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CASE STUDIES ON ENERGY CONSERVATION AND EMPLOYMENT IN THE NETHERLANDS

Subsidy on Condensing Boilers, Subsidy on Energy Management Systems and Introduction of an Energy Performance Standard (EPN)

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Abstract

Three recent policy schemes for energy conservation in the Netherlands have been studied to assess the quality and the size of their employment impacts. These are the subsidy for HR-boilers in the context of the Environmental Action Plan (MAP), Energy Management Systems in the industrial sector as part of the subsidy program TIEB, and the Energy Performance Standard EPN, a regulation that sets demands on the energy performance of new dwellings. Because no figures on the employment impacts were readily available all case studies have involved interviews to estimate these impacts and many assumptions had to be made for a quantitative assessment. Although no solid figure results on the exact number of jobs created, the studies do give an indication of the quantity of work involved and do provide insight in the nature of the employment generated and the skills required for the work that results from these energy conservation policies.

Acknowledgement

This report contains three case studies on the direct employment effects of three energy conservation schemes in the Netherlands. These case studies have been performed in the context of the study ‘Employment effects of energy conservation’, commissioned by the Directorate Energy (DGXVII) of the Commission of European Communities. The aim of this study is to assess the quality and the size of the employment impacts of selected energy conservation policies in EU member countries.

The study ‘Employment effects of energy conservation’ is published in the synthesis report ‘National and Local Employment Impacts of Energy Efficiency Investment Programmes’, SAVE contract XVII/4.1031/D/97-032, Final report to the Commission, September 1999, Volume 1: Results and Task Reports. ECN Project number is 7.7130.

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SUMMARY

For the Netherlands three quite recent policy schemes for energy conservation have been studied to assess the quality and the size of their employment impacts. The first case is the subsidy for HR-boilers, granted from 1991 to 1996 in the context of the Environmental Action Plan (MAP). The second case is on Energy Management Systems in the industrial sector, for which subsidy has been granted between 1991 and 1994 as part of the subsidy program TIEB, Tenders Industrial Energy Conservation. The third case is the Energy Performance Standard EPN, a regulation introduced towards the end of 1995, that sets demands on the energy performance of new dwellings.

As generating employment was not the aim of these energy conservation measures, no figures on the employment impacts were readily available. All case studies therefore have involved interviews to estimate these impacts. Many assumptions had to be made for a quantitative assessment of the employment impacts of the energy conservation measures. No solid figure results on the exact number of jobs created because of these energy conservation programmes. However, the studies do give an indication of the quantity of work involved and do provide insight in the nature of the employment generated and the skills required for the work that results from these energy conservation policies.

On the subsidy for HR-boilers it can be concluded that a total number of 350 temporary jobs is created for the period of the subsidy, if one assumes a direct relation between the subsidy and the number of subsidised HR-boilers sold. The government grants sum up to 10.2 million ECU. The employment concerns mainly installation of boilers and work involved with the production and sales of the boilers by the manufacturers and for a very small part the implementation of the subsidy. However, for the 15 years period that the HR-boilers are in operation, annual maintenance is needed and this generates a number of 180 full time jobs for a long period. In this case the energy saved over the lifetime of the subsidised boilers amounts to 42.9 PJ.

Even under rather optimistic assumptions, the TIEB programme focusing on energy management systems generates a very limited number of direct jobs, with a total employment of 25.5 person-years. Based on the interviews, between 1990 and 1994 the number of temporary jobs in the field of computer sciences is regarded to be most extensive. Maintenance and operation activities have a large part in the generated direct employment with 12.5 person-years. The government expenditures sum op to 1.3 million ECU on grants and administration costs. From an energy point of view, energy management systems are interesting. It concerns profitable investments that can serve other objectives in the company too. The energy saved per company varies between 1% and 20% of the initial energy demand. The energy saved over the lifetime of the eleven systems installed sums up to 9.6 PJ.

Because definite data on the effects of the Energy Performance Standard EPN are not yet available, the impacts must be regarded as indicative for the effect of this energy conservation scheme. Given the assumptions on the amount of work resulting from the EPN and the share of this work that is done by existing staff, the amount of new jobs created because of EPN are in the order of 100. Most of these are in the installation and maintenance of HR-boilers by skilled and semi-skilled blue-collar workers. The number of jobs in the design of houses with a sufficient energy performance is likely to increase in the future. The same holds for jobs doing calculations required for this purpose. Sharpening of the EPN will lead to more complex solutions and the new employees that can handle these matters are likely to be recently graduated professional managers (academic or higher vocational training). The government expenditures (rent subsidy and administration costs) are estimated to be 3.7 million ECU. In terms of energy saving the impacts of the introduction of the EPN, setting the EPC to 1.4, are limited to 4.0 PJ in the first year, 1997. However, the measure is promising with respect to future results, as can be concluded from the technological innovation towards more efficient installations that has been initiated by the prospect of sharper EPC values in the near future.

1. INTRODUCTION

This report contains three case studies on the direct employment effects of three policy measures for energy conservation in the Netherlands. These case studies have been performed in the context of the study ‘Employment effects of energy conservation’, commissioned by the Directorate Energy (DGXVII) of the Commission of European Communities. The aim of this study is to assess the quality and the size of the employment impacts of selected energy conservation policies in EU member countries.

The case studies are the first in sequence of three approaches that contribute to the study on employment effects. The case studies result in detailed - micro level - information on selected policy programmes and instruments, assessment of the energy impact and direct employment effects in qualitative and quantitative terms. Part of the information gathered in the case studies is used for the other two approaches, that use models to asses the induced financial and employment impacts and the impact on the overall economy. Consumption I/O models assess the direct, indirect and induced - meso level - impacts of programmes and instruments for the residential sector; a general equilibrium model (GEM-E3) assesses the - macro level - overall impacts of packages of policy instruments.

Beside the Netherlands eight other countries have performed case studies: Austria, Finland, France, Germany, Greece, Ireland, Spain and the United Kingdom. Together with the modelling studies, the case studies of all countries are presented and analysed in the synthesis report ‘National and Local Employment Impacts of Energy Efficiency Investment Programmes’, SAVE contract XVII/4.1031/D/ 97-032, Final report to the Commission, September 1999, Volume 1: Results and Task Reports.

As generating employment was not the aim of the energy conservation measures studied, no figures on the employment impacts were readily available. All case studies therefore have involved interviews to estimate these impacts. No solid figures result on the exact number of jobs created because of these energy conservation programmes. However, the studies do give an indication of the quantity of work involved and do provide insight in the nature of the employment generated and the skills required for the work that results from these energy conservation policies.

2. HIGHLY EFFICIENT HEATING BOILERS

2.1 Outline

Title of scheme:	Subsidy for HR-boilers.
Country:	the Netherlands
Type of programme:	Grant
Founder:	Energy Distribution Utilities and National Government
Timeframe:	1991-1996
Implementers:	Energy Distribution Utilities
Sector:	Domestic
Measures:	HR-boilers
Energy saved:	42.9 PJ (1991-2010)

2.2 Statement of limitations

The data used in this case study are to a large extent based on the interpretation of incomplete information or sets of data. In particular the information needed to determine the additional employment generated within the companies producing highly efficient heating boilers is due to confidentiality issues incomplete and should therefore be interpreted with care.

The aim of this case study is to assess the impact of a subsidy on the purchases of highly efficient heating boilers. Highly efficient heating boiler is abbreviated as HR-boiler in this report. HR stands for Hoog Rendement, which is Dutch for High Efficiency. The impact of a subsidy is hard to determine and can vary between rather wide ranges, depending on the role that is given to the free-rider issue and to the spin-off effect of such an instrument. This is explained in the chapter itself more elaborately.

Given the boom in the sales of HR-boilers in the period 1991-1996 one can argue that the product was on the edge of breaking through and that the subsidy gave it that tiny push that was still needed. The growth in the number of HR-boilers would have happened anyway, but with the help of the subsidy some time was gained. This is to be considered when applying the subsidy on a larger scale. In the figures used in this case study, the time gaining effect is not incorporated in the analysis.

2.3 Introduction

The Dutch energy distribution companies have, in consultation with the Ministry of Economic Affairs, committed themselves to a certain degree of energy efficiency improvement and CO_2 reduction in the period 1991-2000. The first Environmental Action Plan (MAP[1]) came into force in 1991. Updates were published in 1994 and 1997. The overall aim is a reduction of CO_2 emissions in the period 1991-2000 with 17 Mton. Target groups in this MAP are households, tertiary sector, industry, heat market, renewables and other technologies.

[1] The Dutch abbreviation MAP (Milieu Aktie Plan) is so often used in documents, that we prefer to use that abbreviation instead of EAP, which would be the English version.

In order to finance the MAP, the energy distribution sector receives money from the government. In addition, the sector has been permitted by the Dutch government to put a levy on the end-use price of electricity and gas of 2.0% (maximum since 1997). The revenues, about 246 million guilders in 1994, are recycled in the MAP system to promote energy conservation measures.

Due to the introduction of the MAP, energy conservation for households is now largely controlled by the distribution companies, with the exception of the standard setting for heating of new buildings. Regarding the MAP we therefore focus on the target group households, though also small and medium-sized enterprises (SMEs) are captured by the utility related MAP system. Activities for households concern the promotion of efficient heating boilers, (additional) insulation measures and the use of more efficient electric appliances. Furthermore, attention is given to information campaigns, energy advice teams and good housekeeping.

The progress of the implementation and impacts of the MAP is monitored and reported every year by the distribution companies. Reporting is mandatory in the MAP legislation, however double counting with respect to achievements shared with other sectors occurs. By the end of 1996, 42% of the overall objective was achieved. Concerning the households, it is stated that residential energy consumption would have been 7% higher without the MAP. The present growth in households energy demand is limited to 5% over the period 1991-1996.

The MAP can be regarded as an umbrella policy instrument or a framework for different energy policies. Some instruments are meant to support other MAP activities, by information campaigns or by introducing energy efficiency teams that try to get local consumers to improve their rational use of energy. Other instruments have an independent function, like a subsidy for efficient heating boilers. Since the MAP is too extended for a case study, the subsidy for households buying a highly efficient heating boiler is selected as a case study.

History

The subsidy was introduced in 1991 by merging two separate measures, which were introduced the year before by the Dutch government. It concerned one measure by the Ministry of Economic Affairs, focusing on the promotion of more efficient heating boilers, and another by the Ministry of Environment, focusing on a reduction of the NO_x emissions in the built environment. These two measures were combined in the Subsidy for low-NO_x and energy efficient heating boilers (SNEV). The subsidy was financed by the government and the energy distribution sector (both 50%). When in 1993 the number of applications for a subsidy exceeded the available budget for that year, the subsidy was stopped for a few months. Beginning 1994 the energy distribution companies reintroduced the subsidy under the name ISO-HR. The measure was financed by the revenues from the MAP-levy. Per 1 January 1996, boilers for newly built houses were excluded from the subsidy. On 1 July 1996, the subsidy for households was definitely stopped. It was argued that from that moment, the highly efficient heating boiler would not need additional financial support to penetrate into the heating market for households. Furthermore, the Energy Performance Standard which was introduced in December 1995 for new houses has made the highly efficient heating boiler the standard boiler for newly built houses (see also the case study on the Energy Performance Standard).

Technical and financial information

The highly efficient heating boiler is a condensing heating boiler. In Dutch it is called an HR-boiler. The boiler was introduced in 1981 by some manufacturers of heating boilers together with the Dutch supplier of natural gas (Gasunie). The penetration of the HR-boiler in the eighties was not very successful; the market development kept behind the expectations. Only in the nineties did the HR-boiler gain a substantial and rapidly increasing market share in the Dutch heating boiler market.

Two kinds of HR-boilers exist, one is the solo boiler without a hot water tap, the other one is a combi-boiler including a hot water tap. Its energy efficiency is very high, 95% to 97% by now, and the NO_x emissions are very low, less than 20 ppm. Therewith the HR-boiler is from an energy and environmental point of view more attractive than the conventional boilers with an efficiency of less than 70% and newer VR-boilers with an efficiency of 80%. VR stands for Verbeterd Rendement, meaning improved efficiency. The VR-boiler is not a condensing heating boiler but an improved conventional boiler.

By replacing a conventional boiler by an HR-boiler a household can save 25 to 30% of its energy use and energy bill. Since the alternative for buying an HR-boiler is at the moment the VR-boiler, the additional costs and savings in this case study are related to the VR-boiler. That is, the reference is regarded to be the VR-boiler. Compared to that reference situation, the heat demand of a household will reduce by 10 to 15% when installing an HR-boiler. Depending on the total energy demand and energy prices, a household can therewith save ƒ 100 to ƒ 240 per year on the energy bill.

However, the HR-boiler is also more expensive. Prices for the HR-boiler are ƒ 600 to ƒ 900 higher than the VR-boiler, although the price difference between a HR-boiler and VR-boiler has decreased over the last years. Furthermore, depending on the building construction, the installation of an HR-boiler is ƒ 500 to ƒ 900 more expensive, excluding VAT. Finally, due to the more complex technique of an HR-boiler, the annual maintenance costs are on average ƒ 100 higher than for a VR-boiler.

The total amount of energy saved by the HR-boilers installed thanks to the subsidy is estimated to be 42.9 PJ over the lifetime of the boilers.

2.4 Description of the subsidy scheme for HR-boilers

Aims of the subsidy
With the subsidy, the government and energy sector wanted to stimulate households to overcome the financial barriers to invest in a more efficient but also more expensive heating boiler. An increase in the number of installed HR-boilers was needed in order to achieve the objectives set in the national Memorandum on Energy Conservation and the MAP.

From 1 January to mid 1993, the subsidy per HR-boiler was ƒ 350, of which ƒ 175 was paid by the Ministry of Economic Affairs and ƒ 175 out of the MAP-levies. In 1994 the subsidy was reduced to ƒ 200 per heating boiler, fully paid by the energy distribution sector, out of the MAP-levies. In 1996 the subsidy was reduced to ƒ 150 guilders, still paid out of the MAP-levies, but then only available for existing buildings. On 1 July 1996 the subsidy for households was stopped whereas it is still available for SMEs. It was argued by the energy sector that the HR-boiler for households did not need additional financial support, neither for new nor existing houses. For SMEs the subsidy is continued, since in that sector energy investments meet still many implementation problems, among which a financial barrier.

Procedure
The subsidy is only provided when the heating boiler fulfils rather strict standards with regard to energy efficiency, emissions and noise and when the instalment has been taken care of by a professional registered installer. Before 1994, households that wanted to receive the subsidy had to fill in a particular paper within six weeks after the instalment of the heating boiler and give this to the local energy distribution company. The energy distribution company paid the full ƒ 350 to the household and afterwards was paid back ƒ 175 by the Ministry of Economic Affairs via Senter, an agency of the ministry implementing subsidy measures. Since 1994, the energy distribution companies take care of the subsidy and application procedure themselves.

Starting and ending date
The subsidy was introduced on 1 January 1991 and was ended on 1 July 1996.

Lifetime HR-boiler
The lifetime of an HR-boiler is assumed to be 15 years, that is according to the standards used in other research in this field.

Monitoring methods
All energy distribution companies have provided their branch organisation, EnergieNed, yearly with figures on subsidies provided for HR-boilers for both households and SMEs. EnergieNed then calculated, on the basis of the number of boilers mentioned in the national statistics, the extent to which the sector could claim a certain amount of avoided CO_2 emissions due to the subsidy. In the period 1991-1996 a total number of 319.800 HR-boilers for households have been subsidised.

Possible effects on employment
It is expected that the subsidy has caused a growth of the number of HR-boilers sold. Because of the increased demand, manufacturers of heating boilers are likely to have increased their production and therewith probably needed additional employees. Furthermore, since the installation of an HR-boiler takes more time, the installer branch is expected to have experienced an increased demand too. Finally, the energy distribution companies needed additional people to take care of the implementation of the subsidy measure.

2.5 Market development of the HR-boiler

Figure 2.1 shows the number of heating boilers smaller than 30 kW sold in the period 1991-1996. In the graph, all HR-boilers, subsidised HR-boilers and standard VR-boilers are distinguished. It is clear that the share of HR-boilers in the market for smaller boilers has been increasing over time whereas the total market has not increased drastically. In 1986, the total market share of the HR-boiler was about 10%. For small boilers it was 35% in 1991 and from 1995 onwards the HR-boiler market share exceeded the share of less efficient boilers.

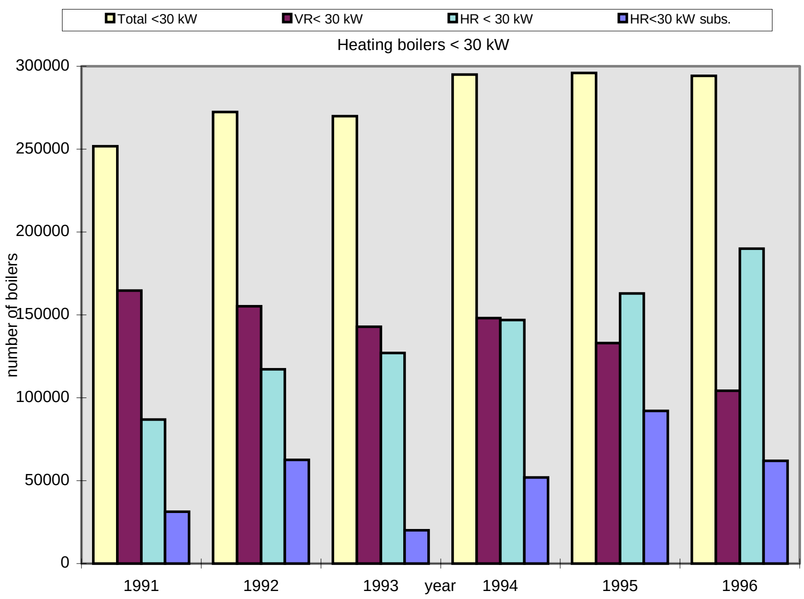

Figure 2.1 *Number of heating boilers < 30 kW sold from 1991-1996. Total, VR-, HR- and subsidised HR-boilers*

The figures show that in the period 1991-1996 the market share of less efficient boilers decreased at the benefit of the HR-boiler. However, on average only 38% of the HR-boilers sold in that period have been subsidised. Apparently, many households did not know or did not need the subsidy to overcome the financial barrier and decided to buy this HR-boiler for its comfort, the environment or other reasons. The other activities of the energy companies within the framework of the MAP, e.g. information and communication campaigns, might indirectly have caused an increased interest in the more expensive and efficient HR-boiler as well.

Import/Export
From the statistical data on heating boilers, it appeared that the Dutch domestic market for heating boilers exceeds the domestic production already since many years. The share of imports of heating boilers (< 30 kW) in the total domestic demand varies between 45% and 65%. Although that figure has decreased slightly over the years, imports still play an important role in the Dutch domestic market for heating boilers.

Unfortunately, the figures available on imports do not distinguish between HR-boilers and VR-boilers. This means that it is not clear to what extent the subsidy measure was used for HR-boilers produced in other countries. It can be argued though that the share of HR-boilers in the imports is to be neglected or is very small. After all, Dutch producers have been the leading companies in producing the advanced HR-boiler and foreign producers have in that respect been behind for a few years.

On the basis of the information gathered it can be concluded that Dutch producers of boilers have decided to concentrate on the production of HR-boilers and neglect the development of the VR-boiler. That market segment was taken care of mainly by foreign producers. So, the import of boilers concerns VR-boilers. The import share of heating boilers is thus decreasing over the years due to the fact that the domestically produced HR-boilers have gained a larger market share at the cost of foreign VR-boilers.

The import only concerns import from EU countries and is assumed to concern only a very small number of additional jobs in the production of heating boilers in the beginning nineties. When the subsidy became successful, the number of VR-boilers bought in foreign countries decreased. In the data presented in Tables 2.1 and 2.4, the employment for the production is not distinguished in domestic and foreign jobs. The installation and maintenance of imported boilers is taken care of by Dutch employees.

2.6 Study method

It was stated in the introduction of this chapter that we assume that with no subsidy, households would have bought a less efficient VR-boiler instead of a more expensive HR-boiler. However, it is clear that the market growth of the HR-boiler can not only be related to the subsidy, simply for the reason that the largest share of the HR-boilers was sold without a subsidy. Over the period 1991-1996 only 38% of the people that bought an HR-boiler < 30 kW received a subsidy. One could state that some households that wanted to buy an HR-boiler anyway, could buy their boiler for a lower price thanks to the subsidy. These households are in the literature referred to as free riders. It is not clear how many people belong to this category in the case of the HR-boiler.

However, it can be argued that other factors had a strong influence on the successfulness of the boiler too. More institutional research on the development and the penetration of the HR-boiler in the Dutch heating boiler market shows that many more barriers than the financial barrier hindered the selling of HR-boilers in the eighties.

Examples of other barriers are:

- Conceptual barriers: manufacturers of heating boilers have a rather technical marketing vision, installers opposed to changes and feared that the HR-boiler would cause technical problems, installers lacked the time for additional education, consumers lacked the knowledge on their energy use and options for new boilers.
- Technical barriers: the solutions to some technical problems were not communicated widely so problems continued too long and caused a bad reputation for the HR-boiler. The HR-boiler had such technical restrictions that it could not be installed in every type of house.
- Financial barriers: the HR-boiler was more expensive than other boilers and installers were circumvented by do-it-your-self-ers who did not tend to buy more complex boilers. Consumers made poor cost-benefit analyses, regulations forced the social housing sector to increase the rent once an HR-boiler was installed. The European certificate for heating boilers required lower quality standards than the Dutch standards.
- Organisational barriers: installers did not tend to co-operate with colleagues nor with energy companies when introducing new technologies. A branch organisation representing energy suppliers, manufacturers and installers was lacking.
- Educational and communicational barriers: installers often lacked sufficient education for adequate service in case of new boilers and could not meet the requirements of the energy companies. Manufacturers did not know the developments and opinions of installers. Consumers were insufficiently informed about the energy aspects of heating boilers and the energy companies did not focus on the realisation of environmental objectives.
- Environmental barriers: short and long term operational objectives in the Dutch environmental and energy policies were missing and therewith the development of new products was delayed, furthermore methodologies for comparing and improving the environmental aspects of heating innovations were lacking.

This list of barriers is based on an excellent PhD research by H. Brezet, ‘Van prototype tot standaard; de diffusie van energiebesparende technologie’. It concerns an investigation of the diffusion process of HR-boilers in the private household sector in the Netherlands in the period 1981-1992. The book presents among others a list of barriers (in this case study not completely rewritten) that hindered the diffusion of the HR-boiler in the heating market in the eighties.

It can be stated that by now, some of these barriers have been removed or reduced. The government presented some clear energy objectives for the year 2000 which were picked up by the energy sector. Installers and manufacturers do co-operate more than before. The extra costs of HR-boilers have decreased over time thanks to larger production scales and new technological changes. The energy distribution companies have, stimulated by the objectives in the MAP, taken over some of the innovation diffusion tasks of the boiler producers and installers. It became the interest of the energy companies as well that as many HR-boilers as possible were sold.

With this background, other reasons have been provided that make clear that one can not state that the sudden penetration of the HR-boiler in the nineties could be achieved thanks to the introduction of the subsidy. Many more activities supported the penetration of the HR-boiler into the heating market.

However, on the other hand, one manufacturer of HR-boilers clearly has stated in an interview that his company relates the sudden successful penetration of the HR-boiler in the nineties fully to the introduction of the subsidy provided for this boiler. Only then the barriers for households were decreased according to the manufacturer. Only then this particular manufacturer decided to fully concentrate its wide range of activities in marketing, production techniques, advertising, etc., on this particular product.

The analysis above therewith makes it difficult to determine the size of the free rider effect at one hand and the positive spin off effect by the subsidy measure and the institutional and policy changes at the other hand. However, to calculate the employment and energy conservation effect of the subsidy, nevertheless assumptions had to be made with respect to this complex issue.

Based on the qualitative and quantitative information available on the subsidy and the HR-boilers the following was assumed and considered in the calculations:

- The main assumption is that all HR-boilers subsidised in the period 1991-1996 were sold thanks to the existence of the subsidy for this particular boiler. Not one additional boiler was sold thanks to the subsidy and no free-riders did exist. Figures in Tables 2.1, 2.2 and 2.4 and all other figures on employment and energy impacts in this case study are based on this assumption.
- In order to check the validity and the sensitivity of this main assumption, it is also analysed what the impact on employment and energy conservation would have been, if one assumes that 35% of the boilers that were subsidised were in fact very beneficial to a group of free riders that would have bought the HR-boiler anyway. That means that the subsidy has only been effective for 65% of the subsidised HR-boilers.
- On the other hand, calculations are also done for the situation that 90% of all HR-boilers sold were sold due to the existence of the subsidy on the HR-boiler and its positive spin-off. That situation is presented by the upper line in the graph below.

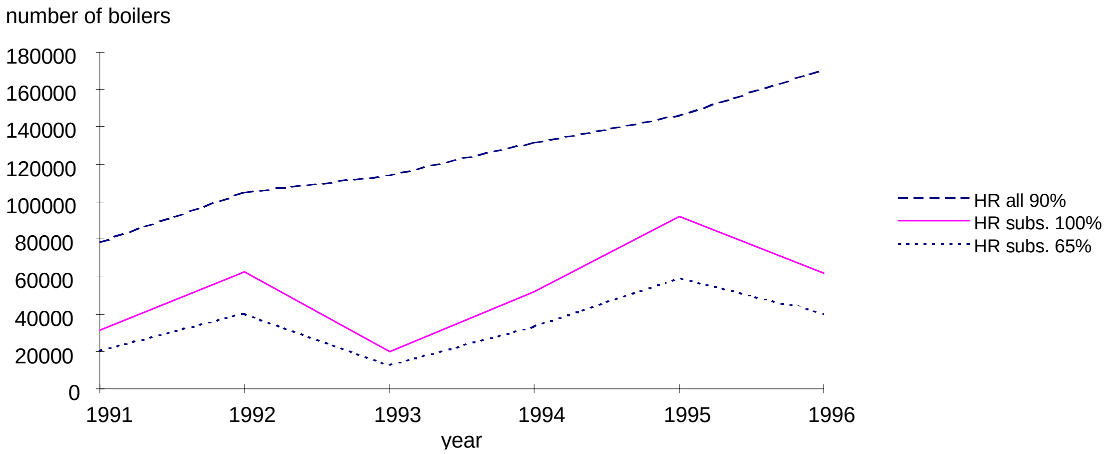

Figure 2.2 *Upper and lower ranges for the possible impact of the subsidy on the number of HR-boilers sold*

Number of subsidised boilers and subsidy budget

The figures for the number of subsidised boilers in 1993 and 1994 are based on an interpretation of different data from various sources (EnergieNed, CBS).

The total budget provided for the subsidy measure was not available. This is partly due to the fact that the measure is both for households and SMEs whereas in this case study we concentrate on households. On the basis of the number of subsidised boilers per year for households, a total provided subsidy budget has been calculated though, which is regarded as fairly accurate. The total subsidy budget for the period 1991-1996 is estimated to be 37 million ECU or 78 million guilders.

Energy saving impact

By collecting data on the subsidy budget involved and the number of boilers (< 30 kW) that has been subsidised each year, it appeared that it is not monitored what kind of households have received the subsidy. This means that the energy saved by an HR-boiler could not be related to the household type, dwelling type and its energy use. However, since most boilers are replaced after 15 years whereas the subsidy measure covers the period 1991-1996, a good indication can be given of the minimum age of the houses. With the help of statistical data on newly built houses and by use of guidelines used by EnergieNed, an accurate guess could be made with regard to the number of m^3 gas saved by installing a subsidised HR-boiler. For the years 1991 and 1992 an amount of 300 m^3 gas is assumed to be saved per house, for the years 1993-1996 calculations are based on the assumption of 275 m^3 gas saved per house per year.

2.7 Qualitative results

Employment in the manufacturing industry

Data on the employment in the manufacturing industry, that is the companies producing heating boilers, were provided by one main producer in an interview. This interview had some unexpected outcomes. It was assumed in advance that a more advanced boiler, given its technical complexity, would take more time to produce then the conventional boilers. However, it appeared that once the subsidy was introduced by the government, the company chose the strategy to concentrate all its effort and research on the optimisation of the production and assemblage process of the HR-boiler. This was done at the cost of the further development of production processes for the standard boilers. Technological development in the HR-boiler production therewith developed impressively fast, whereas for standard boilers the production (process) development stayed behind. To achieve this progress, a lot of R&D was done, partly within the company and partly by external institutes.

A conventional VR-boiler takes by now 1.5 labour hours to produce, whereas an HR-boiler takes on average 0.5 labour hour. At the end of the eighties, an HR-boiler still took two hours to produce.

This means that the labour hours needed for producing an HR-boiler have not increased but decreased, which is an unexpected outcome. However, the reference situation is again important here. What would have happened with the R&D efforts if the subsidy was not introduced by government? It seems fair to argue that in those circumstances it had been decided by manufacturers to concentrate R&D on the optimisation of the production process for VR-boilers instead. Then, the labour time needed for producing one VR-boiler would still have decreased.

What then to assume for the case study with regard to additional employment in the production of HR-boilers? Given the fast developments in the production process for HR-boilers and taking into consideration the possibility that such a development would have taken place for the VR-boiler if not a subsidy was introduced, it was decided to set the additional labour time needed for producing an HR-boiler at zero.

New employees in the heating boiler industry have been attracted over the last couple of years by the manufacturers of heating boilers. However, at first sight it is not clear why this is the case. Given the few labour hours needed to produce an HR-boiler, the reason can not simply be the increased selling of HR-boilers. Furthermore, the figures on the total number of heating boilers < 30 kW sold for the domestic market do appear to be rather constant over the period 1991-1996, which means that the share of the HR-boiler in the market has increased mainly at the cost of the VR-boiler. Finally, competition within the heating boiler industry has increased due to the entrance of new manufacturers to this particular market.

Here the issue of import/export is relevant. The total domestic market for heating boilers < 30 kW did not increase much over the indicated time period. However, the HR-boilers did gain a larger market share at the cost of the VR-boilers. And these were used to be imported for a large share from foreign countries. This means that still an increase in employment at the manufacturers did take place, thanks to the decreased role of imports.

On the basis of statistical data, it is thus concluded that the role of domestic producers in the domestic market has increased slightly over time and that this has caused some additional employment. In combination with some qualitative and quantitative information provided by manufacturers, it is decided in this case study to assume that the number of people needed for administration, marketing and sales has increased slightly over time, whereas the labour needed for producing a boiler has remained constant. Regarding the additional jobs in the domestic production of HR-boilers, only guesses could be made for the number and skill level (see appendix for explanation of the skill level classification). The following has been estimated: 30 in group 8 (LBO), 30 in group 7 (MBO), 80 in group 3 (HBO/WO) and 10 in group 1 (WO). It should be realised though that it concerns only a rough guess.

The number of people involved directly or indirectly in R&D could only be guessed. A number of twenty employees is included as a rough estimate for the additional temporary jobs that were generated. These employees belong to group 3, physical and engineering science associate professionals. The jobs last for a period of about five years to achieve the optimisation in the production and assemblage process of HR-boilers.

The age of newly employed people at the manufacturing companies varies largely. Most people are aged between 18 and 30 and are recent school leavers, according to one manufacturer. Nevertheless, people between 30 and 55 were attracted too, to keep age structures within the company balanced.

Employment in the installation branch

The overall installation sector in the Netherlands does currently provide employment for about 48.000 people. The sector has grown over the last couple of years. Interviews with installation companies have provided information on the nature of employment in this branch and on the work involved in installing and maintaining HR-boilers. New employees in the installation and maintenance sector are mainly young school leavers. They have had some technical education and can be classified under group 7, skilled blue collar, that is craft and related trades workers. Next to recent graduates, retrained unemployed people and people from related sectors have been recruited over the last couple of years.

The installation of an HR-boiler takes more time than a VR-boiler. Per boiler it involves three additional hours by a mechanic and three extra hours by an assistant mechanic. Furthermore, the maintenance of an HR-boiler takes on average one hour extra for the installer, compared to a VR-boiler. These figures indicate that the switch in the heating boiler market from VR-boilers to HR-boilers has caused a lasting additional load of work for the mechanics and installers.

Employment in the energy sector and at the government

Information on the total of jobs directly related to the MAP implementation is available but not distinguished for the HR-subsidies. On the basis of interviews and the reading of annual reports, a rough estimation has been made with regard to the number of people involved in the implementation of the HR-subsidy. A total amount of fifteen employees is assumed for the period 1991-1996, at the government and EnergieNed together. These people all have an academic or higher vocational education and belong to groups 1 to 3.

Given the above information on employment in various sectors, it can be concluded that the installation and in particular the maintenance activities have grown substantially thanks to the increased selling of HR-boilers.

2.8 Quantitative results

Table 2.1 presents the figures for the situation in which all subsidised boilers are assumed to be installed thanks to the existence of the subsidy instrument.

Table 2.1 *Annual cumulative figures [ECU $\times$ 1000]*

HR-boiler subsidy	1991	1992	1993	1994	1995	1996	Total[1]
Grants awarded	5,799	11,166	3,480	5,039	8,766	4,323	38,574
Administration costs	596	586	623	620	622	619	3,664
Number of subsidised HR-boilers [$\times$ 1000]	31	63	20	52	92	62	320
Total expend./investm. (VAT incl.)	34,625	62,363	24,187	50,622	80,473	59,656	525,478
civil service administration	596	586	623	620	622	619	3,664
Installation	17,522	29,990	9,346	20,723	30,902	18,624	127,107
Equipment	15,575	28,116	8,178	20,723	36,052	23,703	132,347
Maintenance	1,947	5,626	6,648	9,439	14,432	17,466	269,110
Employment[2] [person years] by:							
A. managers, professional, administering the scheme	4	4	3	2	1	1	15
B. technicians & associate professionals adm.	10	10	12	13	14	14	73
C. other white collar/non-manual adm.							
D. craft & related trade, research, (i.e.skilled)	90	90	90	90	90	70	520
D. installation: private sector employment	110	256	82	213	377	254	1,291
D. producing the investment item	--	--	--	--	--	--	--
D. maintenance	18	55	67	97	151	187	2,805
E. plant/machine operators (semi-skilled)	60	60	60	60	60	60	360
F. elementary occupations (i.e. unskilled)							
Employment in total wages paid	7,984	11,761	8,092	11,678	16,637	14,052	123,433
Quantity of energy saved [TJ]	297	891	1,065	1,517	2,318	2,858	42,865
CO_2 saved [tonnes]	17	50	60	85	130	160	2,405

[1] Total over the period 1991-2011; maintenance goes on during the lifetime of the boilers.
[2] See Table 2.3 for skill level classification.

2.9 Conclusions on the scheme

Given the analysis above, it has become clear that one has to be careful in relating the subsidy instrument directly to a number of newly generated jobs. It is very difficult to give an answer on the question what would have happened without a measure or subsidy. In other words, it is very difficult to define the reference situation. Furthermore, it is a very complex task to relate the subsidy given for an HR-boiler to its possible impacts on employment and energy on a country level. Many assumptions have to be made and the explicit contribution of the instrument to the number of HR-boilers sold is hard to define. However, the employment and energy impacts per boiler could be more easily determined.

In the situation where one assumes a direct relation between the subsidy and the number of subsidised HR-boilers sold, a total number of 350 temporary jobs is created for the period of the subsidy. Employment concerns for the main part the installation of boilers and the work involved with the production and selling of the boilers by the manufacturers and for a very small part the implementation of the subsidy. However, for the fifteen years period that the HR-boilers are in operation annual maintenance is needed and this generated a number of 180 full time jobs for a long period. In this case the energy saved over the lifetime of the subsidised boilers amounts to 42.9 thousand TJ.

In the very optimistic case in which it is assumed that that all HR-boilers sold were sold thanks to the existence of the subsidy, the total number of additional maintenance jobs sums up to 480. In the more critical case, it is assumed that many people received the subsidy as a bonus. These people wanted to buy the HR-boiler anyway but were thanks to the subsidy now offered a lower price. The total number of jobs in the maintenance sector in this case sums up to 117.

Despite the many conceptual issues and buts, the collected figures presented in this case study do provide on headlines some useful outcomes and conclusions:

- Promoting the HR-boiler on an EU-level would provide a considerable number of additional jobs mainly in the installation and maintenance sector. Employees in this sector are fairly young and have a Junior or Senior Secondary Vocational Education. To some extent unemployed people can be retrained in order to be able to do this kind of installation and maintenance work too.
- The jobs will be generated in all EU countries since maintenance and installation activities are location-bounded.
- The measure to which HR-boilers can be introduced in each country depends however on the role that gas currently plays in the energy supply for households in a particular EU-country.

2.10 Appendix

In this appendix some information is given on subsidies, additional labour hours, energy saved per HR-boiler and wage levels for different categories employees over time.

Table 2.2 *Detailed information boilers*

		1991	1992	1993	1994	1995	1996
Subsidy per boiler per year [ƒ]		350	350	350	200	200	150
Additional costs per boiler [ƒ]		800	750	700	700	700	700
Add. installation costs p.b. [ƒ]		900	800	800	700	600	550
Add. installation hours p.b.		6	6	6	6	6	6
Add. maintenance hours p.y.		1	1	1	1	1	1
Energy saved p.b. in m^3 natural gas p.y		300	300	275	275	275	275
Energy saved p.b. in MJ p.y.		9495	9495	8704	8704	8704	8704
Monthly wages in guilders:							
Group 1	Professionals	7020	7160	7304	7450	7599	7751
Groups 1-2	EnergieNed&Governmt., average wage	6696	6830	6967	7106	7248	7393
Group 3	HBO/WO young	4968	5067	5169	5272	5378	5485
Group 7	MBO, ten years exp.; installation	4428	4517	4607	4699	4793	4889
Group 7	MBO; maintenance	3780	3856	3933	4011	4092	4173
Group 7/8	MBO/LBO, (semi-)skilled; production	3456	3525	3596	3668	3741	3816
Group 8	LBO, two years exp.; installation, production	2808	2864	2921	2980	3039	3100

See Table 2.3 for skill level classification.

In the following table, Table 2.4, the cumulated figures over the lifetime of an HR-boiler are presented. After the subsidy has stopped, the maintenance of the subsidised HR-boilers goes on during their assumed lifetime of fifteen years. That means that from 2006 onwards the employment in maintenance of the subsidised boilers goes down until it is zero in 2011. For reasons of space, the years 1999-2004 are missing in the table but the figures for these years bear on the full number of subsidised boilers and are similar to 1997 or 2008. The column with totals includes all the years.

Sources of information

Sources of information are interviews with the association of distribution utilities, manufacturers of HR-boilers, a branch of trade organisation of installers and literature (see references).

Table 2.3 *Occupational categories*

SAVE Employment Classification		ISCO-88 Classification	Dutch education levels
A.	Managers, professionals	(1) + (2)	WO
B.	Technicians and associate professionals	(3)	HBO
C.	Other white collar or other non-manual	(4) + (5)	MBO
D.	Craft and related trade or skilled blue collar	(7)	MBO
E.	Plant and machine operators and assemblers (semi-skilled)	(8)	LBO
F.	F. Elementary occupations (unskilled)	(9)	-

Table 2.4 *Annual cumulative figures [ECU $\times$ 1000] (see annex for skill level classification)*

HR boiler subsidy	1991	1992	1993	1994	1995	1996	1997	1998
a.) grants awarded	5,799	11,165	3,480	5,039	8,766	4,323		
administration costs	596	586	623	620	622	619		
number of subsidised HR-boilers	31	63	20	52	92	62		
b.) private expenditure (VAT incl.)	28,230	50,611	20,083	44,963	71,085	54,714	17,903	17,903
amount of VAT	4,940	8,857	3,515	7,869	12,440	9,575	3,133	3,133
value of imports								
c.) total expend./investm. (VAT incl.)	34,625	62,363	24,187	50,622	80,473	59,656	17,903	17,903
amount of VAT (ECU)								
d.) total expend./investm.	34,625	62,363	24,187	50,622	80,473	59,656	17,903	17,903
civil service administration	596	588	623	620	622	619		
Installation	17,522	29,990	9,346	20,723	30,902	18,624		
equipment	15,575	28,116	8,178	20,723	36,052	23,703		
maintenance	1,947	5,626	6,648	9,439	14,432	17,466	17,903	17,903
e.) employment [person years] by:								
A. managers, professional, adm. Scheme	4	4	3	2	1	1		
B. technicians & ass. professionals adm.	10	10	12	13	14	14		
C. other white collar/non-manual adm.								
D. craft & related trade, research, (skilled)	90	90	90	90	90	70		
D. installation: private sector employment	110	256	82	213	377	254		
D. producing the investment item	--	--	--	--	--	--		
D. maintenance	18	55	67	97	151	187	187	187
E. plant/machine oper. & ass. (semi-skilled)	60	60	60	60	60	60		
F. elementary occupations (i.e. unskilled)								
f.) employment in total wages paid	7,984	11,761	8,092	11,678	16,637	14,052	4,462	4,462
amount of tax in wages	2,635	3,881	2,670	3,854	5,490	4,637	4,462	1,473
g.) quantity of energy saved [TJ]	297	891	1,065	1,517	2,318	2,858	2858	2,858
CO_2 saved [tonnes]	17	50	60	85	130	160	160	160
h.) value of energy saved (tax incl.)	2,675	7,936	8,072	11,675	17,284	21,601	22,141	22,141
tax content)	483	1,673	1,650	2,361	3,570	5,737	5,881	5,881

Table 2.4 *(continued) Annual cumulative figures [ECU × 1000]*

HR boiler subsidy	2005	2006	2007	2008	2009	2010	Total[1]
a.) grants awarded							38,574
administration costs							3,664
number of subsidised HR-boilers							320
b.) private expend. (VAT incl.)	17,903	16,151	12,652	11,532	8,621	3,471	483,239
amount of VAT	3,133	2,826	2,214	2,018	1,509	607	84,567
value of imports							
c.) total expend./investm. (VAT incl.)	17,903	16,151	12,652	11,532	8,621	3,471	525,478
amount of VAT							
d.) total expend./investm.	17,903	16,151	12,652	11,532	8,621	3,471	525,478
civil service administration							3,664
installation							127,107
equipment							132,347
maintenance	17,903	16,151	12,652	11,532	8,621	3,471	269,110
e.) employment [person years] by:							
A. managers, professional, adm. Scheme							15
B. technicians & ass. Professionals adm.							73
C. other white collar/non-manual adm.							
D. craft & related trade, research, (skilled)							520
D. installation: private sector employment							1291
D. producing the investment item							
D. maintenance	187	169	132	120	90	36	2805
E. plant/machine oper. & ass.(semi-skilled)							360
F. elementary occupations (i.e. unskilled)							
f. employment in total wages paid)	4,462	4,026	3,153	2,874	2,149	865	123,433
amount of tax in wages	1,473	1,328	1,042	949	709	285	43,723
g.) quantity of energy saved [TJ]	2,858	2,560	1,967	1,793	1,340	540	42,865
CO_2 saved [tonnes]	160	144	110	101	75	30	2,405
h.) value of energy saved (tax incl.)	22,141	23,403	17,979	16,388	12,251	4,932	343,471
tax content	5,881	6,983	5,365	4,890	3,656	1,472	90,769

[1] Total over the period 1991-2010; maintenance goes on during the lifetime of the boilers; columns for the years 1997-2005 have identical values

3. TENDER INDUSTRIAL ENERGY SAVING

3.1 Outline

Title of scheme:	Energy Management Systems.
Country:	the Netherlands
Type of programme:	Subsidy
Funder:	National Government
Timeframe:	1991-1994
Implementers:	Novem
Sector:	Industrial
Measures:	Energy Management and Energy Monitoring Systems
Energy saved:	≤ 9.6 PJ (1991-2004)

3.2 Statement of limitations

Energy management systems are not only subsidised within the programme Tender Industrial Energy Saving. Other Dutch programmes do support the systems too. However, these other programmes are excluded from the case study since the character of those programmes is different and it would become a far too extended a case study.

The information on energy conservation in this study are very much reliable, since energy conservation data have been monitored closely. However, data on total investments are less sure since it is not always known which part of an investment concerns energy and which part serves other goals aimed at by the energy management systems. Furthermore, data on employment represent only the averages estimated by the authors based on an extremely wide range of data provided by companies that have been interviewed.

3.3 Introduction

The 'Tender Industrial Energy Saving (TIEB)' is an initiative of the Dutch Ministry of Economic Affairs and was launched in 1991 as a reaction to the first Memorandum on Energy Conservation. The programme is implemented by the Netherlands Agency for Energy and the Environment, Novem, and is meant for the industrial or manufacturing sector. The programme is still running.

This case study focuses on the generated energy and employment impacts of a part of the TIEB programme, that in the period 1991-1994 provided a subsidy to eleven large Dutch industrial companies that implemented an energy management or energy monitoring system.

The overall amount of energy saved by the eleven energy management systems installed in the period 1991-1994 within the programme TIEB sums up to 9.6 PJ by the year 2004 according to the information provided by Novem and separate companies. It is realised by Novem, the companies and ECN though that this is a very optimistic value. First of all, this figure is based on the optimistic assumption that each system achieves the expected energy efficiency improvement already in the year of installation and that this improvement effect will last for 10 years. Secondly, the figure includes not only the energy saving effects by use of the energy management systems but also some related investments in not specified equipment that supports the system and the processes within the company. In practice therefore, the energy saving impact must be expected to be lower than 9.6 PJ.

3.4 Description of the case study TIEB

Introduction

The TIEB programme focuses on industries and collaborations of industrial companies. Many different innovative energy efficient processes and technologies have been researched and implemented within the TIEB framework since 1990.

Since an evaluation of the overall TIEB programme is too extensive, Energy Management and Energy Monitoring Systems have been selected as a specific category of projects, to be analysed within this SAVE Employment case study. These systems have a very wide applicability in many companies and sectors in all EU-countries and therefore are regarded to be most interesting within the SAVE Employment project.

Financial information on TIEB

Every year the Ministry of Economic Affairs determines a budget for the TIEB programme. Since 1990 the available budget has been 20 million guilders per year for TIEB as a whole, that is about 9.3 million ECU. A small part of the budget is spent on subsidies for research projects, like studies on starting an energy conservation programme within an industrial sub-sector or feasibility studies of new industrial processes (0.8 million guilders in 1994). The large part of the budget is spent on subsidies for demonstration projects and market introduction projects, in order to bring the outcome of the studies into practice (Oosterheert, 1995).

Procedure

Projects are selected according to a tender procedure. The period in which companies can deliver proposals for either studies or market introduction and demonstration projects is announced every year by the Ministry of Economic Affairs in the State newspaper. Criteria for selection are the potential quantity of energy saved per guilder, the innovativeness, etc. Novem selects the proposals and supports companies in the implementation of a project.

Studies on a more efficient energy use, feasibility studies and studies to establish an energy conservation plan can receive a subsidy of maximum 50%.

Demonstration projects get a maximum of 40% and market introduction projects receive a subsidy of 25% at the most. The last two categories of projects should concern investments that lead to a lower energy use and concern new or not yet often used technologies and processes.

The TIEB programme is rather popular and regarded as successful. The instrument is well known to the companies that were approached for this case study. Some companies have a rather close co-operation with an expert representative of Novem and in that way are more involved in energy issues. Often some co-operation already existed between the company and the provider of the energy management system, but then for other products and services. The initiative for tendering lies mostly with the company.

Monitoring methods

The activities within the framework of TIEB are supported by a representative sector expert of Novem. The energy impacts and costs for each project are monitored too. The results of all projects within the TIEB framework are published every year by Novem in leaflets and magazines and next to that the project descriptions are available on CD-ROM. Novem tries to exchange the experiences within the projects with as many companies and sectors as possible, in order to increase the spin-off effects of the TIEB programme.

Implementation of Energy Management Systems

Energy Management can be defined as ‘ordening and watching the energy flows in a company in a systematic way according to a predefined plan with the objective to realise the company objectives at minimal energy costs’.

Energy Management is not an aim in itself but serves to achieve other objectives. For example, a company wants to have a better understanding of and insight in the energy flows and their destination, in order to be able to make realistic cost price calculations for the various products that are produced. Energy Management can be a tool to control costs. Energy Management Systems also provide a useful tool to those companies that have signed a Voluntary Agreement with the Ministry of Economic Affairs. With the system, a company can easily monitor its energy use over time and see what progress is made in improving energy efficiency. Furthermore, it provides Novem, who is in charge of monitoring the Voluntary Agreements, a useful tool.

Introduction of Energy Management in a company requires at first an analysis of the energy costs in a company. Next step is to find out how, where and at what time this energy is used. The information gathered so far gives insight in the relative importance of energy use in different parts of the company and at different moments in the processes. Therewith it can be decided what sort of Energy Management should be started, at what costs and on what scale. Then, a monitoring system is to be developed and the following questions have to be answered in advance:

- What is to be monitored?
- How to monitor this (by hand, automatically)?
- At which frequency (hour, day, week, month)?
- Who is to do this?

The information that is provided by the monitoring system has to be gathered and to be analysed. Beforehand, targets for the energy use in different parts of a process or various places in a building are to be set. This makes it possible to assess whether the energy use is too high, and if so, what action should be taken. The data provided by the monitoring system and the actions taken are to be presented frequently to most of or all employees of the company. It helps to increase the attention for energy efficiency and the support for energy saving measures within the company. The implementation of energy management systems furthermore implies regular communication on energy use at all levels within a company to maintain support for energy management.

Energy Management as meant in this case study implies the introduction of very complex and specialised software and hardware, which is developed for a particular company and the installation of related equipment. On the basis of a very detailed analysis of the energy use for different processes within the company, various measures are taken. These concern either organisational, technical or behavioural measures. An example could be creating a specific task for one employee within the company, like checking the energy use every month or week. Other examples are implementing weather dependent regulation of the heating system, or avoiding losses through standstill situations. Once the system is implemented, data are provided very regularly to different employees within a company. Maintenance of the system is taken care of by experts within or outside the company.

Large Dutch energy-intensive companies, producing products like fertilisers, oil products, bulk chemical products and metals, do often already have a sort of Energy Management System in operation in their factories. For them, energy is such a large part of the total production costs that it is an integrated part of the investment decisions. Monitoring the energy use is therefore a daily activity. The large companies that are included in this case study invested in an extension and improvement of an existing Energy Management System. For small companies, energy plays a less important role and therewith, energy saving itself is generally not a sufficiently strong argument for an investment in an Energy Management System. The system should for example support other processes in the company, facilitate the monitoring of a voluntary agreement and/or improve the image of the company. The investment decision in smaller companies is thus strongly related to the involvement and knowledge of the energy co-ordinator and management of the company. Once the Energy Management System is installed, the monitoring of data is done less frequently than in large energy intensive industries, for example once a week or once a month.

Lifetime energy management systems
The economic lifetime of an Energy Management System is minimally 10 years and can easily achieve 20 years. Personal computers and the software are to be replaced more frequently. When the production processes are changed, the Energy Management System needs some adaptations too. In this case study a lifetime of 10 years is assumed.

Possible effects on employment
The software and hardware for an Energy Management System is to be developed and a lot of measuring equipment has to be installed. Once the Management System is in operation, some employees within a company have to keep an eye on the system very regularly and data are to printed and analysed, in order to take action. The system requires regular maintenance (once a month to once a year) and a back up emergency service is needed too in some companies.

3.5 Study method

In the case study, eleven companies have been selected that with support of the TIEB scheme installed some kind of energy management system in their company, all in the period 1991-1994. Information on costs, expected energy savings etc. were provided by Novem. Five people responsible for the operation of the energy management system within their company have been interviewed. Four companies that provided parts of an energy management system or process control system to one or more of these companies have been interviewed as well. The outcomes of these interviews have been discussed and checked with an employee of Novem, who was involved in some of the TIEB projects on energy management systems.

Data on the costs and energy saving impacts of the Energy Management System and information on the processes and contact persons have been obtained from Novem. Information on wage levels is based on estimates. The reference in this situation appeared to be difficult to set. It has been assumed that impacts of the subsidy instrument on employment and energy have to be compared with the situation without an (extension of an) Energy Management System. It means that the labour hours needed for operating the system and providing the energy data on a regular basis is regarded as additional employment compared to the reference situation. This assumption however is questionable. Some companies argued that the installation of an Energy Management System could also cause a net negative employment effect for the company, since it will become much easier to get all sort of data needed for determining the energy use and calculating cost prices of different products. However, as this quite sensible argument is so hard to quantify, it has not been considered in the determination of the qualitative impacts of the TIEB instrument. It will be mentioned though as a comment in the conclusions.

3.6 Qualitative results

As indicated in the former subchapter, interviews were held with representatives from companies that have bought and companies that have provided equipment/software for Energy Management Systems. Some remarks and conclusions can be made on the basis of these interviews:

- A higher energy efficiency is not the only reason to invest in an Energy Management System. Most companies reported that they invested in the system to get more insight in their energy use. In non energy-intensive industries it is often not known which product group or which part of the production process uses how much energy. This information is nevertheless very relevant when trying to calculate the cost prices per product. Companies did indeed get more insight in their energy use and often they found very huge losses in some part of a process which could very easily be prevented.

- Each company appears to have its own specific Energy Management System, including software. Before buying one kind of system, time is needed to analyse the current energy use, to decide on the number of meters, the frequency of measurements etc. This preparation is mostly done in co-operation with the company that will develop the system. The installation of the equipment and the system is done in co-operation with or fully by an external company.
- All investments appeared to be financially attractive and profitable. The payback period varied between 6 months and 5 years, but mostly it was around 1.5 year.
- Once the system has been installed and is in operation, very few additional hours are needed by the employees that are responsible for checking the system and providing the data. The time needed for operating a system depends on the frequency of measurement.
- Most companies have set a maintenance contract with the company that developed and often installed the system. It can concern a contract for emergency situations but it can also include precautionary maintenance, e.g. once a year. In some cases, this contract was part of the deal, in other cases, it means additional costs to the company.
- In the interviews with the companies that decided to install an Energy Management System it was often said that the existence of the TIEB subsidy gave just that little push or support to convince the management staff to say yes to the investment proposal. Most managers of smaller companies do hesitate to take such a step. After all, money can only be invested once and other things have mostly more priority within the company. For the larger energy intensive companies on the other hand, the subsidy has played a minor role.
- In the interviews it was argued by suppliers of energy management systems that such a system is only to be installed once the big pieces of the pie have been eaten. That is, other energy investments can often be more profitable and therefore have to be taken first. Energy management systems are at the end of the energy saving investments road.

Impact on Employment
The time that is needed for the development of the software for an energy management system varies largely. One important factor is whether the computer company is familiar with the particular company processes or not. The first phase is rather labour intensive, since the energy demand of the company is to be analysed in order to be able to decide e.g. on the number of measure points. Co-operation with the employees within the companies is then required. Indications for the time needed for the development of the software can be given though: 1000 to 1200 labour hours for one system. Employees in charge of such a task do have a higher vocational education, mostly in computer science.

Maintenance of the system is not so labour intensive. The frequency of maintenance activities depends on the complexity of the system and the importance of energy use for the company. This means in practice that maintenance in energy-intensive industries is on a regular basis, for example once a month, whereas for smaller companies it is once or twice a year. Again, the maintenance is taken care of mostly by employees with a higher vocational education, in technical or electrical engineering.

The operation of the system within the company takes not too much time. In large energy intensive companies the checking and distribution of energy data is mostly done on a daily basis, in smaller companies where energy plays a less important role it can be once a week or once a month. The total amount of work varies between 5 hours per week to 1 hour a month. Mostly one employee is responsible for the printing of the data and the distribution to the relevant employees. This employee has a technical background, on a Senior Secondary or Higher Vocational Education level.
At Novem, one person is full time involved in the promotion of the installation of Energy Management Systems. However, these activities concern various support programmes and not only TIEB. Some other Novem employees devote a small part of their time to the TIEB projects on Energy Management Systems. All Novem employees do have an university background.

The overall direct impact on employment appears to be very small. Employment achieved from 1990 till 1994 amounts to 15 person-years. After that a number of 1.5 jobs lasts until 2000, all for maintenance and operating the system. From 2001 this number is rapidly decreasing to 0 jobs in 2004. The work is done by people who already had a job. No school leavers or unemployed people appear to have been attracted to do this work. There is no indication that they would have lost their jobs if this programme would not have existed, nor that their workload was too much.

Energy
All systems that have been installed proved to be profitable investments, both from an economic and energy point of view. The pay-back period varied between 0.5 and 5 years, but mostly was about 1.5 years. In Table 3.1 in the appendix the total energy savings per year are presented.

Energy Management Systems
Some companies that provided software and hardware for the energy management systems have tried to extend their activities in this field. One firm started a mailing action to 150 companies to inform them on the possibilities of an Energy Management System. About 85 visits were made to these companies but although they mostly were very interested, a lot of companies shrank from concrete decisions. This computer company did not sell any additional system. The disadvantage of energy management systems is that first a check-up of the current energy demand for different processes is needed before an indication can be given on the costs and benefits of installing such a system. That appears to be a too big a barrier for managers. Since the companies often do not know exactly what they want, the computer company is not able to directly convince them of the attractiveness of an Energy Management System. One company stated that time is not ready for it yet.

The companies that develop and deliver hardware and software and related equipment for the Energy Management Systems have not observed an increase in the sales of their systems since the introduction of the TIEB scheme. The activities involved with energy management systems are not their core business and so far they have not been able to make its role more important. However, some companies still expect an increase in the near future because of expected energy policies of the government.

Novem confirms that the installation of Energy Management Systems, particularly in smaller non energy-intensive companies, is slightly disappointing. Many barriers are of influence, as was described above.

With the installation of an Energy Management System, some related equipment is used too. Since these components vary largely per company and do not always have a direct relation with energy, they are not included in the employment analysis. The Input-Output modelling however may provide data on indirect employment generated by investments in Energy Management Systems. At the same time, it is not clear what part of the investments done is strictly related to energy and what to other aspects.

3.7 Quantitative results

The total number of jobs, directly generated through the TIEB programme for energy management systems, is very limited. From 1991 till 2004, the estimated total employment is 25.5 person-years. During the installation period, the number of temporary jobs in the field of computer sciences is estimated to be contributing the most to employment, with a number of 6.5 person-years from 1990 till 1994. It concerns the work to be done in order to develop the hardware/software needed for energy management systems. Maintenance and operation activities take an estimated 1.5 person-years for the lifetime of the eleven systems and therewith have a large part of 12.5 person-years in the direct employment generated. The implementation of the instrument TIEB, in particular that part focusing on energy management systems, requires a maximum of one employee from Novem, 4 person-years in the period 1990-1994.

All jobs have a technical/engineering/computer science character, mostly on a Higher or Senior Secondary Vocational Education level. The one employee from Novem has an academic background.

The information on maintenance, operation and development of software varies per company. Therewith it has been difficult to quantify the time needed for these activities. All figures presented on jobs therefore are only estimates.

3.8 Conclusions on the scheme

From this case study a few conclusions can be drawn:

1. Energy management systems are interesting from an energy point of view. It concerns profitable investments that can serve other objectives in the company too. The energy saved per company varies between 1% and 20% of the original energy demand. Cumulated energy saved over the lifetime of the eleven systems installed sums up to 9.6 PJ. It concern both electricity and natural gas.
2. Direct jobs generated thanks to the part of the TIEB programme focusing on energy management systems are very limited, even under rather optimistic assumptions. The total employment is 25.5 person-years Based on the interviews, between 1990 and 1994 the number of temporary jobs in the field of computer sciences is regarded to be most extensive. Maintenance and operation activities have a large part in the total of direct employment generated with 12.5 person-years.
3. The figures on direct employment can be regarded as optimistic. One could also argue that operation takes a few additional hours compared to the reference situation whereas on the other hand, in other parts of the company a lot of hours are saved. The net employment effect within the company therefore could easily be negative also.
4. Energy management systems could be implemented on a large scale in all EU-countries. Implementation however is problematic since individual companies, in particular non energy-intensive companies, do not regard energy saving as a top priority. Many social, institutional and financial barriers have to be overcome before managers decide to spend money on an energy management system. In order to have many energy management systems installed at companies, a subsidy programme is to be launched on a large scale. It is to be accompanied with many energy experts that support companies in choosing the most optimal type of system. However, as long as the installation of energy management systems is not obligatory but voluntary, it is expected that the success of such a programme will be very limited.

3.9 Appendix

The sources of data are mentioned in the section on the study method:

- Cost and energy savings information of eleven companies were provided by Novem, who implemented the subsidy and monitors the energy use of the companies with an energy management system.
- Interviews were made with five people in charge of the operation of energy management systems and with four people providing parts of such systems.
- Wage levels were estimated.

Imports have been neglected in this case study, because the Energy Management Systems in this study have been developed and installed mainly by Dutch firms.

Energy Management systems do not raise comfort levels, but by definition they do serve other goals than energy saving alone, for example controlling costs or monitoring the energy use of processes.

Table 3.1 *Occupational categories*

SAVE Employment Classification		ISCO-88 Classification	Dutch education levels
A.	Managers, professionals	(1) + (2)	WO
B.	Technicians and associate professionals	(3)	HBO
C.	Other white collar or other non-manual	(4) + (5)	MBO
D.	Craft and related trade or skilled blue collar	(7)	MBO
E.	Plant and machine operators and assemblers (semi-skilled)	(8)	LBO
F.	F. Elementary occupations (unskilled)	(9)	-

Table 3.2 *Annual cumulative figures [ECU 1995 × 1000]*

Policy type / year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	TOTAL
a.) grants awarded	511	499	33	91											1,135
administration costs	41	41	40	40											175
b.) private expend. (VAT incl.)	1,059	1,620	129	274											3,082
amount of VAT	158	241	19	41											459
value of imports															
c.) total expend./investm.(VAT incl.)	1,611	2,160	203	406											4,380
amount of VAT	247	329	38	68											682
value of imports															
d.) total expend./investm.	1,611	2,160	203	406											4,380
no further breaking down possible															
e.) employment[1] [person years] by:															
A. managers, professional, admin. the scheme	1	1	1	1											4.0
B. technicians & associate professionals adm.															
C. white collar/other non-manual adm. scheme															
D. skilled employees, developing/installing systems.	1.8	2.9	1.2	0.6											6.4
D. skilled employees, maintenance of system	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.02	0.02	2.6
E. operating the system	0.3	0.9	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	0.9	0.3	0.1	0.1	12.5
F. elementary occupations (i.e. unskilled)															
f.) employment in total wages paid (incl. tax)	112	166	118	103	41	41	41	41	41	41	30	13	5	2	793
amount of tax	37	55	39	34	14	14	14	14	14	14	10	4	2	0.5	262
g.) quantity of energy saved [TJ]	0.4	0.8	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.0	0.6	0.1	1.0	0.0	9,593
CO_2 saved (optional) [1000 tonnes]	21.2	47.6	48.4	53.8	53.8	53.8	53.8	53.8	53.8	53.8	32.6	6.2	5.4	0.0	538
h.) value of energy saved (tax incl..)	1,578	3,423	3,388	3,671	3,610	3,610	3,610	3,610	3,610	3,610	2,189	415	363	0	36,689
tax content	237	513	508	551	542	528	542	542	542	542	328	62	54.5	0	54,900

[1]See Table 3.1 for skill level classification. Wages for these levels are similar to those in the Netherlands' case study on HR-boilers.

4. ENERGY PERFORMANCE STANDARD

4.1 Outline

Title of scheme:	Energy Performance Standard (EPN).
Country:	the Netherlands
Type of programme:	Regulation
Funder:	-
Timeframe:	December 1995-present
Implementers:	Building sector
Sector:	Domestic
Measures:	HR-boiler, HR-windowpanes
Energy saved:	4.0 million GJ (1997-2011)

4.2 Statement of limitations

Monitored data on the effects of the subject of this case study, the Energy Performance Standard (Energie Prestatie Norm in Dutch, abbreviated EPN) for houses, have at the time of this study not been published nor been fully examined. This holds for the energy saving measures taken and investments made as well as the resulting energy saving.

The reason lies in the fact that the Energy Performance Standard is a legal regulation applying to the building requests. Time delays occur between the filing of these requests and the delivery of building permits by the authorities, and also between the delivery of building permits and the delivery of the houses. Because of these delays, the first measures are realised more than a year after the filing of the building requests. Then, data gathering on yearly energy use takes another several months to a year. The EPN started 15 December 1995, so that the first permits under EPN have been approved in 1996 and the greater lot of first houses built under EPN have been delivered for inhabitation in 1997. That means that resulting energy saving measures are effectuated from 1997 on. Energy use can be measured from 1998 on and are at the time of writing this case study report being gathered by the Netherlands Agency for Energy and the Environment (Novem).

Effects on employment, creation of employment not being the aim of this policy measure, have not been subject of monitoring. Therefore, the data presented in this case study are either based on tentative figures and estimates of the effects on energy saving, or are estimates that are based on telephone interviews with people in several positions in the building sector. Especially the employment figures vary between quite fair and rather rough estimates.

4.3 Introduction

The Energy Performance Standard was introduced at the end of 1995 as part of the Dutch Building Decree (Staatsblad 295, 1995). The Energy Performance Standard makes it possible to calculate the integral energy performance of a new house or office and its heating, ventilation, air conditioning and lighting equipment, expressed as the Energy Performance Coefficient (EPC). It applies to new buildings. The lower the EPC, the more energy efficient the building is. The fictional standard new Dutch house with an EPC of 1.4 has an energy demand equivalent to 1400 cubic metres of natural gas. An EPC of 1.2 would mean an energy demand of 1200 cubic metres natural gas equivalents.

The EPN is a national regulation instrument applying to all buildings (re)built in the Netherlands from 15 December 1995 on. Since it has a major impact on the building sector and on energy use, it is an interesting instrument for a case study. In order to focus on the consumer sector, this case study concerns the effects of the EPN for newly built houses only. This case study concerns the introduction of the EPN, that is the period of December 1995 through December 1997, when the EPC was set to 1.4.

In December 1995 the standard started with a maximum EPC value of 1.4 for houses, and 1.9 for office buildings, while it was already announced that the maximum EPC for houses would be set to 1.2 in 1998 and was scheduled to meet the maximum value of 1.0 by the year 2000. The sharpening from 1.4 tot 1.2 has indeed been formalised through an adjustment of the regulation by the 1st of January 1998. However, the law gives the possibility to local authorities to demand sharper EPC values, a possibility that is often used. Moreover, housing developers use sharper EPC values to show the high quality of their houses. A low EPC value has become a sales argument.

The Energy Performance Standard concerns all parties involved in building houses, e.g.:

- Architects and their advising consultants, who have to design the houses so that they meet the standard in consult with their customers.
- Civil servants of the local authorities, who have to check both the calculations and the houses being built.
- Builders, who have to install the chosen insulation measures and installations.

During the introduction period, on top of the insulation that was already required under the Building Decree, especially highly efficient (abbreviated in Dutch as HR for Hoog Rendement, which means High Efficiency) windowpanes and highly efficient (HR) heating boilers are used to reach the required EPC. In practice, regarding the stimulation of the HR-boiler, the EPN acts as the successor to the subsidy for HR-boilers. In fact, the introduction of the EPN and its expected effect on the use of HR-boilers was the main reason for the energy distribution utilities to stop the subsidy (see also the case study on the HR-boiler subsidy).

The introduction of the EPN was expected to lead to a decrease of 10 to 20% of the energy consumption of newly built houses. The sharpening from 1.4 to 1.2 is expected to lead to a 13% decrease of the energy consumption of a single new house. The estimated total saving will climb from 35 million cubic metres of natural gas in the period 1998 till 2000, via 100 million m^3 over the period 1998 till 2005, to 150 million m^3 till 2010. It is calculated that sharpening the EPC for most houses leads to minor shifts in housing costs which vary from an advantage of about 50 NLG/year to a disadvantage of 16 NLG/year. Only with poorly designed buildings, the sharpening of the standard will lead to a substantial increase in housing costs (Staatsblad 461, 1997).

4.4 Description of the Energy Performance Standard (EPN)

History

The Building Decree from 1992 already contained requirements for thermal insulation and air permeability of the outer layer of a building. These requirements served to limit heat losses, for reasons of energy efficiency and, concerning houses, also to limit the living expenses. In the context of the policy for sustainable building a way to achieve a better energy efficiency of buildings was found in the Energy Performance Standard (EPN). This EPN was already announced in the policy bills on Sustainable Building (1990) and on Energy Saving (1990). These bills stated that more far-reaching requirements should be made to the building-related energy use, even though further insulation measures at the present energy prices would not be economically profitable.

The Netherlands Normalisation Institute (NNI) was asked by the government to co-ordinate the development of a standardised method to calculate the resulting energy use from heat losses, heat gains (solar irradiation and use of solar energy) and energy use of building-bound installations. Also other institutes and consultancies were involved in the process of developing and introducing the method.

Technical information

The Energy Performance Standard enables calculation of the integral energy performance of a new house or office and its heating, ventilation, air conditioning and lighting equipment. The standard consists of two standardised methods for the calculation of an Energy Performance Coefficient (EPC), one for houses and one for tertiary sector buildings (for both non-profit and profit services, like schools, hospitals, government buildings, but also offices and shops). This EPC is calculated by dividing the calculated energy demand (the characteristic energy use) by a reference figure which is related to the size of the house or building (surface size of outer layer of the building and the floors of the heated part). The values of constants in the equation which determine the reference figure are chosen in such a way that a new Dutch house of the size and shape built most often, has an annual primary energy demand of 1400 cubic metres natural gas equivalent when its EPC has the value of 1.4. Correspondingly, a demand of 1000 cubic metres of natural gas has an EPC of 1.0. The advantage of this method is that architects, builders and installers can share their efforts on meeting the energy performance standard.

The essential feature of this regulation is the freedom to choose any combination of measures that suffices the required EPC. These measures are taken on top of some minimum insulation demands in the Building Decree that have been maintained. Achieving the EPC may be done by using energy efficient installations, by limiting heat losses through insulation, by using renewable energy for heating and warm water supply, by optimising the solar irradiation through the orientation of the house, et cetera. A list of features, like heat losses, solar irradiation, internal heat sources (lighting, equipment, people), ventilation, heating boiler efficiency et cetera serves as input for the calculation of the characteristic energy use of a house. This characteristic energy use, divided by a factor that corrects for the used surface (heated part) and loss surface (outer layer) of the building, is not to be larger than the set EPC-value (Nieman, 1996).

Insulation measures generally last longer than installations and are more difficult to apply after a house has been built. Therefore, in order to ensure that the EPC is not achieved by energy-efficient installations only, most of the insulation requirements for the heat resistance and air permeability of partitions in the Building Decree have been maintained.

The legal standard set by the EPN is fulfilled by a range of energy saving measures, of which the installation of a highly efficient heating boiler (HR-boiler) and the use of highly efficient (HR+) windowpanes are the most common. HR-boilers are installed instead of so-called improved efficiency boilers (VR-boilers in Dutch; VR stands for Verbeterd Rendement, meaning Improved Efficiency). VR-boilers are improved boilers in comparison to the conventional boilers that were commonly used before the VR-boiler was developed. HR+-windowpanes are used instead of normal double windowpanes. These are the least expensive measures to fulfil the requirements and therefore the most commonly chosen.

Other measures that affect the energy performance are being stimulated by separate activities, like a subsidy for solar boilers, a heat pump stimulation program, and directions by the local authorities in the context of sustainable building. The use of these measures thus cannot be ascribed to the EPN only. Also, these measures are less frequently used to reach the EPC-value of 1.4. They gain in importance for the lower EPC-values following after the first standard. Therefore this case study on the introduction of the EPN focuses on the aforementioned HR-boiler and HR+-windowpanes.

Aims of the regulation
The EPN is introduced to make far-reaching demands on the energy use of buildings possible. The requirements of the buildings at first, however, are not that strict, so that parties involved can get used to the new regulation.

The EPN requires knowledge of the EPC-calculation, but also demands a different way of designing houses by architects and a different approach by commissioners and building contractors. Therefore the EPC at first has been set to a value that does not require too far-reaching adjustments to the houses as were built before December 1995. The energy saving aimed at by setting the EPC to 1.4 is 10 to 15% (Staatsblad 295, 1995).

Procedure
To obtain a building permit, one must file a building request with the local authority. On the basis of the new regulation the building request must contain a calculation of the EPC that meets the Energy Performance Standard.

Local authorities have to supervise the compliance with the legislation. They have to check the EPC-calculations in the building requests and also check whether the houses being built are indeed according to the specifications.

Introduction and education
The NNI, that has co-ordinated the development of the EPC-calculation method, has also taken care that computer software was developed to do the calculations and has published guidelines for the practice of the use of the EPN.

In between the announcement of the new legislation in the State Journal (Staatsblad) and the start of the regulation, specific groups of involved persons have been trained to work with the EPN. NNI has started to inform the building world from the beginning of 1995 with introduction meetings. NNI as well as other agencies organised courses where those going to work with the EPN learned how to do EPC-calculations. Typically an introduction meeting takes half a working day or one evening and a course to learn either one of the calculation methods takes one working day.

Starting date
The EPN started at 15 December 1995, that is building requests that are filed from this day on have to fulfil the EPN, with an EPC of 1.4. For building requests filed from 1 January 1998 on a sharper EPC applies of 1.2. An ending date of the regulation is not foreseen.

Monitoring methods
EPN effects on the energy saving measures taken are monitored in the context of monitoring sustainable building. Since 1995 samples are taken of approved building plans to register the sustainable building measures. This is done in a few steps. To obtain figures on the penetration of measures in building plans from 1997 on, samples are taken as follows. Of the total of about 750 municipalities, a sample of 80-85 is taken, divided over large, mid-sized and small municipalities. Of these municipalities a sample is taken of the building plans, so that 300 plans result. The tentative data from building plans approved of in 1995 and 1996 have been gathered following the same method, but with larger the samples. Of these plans, the measures taken are registered. Among them are measures that affect the EPC, like for example the kind of warm water boiler, the presence of a solar heating boiler, the insulation value of the floor, loft and front insulation. Also, since the introduction, the EPC is registered. These data do not cover the actual energy used when the houses are being lived in. Employment effects, not being the aim of the regulation, are not monitored.

Possible effects on employment
The employment effects of this successful legislative instrument are not known so far. It is expected that some additional employment is generated in the building sector, architects, local authorities etc. Next to that, additional investments are made in insulation measures, highly efficient heating boilers etc. Many sectors and authorities are involved with the implementation of the EPN. Although employment effects are not available yet, it is expected that interviews with parties involved will provide most of the information required.

4.5 Study method

Tentative data used on building plans of houses approved in 1996
Definite monitoring results on the effects of the EPN were not yet available when this case study was performed. Because of the time lag between the filing of a building request and the building and delivering of a house, the first levy of houses under the EPN have been built mainly in 1997. Although several parties have an interest in the effects of the new regulation, first monitoring results are about to be published by the end of 1998 and do not yet cover the energy use.

Only tentative figures on requests approved of in 1996, assumed to result in new houses in 1997, could be obtained for this study. Therefore the case study is based on these tentative monitoring results, on the documented expectations of this regulation, and on interviews with people in several different positions in the building sector and supplying industry. In order to focus on the consumer sector, only that part of the Energy Performance Standard is studied, that concerns the building of houses.

Reference situation development and monitoring, design, calculation and checking
The reference situation should be the situation without the EPN. Without this, no work would have to be done on development and monitoring of the EPN, nor would there be any surplus work on designing houses because of the EPN, calculation of the Energy Performance Coefficient and checking of this EPC. All this work is a result of the introduction of the EPN.

The development and introduction of the EPN of course started before the introduction but is assumed to have resulted in a substantial amount of work in 1995. With respect to this work field, the amount of work is estimated as well as the extent to which this results in jobs. Concerning the work done on design, calculation and checking, it is assumed that this starts in 1996, neglecting the last two weeks of 1995. The amount of work per building request is estimated from interviews. The number of building requests for houses is estimated on the basis of statistical data on the building sector.

Reference situation for energy saving measures
Concerning the energy saving measures the year 1995 was chosen as the reference period (considered to be the period just before introduction of the EPN). VR-boilers (improved efficiency boilers) and normal double windowpanes are the references for the HR-boilers and HR-windowpanes respectively regarding costs and energy saving. Tentative monitoring figures were available on those measures identified as the most commonly applied because of the EPN. The percentage of houses with HR-windowpanes as well as the percentage of houses with an HR-boiler were higher in the requests filed in 1996 than in the requests filed in 1995.

The main assumption is, that the rise in these percentages is the result of the introduction of the EPN. The number of HR-boilers and the amount of HR-windowpanes are derived from these percentages and the amount of building requests. Above that, for the HR-windowpanes, window surface dimensions of reference houses have been used together with assumptions on the share of these reference types in the newly built houses to estimate the surplus amount used because of the EPN. It is assumed that for the surplus of houses built with HR-windowpanes so-called

HR+ glass is used (this is a double window with coating and filled with argon instead of air), because this has a substantial effect on the EPC that is in the same order as that of the HR-boiler.

Effects of the EPN on investments and employment related to the use of energy saving measures are the surplus amounts of consumer costs and of work in production, installation and maintenance of HR-boilers compared to VR-boilers and of HR-windowpanes compared to normal double glass windowpanes. Although the effects on the EPC of each of these measures vary with the features of a house, an average lowering of the EPC is assumed of 0.14 for an HR-boiler and of 0.13 for HR-windowpanes. This is supposed to mean an energy saving of 140 and 130 m^3 natural gas equivalents. The calculated amounts of energy, money and CO_2 saved are based on these numbers and figures.

First energy saving measures realised in 1997
The tentative data available relate to the measures in the building requests that were granted a building permit in the years 1995 and 1996. The year 1995 is used as the reference year. Taking into account that the EPN was introduced at the very end of 1995, the first building permits under EPN will have been granted in 1996. It is well possible that also some building requests dating from before 15 December 1995 will have been granted a permit only in 1996, but neglecting this, building requests approved in the year 1996 are considered to fulfil the EPN. Thus, building requests approved in 1995 serve to compare those granted a permit in 1996. Assuming that houses are finished with a delay of one year between filing of the building request and delivery of the house, the first measures because of EPN are realised in 1997. Also the investments are made and the employment is generated in 1997.

4.6 Qualitative results

From a viewpoint of employment, three fields of work because of the Energy Performance Standard can be distinguished:
- development, introduction and monitoring of energy effects,
- design of houses according to the EPN, calculation of the EPC, and checking the EPC calculation and the building of houses,
- production, installation and maintenance of insulation measures and installations.

The nature of employment in each of these work fields will be discussed in the following.

Development, introduction and monitoring
In charge of the development of the new building regulation EPN are the Ministries of Housing and of Economic Affairs, the Netherlands Agency for Energy and the Environment (Novem) and the Netherlands Normalisation Institute (NNI), that farmed out several activities to the technological research institute TNO and several consultancies. Also introduction courses are organised, by NNI, but also by professional training agencies. Teaching these courses are part-time jobs, but the teachers generally have jobs in the field of designing and making building calculations and are hired to give these courses. Monitoring is done by the Dutch energy agency Novem, in dialogue with the Ministry of Housing and with help of consultancies in the data gathering.

The people in charge of the development, introduction and monitoring in the (semi)government institutes are assumed to be highly educated and well experienced employees. Development and implementation of standards and regulation belongs to the core business of the (semi)government institutes, so that the EPN is not necessarily a reason to employ new people. Those working in the consultancies are assumed not to have an equally long career, but still are assumed to have several years of working experience.

Though no new people have been recruited to work on the EPN, some new jobs elsewhere in the organisations may have resulted to be fulfilled by young people. It was said in one interview that two new people had been attracted at NNI, but this could not be ascribed solely to the EPN work, but also to organisational developments and the favourable economic climate.

The development of new regulation is of course a temporal matter. But the work is not finished with the implementation; beyond the scope of this case study, in sequence to the introduction, the EPN will be adjusted to new techniques and sharpened in order to bring about larger energy savings. However, a conservative estimate of the amount of work involved is made in this case study, not counting the work involved in adjusting the regulation, since this study focuses on the introduction of the EPN and on the period when the EPC value was 1.4. The estimates of the amount of work involved in the development, introduction and monitoring thus relate to this first period only.

Design and calculation and checking by the authorities

The design of houses according to the EPN and the calculation of the EPC by architects and their advising consultants, and checking their calculations and the practice of building by the local authorities appears to be a more important source of employment, that is still limited during the introduction of the EPN, but is expected to become more evident when the EPC is sharpened and solutions are getting more complex.

The workers involved in the EPC calculations can be distinguished in on the one hand architects and advising consultants who design the houses and on the other hand the civil servants who have to check their calculations. It is the architect’s job to prepare the building request and to obtain a building permit. In order to get the request approved, it must fulfil the demands of the Building Decree, including a correct EPC-calculation resulting in a low enough EPC-value.

Architect agencies may do these EPC-calculations themselves, but they can also farm these out to an advising consultant, for instance a consultancy specialised in building constructions, building physics, or in installation techniques. The interviews did not render a figure for the extent to which this work is contracted out by architects. What came forward from the interviews was, that it is likely that architects have done most of the EPC-calculations for houses themselves so far, because most often an EPC of 1.4 can be achieved with standard solutions (like an HR heating boiler or HR windowpanes). But when the solutions get more complex, consultants will more often be called in. This is already the case for tertiary sector buildings, where quite often different use functions must be combined.

In several interviews it was stated that the introduction of the EPN has led to a new approach of thinking with respect to building. It has led to a different sequence of actions in the process of designing and building houses. Whereas formerly the architects in their design of houses only had to account for the insulation demands, the choice of installations for heating et cetera was made in a later phase. Now, however, the design of the house including the installations has to fulfil the demands of the Energy Performance Standard. It leaves the architect a range of possible solutions of building measures and choice of installations that have to be thought over and usually must be discussed with an installations expert. The latter is therefore nowadays involved in as early a phase as the design of the building, which is in a much earlier stage of the building process than before.

Several interviewees have mentioned that employment in the advising consultancies in the building sector is growing and that one-man consultancies specialised in EPC calculations have emerged. This may be partly an effect of the EPN, but it was also pointed out that building physics has gained importance lately and that there is much activity in the building sector in general.

It is generally acknowledged that the EPN means that more work has do be done (or farmed out) by architects before they can apply for a building permit, although it is not yet clear how much more time it takes on the average.

The architect's fees are subject of discussion; can or cannot architects charge their customers for the extra work to be done? Architects charge their customers on the basis of the Standard Regulation customer/architect. On one hand it can be argued that the architect fees for the preparation of the building request also include EPC-analysis and calculation since these are an integral part of the building request. On the other hand the text of this Standard Regulation says that activities on behalf of the EPN must be considered as extra activities (Stichting Bouwresearch, 1997). In practice it appears that not all customers are willing to pay for the extra work.

The architects therefore want to reconsider the fees and are in the process of quantifying the amount of extra work that is done more precisely. The branch of trade organisation has assigned an investigation, but no results have been published yet. Estimates in interviews varied widely; we assume it to be 3 hours per house, taking into account that it is not only a calculation that has to be done, but also an analysis beforehand to list the possible solutions, while on the other hand the solutions generally do not have to be very complex with an EPC-value of 1.4.

It is not known to what extent the costs of the extra work for the design of houses is paid by architects (whether they farm out the work or do it themselves) who do not get paid extra for the EPN-activities and by households that are going to rent or buy the houses, in those cases where the commissioners do pay extra for the EPN work.

Civil servants of the local authorities have to check the EPC-calculations before a building permit can be granted. Often this checking is done by workers of the departments of Building and Housing Supervision. These departments also have to check if the buildings that are realised agree with the granted building permit. Although the EPN means extra work, generally there is no budget to enlarge the staff of the already busy departments, so that the EPC calculations and check of measures on the building sites have replaced other duties and have not led to new jobs in the local authorities.

Practically all those working with the EPN for houses have followed a course, typically of 1 day, to learn how to deal with the standard, and how to calculate the EPC and to use the software developed for that purpose.

The skill level of new jobs in consultancies and architect agencies was said to vary from skilled blue collar (for practical advice on the site) to professionals with an academic degree (for designing complex solutions). We assume the majority of new jobs to be on higher vocational training level. Though sometimes the newly employed will be working on a one-year contract to begin with, or will be detached by an employment agency, the jobs can be considered to be permanent as the foresight for the economic climate in the building sector is good and EPC calculations is a good field to be expert on. As the EPC-demands on the energy efficiency of new houses will be set higher, this type of work is the most likely to render more employment.

The skill level of civil servants checking the EPC-calculation and realisation is typically that of bachelor degree. As was stated before, no new jobs have been created because of EPN.

Energy saving measures

The simplest and cheapest way to fulfil the requirements of the EPN are the installation of highly efficient heating boilers instead of improved efficiency boilers and highly efficient windowpanes instead of normal double windowpanes. It is assumed that these are the main energy saving measures that are more often applied because of introduction of the EPN. As has been described in the case study of subsidies for highly efficient heating boilers, abbreviated as HR-boilers, these have been stimulated by subsidies until 1996. Because of the introduction of the

EPN, these subsidies were considered to become abundant and have been put to an end. According to the expectations, the implementation of HR-boilers has increased further still. The additional percentage of new houses with an HR-boiler installation is ascribed to the effect of EPN.
As mentioned in the section on the study method, HR-boilers are compared with VR-boilers. The surplus amounts of work and the surplus investment costs are used to estimate the effects of the EPN. As has been pointed out in the case study on highly efficient heating boilers, production of HR-boilers does not require more labour than production of VR-boilers. Surplus employment associated with HR-boilers involves installation and maintenance. These jobs are fulfilled by skilled and semi-skilled blue collar employees. Installation of HR-boilers must be performed by one skilled technician with ample working experience and one semi-skilled assistant for whom less experience is required. Maintenance must be performed by a skilled technician with a few years of experience.

HR windowpanes are double windowpanes, with a special coating that reflects more radiation than normal windowpanes. To enlarge the insulating value even more, they can be filled with argon instead of air and still better reflecting coating can be applied; this gives the so-called HR+ windowpane. It is assumed that the variety applied on a large scale to fulfil the EPN is the HR+ windowpane, that together with the window frame gives a window insulation value U of 1.8 W/m^2K, whereas for normal double glass windowpanes U equals 2.8 W/m^2K.

Comparing HR-windowpanes and normal double glass windowpanes, no extra work is involved in installing the windowpanes. In producing the HR-windowpanes, assembling and filling them with argon does not require extra work. Only application of the coating to the glass plates is an extra step in the production process that generates employment.

The production of the coated windows has led to about 60 new jobs in the period 1995-1997. Two firms in the Netherlands have invested in a machine to apply this coating to glass plates. These new jobs cannot all be ascribed to the effect of the EPN. Also the energy regulation in Germany has stimulated the investments in HR windowpanes production capacity. Between 60% and 70% of the product is exported, mainly to Germany. Also imports are substantial; about 45% of the HR windowpanes sold in the Netherlands was imported into the Netherlands. The amount of new jobs ascribed to the EPN correspond with the extra HR window surface applied in the Netherlands in new houses because of the EPN, corrected for an imports share of 45%.

The education level of the employees working in the two coating machines in the Netherlands varies from semi-skilled labourers to professionals with an academic degree, with the emphasis on jobs for skilled labourers and higher vocational training level. The new jobs are permanent full-time ones.

A local authority tool for sustainable building and CO_2 abatement
Local authorities in the Netherlands have the possibility to use the EPN for stricter demands on the energy use of houses than required by the national law. Local authorities that make a point of sustainable building and CO_2 abatement (many municipalities have joined the Climate Treaty) use the EPN as a policy instrument. Also local authorities can influence the way a lower EPC is achieved, by deciding about the energy-infrastructure; will they allow the common combination of gas and electricity, or do they choose for example heat distribution together with electricity, or electricity and heating of houses and groups of houses with electric heat pumps. Also local authorities can either be the party ordering the building of new districts or have a lot of influence on the building corporations and order for example that all new houses in a neighbourhood are provided with solar heating boilers. Although stricter EPC demands by local authorities may lead to the use of additional or other energy saving measures, these are not counted in this study as resulting from the introduction of the EPN.

Announced sharpening invokes innovation
Although the EPC of 1.4 in force from December 1995 through December 1997 does not impose high demands of the building and installations, from the beginning it was made clear that the aims of the instrument are to reach a substantial reduction of the energy use of buildings and the trajectory of sharpening the EPC was already laid out. A technology push of energy-efficient installations resulted. For example systems for balanced heating with heat recovery equipment are being developed, and also improved varieties of insulating pane (after HR an HR+ also HR++ pane) are developed. Because of the EPN and foreseen lower EPC, energy efficiency is becoming a selling feature. These effects have not been accounted to the introduction of the EPN.

4.7 Quantitative results

Results on 1997
A delay time of one year is assumed between the filing of a building request and the finishing of a new house. The year 1996 is the first year for the building requests to fulfil the EPN. As is explained in the section study method, because of the delay time, 1997 really is the year in which the most important effects of the introduction of the EPN begin to occur. Therefore in the following the estimates for the year 1997 are given.

It is important to note that all quantitative results presented must be considered estimates, because they are based on tentative or estimated figures and on assumptions made for missing information.

The number of houses built in 1997 under EPN used for calculations is assumed to be 102,000. From the comparison of building requests approved of in 1996 and 1995 it was concluded that the EPN has led to 24% of the new houses in 1997 to have an HR-boiler installed and 32% to have HR-windowpanes, because in total 68% have an HR-boiler and 55% have HR-windowpanes in all heated rooms in the building plans approved in 1996, while these percentages were 44% and 23% respectively in those of 1995. This means 24,504 houses with an HR-boiler and a number of 32,640 houses with HR-windowpanes, assumed to correspond with 1.2 thousand m^2 of HR-glass, as a result of the EPN.

In 1997 the thus estimated employment in the three fields accounts to:
- In the order of 5 person-years in development, introduction and monitoring; these are mainly existing jobs, although some new people may have been employed to take over other duties of those involved in EPN.
- About 51 person-years in design, calculation and checking, more or less equally divided over architect agencies/advising consultancies and local authorities; these are mainly existing jobs, although in the architect/consultancy branch some new jobs may have been created.
- In the order 106 person-years in production, installation and maintenance, a very small part (about 6 person-years) in the production of HR windowpanes, the largest part (about 86 person-years) in installation of HR-boilers, which is a onetime event, the other part maintenance (about 14 person-years). Although it is not so much as needed for installation, the maintenance duties return every year. Most jobs of HR-boiler installation and maintenance are permanent new jobs.

In 1997 the total of expenditures and investments on behalf of the EPN is 56 million ECU, while 268 thousand GJ of energy saved in terms of money spares 2,7 million ECU. The CO_2 saved corresponding with the energy saving is 15 tonnes.

4.8 Conclusions on the scheme

Because definite data on the effects of EPN are not yet available, the conclusions made must be regarded indications for the probable effect of this new regulation.

Employment creation not being the aim of the Energy Performance Standard, the employment effects have not been monitored. Only estimates are given of the employment resulting from the introductions of the EPN.

Given the assumptions on the amount of work resulting from the EPN and the share of this work that is done by existing staff, the amount of new jobs created because of EPN are in the order of 100. Most of these are in the installation and maintenance of HR-boilers, that is for skilled and semi-skilled blue collar workers. The number of jobs in the design of houses with a low enough EPC and the calculations required for this purpose are likely to increase in the future; sharpening of the EPC will lead to more complex solutions and the new employees that can handle these matters are likely to be recently graduated professional managers (academic or higher vocational training).

With respect to the replicability of the EPN the following can be said. Within the Netherlands the Energy Performance Standard has already been applied at the largest (namely national) scale, holding for new houses and for new tertiary sector buildings.

To expand the working of the EPN as it is to existing houses is not possible, because it acts on the building request, which does not come up for existing houses. However, energy efficiency requirements, but with much less strict energy efficiency demands, are considered for certain levies of existing houses too.

Whether an Energy Performance Standard could be a useful instrument for other EU countries also depends on the existence of regulation similar to the Dutch Building Decree. The choice of energy saving measures and the appreciation of these measures in terms of their effect on the value of the EPC should be country-specific.

The impacts of the introduction of the EPN, setting the EPC to 1.4, in terms of energy saving are limited, but the measure is promising with respect to future results, as can be concluded from the technological innovation towards more efficient installations that has been initiated by the prospect of sharper EPC values in the near future.

This is in line with the aim at the introduction: to let those involved get used to the new regulation, not at the same time demanding too much change in the use of materials and installations that determine the energy performance of a house.

Employment effects from the sharpening of the EPC have not been included in the quantitative analysis of this case study, because it is limited to the introduction of the EPC value of 1.4. However, these effects are expected to be more extended, because of the higher demands made, both of the design of the house as of the performance of the installations applied. In the period 1995-2005 the building of 1 million new houses is foreseen. In the year 2000 the EPC will be sharpened to 1.2 and it is intended to be sharpened even more after the year 2000.

Employment can be expected in the advising consultancy, in research and development of more advanced installations and in the production, installation and maintenance of these installations, like solar heating boilers and heat recovery for heating systems.

4.9 Appendix

The estimated results are presented in data Table 4.4[2]. In this table the cumulated figures over the lifetime of the EPN measures are presented. The maintenance of the HR-boilers is assumed to go on during this 15-year period. For reasons of space, the years 2000-2009 are missing in the table, but the number of HR-boilers is the same as in 1998 or 2011, so the figures are the same as for these years. The column with totals includes all the years. The tentative figures on energy saving measures taken are presented in Table 4.1.

Table 4.1 *Tentative figures from Kodal-file*

Tentative figures	1995	1996	1996 minus 1995
Number of building permits granted	98,400	102,100	
Percentage with HR-boiler	44%	68%	24%
Percentage with HR-windowpanes in all heated rooms	23%	55%	32%

Source: Rigo, 1997

These tentative figures of 1995 and 1996 show a significant increase in the use of HR-boilers and HR-windowpanes that in this case study is ascribed to the EPN. Very recently data on building permits of 1997 have been received by Novem. Though the percentages have not yet been calculated exactly, the total percentage of new houses according to these building plans with an HR-boiler is approaching 90% and the percentage with HR-windowpanes in all heated rooms is in the order of 80% (Novem, 1997). This shows that these measures are becoming the standard under the EPN.

Methods and sources of information for calculating job creation

Job creation because of development, introduction and monitoring has been estimated on the basis of qualitative information provided by the interviews with the normalisation institute NNI, the energy agency Novem and a consultant involved in development of the standard and organising introduction courses. Expert estimates of the number of person-years involved were also given by these interviewees. Additional data on the extent to which introduction courses have been followed and organised was provided by an evaluation study of the introduction of the EPN (BBB, 1997).

Estimates of job creation in the design of houses, and calculation and checking the EPC are based on interviews with 2 architect agencies and 2 advising consultants, 2 branch of trade organisations, 2 local authorities and also with the aforementioned institutes. Both qualitative information as well as quantitative estimations were given in these interviews. Based on this, for the design of houses and the calculation of the EPC an average of 3 hours per building request was assumed. Checking of the calculations and the building of the houses by local authorities was assumed to be 25 minutes per building request.

Architects and advising consultants mostly could not distinguish between design of houses and design of tertiary sector buildings when estimating the workload caused by the EPN. To estimate the share of houses in this workload, statistical data were used. Statistics on the number of building requests, the number of houses built, the money spent on the building of houses and of other buildings and on the number of people employed by architect agencies were combined (Statistisch jaarboek 1998, 1998). Together with the estimates given by the interviewees these were used to calculate the employment involved.

[2] Grants awarded are the individual rent subsidies that low income households that live in cheap rented houses can apply for. An HR-boiler that, in contrast with a conventional heating boiler, usually is not included in the basic rent may be claimed as service costs (Rijksbegroting 1995 Volkshuisvesting, Ruimtelijke ordening en milieubeheer, 1994/1995). These grants in this table are supposed to be a government contribution to the maintenance of HR-boilers.

To estimate the wages earned, in addition to information provided via interviews assumptions have been made. Wages for these levels are similar to those in the Netherlands' case study on HR-boilers. A yearly rise of 2% is assumed. Monthly wages for different groups are shown in Table 4.2. See Table 4.3 for skill level classification.

Table 4.2 *Monthly wages in guilders*

		1995	1996	1997
Group 1	Professionals; semi-government	7599	7751	7906
Group 3	HBO/WO; building expert with experience	6436	6565	6696
Group 3	HBO/WO; not much experience	5378	5485	5595
Group 7	MBO, ten years exp.; installation	4793	4889	4987
Group 7	MBO; maintenance, production	4092	4173	4257
Group 8	LBO, two years exp.; installation, production	3039	3100	3162

Job creation because of the measures applied, HR-boilers and HR windowpanes, was based on tentative monitoring results. These concerned the number of building requests that have been filed and the percentages of houses with HR windowpanes in all heated rooms and of HR-boilers according to these requests (Rigo, 1997). The total surface of HR windowpanes used because of the EPN was estimated with help of the description of reference houses (EP Variantenboek woningbouw, 1996).

Interviews with two glass manufacturing and two glass selling companies have provided qualitative information as well as bases for the estimates on the employment effects. Employment effects of the increased use of HR-boilers are assumed to be similar to those presented in the case study on subsidies for these installations.

An average duration of 15 years is assumed for the effects of the EPN. This is a very conservative assumption; most often in modelling households energy use a lifetime of 20 years is assumed for energy efficient building measures. These twenty years are an average between the lifetime of insulation, that often lasts as long as the house, and installations, which are replaced after a period of for example fifteen years. However, because the maintenance of the HR-boilers is the only lasting source of employment, the lifetime of HR-boilers is chosen to calculate employment effects and also energy saving effects.

Varying some assumptions

A calculation was made for a variety on the main assumption that only the surplus percentages HR-boilers and HR-windowpanes in 1996 compared to 1995 result in the effect of EPN in 1997.

Suppose that all newly built houses in 1997 fulfil the EPN either because of an HR-boilers placed or HR-windowpane used, taking 68%, the full amount, of HR-boilers to be the effect of EPN, and 32% of HR+ windowpane to be the effect of EPN, this is the surplus amount. The other 26% are assumed to be HR windowpanes and are left out of the calculations. This results in more employment in 1997 in installation and maintenance of HR-boilers for skilled and semi-skilled blue collar workers: two times 110 instead of 43 for installation and 37 instead of 14 for maintenance in 1997 and the following years.

Also more energy, CO_2 and money would be saved: 442 thousand GJ, 25 tonnes of CO_2 and 4.4 million ECU. This however, is not a realistic assumption, considering the percentages of HR-boilers and HR-windowpanes that were already placed before introduction of the EPN.

Another assumption that has been varied is the amount of work done by architects or advising consultants. The assumption used is that it takes 3 hours per building request, but it could also be assumed to be 1.5 hours or 4.5 hours. That would make a difference of 10 jobs (less of more, respectively) together at architect agencies and consultancies for academic or higher vocational trained employees.

Issues that do not apply

Some items have not been addressed explicitly in the above, because they do not apply to this policy instrument. It is difficult to say whether comfort levels are being raised by this measure or not. Definitely the energy saving measures are applied to the new houses right at the start, during the building of the house. They are not measures applied to raise the original comfort level beside saving energy. If this regulation would not have been introduced and demands of the energy use would have been less strict, would new houses have had a higher or lower comfort level? It can just as well be assumed that the comfort levels would have been the same.

Displacement effects on firms that are not included in the program are not in order, because it is a national regulation that applies for all parties working in the building process. No indications were found for indirect employment effects, due to a reduced energy demand or changes in consumers' expenditures because of investments in energy savings or of money saved by lowered energy costs.

The occupational categories of employment for the SAVE project are derived from the ISCO-88 classification. In the following they are related to the Dutch education levels.

Table 4.3 *Skill level classification*

SAVE Employment Classification	ISCO-88 Classification	Dutch education levels
A. Managers, professionals	(1) + (2)	WO
B. Technicians and associate professionals	(3)	HBO
C. Other white collar or other non-manual	(4) + (5)	MBO
D. Craft and related trade or skilled blue collar	(7)	MBO
E. Plant and machine operators and assemblers (semi-skilled)	(8)	LBO
F. Elementary occupations (unskilled)	(9)	-

Table 4.4 *EPN regulation costs, prices of 1995 [million ECU]*

	1995	1996	1997	1998	1999	2010	2011	Cumulated
a.) grants awarded	0	0.000	0.027	0.027	0.027	0.027	0.027	0.408
Administration costs	0.552	1.460	1.319					3.330
b.) private expenditure (VAT inclusive)	0.458	21.393	54.329	1.279	1.279	1.279	1.279	94.083
amount of VAT	0.068	3.186	8.092	0.191	0,191	0.191	0.191	14.012
value of imports (specify origin)	0	0	7.285	0	0	0	0	7.285
c.) total expenditure/investment (VAT inclusive)	1.010	22.853	55.668	1.306	1.306	1.306	1.306	97.821
value of imports (specify origin)	0.000	0.000	7.285	0.000	0.000	0.000	0.000	7.285
d.) total expenditure/investment:	1.010	22.853	55.668	1.306	1.306	1.306	1.306	97.821
civil service administration	0.375	1.285	1.144					2.804
Consultancy	0.634	21.568	20.698					42.901
equipment	0	0	25.334					25.334
installation	0	0	7.185					7.185
operation	0	0	0.000					
Maintenance	0.000	0.000	1.306	1.306	1.306	1.306	1.306	19.597
e.) employment [person years]								
Employment, total, [person years]	8	59	162	14	14	14	14	430
full time:								
A. managers, professional								
A. i) administering the scheme	7	7	5					18
A. iv) design and calculation	0	13	13					26
B. technicians and associate professionals								
B.i) administering the scheme	0	25	24					49
B iii) producing the investment item	0	0	1.4					1
B.iv) design and calculation	0	7	7					13
D. craft and related trade or skilled blue collar (i.e. skilled)								
D. ii) installation; private sector employment	0	0	43					43
D. iii) producing the investment item	0	0	3					3
D. iv) design and calculation	0	7	7					13
D. v) maintenance	0	0	14	14	14	14	14	215
E. semi-skilled operators and assemblers								
E. ii) installation; private sector employment	0	0	43					43
E. iii) producing the investment item	0	0	1.5					1
part-time:								
A. i) professional managers administering the scheme	1.3	1.3	0.3					3
f.) employment broken down as in e. but in terms of total wages paid (including taxes)								
total of wages paid	0.327	2.093	4.286	0.304	0.304	0.304	0.304	10.957
amount of tax	0.109	0.698	1.429	0.101	0.101	0.101	0.101	3.652
g.) quantity of energy saved [GJ] total	0	0	268,727	268,727	268,727	268,727	268,727	4,030,908
natural gas [GJ]	0	0	245,698	245,698	245,698	245,698	245,698	3,685,464
Elektricity (GJ)	0	0	23,030	23,030	23,030	23,030	23,030	345,444
CO_2 saved (1000 tonnes)	0.000	0.000	0.015	0.015	0.015	0.015	0.015	0.226
h.) value of energy saved (tax inclusive)	0.000	0.000	2.684	2.684	2.684	2.684	2.684	40.264
tax content	0.000	0.000	0.774	0.774	0.774	0.774	0.774	11.607

REFERENCES

BBB/ProCommunicatie/DHV (1997): *Onderzoek Evaluatie Energieprestatienormering* (EPN) *woningbouw-utiliteitsbouw*. July 1997.

Staatsblad 295 (1995);*Besluit van 30 mei 1995, houdende wijziging van het Bouwbesluit inzake energieprestatie*, June 1995.

Staatsblad 461 (1997):*Besluit van 6 oktober 1997, houdende wijziging van het Bouwbesluit (aanscherping energieprestatiecoëfficient voor woningen en woongebouwen 1998)*, October 1997.

Brezet (1994): *Van prototype tot standaard: de diffusie van energiebesparende technologie*, (The diffusion of High-Efficiency Central Heating Boilers in the Netherlands). Thesis, Erasmus University of Rotterdam, 1994.

CBS (1998): *Maandstatistieken van de buitenlandse handel*. Voorburg,1998.

CBS (1998): *Statistisch jaarboek 1998*. Voorburg/Heerlen, 1998.

Dougle, P.G. et al. (1997): *Energie Verslag Nederland 1996.* ECN, Petten, 1997.

EnergieNed (1996): *Milieu Actie Plan 2000*. Arnhem, 1996.

EnergieNed (1996): *Resultaten Milieu Actie Plan*, Arnhem, 1996.

EnergieNed (1997): Basisonderzoek Aardgasverbruik Kleinverbruikers. Arnhem, 1997.

Huizinga, B., de Vries (1986): *Werkgelegenheid bij een doelmatige en duurzame energievoorziening in het noorden des land; De arbeidsmarkt in Energie*. IVEM report nr.8, University of Groningen, april 1986.

Iwema, C.H.T., Vijverberg (1983): *Werkgelegenheidseffecten van milieumaatregelen, een economische-theoretische verkenning op het niveau van het individuele bedrijf*. NEI, Rotterdam, December 1983.

Jeeninga, H. (1997): *Analyse energieverbruik sector Huishoudens.* ECN-I--97-051, Petten, 1997.

NEN 5128 (1994): *Energieprestatie van woningen en woongebouwen*. Nederlands Normalisatie Instituut, september 1994.

Nieman, H.G. (red.) (1996): *Bouwbesluit Praktijk. Knelpunten, richtlijnen, oplossingen*. Den Haag, Ten Hagen Stam uitgevers, 1996.

Novem (1996): *EP Variantenboek woningbouw*, March 1996.

Novem (1997): Correspondence. Sittard, September 1997.

Oosterheert, R.J., I.C. Kok, P. Kroon, A. Stoffer, A.W.N. van Dril, O. van Hilten, F.A.T.M. Ligthart, J.J.C. Bruggink, W.G. van Arkel, M. Beeldman, J.C. Römer. (1995): *Energie Verslag Nederland 1994*. ECN, Petten, 1995.

Oosterheert, R.J., P.G. Dougle, R.F.T. Aalbers, W.G. van Arkel, J.M. Bais, M. Beeldman, G.H. Dinkelman, O. van Hilten, I.C. Kok, P. Lako, P.C. McKay, E. Schol. (1996): *Energie Verslag Nederland 1995*, ECN, Petten, 1996.

Rigo (1997): Correspondence. Tentative figures from the Kodal-file. Amsterdam, 1997.

Rijksbegroting 1995 Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (1998): Kamerstuk 23 900 XI nr. 1 1994/1995.

Stichting Bouwresearch (1997): *EPN in vogelvlucht*. Consequenties voor ontwerp en uitvoering: woningbouw. Rotterdam, August 1997.