-1998: low fuel prices, economic growth, and increasing effort in conservation policy.

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. The primary energy intensity rose because of increasing non-energy uses in the basic industries. After 1986, the economic growth picked up again and the intensity development may reflect autonomous trends with few structural changes. In addition, a series of mild winters after 1986 also caused a further decrease in the final energy intensity (see also Figure 3.6). 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, larger cars. In 1997 and 1998, the improvement of the final intensity is mainly due to the high level of economic growth.

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 0.35, compared to the other periods. This means that about 35% of the primary energy consumption goes to the transformation sector, non-energy uses and bunkers, with 14% for 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 remaining 21% transformation share can be attributed to average overall supply losses and consumption in the transformation sector in this period. This 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 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 cleaned from 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.

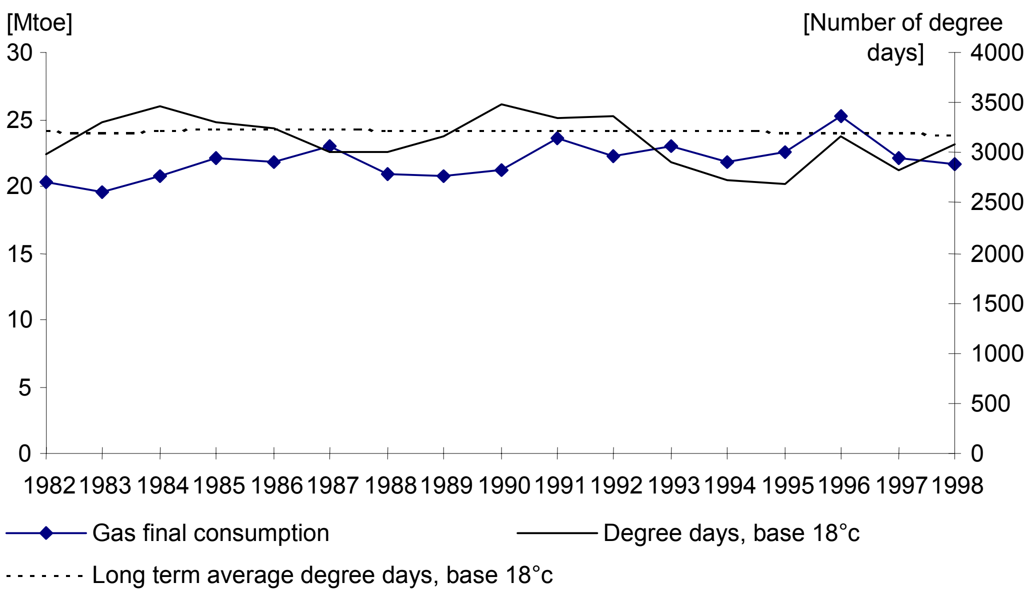

Figure 3.5 *Comparison between number of degree days and final consumption of natural gas in the Netherlands*

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

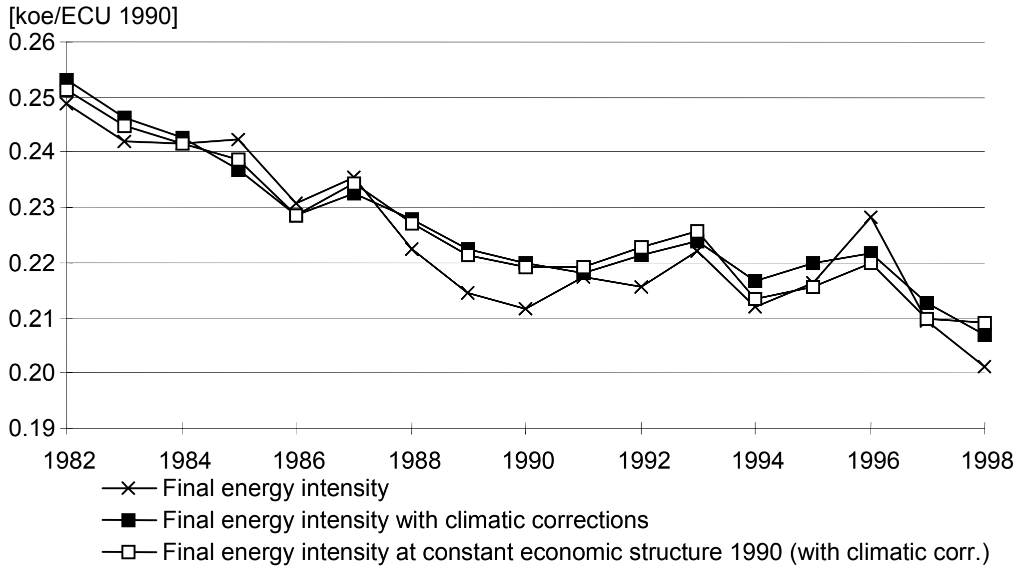

Figure 3.6 *Final energy intensity: role of climate and structural changes*

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 it 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 1990.

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 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 (climate corrected)
1982-1986	High	Recession	Active	2.4%
1986-1991	Low	Recovery	Less active	0.9%
1991- present	Low + energy tax	Growth	Increase	0.7%

In the period 1982-1998, total final energy demand has grown with 25%. Over the same period, the final energy intensity decreased with 18%. However, Table 3.1 shows that the highest efficiency improvement occurred in the eighties. In the nineties, the energy efficiency improvement rate 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, 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 will be difficult to achieve the ambition level of energy savings of 2% annually (see Section 2.2.1) 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 Chapter 8).

4.1 Energy consumption by industrial branch

Industrial branches include manufacturing industry, construction and non-energy mining. The manufacturing industry is subdivided in several main branches. The oil industry 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 manufacturing and total industry, the difference being the construction sector and non-energy mining. In Figure 4.2, shares of the different main industry branches are presented for 1998, the last year within the available time series.

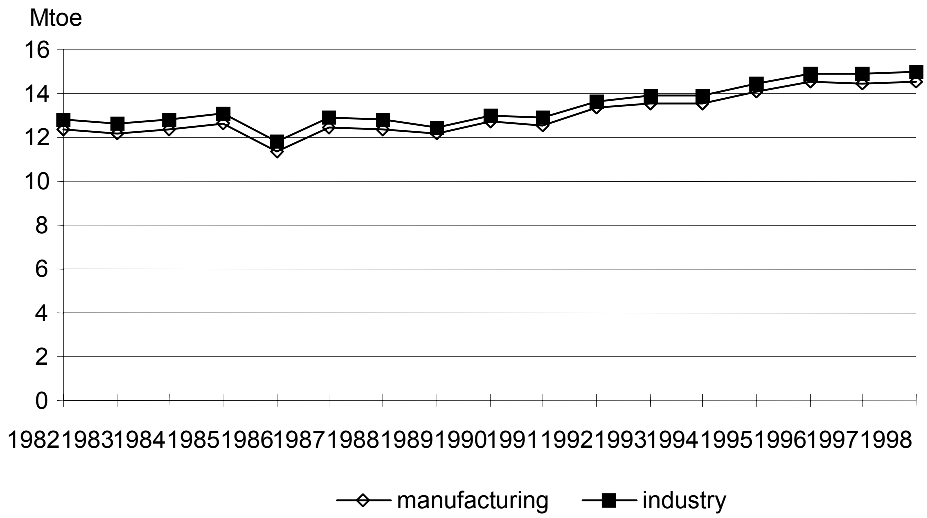

Figure 4.1 *Development of final energy consumption in industry and manufacturing*

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. Equipment refers to all other metal sectors, metal products, machinery; transport equipment and electrotechnical equipment. The structure of energy consumption by sectors is relatively stable, but fluctuates with the cyclical movements of the chemical and basic metals sector.

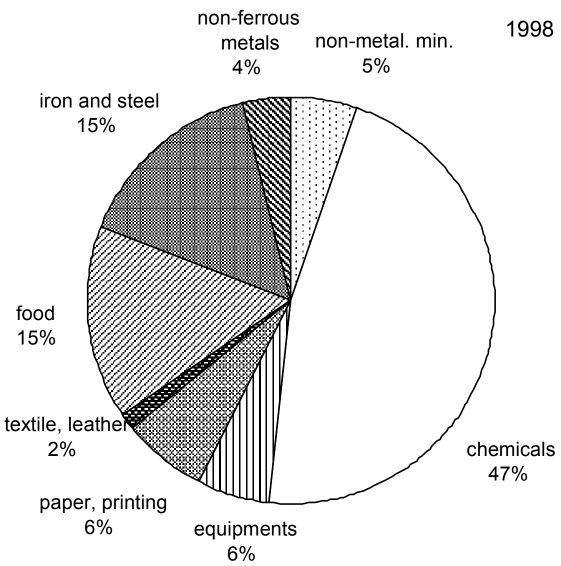

Figure 4.2 *Final energy consumption shares of main manufacturing industry branches*

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 shows the energy intensity of total industry and the manufacturing sector respectively, the difference indicating mainly the low energy consumption and considerable contribution to GDP of the construction sector. Figure 4.4 presents intensity developments within separate manufacturing branches.

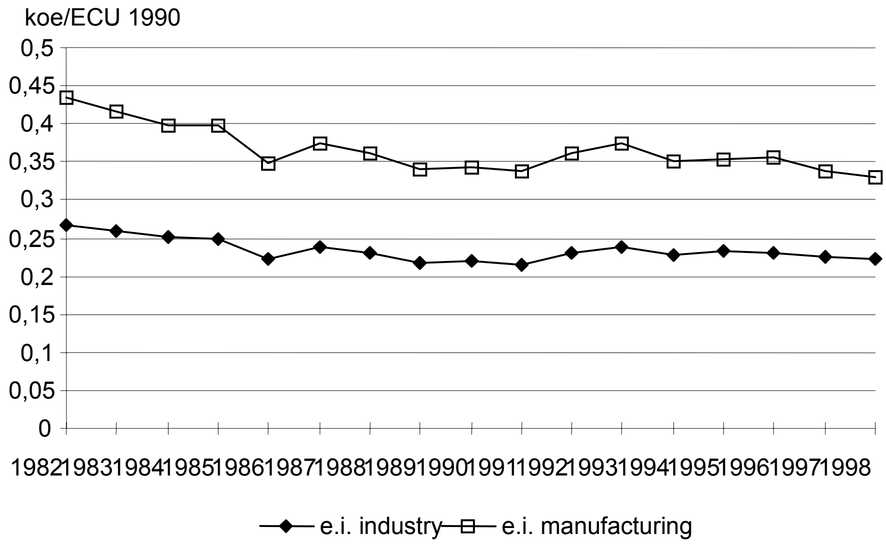

Figure 4.3 *Final energy intensity of industry and manufacturing*

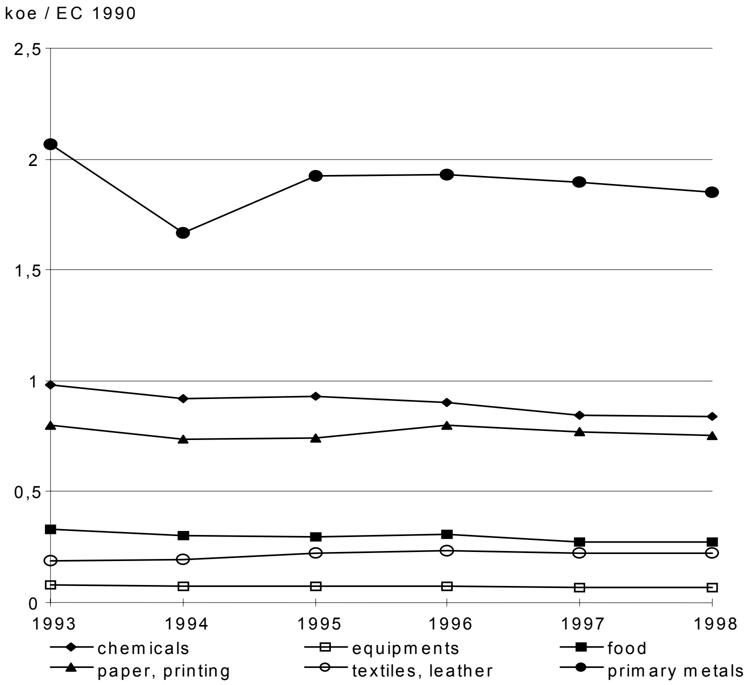

Figure 4.4 *Energy intensity of manufacturing branches*

Primary metals is clearly the most energy intensive branch. In basic metals all coal and coke inputs for iron production are included. The intensity of primary metals has decreased by 10% since 1993. The chemical industry is also energy intensive, as it includes a large basic chemicals production section.

Over the few years where consistent time series are available, the intensity has decreased by about 15% in the chemicals, food and equipments sectors. These three sectors represent 70% of manufacturing value added in 1998. In paper and printing, intensity has decreased by about 5%. Food industry is energy intensive as far as dairy, sugar and starch production is concerned. The textiles and leather section had an increasing energy intensity. Value added decreased up to 1996 and rose again afterwards, but energy consumption grew steadily by 19%.

The energy intensity of most branches has decreased in the eighties with about 2% annually. After that the overall intensity has hardly decreased, though recent years show a decreasing trend. In the next section, underlying factors will be analysed. These include different sectoral growth rates 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.

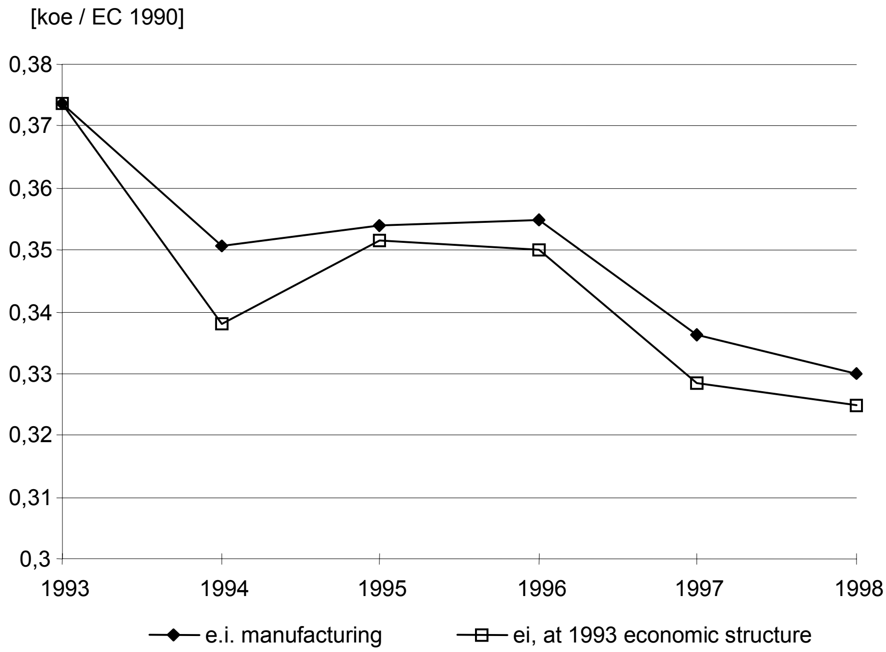

Figure 4.5 *Effect of economic structure on energy intensity in manufacturing*

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, see Section 2.6.2). 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. The LTA efficiency improvements are 19% up to 1997, whereas energy intensity has decreased only 1% and efficiency compared to final consumption only grew 5%. This counterintuitive phenomenon is explained by a number of reasons.

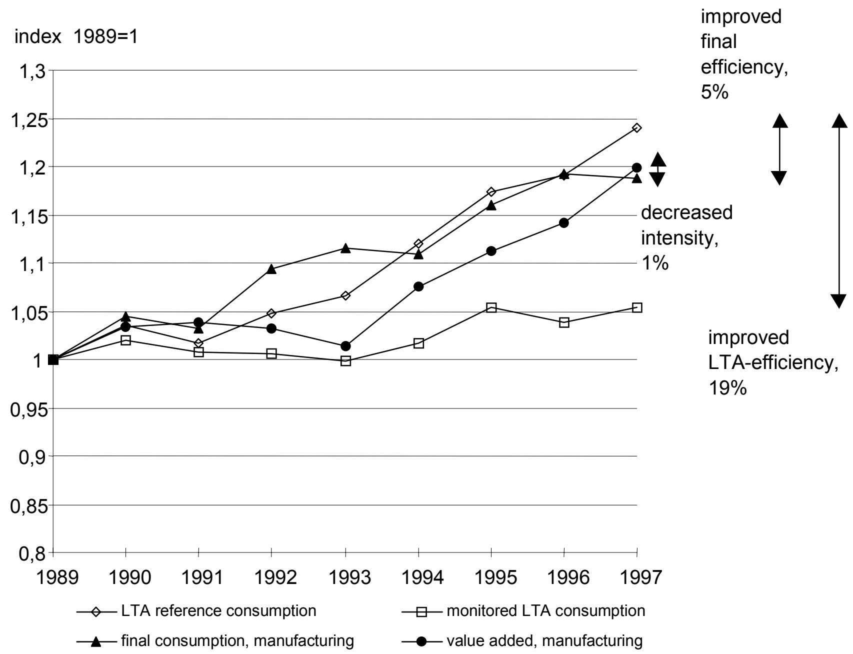

Figure 4.6 *Energy efficiency improvement based on LTA-monitoring (index 1989=1)*

First, physical production has increased more than value added, especially in 1992 and 1993. This means that production output became more energy intensive. Second, final consumption rose substantially compared to monitored LTA consumption. This is caused by:

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

Using the LTA reference consumption as a representation of relevant physical output in manufacturing, final energy efficiency has improved only 5%. 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.

5. HOUSEHOLDS

5.1 Introduction

In The Netherlands, the only energy carriers playing a significant role in households are natural gas and electricity. Natural gas is mainly used for space heating, hot water production and cooking, whereas electricity is used for appliances and lighting. Although the average gas consumption has been decreasing since 1980 and has stabilised in recent years, electricity consumption has, after a decrease, been increasing rapidly since 1988, see Figure 5.1. 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.

Therefore the decrease in energy used for space heating was not sufficient to counterbalance the effect of the increase in energy used for domestic appliances. This chapter will evaluate the effectiveness of policy instruments and the role of lifestyle trends in explaining the electricity consumption growth in The Netherlands. It is largely based on (Uyterlinde and Jeeninga, 2000).

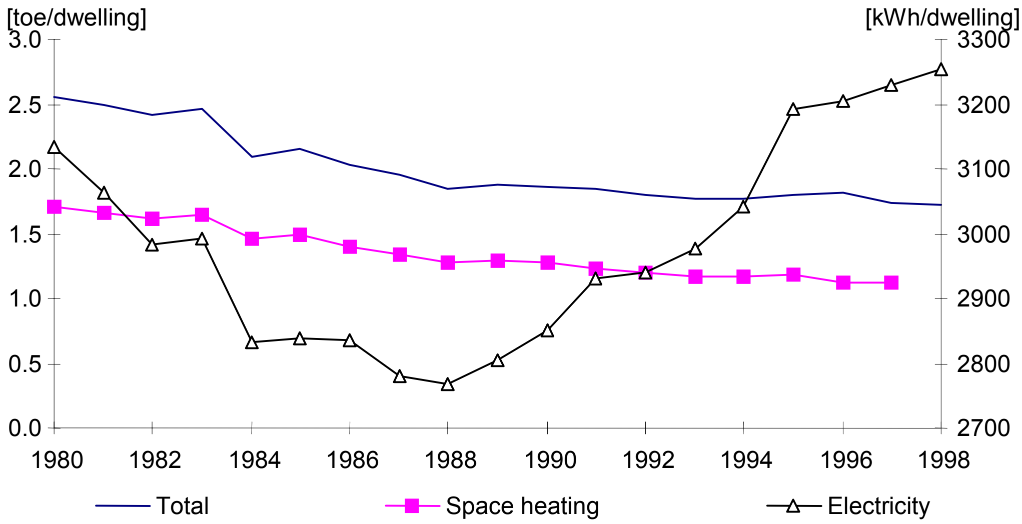

Figure 5.1 *Unit consumption of households total[1], space heating[1] and specific uses*
[1] with climatic corrections

5.2 Electricity consumption trends explained

In The Netherlands, the electricity consumption per household has decreased continually until 1988, but has been increasing ever since. Figure 5.1 shows that the decrease until 1988 was at an average rate of 1.5% per year, while the increase after 1988 amounts to on average 1.9% per year.

Obviously, it is important for policy makers to understand the factors underlying the upward trend, in order to be able to direct policy efforts in such a direction that the increase can be turned into a stabilisation or even a decrease. A number of factors could explain this trend, which will be elaborated in the next sections:

- policy intensity and macro-economic circumstances,
- the level of energy prices as an incentive to save energy,
- the development of the penetration rate of electrical appliances. This is closely related to a number of lifestyle trends,
- the development of the efficiency and performance of electrical appliances.

5.2.1 Policy efforts since 1980

Looking back over the years since 1980, a number of shifts have occurred regarding the different factors influencing residential energy consumption. Three periods can be distinguished.

The first period, 1980-1986, can be characterised by high fuel prices, economic recession, and active conservation policy. In this period, one of the main policy instruments was the National Insulation Plan. This Plan subsidised various insulation measures in existing dwellings as well as efficient condensing boilers, and was highly cost effective. It received a wide support, mainly due to the rising fuel prices in this period.

The second period, 1986-1991, is characterised by low fuel prices, economic recovery, and less attention paid to energy conservation. In 1990, the utilities started their Environmental Action Plans (MAP), as a result of the aim of the government to have target groups in the energy sector take responsibility for energy conservation. The plans included subsidies for insulation in dwellings and energy efficient lighting. In addition, the market introduction of technologies such as heat pumps, high efficiency boilers, and CFLs was supported.

The third period, 1991-present, is characterised by low fuel prices, economic growth, and increasing effort in conservation policy, however now the main driving force is the climate problem. The Environmental Action Plans still play an important role, but there are also governmental initiatives, such as the Energy Performance Standard for new buildings. As a result of the changing role of utilities in the context of market liberalisation, the Environmental Action Plans will not be continued after 2000.

During the different periods, a shift in actors can also be observed: from government to utilities (MAP), and back to government, including a more important role for the EU (e.g. labelling). There is also a trend towards more market-based instruments, under influence of the ongoing market liberalisation.

In Figure 5.1, the electricity consumption starts rising again after 1987, which is partly explained by the factors highlighted in this section, i.e. fuel prices, effort in conservation policy, and consumer awareness. It must be mentioned, however, that policy measures have concentrated to a great extent on achieving natural gas savings. Apart from stimulating energy efficient lighting, measures aiming at reducing electricity consumption are from a very recent date. These measures will be discussed in Section 5.3.

5.2.2 Energy prices

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 1998, as a result of the newly introduced energy tax. Figure 5.2 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. As already mentioned in the previous section, 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.

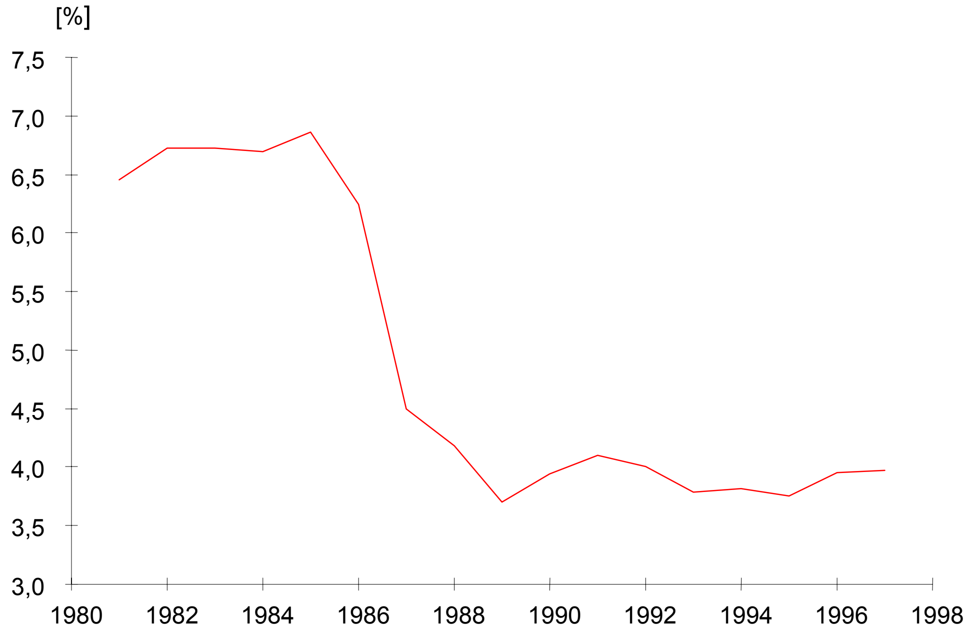

Figure 5.2 *Development of total household expenditures on energy as percentage of disposable income*

5.2.3 Ownership of appliances related to lifestyle trends

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 (Jeeninga, 1998). In this section, the most relevant lifestyle trends will be discussed along with their implications for residential electricity consumption.

Disposable income

For most people, their disposable income has increased in the nineties. This results in an improvement in the quality of life. People will desire a higher level of convenience in their houses, and are prepared to spend money on new and improved equipment. 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 dish washer and microwave are almost standard accessories. Redecoration and upgrading of bathrooms is currently also very fashionable.

Social recognition
A related issue is social recognition, which means that households want to possess those appliances needed to reach the level of the quality of life associated with the social class with which they identify. The recent, fast penetration of the mobile phone is an example. Due to social, demographic and economic dynamics, new opportunities arise for comparison. Moreover, as soon as this convenience level is reached, new demands for a higher quality of life arise again. Therefore, manufacturers of domestic appliances are deemed to come up with updates or even new types of appliances at regular intervals.

Scarcity of spare time
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 increase in daily tasks is mainly related to the increase in labour participation, and applies in particular to women. In addition, the demand for self-development, e.g. education during evening hours, contributes to the increase in tasks. The increase in the proportion of one-family households leads to decreasing economies of scale, since it is not possible to divide household tasks. The decrease in scarcity of time can be compensated for by the purchase of appliances, such as a dishwasher, clothes dryer and micro-wave oven, which contribute to a more efficient performance of daily tasks.

Scarcity of time may also account for the shift observed in Figure 5.3 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[2].

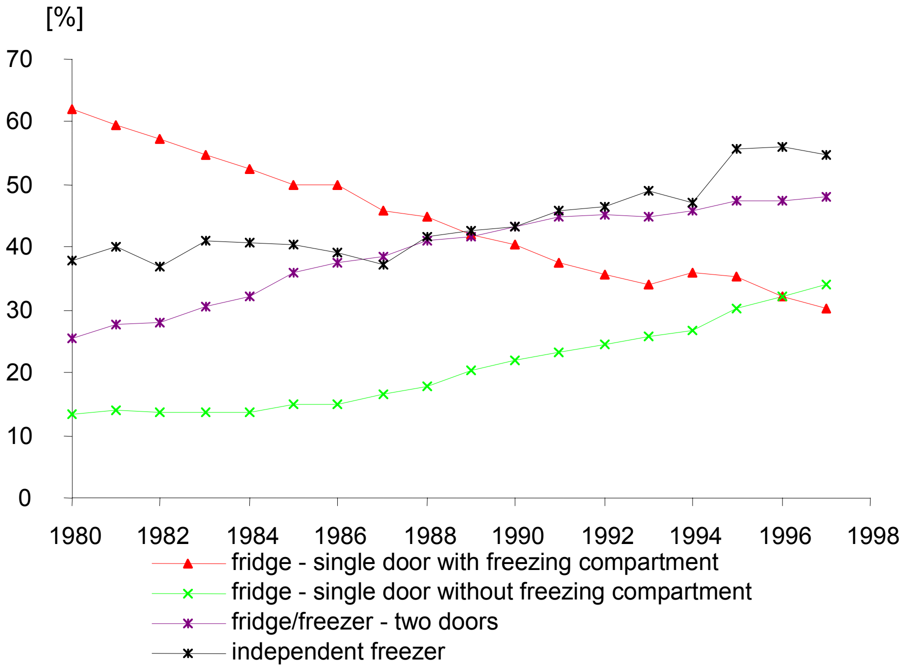

Figure 5.3 *Development of the penetration rate of refrigerators and freezers*

[2] 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
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 5.4. The penetration rate of the television increases due to an increase in second (8% in 1980, 40% in 1996) and third TV-sets (1% in 1980, 14% 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.

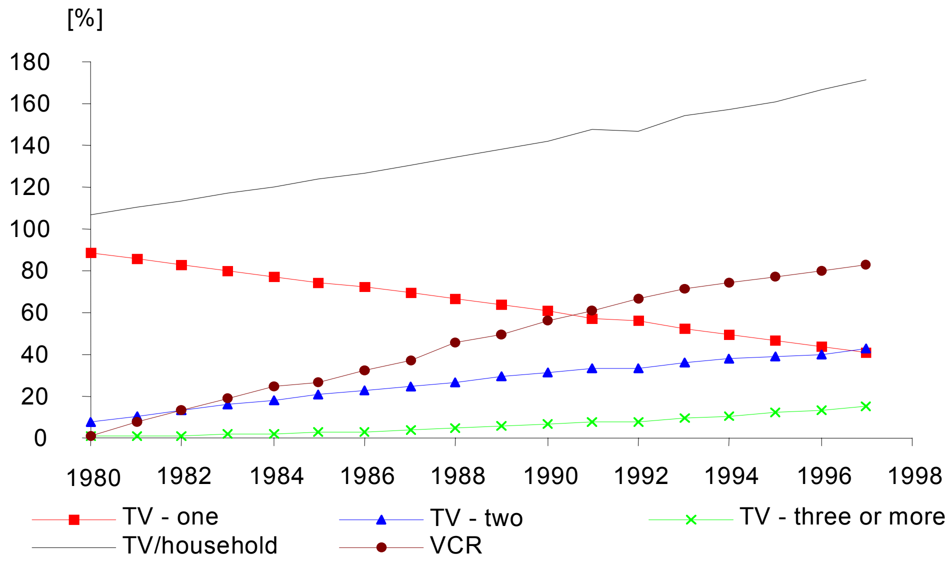

Figure 5.4 *Development of the number of TV sets per household and penetration rate of the VCR*

Increase in comfort level
In a period of economic growth and relatively low energy prices, people do not hesitate to purchase electrical appliances which increase their comfort level. The CD-player, the VCR, the home computer and the microwave show the strongest increase in penetration rate over the period 1980 - 1996. In 1980, hardly any of these appliances were present in households. The penetration rate of the clothes dryer increased by a factor of four in the period 1980 to 1996 (11% in 1980, 52% in 1996) and the penetration rate of the dishwasher increased from 7% in 1980 to 25% in 1996. Both the clothes dryer and the dishwasher are appliances with a high specific energy use.

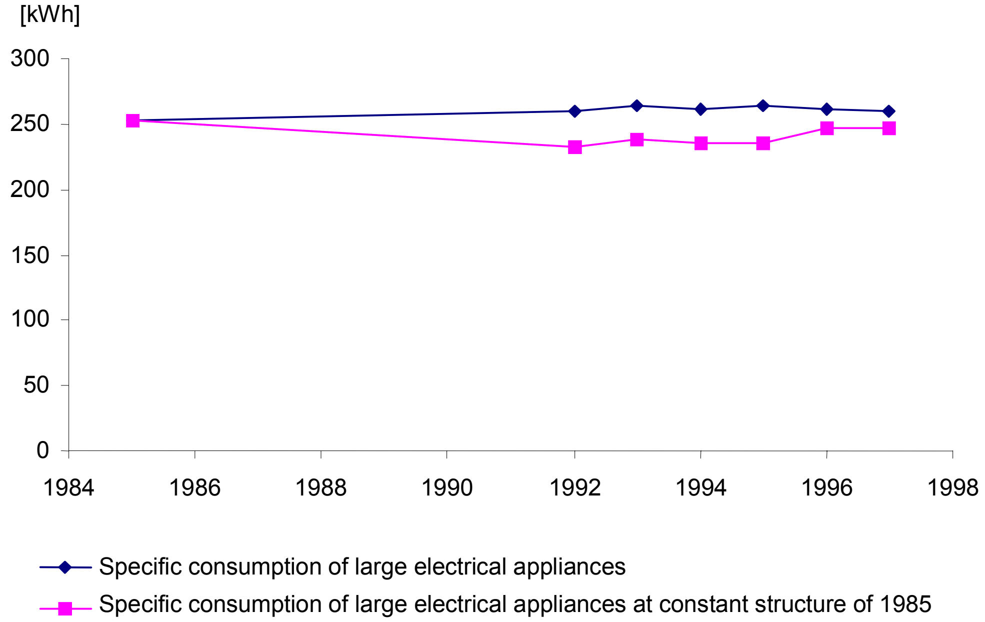

Figure 5.5 Specific consumption of large electrical appliances (weighted average) and at constant stock structure of 1985

Figure 5.5 shows the effect of increased ownership of large appliances by comparing the historical trend with a 'constant stock' indicator. It concerns refrigerators, freezers, washing machines, dish washers, dryers, TV's and air conditioners. If only people who possessed a certain appliance in 1985 had replaced it with a more efficient one in later years, the average specific consumption would have remained below the 1985 level. However, the actual values show that the larger diffusion of electrical appliances counterbalances the technical efficiency improvements.

5.2.4 Appliance efficiency and usage

As explained in the previous section, the development of residential electricity consumption is closely related to the ownership of electrical appliances. However, the efficiency and performance of the appliance, together with the frequency and duration of use, determine the actual electricity consumption.

The average annual energy consumption of an appliance equals the product of the specific energy use (kWh / hour) and hours of usage (hours / year). In general, while the specific energy use is fairly well-known, the (evolution of) hours of usage is not and may be related to changes in life-style. To derive some information on this last issue, the electricity consumption per household, given a constant consumption per appliance, is constructed by multiplying the 1996 annual energy consumption per appliance with the (actual) penetration rate for each year.

As a result, Figure 5.6 shows the development of the average electricity consumption per household compared to the development of electricity consumption given a constant annual energy consumption per appliance (level 1996).

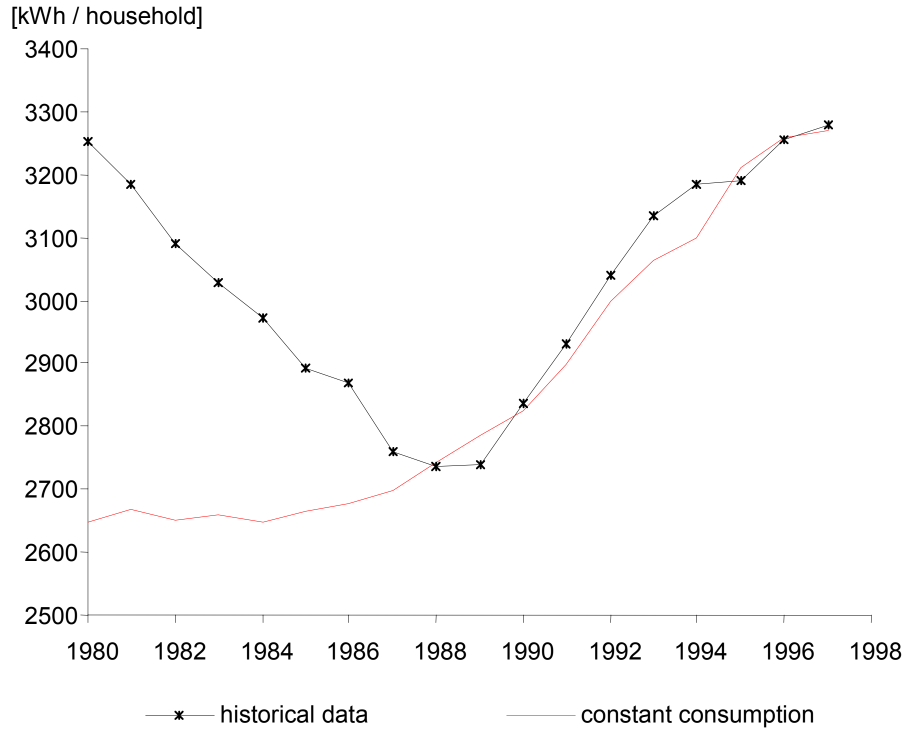

Figure 5.6 *Development of electricity consumption by household; historical data and at constant annual energy consumption per appliance (1996-level)*

It is remarkable that the (calculated) product of the penetration rate and the 1996 specific consumption per appliance can well explain the historical development of the electricity consumption in the period 1988-1998. At first sight, this would imply that the energy efficiency improvement per appliance is almost zero over this period. In the period 1980-1988 however, the average energy efficiency improvement per appliance would amount to 3.3% per year. Therefore, some other effects must have influenced the development of electricity consumption. Since the average energy consumption per appliance is the product of specific energy use and hours of usage, it is likely that the efficiency improvements in the period 1988-1998 are counterbalanced by an increase in hours of usage (e.g. washing and drying of clothes, watching television) and an increase in performance (e.g. more power, functionality). In the period 1980 - 1988 however, the opposite effect seems to have occurred for the hours of usage (good housekeeping) and performance of appliances.

5.3 Recent policy initiatives

This section summarises the most recent policy initiatives with respect to saving of electricity. In June 1999, the *Action Programme Energy Conservation 1999-2002* was published. It aims at increasing the energy efficiency improvement from 1.6% to 2% annually. The Action Programme recognises that the increase of residential electricity consumption is one of the most difficult issues to be solved, partly because consumer behaviour plays an important role. It aims at an efficiency improvement of appliances of on average 1.8% annually in the period 1995-2010. In Section 2.2.1 a detailed account is given of the content of the Action Plan for the different target groups. In this chapter we focus on the measures for the residential sector, in particular those aiming at reducing electricity consumption.

Core-instruments for the residential sector are levies such as the Energy Regulatory Tax (REB), the Energy Performance Advice for existing buildings and the Energy Performance Standard for new dwellings. A behavioural instrument is the 'Ecoteam', in which groups of people regularly come together to discuss what they can do to reduce the environmental burden resulting from their daily activities.

Specifically for appliances, the following instruments are deployed.

- The Energy Rebates ('Energiepremies') programme for households has started in January 2000. Buyers of efficient (A-class) appliances receive a financial incentive. Subsidies are also available for insulation measures. This programme is supported by a media campaign. The utilities carry out the programme, the subsidies are paid from the revenues of the Regulatory Energy Tax (most of the revenues however are recycled back through income tax reductions).
- On EU level, there are negotiated agreements with manufacturers of televisions and VCRs to reduce the stand-by energy consumption of those appliances, and with manufacturers of washing machines to improve their energy efficiency. The covenant on televisions and VCRs seems to be effective, as research shows that the stand-by consumption of these appliances has gradually diminished in the past four years (Ministry of Economic Affairs, 1999). Agreements on decoders, battery chargers, loaders and feeders are in preparation. Energy labelling, another initiative on EU level, is described in the next section.

As stated in the *Energy Report 1999* (see Section 2.2.5), the undesired environmental effects of the expected price decrease in a liberalised market will be counterbalanced by an increase in the REB rates. However, consumers are hardly aware of the existence and height of this tax. The REB will be raised in three steps: 1999, 2000 en 2001, and it is anticipated that this will generate 3,4 billion Dutch guilders every year. The extra gains will be returned to tax payers through a reduction of the income tax and the tax on wages.

5.4 The effectiveness of labelling in The Netherlands

In The Netherlands, energy labelling has been introduced following the respective EU directives as shown in Table 5.1. Energy labelling is regarded an important supporting tool for energy efficiency policy, because it makes the energy consumption of appliances explicit and easily comparable.

A community-wide evaluation of the Energy Label for cold appliances shows that in The Netherlands, after Denmark, both dealer/supplier compliance and customer awareness (customers mentioning energy efficiency as an important factor in choosing an appliance) are the highest among EU countries (Winward et al., 1998).

Table 5.1 *Legal implementation of EU directives concerning energy labelling in The Netherlands*

Appliance	Year	Directive
Refrigerators	1996	92/2/EC (21/01/94)
Freezers	1996	92/2/EC (21/01/94)
Washing machines	1996	95/12/EC (23/05/95)
Dish washers	1/8/1999	97/17/EC (16/04/97)
Dryers	1996	96/60/EC (19/09/96)
Lamps	1/1/2001	(01/98)

Figure 5.7, Figure 5.8 and Figure 5.9 show the sales figures for different types of refrigerators and freezers by label class (Waide, 1998). At first sight, the results are very favourable. Labelling seems to be effective, because the share in sales of the more efficient models is increasing continuously. This observation is supported by the fact that all three figures, for refrigerators without freezers, fridge/freezers as well as independent freezers show the same tendency towards efficient models.

However, it is important to note that, as shown in Table 5.1, labelling became compulsory for refrigerators and freezers in The Netherlands only in 1996. This implies that in 1994-1995, buyers probably were unaware of the labels when buying cold appliances, although manufacturers were already obliged to distribute the labels with the appliances. Of course there were other sources, for instance consumers' organisations publishing test results, that were influencing buyers' decisions in favour of energy efficient appliances.

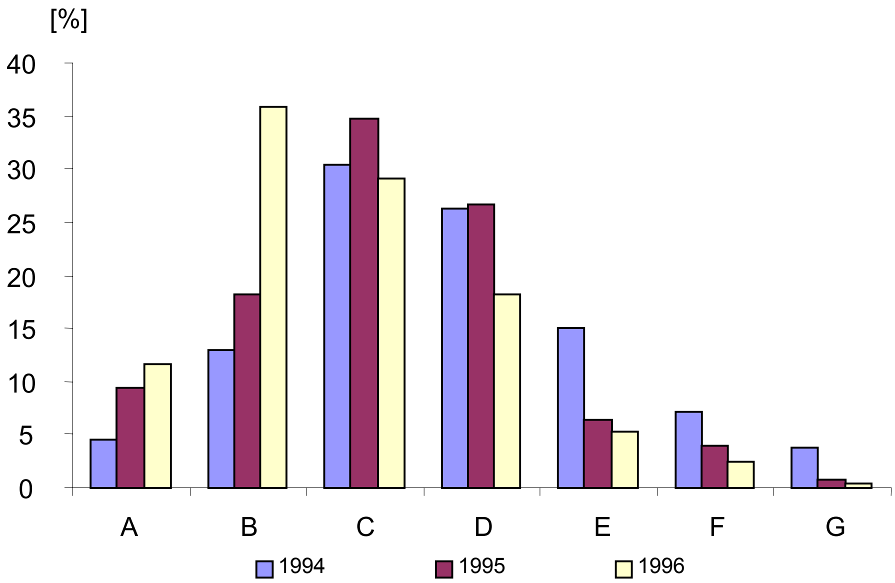

Figure 5.7 *Purchase of new refrigerators without freezer per energy class in 1994, 1995 and 1996*

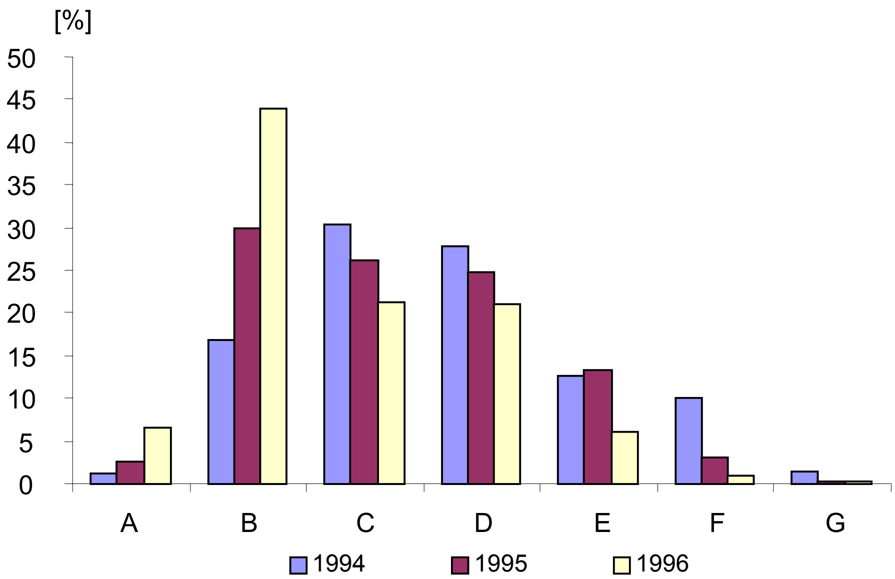

Figure 5.8 *Purchase of new fridge/freezers per energy class in 1994, 1995 and 1996*

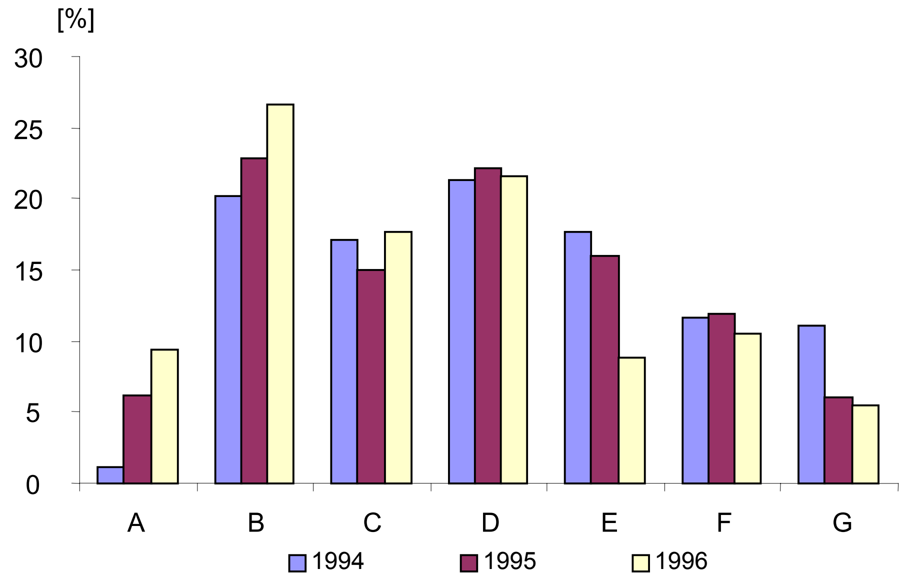

Figure 5.9 *Purchase of new independent freezers per energy class in 1994, 1995 and 1996*

In addition, the manufacturers were already anticipating the introduction of the energy labels by positioning new products just within the highest labelling category they could achieve. Therefore the number of appliances available in the more efficient classes was increasing, implying that the sales figures for efficient appliances will also tend to increase anyhow, compared to those for less efficient models. This is another factor influencing the growth in sales in A/B class appliances.

Summarising, these favourable figures might partly be explained by some autonomous trends. On the other hand, it is the only and best evidence available at the moment. These observations stress the need for monitoring the effectiveness of policy measures such as labelling.

5.5 Conclusions

Over the last decade, the residential electricity consumption in The Netherlands has increased rapidly. This rise poses a difficult task on the government, since the growth in electricity consumption is to a large extent due to growth and composition of population and growth of GDP, factors that can not be influenced by policy makers, even if they would want to. This paper has shown that there are also other factors responsible for the growth in electricity consumption. What does this imply for policy makers and the instruments that they have at their disposal?

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. However, subsidising energy efficient equipment may also have a some adverse effects. For example, a subsidy on clothes dryers or dish washers could accelerate the increase in penetration rate of these appliances. Moreover, this subsidy might suggest that the purchase of these types of appliances has an environmental benefit (increase of social acceptance). However, this is not the case, since the use of efficient appliances is only less harmful to the environment instead of beneficial. The best way to reduce the impact on the environment is to purchase (or use) no appliances at all. Due to free riders, subsidising appliances which already have a high penetration rate is expensive. Subsidising very efficient refrigerators might be a good option, since the penetration rate is almost saturated and the potential for energy saving is sufficiently large.

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. Again, these factors are greatly determined by lifestyle trends and customer behaviour, and therefore not easily influenced. A factor that can be influenced, by minimum efficiency standards and labelling, is the efficiency of the appliance itself, as well as its stand-by consumption. Policy efforts in this direction seem to have some effect. In addition, policy measures should focus on removing institutional and practical barriers for new highly efficient appliances (such as heatpump clothes dryers), and stimulation of the penetration of renewable sources of electricity such as photovoltaic energy and green electricity.

Finally, the paper shows several examples of the importance of high quality data for monitoring, as well as the importance of a solid analysis of trends. Valid conclusions must be based on well-defined indicators and solid monitoring. It is not that hard to interpret a figure in what seems an obvious way. However, reality often appears to be more complex.

For instance, in Figure 5.6 the (calculated) product of the penetration rate and the 1996 annual energy consumption per appliance seems to explain the historical development of the electricity consumption in the period 1988-1998. However, if the period 1980-1988 is considered, it becomes clear that there must be additional factors playing a role, i.e. the hours of usage and the performance of the appliance. In addition, the sales figures for different types of refrigerators and freezers by label class (Figure 5.7-6.9) give a favourable impression of the effectiveness of labels in The Netherlands. However, some of these figures may also be explained by autonomous trends. On the other hand, it is the only and best evidence available at the moment. These observations stress the need for monitoring the effectiveness of policy measures such as labelling. The effectiveness of the newly introduced Energy Rebates on A-labelled appliances should also be monitored. A complicating factor in this respect is that in the liberalising market, some data previously published by utilities now are regarded confidential.

6. TRANSPORT

In this chapter, energy consumption in transport is dealt with. By definition, it refers to energy consumption of vehicles on public territory.

6.1 Transport consumption by mode

Since 1980 the energy consumption in the transport sector has increased with 59%. Between 1996 and 1997 energy consumption increased with 2,9%, of which 1,8% is caused by road transport and 1,1% is caused by air 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)[3]. 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).

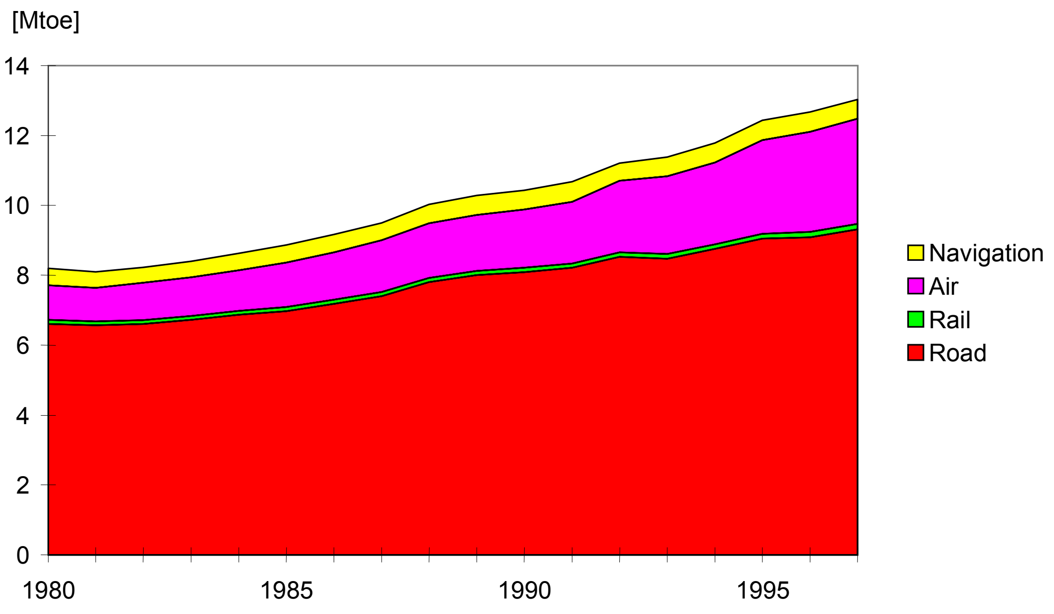

Figure 6.1 *Transport energy consumption by mode*

[3] 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.

Between 1980 and 1997 the energy consumption for road transport increased with 41%. Only air transport increased much faster (202%). Navigation increased with 18% and rail transport with 29%. A special aspect of rail transport is the switch from diesel to electricity[4]. In 1980 37% of the energy consumption by trains was diesel; in 1997 only 19%. In Figure 6.1 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 71% road, 23% air, 4% navigation, and still 1% rail. Excluding air transport, the share of road transport has slightly risen from 92% to 93%.

Figure 6.2 and Figure 6.3 present the relationships between the growth of energy consumption in the transport sector and economic growth. Figure 6.2 shows some main characteristics. The general upward trend is related to the economic growth, which was relatively high in the late eighties. From 1990 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). Economic growth, passenger transport and freight transport are still strongly related. Although in 1995 and 1996 transport growth slowed down, in 1997 the economic growth level was picked up again.

Despite an increase in vehicle efficiency, the energy consumption shows an upward trend for road transport, see Figure 6.3. Until 1985 the energy consumption had 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. This is also the case if international air transport is included in passenger transport in Figure 6.2.

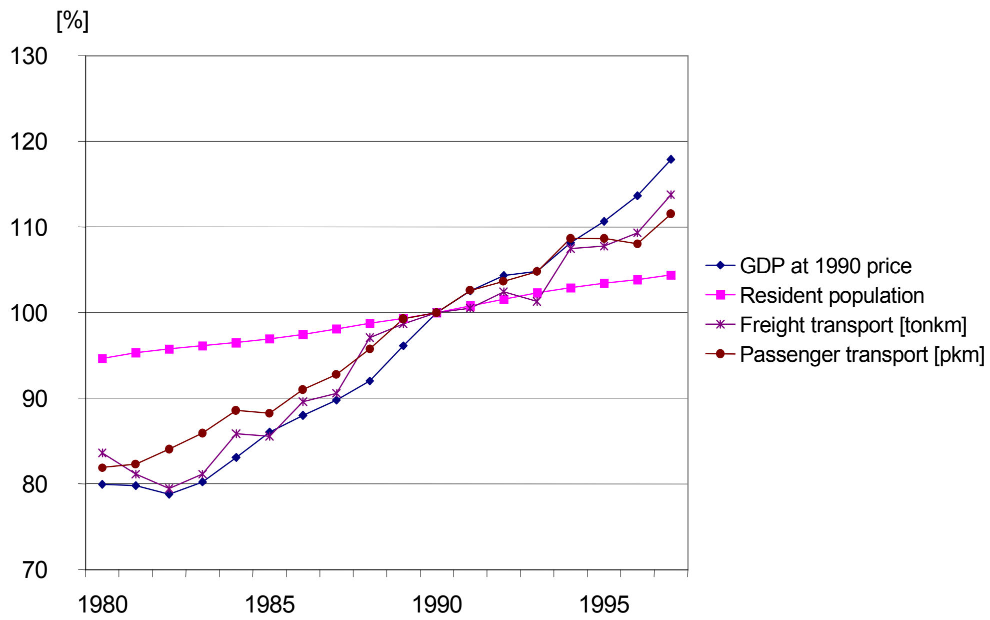

Figure 6.2 *Main economic and transport demand growth figures (1990=100%)*

[4] 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.

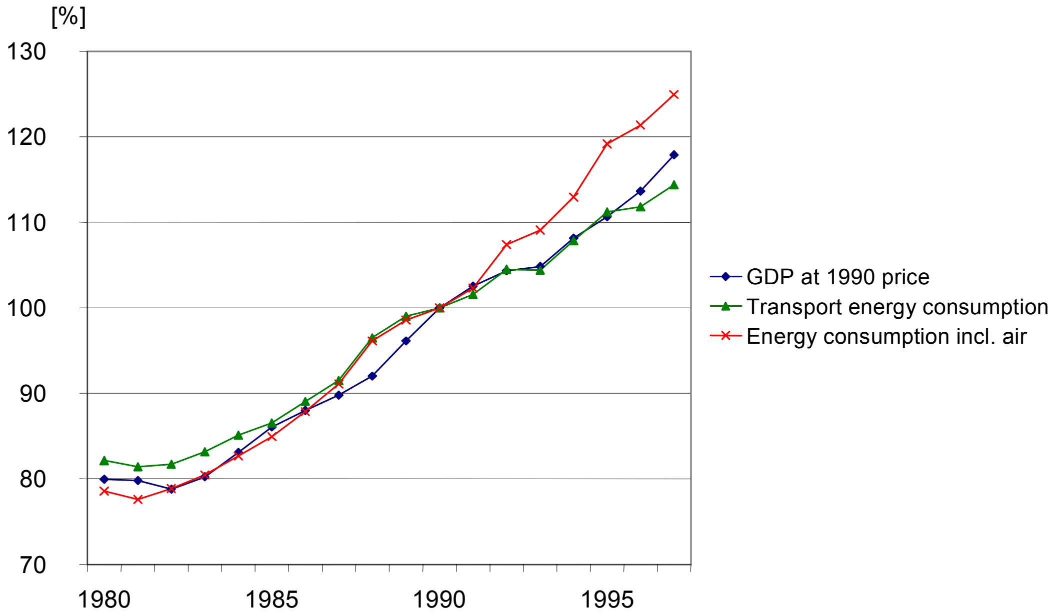

Figure 6.3 *Main economic and transport energy consumption growth (1990=100%)*

Figure 6.4 presents the total energy consumption by service; passenger transport and freight transport. Again the general upward trend is related to the economic growth and the resulting income development. In this figure, compared to Figure 6.1, air transport is excluded. For road transport also special vehicles (e.g.: fire engines, ambulances, cranes) and light vehicles (vans) are excluded[5]. The energy consumption of rail transport was broken up by ECN in passenger and goods transport[6].

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 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 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.

Furthermore, just as for passenger transport, the same holds for freight transport: an increase in the number of vehicles and the vehicle performance and a decrease in the energy consumption per vehicle (improved efficiency) results in an overall increase in the energy consumption. 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).

[5] 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.

[6] The division of energy use of rail transport between goods en passengers is published in the statistics. ECN made a division based on figures for one year of several studies.

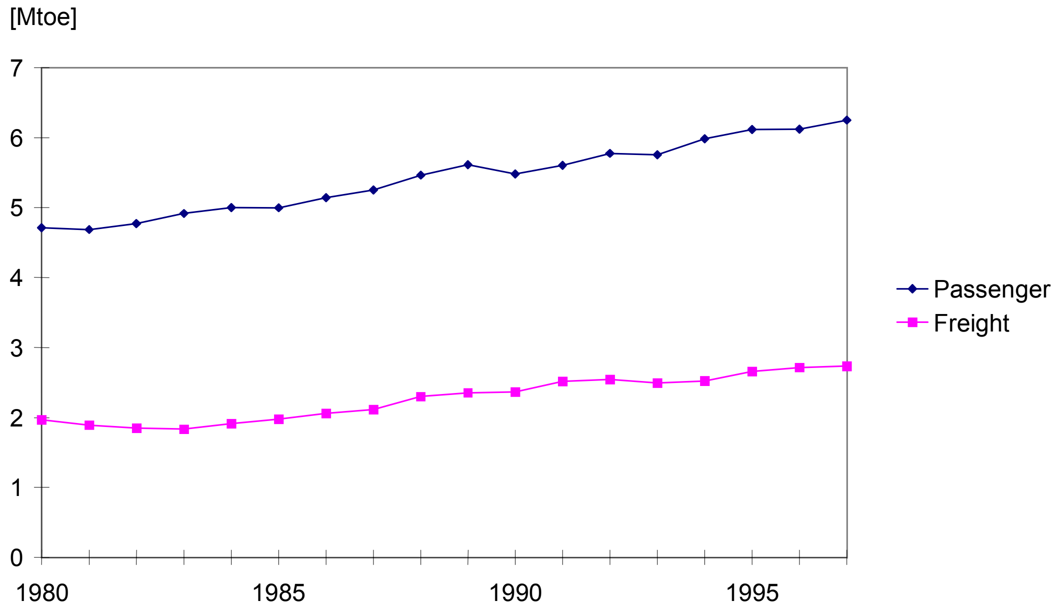

Figure 6.4 *Transport energy consumption by service: passenger and freight*

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 1997. 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, despite the increase in overall energy consumption for passenger transport. 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 1997 with 34%. The energy consumption of trucks (+47%) and vans (+145%) has increased even more. The (small) energy consumption of special vehicles declined with almost 395% over time.

The share of energy consumption for the different vehicles has changed between 1980 and 1997. The share of private cars, trucks and vans has changed from 66%, 22% and 6% respectively in 1980 into 63%, 23%, and 10% in 1996. 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.

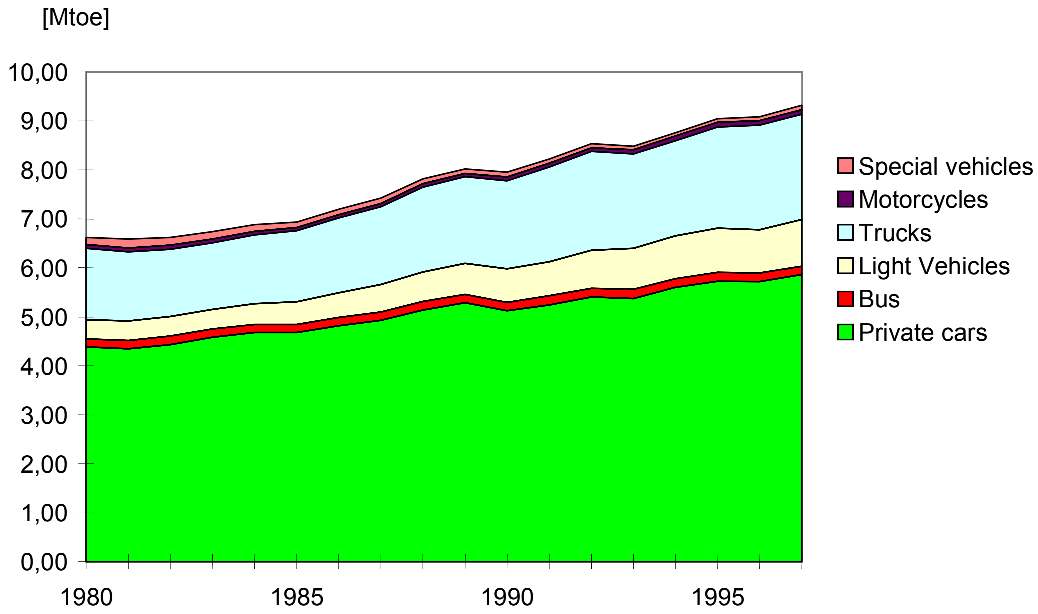

Figure 6.5 *Road transport energy consumption by type of vehicle*

The development of the person kilometres shows a high growth rate (Annema, 1997). 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 of the cars. On the other hand the efficiency of the cars has improved. This is further discussed in section 6.2. 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. This is discussed in more detail in section 6.3.

6.2 Cars

6.2.1 Specific consumption

For road vehicles the overall efficiency can be monitored with the average specific consumption, expressed in litres/100 km (CBS, 1999). 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 made within the European Union with the car manufacturers about 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.

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 vehicle weight. 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.

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.

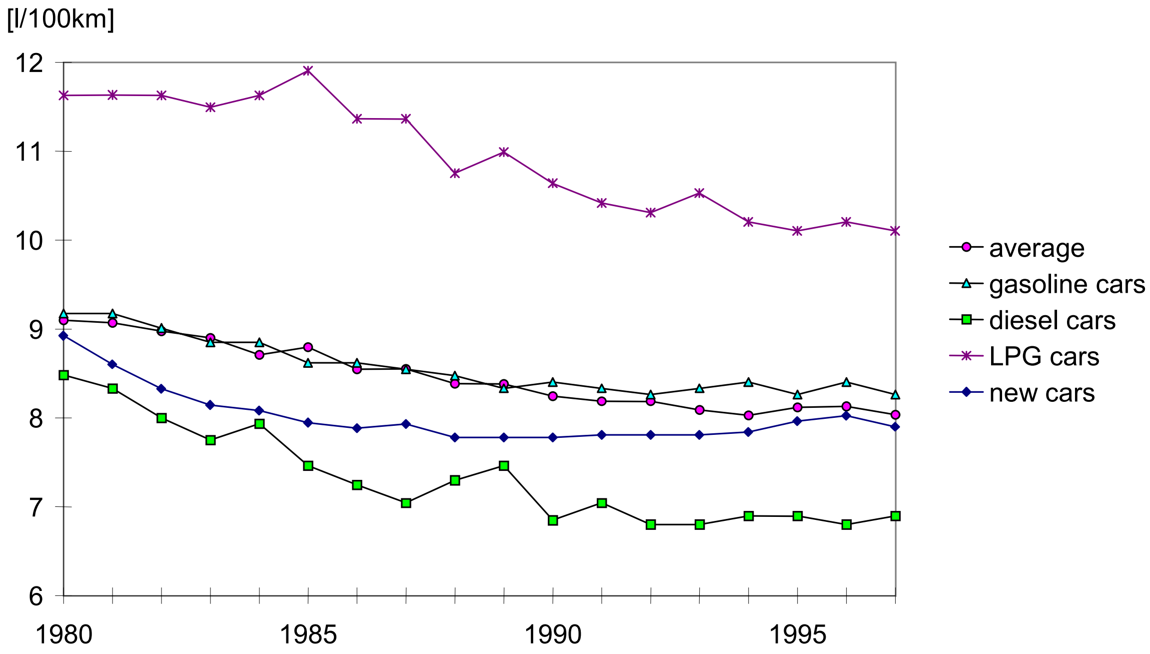

Figure 6.6 *Specific consumption of passenger cars*

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 1997, new cars are 22% heavier than in 1984 (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.

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. In addition, a system of fuel efficiency labels for new cars is under development. The energy label, which is already in use in the Netherlands for refrigerators, washing machines, and dryers, shows the buyer immediately how efficient the car is compared to others. Finally, there is an EU policy, based on agreements with car producers on lowering fuel consumption of new passenger cars.

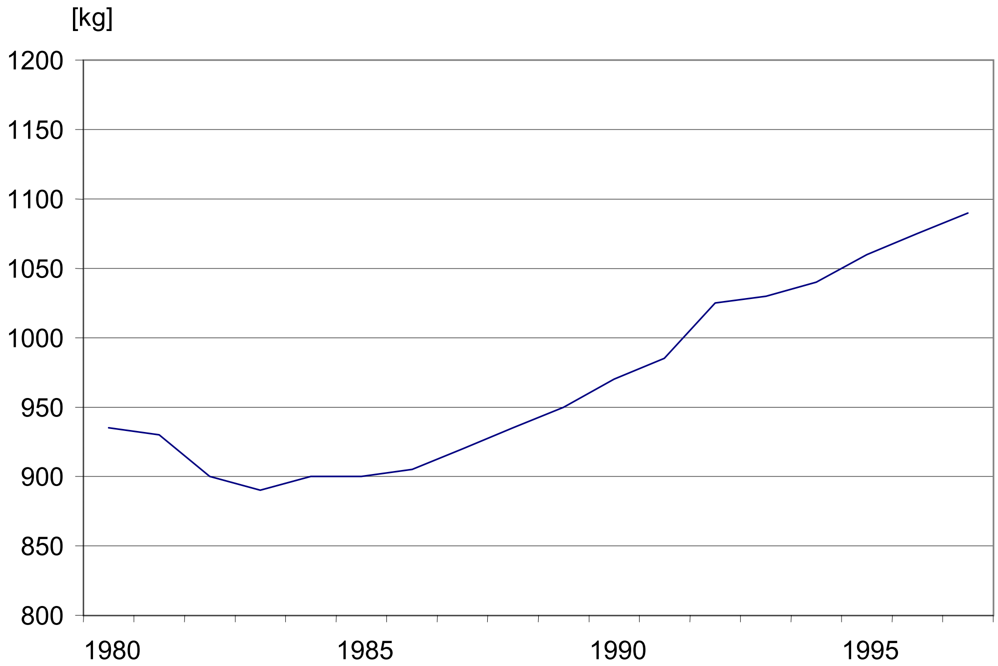

Figure 6.7 *Mean weight of new passenger cars (Annema, 1999)*

6.2.2 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 one car. The growth of energy use of Dutch passenger cars in the Netherlands almost equals the growth of the number of cars.

6.2.3 Savings

The variation of the unit consumption between years, the unit consumption effect, can be divided into three effects:

- the kilometre effect, the variation in yearly performance of cars,
- the technology effect, the variation in efficiency of cars,
- the behavioural effect, the variation in the driving behaviour, this is a residual effect.

In the Netherlands there are no technical data available to determine the difference between the technology effect and the behaviour effect. As can be seen in Figure 6.8 and Figure 6.9, the changes in efficiency of the passenger car are the main factor for the specific consumption of passenger transport as a whole.

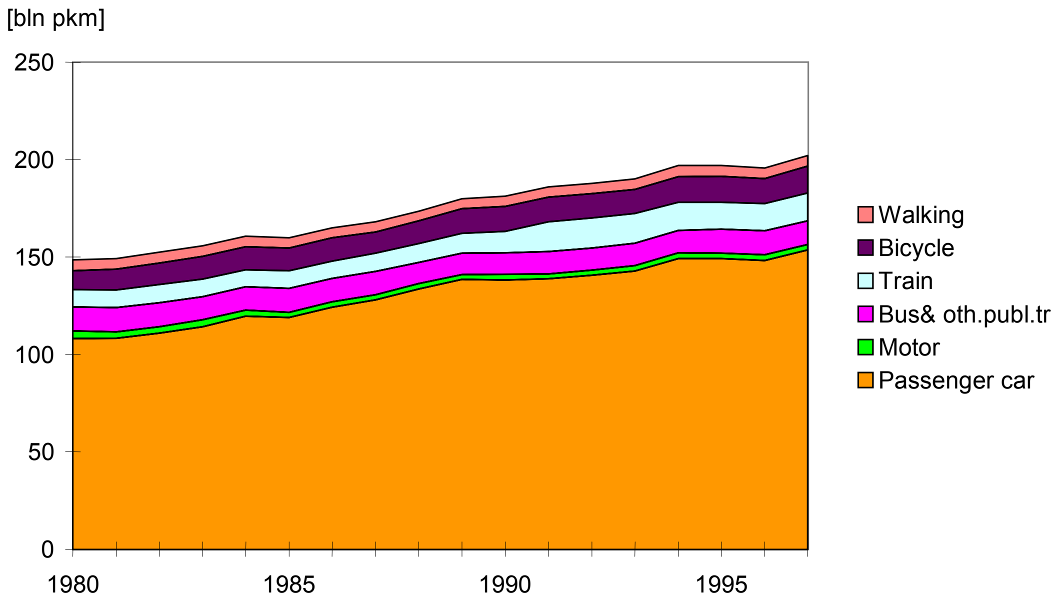

Figure 6.8 *Modal split passenger transport*

The development of the energy efficiency of passenger transport is presented in Figure 6.9 (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.

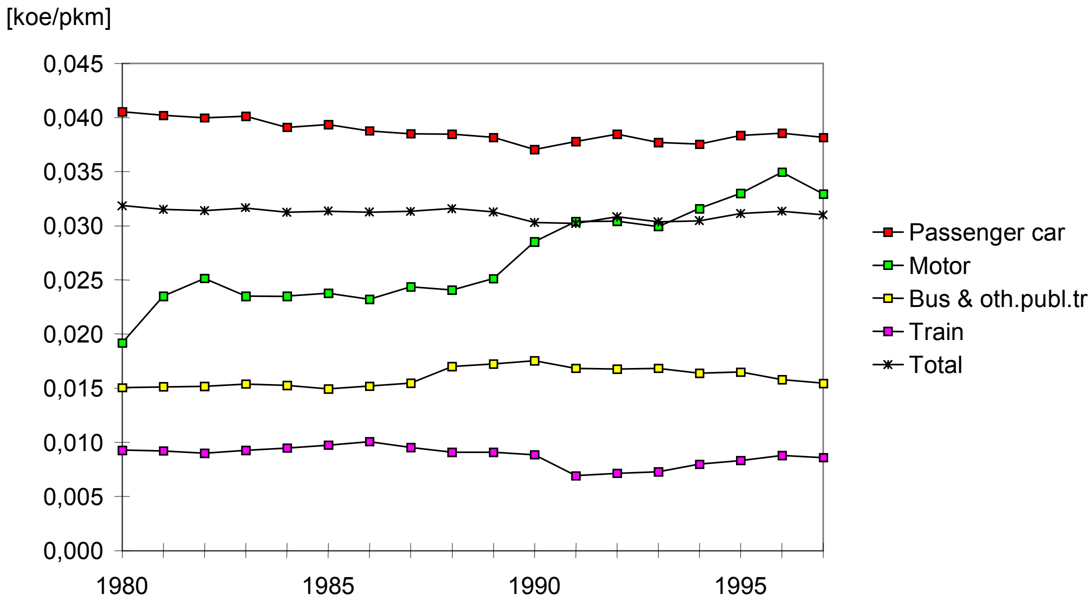

Figure 6.9 *Specific consumption passenger transport*

6.3 Trucks

6.3.1 Specific consumption

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

Figure 6.10 shows that over the years, vehicles became more efficient, but on the other hand some factors resulted in stabilisation of the specific consumption of trucks between 1980 and 1994. 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/km.

6.3.2 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.
- Tonnes 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.

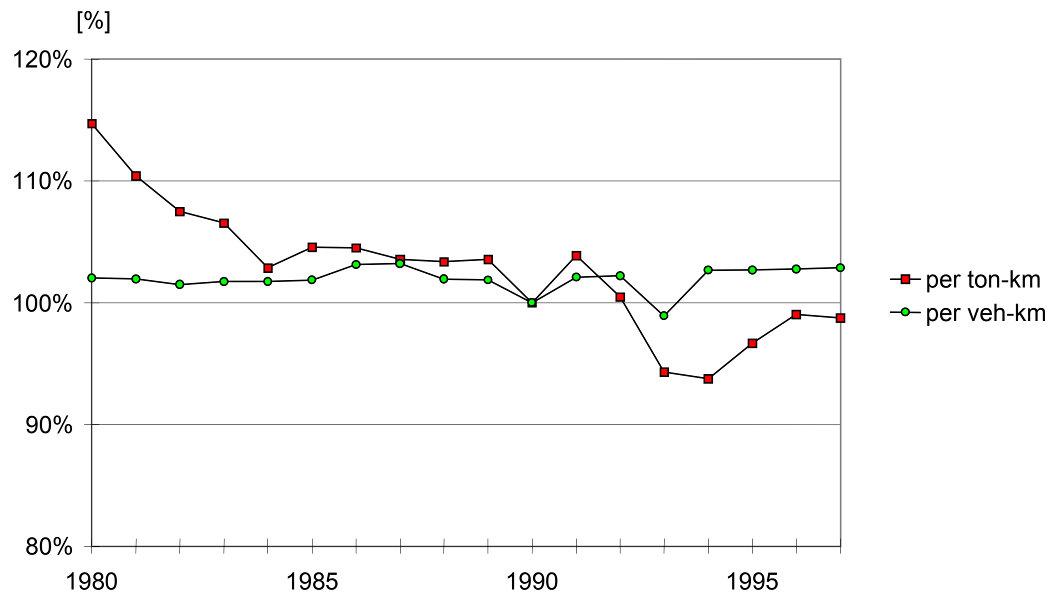

Figure 6.10 *Energy consumption of trucks (1990=100%)*

Figure 6.10 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.

6.4 Energy savings for road transport

The energy savings for road transport, presented in Figure 6.4, 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.

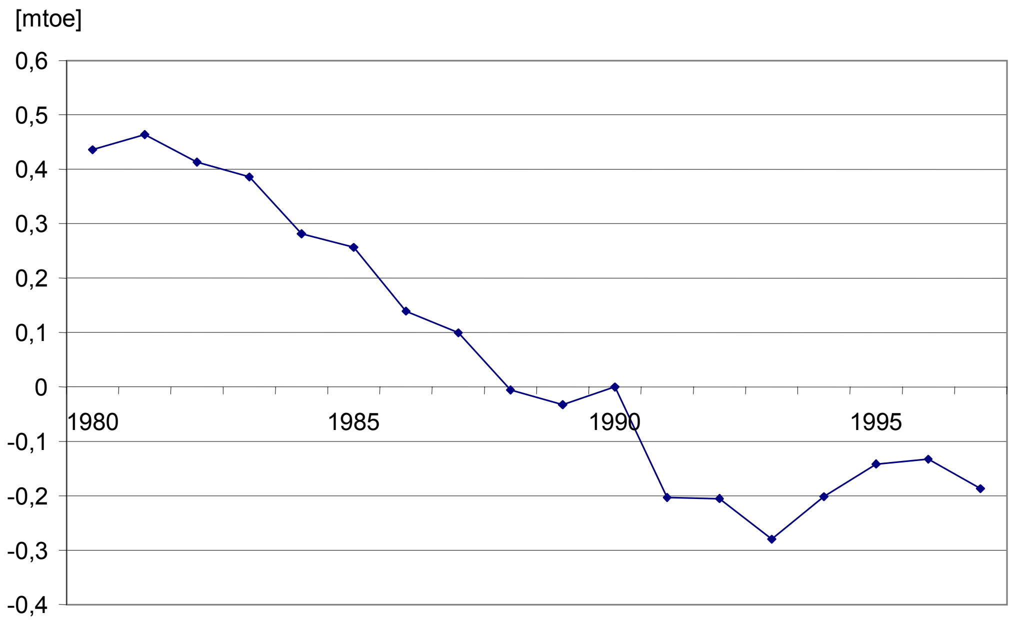

Figure 6.11 *Energy savings for cars and trucks*

The reference year for the energy savings is 1990, which means that savings before 1990 are > 0 and savings after 1990 are < 0. Because of the stabilisation of the savings for cars it can be concluded that the savings after 1990 are mostly due to savings for trucks.

6.5 Water and rail transport

There is limited data available to draw conclusions 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 6.12 freight transport is depicted by mode. In the period 1980-1996 road transport shows a steady increase. Rail transport declined with about 10% and navigation grew with about 5%. Because road transport is the most energy intensive per ton-km, for the complete freight transport sector a growth in energy demand (by the growing amount of ton-km) and specific energy demand (by the growing market share of road transport) can be expected.

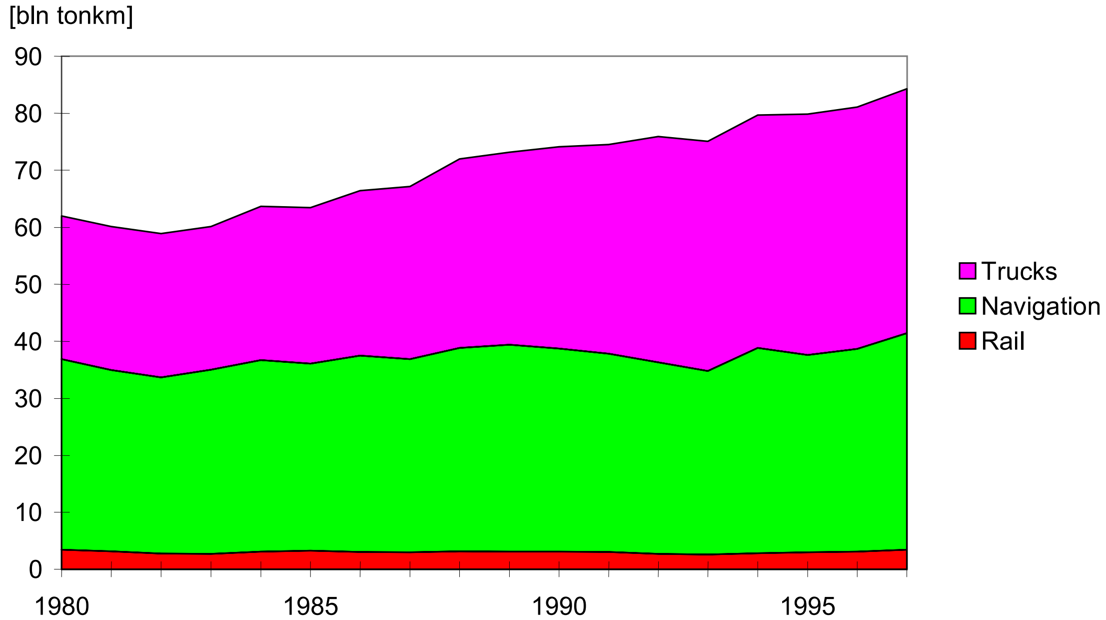

Figure 6.12 *Modal shift in freight transport; ton-km per mode*

In Figure 6.13 the impact of the modal shift on the specific energy consumption can be seen. The specific consumption of rail transport decreased with almost 25% (1980-1996) due to electrification and energy improvements. In primary energy terms the decrease is lower. The specific energy consumption of navigation increased with 8%. 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 18% between 1980 and 1993 but rose again with 5% in 1994-1997. Between 1980 and 1997, modal split effects result in 13% more energy use and efficiency improvements in 11% less energy use. Overall energy consumption per ton km rose with 2% mostly after 1990. 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.

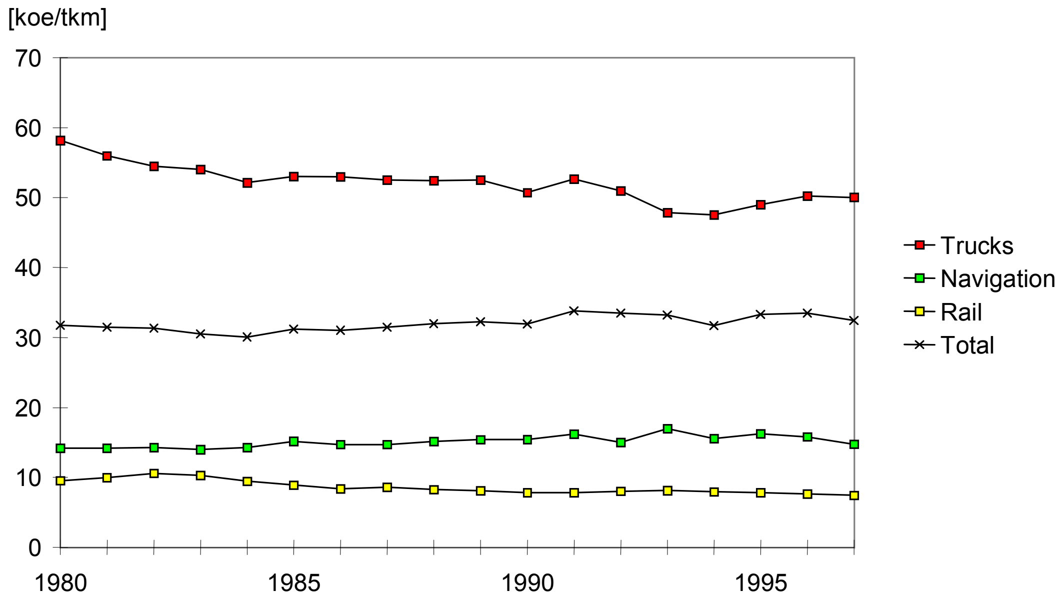

Figure 6.13 *Impact of modal shift on freight transport: energy consumption*

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 Overall energy performance

The following types of energy indicators are considered for the service sector:

- energy intensity,
- unit consumption per employee.

Figure 7.1 shows the variation of the total and electricity intensities.

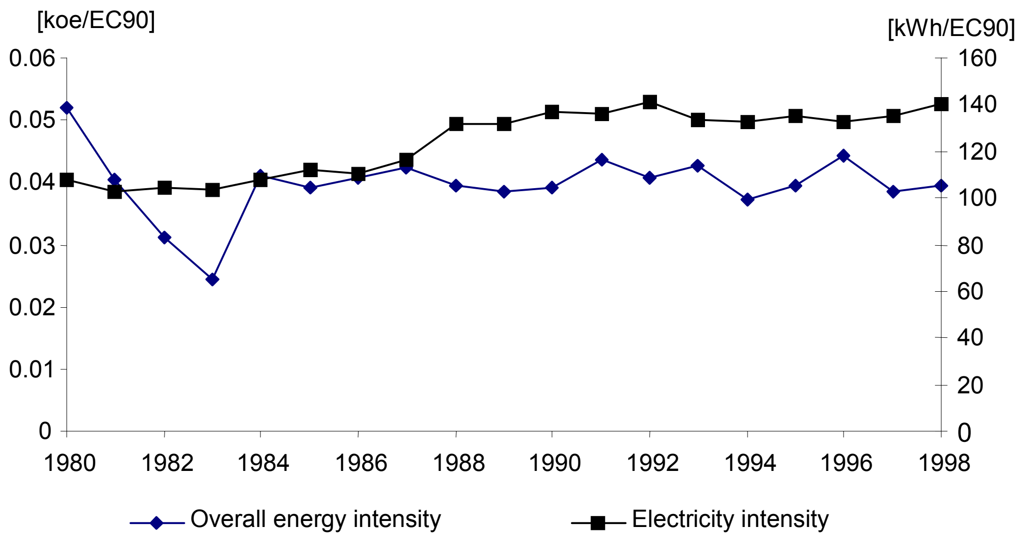

Figure 7.1 *Energy intensity in the service sector*

In the period 1984-1998, the total intensity is relatively stable at on average 0.04 koe/EC90. For electricity, the general trend is an increasing intensity of 1.7%/year on average between 1980 and 1998. Part of the increasing use of electricity is due to penetration of equipment for office automation and climate control.

The unit consumption per employee decreases in the period 1988-1997 with 0.4%/year. (Figure 7.2).

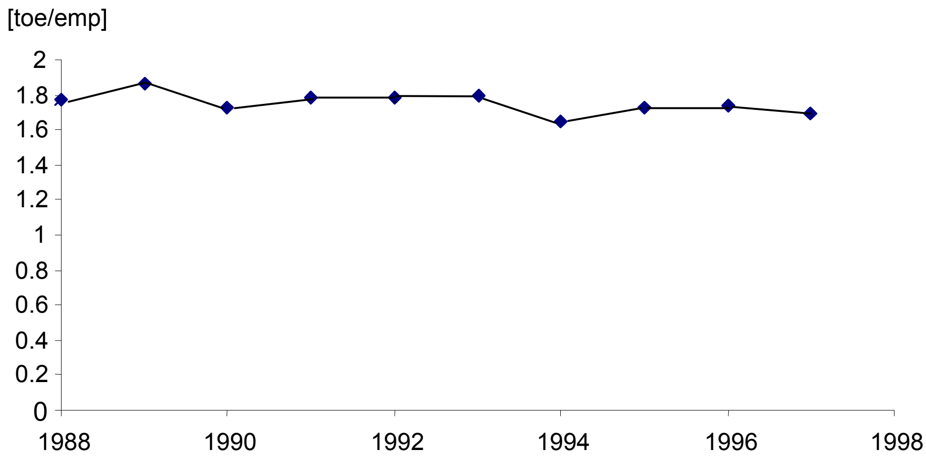

Figure 7.2 *Unit consumption per employee in the service sector*

The difference between the decrease of total energy intensity and the decrease of unit consumption per employee is almost zero, meaning that the change in average labour productivity within the service sector is small within this period. These two indicators can provide an assessment of energy efficiency trends in the sector from an economic viewpoint.

7.2 Indicators by branch

Five activities are considered in the service sector:

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

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

The hotels and restaurants branch turns out to be more than three times as energy intensive than commerce and the average of the sector (see Figure 7.3). On average, the intensity of the hotel and restaurant branch and commerce increased by about 0.2%/year in 1993-1997, trade decreased by 1.1%/year, government increased by 1.2%/year and education decreased by 2.3%/year.

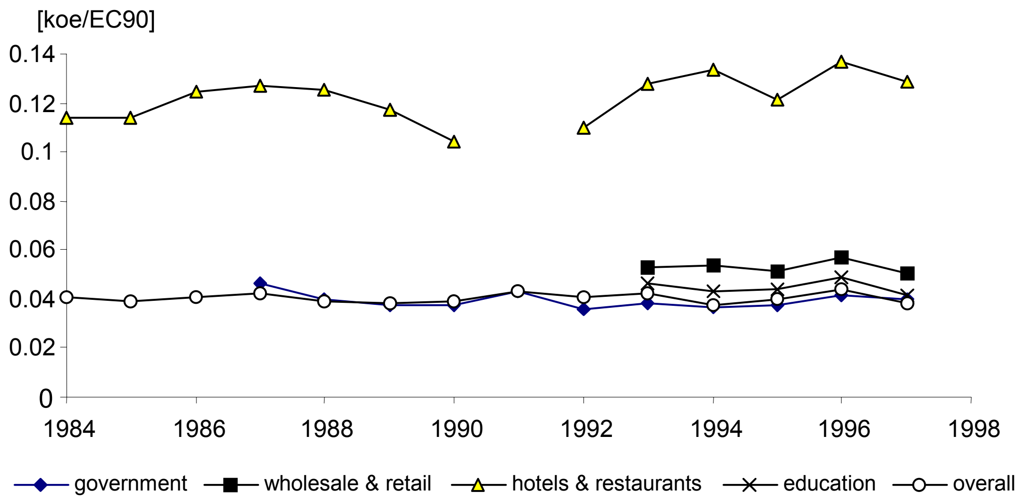

Figure 7.3 *Energy intensity by branch*

Figure 7.4 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.

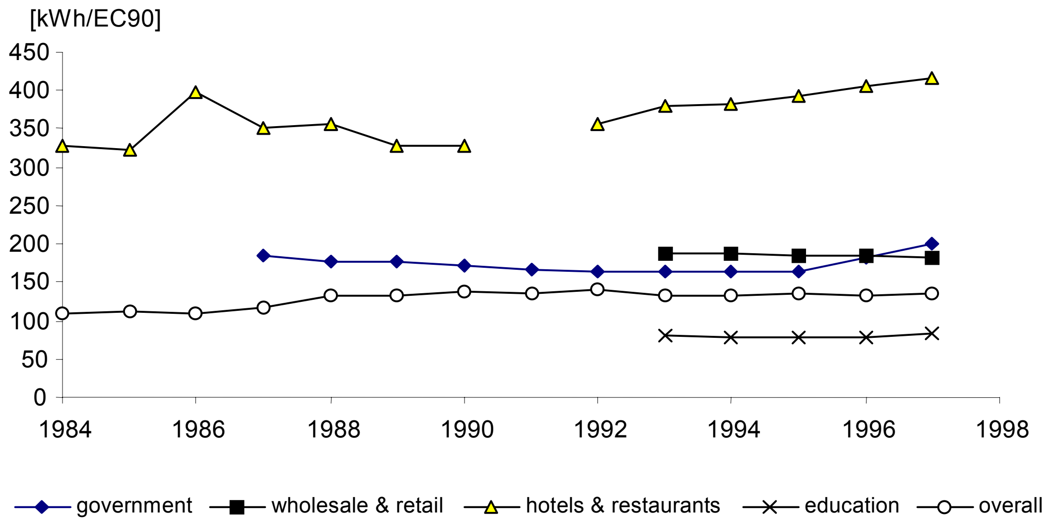

Figure 7.4 *Electricity intensity by branch*

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 NEEDIS (National Energy and Efficiency Data Information System), operated by ECN Policy Studies (Blok et al., 1997). 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. NEEDIS 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 1983-1997/1998, and updates are carried out each year.

NEEDIS 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 NEEDIS. 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 1999 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 [7]	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 Inorganic chemical industry Other basic chemical industry Chemical products	24141, 24142 2413 rest 241, 247 rest 24
Building materials, ceramics and glass industry	32	Building materials	26
Basic metal industry	33	Basic metal - iron and steel Basic metal - non-ferrous	271-273 (partly), 2751, 2752 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.

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

Apart from NEEDIS, 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).

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 1999

Compared to Phase 4 of the project (van Dril et al., 1999), 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, the 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. Next year, the data for value added according to the new definitions will be published in consistent time series as of 1986.

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.

Tertiary
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 1998. For electricity consumption, this report has not been published to date.

Transport
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.

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 efficiency improvement slowed down to an average rate of 0.7% annually.

In the period 1982-1998, total final demand has increased with 25%. The service sector doubled whereas households remained relatively stable. 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.

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

For the manufacturing sector, the results of monitoring Long Term Agreements show an efficiency improvement of 19% up to 1997, whereas energy intensity has decreased only 1% and efficiency compared to final consumption only grew 5%. 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.

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. This report has focused on the electricity consumption per dwelling in The Netherlands, which 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 *perform-*

ance 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?
Despite an increase in vehicle efficiency, the energy consumption for road transport keeps growing.
- 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. 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. 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. In addition, a system of fuel efficiency labels for new cars is under development. The energy label shows the buyer immediately how efficient the car is compared to others. Finally, there is an EU policy, based on agreements with car producers on lowering fuel consumption of new passenger cars.
- 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 1980 and 1997, *modal split effects* result in 13% more energy use, while efficiency improvements result in 11% less energy use. Overall energy consumption per ton km rose with 2%, mainly after 1990. 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 in changes in overall energy efficiency.

What are the main trends with respect to energy efficiency 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. This is compensated by improvements in labour productivity and building insulation. The hotels and restaurants branch turns out to be more than three times as energy intensive as the average of the sector.

What is the status of data collection?
Data collection according to ODYSSEE requirements has considerably improved. Matters still to be dealt with in the next phase of the project 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 cars and appliances.

A complicating factor in this respect is that in the liberalising market, some data previously published by utilities now are regarded confidential. It concerns mainly natural gas and electricity consumption data for households.

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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 ON DSM BUDGETS AND POLICY MEASURES IN THE NETHERLANDS

B.1 Existence of a national DSM programme[8] :

Yes ❐ No ✘

Name: There is no national programme.

Objectives[9]:

1. The Action programme Energy Conservation 1999-2002, which was published in summer 1999, sets a target for appliance energy efficiency improvement (in households) of on average 1.8% per year in 1995-2010.

2. The Environmental Action Plan of the Dutch utilities formulates its objectives in terms of CO_2 emission reductions; 17.000 tons reduction in 2000, compared to 1991. For households, one of the objectives is 1.6 million MWh in 2000.

Results achieved (electricity savings) in 1997: 160.000 MWh in households (by Environmental Action Plan, government incentives will have achieved additional savings)

B.1.2 National budgets for DSM programmes

Not available. Only budgets for energy conservation are published, because DSM (electricity savings) is not subject of separate programs.

B.1.3 Electricity pricing: energy/environment tax

Table B.1 Taxes

Sector	First year	Total tax level[10] [%]	
		1998	1999
Households	1996	12.7	19.9
Services	1996	12.5	12.7
Industry	1999	0.0	1.8

Notes:

- The percentages should be regarded as highly indicative, and have been derived under certain assumptions. The Regulatory Energy Tax is levied as absolute amounts, only dependent on the consumption levels. Also, tariffs are not given by sector, but based on consumption levels and operation hours within three categories: small scale residential (6 tariff classes), small scale non-residential (6 tariff classes), large consumers (32 tariff classes). Especially in the services sector, there is a large variation in consumption (compare small shops to

[8] Programme with quantitative targets of electricity savings

[9] Summarises quantitative objectives (e.g. 10 % reduction in electricity consumption of specific sectors, 2000 MW savings...)

[10] Percentage of consumer price for specific environment or energy tax (excluding usual excise tax)

hospitals), so the sector distinction is quite artificial in this case. Tariffs also slightly differ by utility, national averages have been used. The table below shows the assumptions.

- As of January 1, 1998, the tax is not levied on electricity from renewable sources, the so-called 'Green electricity', which is sold to households at a higher price than regular electricity.

Table B.2 *Electricity prices and taxes*

Sector	Assumed standard annual consumption	Tariff excl VAT, incl levies [ct/kWh]		Tax consumption class [kWh]	Tax level [ct/kWh]	
		1998	1999		1998	1999
Households	3000 kWh	23.20	24.9	800-10.000 kWh	2.95	4.95
Services	Non residential small scale consumers 10000 kWh	23.66	25.43	10.000-50.000 kWh	2.95	3.23
Industry	1000kW/5000h	11.91	12.01	> 50.000 kWh	0	0.22

Table B.3 *National efficiency standards*

	Year[11]	Status[12]	%Saving[13]	Summary[14]
Refrigerators	1999	M		Max specific consumption in kWh/day dependent on type of refrigerator; consistent
Freezers	1999	M		with EU legislation (EN-153, Dir. 96/57/EC)
Lighting				
Air conditioning				

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

[11] *Years of implementation* for mandatory standards (e.g. 1989) or *reference years* for target values (e.g. 2000) ; if standards reinforced in several steps indicate each year of revision.

[12] *M* = Mandatory ; ***V*** = Voluntary or target value ; ***C*** = under consideration.

[13] ***% savings*** compared to energy efficiency performance (i.e specific consumption) before standards (e.g. 20%), or *target values* (e.g. 15% in 2000), (specify reference dwelling or appliance when necessary, e.g. multifamily dwelling, 200 liters refigerators...).

[14] Specify the *efficiency standards unit* : e.g heat loss lower than ...Gj or toe/m2, specific consumptio lower than... kWh/year for refrigerators, liters/100km (or km/year) for cars ; energy efficiency above...% for air conditionners (EER) or for boilers ; if necessary, add new lines and/or footnotes.

B.3 Implementation of Commission Directives

Tabel B.4 *Efficiency requirements*

	Year	Summary
Refrigerators	1999	Directive 96/57/EC
Freezer	1999	Directive 96/57/EC

Table B.5 *Labelling*

	Year	
- Refrigerators	1996	Directive 92/2/EC (21/01/94)
- Freezers	1996	Directive 92/2/EC (21/01/94)
- Washing machines	1996	Directive 95/12/EC (23/05/95)
- Dish washers	1/8/1999	Directive 97/17/EC (16/04/97)
- Dryers	1996	Directive 96/60/EC (19/09/96)
- Lamps	1/1/2001	(01/98)

B.4 Fiscal and economic incentives (related to electricity savings)

Regeling Energiepremies (for households, starting July 1999): buyers of efficient (A-class) appliances will receive a financial incentive.

Activities by utilities (Environmental Action Plans):

- Information campaigns for households to stimulate the purchase of energy efficient lamps (CFLs), and to stimulate the purchase of energy efficient appliances.
- In January 1997, the utilities have established a fund that enables Small and Medium sized Enterprises to finance investments in energy efficiency with a reduced discount rate.
- Subsidies to energy efficient cooling equipment for food storage and preservation (service sector).

The incentives below (by the government) are not especially for electricity savings, but include savings on all energy carriers:

- The Energy Investment Allowance (EIA) offers a lower corporate tax in the first year by deducting 30-40% of the investment sum from the profit in that year. This is equivalent to a subsidy of 14-18%. The investment must concern specific energy saving technologies or renewables.
- The Accelerated Depreciation of Environmental Investments programme (VAMIL), gives a corporate tax advantage to companies that invest in specific energy saving measures or environmentally friendly technologies.

ANNEX C UNITS

1 koe (kilo oil equivalent)	=	41,868	MJ
1 toe	=	41,868	GJ
1 Mtoe	=	41,868	PJ
1 EC90	=	1	ECU in 1990 prices