Finland's National Energy Efficiency Action Plan

(NEEAP 2008–2010)

26.6.2007

Ministry of Trade and Industry
Ministry of Transport and Communications
Ministry of Agriculture and Forestry
Ministry of Finance
Ministry of the Environment

Foreword

The European Commission presented a proposal for a Directive on energy services and efficient end-use of energy on 10 December 2003. The "Energy Services Directive" (ESD) entered into force on 17 May 2006, and it must be transposed by 17 May 2008. The scope of application of the EDS is the entire end-use of energy in Finland, excluding maritime traffic, air traffic and industrial sites within the scope of the emissions trading scheme (ETS sites). According to the Directive, Member States have to set an overall national indicative energy savings target of 9% and initiate actions intended for promoting the attainment of the target. The calculation basis used for the target, expressed in terms of a fixed amount of energy, is the average official statistical data of 2001–2005 for the end-use of energy falling within the scope of application of the Directive. The Member States must also ensure that the public sector assumes an exemplary role in the actions required by the Directive and initiate actions for promoting the functioning of the market in energy efficiency. The Member States must report to the European Commission regarding the actions it has initiated and the energy savings thus achieved in its action plans in 2007, 2011 and 2014.

The Climate and Energy Policy Network established between the ministries decided on 17 February 2006 to form an ESD Implementation Group to make preparations for the national implementation of the Directive and the first National Energy Efficiency Action Plan. The Implementation Group started its work on 14 April 2006, and it has had a total of 10 meetings.

Senior Inspector Heikki Väisänen from the Ministry of Trade and Industry has acted as the chairman of the ESD Implementation Group, and its members have been Chief Engineer Pentti Puhakka and Senior Inspector Mirja Kosonen from the Ministry of Trade and Industry, Senior Inspector Elina Nikkola from the Ministry of Agriculture and Forestry, Building Counsellor Raimo Ahokas from the Ministry of the Environment, Transport Counsellor Risto Saari from the Ministry of Transport and Communications, Finance Counsellor Heikki Sourama and Finance Secretary Marjut Vierimaa from the Ministry of Finance and Unit Manager Ulla Suomi from Motiva Oy. Ms. Erja Reinikainen of Insinööritoimisto Olof Granlund Oy has acted as the Expert Secretary of the ESD Implementation Group.

The ESD Implementation Group has sought to compile into this National Energy Efficiency Action Plan actions that have energy conservation effects, which are targeted at the energy end-users within the scope of application of the ESD. The work has focused, in particular on actions whose saving effect can be verified and measured or estimated with sufficient accuracy so that the results can be expected to be accepted as part of Finland's fulfilment of its national target. Planning new actions was not actually one of the goals, but they have been presented with the accuracy allowed by the information available at the time of drawing up the action plan.

In order for the action plan to reflect the scope and long-term nature of the entire energy conservation and efficiency enhancing activities, it also includes a description of the actions with an energy conservation effect which cannot be quantified at this stage. A committee working under the Commission will harmonise the calculation methods at the EU level for some of the actions. This may result in changes to the now calculated savings effects in the next National Action Plan to be drawn up in 2011. Harmonisation of the calculation methods may also enable the calculation of savings effects with respect to certain national actions that have only been presented as a description in this action plan.

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1. Introduction

Energy savings and energy efficiency have had a focal role in Finland's national energy policies for decades. As a result of separate energy conservation programmes, the work has been systematic and sustained since the early 90s. Quantitatively speaking, the promotion activities can be estimated to have increased four-fold during the last ten years or so. The establishment of the National Energy Agency, Motiva, in 1993 contributed towards making the actions more systematic. The first separate energy conservation programme was drawn up in Finland in 1992. The programmes have been reformed and updated at regular intervals. The new Government Programme (April 2007) mentions drawing up a new, more rigorous energy conservation programme by the end of 2008.

This National Energy Efficiency Action Plan of Finland, drawn up pursuant to the obligations of the Energy Services Directive (2006/32/EC), is primarily a description of the starting position. The results of already implemented actions, the so-called Early Actions, can also be counted in the 9% energy savings target of the ESD; this was the basic prerequisite that allowed all Member States to accept the same target. The savings target of the ESD is indicative, but the Member States are obliged to initiate actions aimed at achieving the target. The Member States are also under an obligation to plan new actions in case achieving the savings target using the current actions proves unlikely. A thorough survey of the current situation is necessary for evaluating the quantitative and qualitative need for new actions.

Finland's national energy conservation target of 9% totals 17.8 TWh, and achieving it must be evidenced in 2016. The ESD also requires that an interim target is set for 2010. According to the Directive, the interim target in line with the total target is 5.9 TWh. It is estimated that the actions for which the savings effect can at this stage be calculated will achieve energy savings amounting to approximately 12.7 TWh in 2016. The energy savings in 2010 are estimated at 9.2 TWh. Section 4.3 of the Action Plan also describes several actions, the savings effects of which cannot be calculated yet in the absence of applicable bases or useful methods. How large additional savings can be calculated as a result of these actions, remains to be seen.

Calculating the amount of energy saved is an unambiguous process for some of the actions presented in this Action Plan, and the initial data are obtained from official statistics. However, for certain actions, the calculation requires the collection of large amounts of data every year using a separate monitoring system. Some estimates by experts must be used in the calculations for all actions. The energy savings achieved during the period 2008–2016 are naturally based on assumptions regarding future developments.

If the assumptions made when calculating the estimated energy savings of 12.7 TWh for 2016 materialise during the period 2008–2016, the new actions must be designed so that the resulting energy savings amount to 5–6 TWh in 2016. The preliminary estimate regarding the additional savings achieved by the new energy efficiency agreements is 2.8–4.7 TWh in 2016; this, however, will require that the future agreement system is very comprehensive with regard to the end-use of energy.

If calculating the savings effects of the actions set out in section 4.3 were to become

possible, this would reduce the amount of additional savings required, but all calculations carry considerable uncertainties until the calculation methods, harmonised at EU level, have been created and the Regulatory Committee has approved them. If the EMEEES project now in progress fails to produce sufficiently practical and reasonable calculation methods in terms of cost, the revision and verification of the calculations presented herein may be postponed until 2011 when the Member States next have to submit their reports to the Commission.

Finland has long-term experience in monitoring energy conservation actions and evaluating their effects. The effects of energy audit activities have been monitored through our own monitoring system since 1994, and the effects of energy conservation agreements since 1999. These systems have also provided good insight into the actual energy conservation potential of the industry and the private and public sectors, as well as into the profitability of different actions. On this basis, achieving the annual additional savings amounting to 5–6 TWh through the new actions for improving energy efficiency implemented during the period 2008–2016 is a challenging target for Finland.

2 Starting points and goals

2.1 Starting points

2.1.1 Use of energy in Finland

Primary energy consumption in Finland has doubled from the early 1970s (Figure 1). Energy has been required for the needs of energy-intensive export industries, but the increasing demand of the private sector is also an integral part of the total consumption. After the energy crises, nuclear power, natural gas, peat and wood-based fuels have made the energy spectrum more diverse and improved energy security. 2005 was an exceptional year due to the long-lasting industrial dispute in the forestry industry. Since then, energy consumption has returned to a growth track.

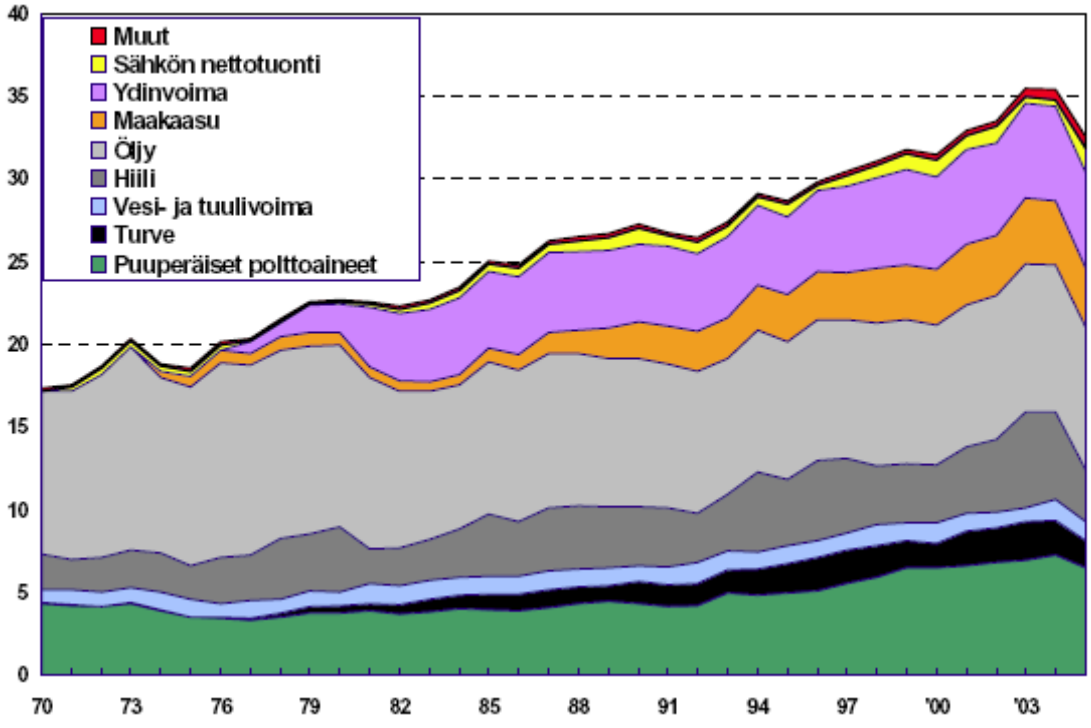

Figure 1. Primary energy consumption in Finland by source during the period 1970-2005 (Mtoe).

Others
Net imports of electricity
Nuclear power
Natural gas
Oil
Coal
Hydroelectric and wind power
Peat
Wood-based fuels

The energy-intensity of the entire economy (Figure 2) has decreased over the longer term, which evidences effective energy utilisation on one hand, and a gradual structural change of the national economy on the other. The relative share of forestry, basic metal and chemical industries of GNP has decreased while the less energy-intensive electronics industry has considerably expanded since the 1990s. For the same reason, the electricity-intensity of economy has also taken a downward turn in the early 90s after the steady growth in the 70s and 80s. The long-lasting industrial dispute in the energy-intensive forestry industry is shown as a change in energy intensity during 2005.

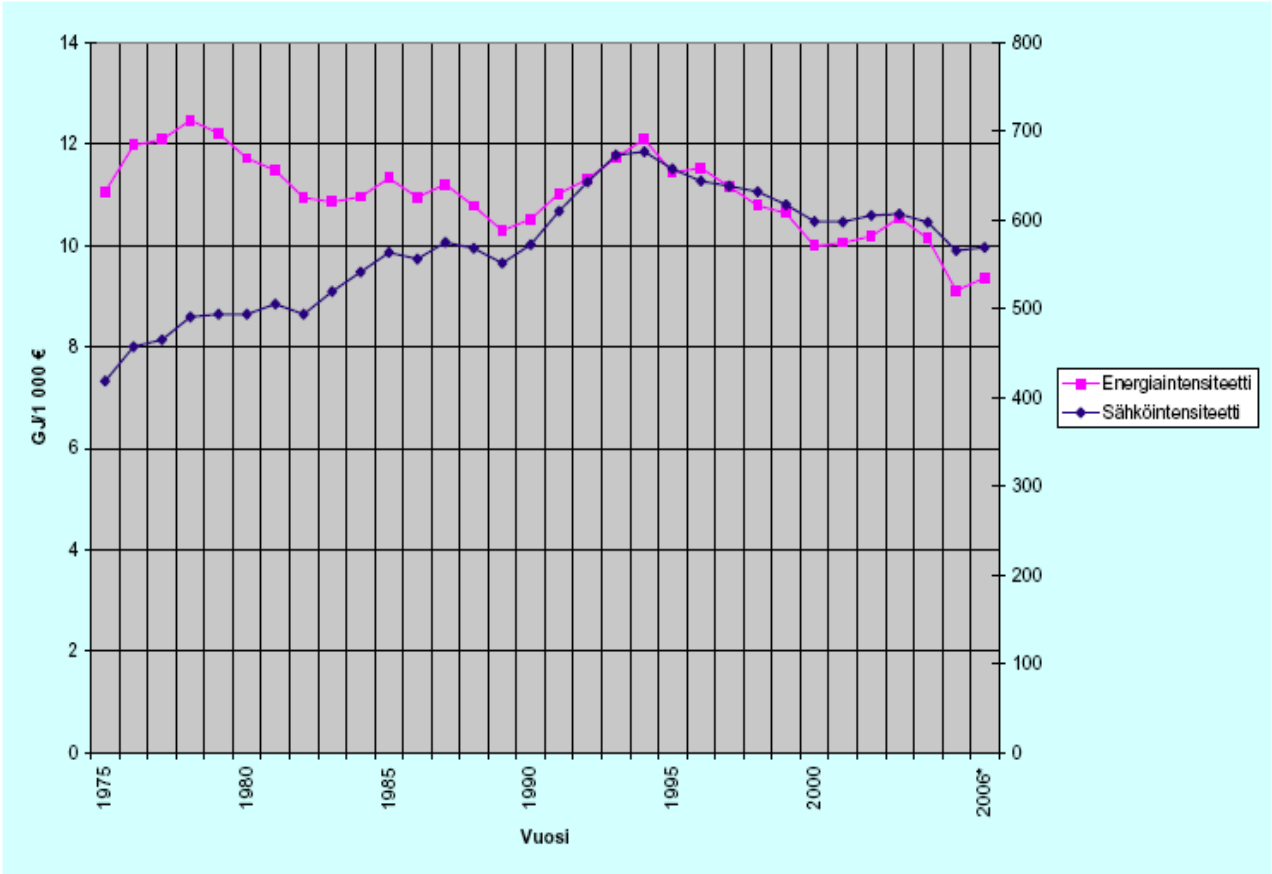

Figure 2. Energy- and electricity-intensity of the Finnish national economy during the period 1975–2005.

GJ/€1,000
Energy intensity
Electricity intensity
Year

In international comparison, Finland has a high energy consumption in relation to its population; this has to do with our northern geographical location and long distances. The energy consumption of industry, equal to roughly half of the total consumption of electricity and fuels, also increases the average consumption levels.

The energy consumption of buildings has remained almost the same for 30 years even though the number of dwellings, for example, has increased from 1.7 to 2.7 million during the same period. The standard of housing has improved significantly, particularly as a result of the production of new housing that peaked both in the early 70s and late 80s. Since then, the volume of reconditioning work done on housing has increased so that it equals that of new housing construction, and it has become an important factor in improving the energy efficiency of buildings.

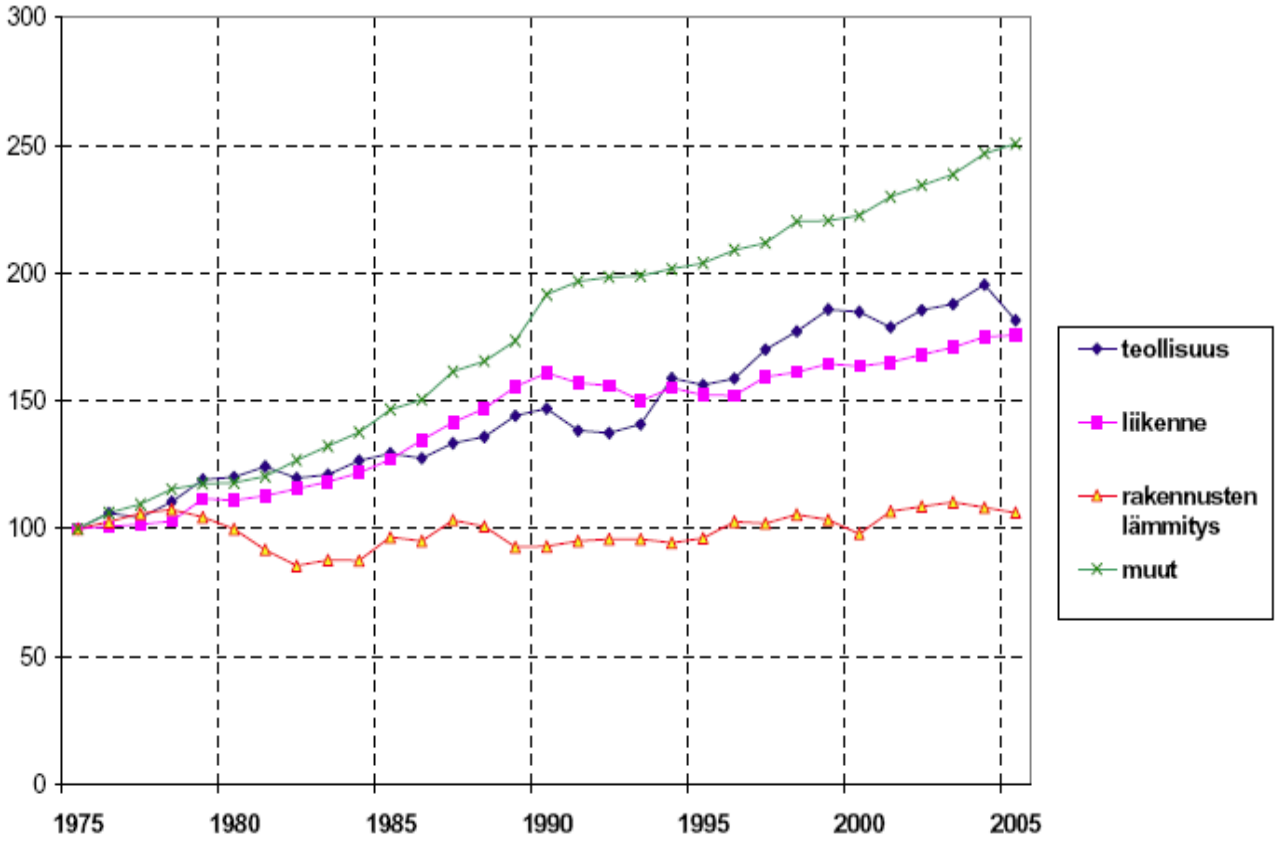

Figure 3. End-use of energy in Finland by sector during the period 1975–2005.

Industry sector
Transportation
Heating of buildings
Others

The ESD addresses energy consumption outside the Emissions Trading Scheme (non-ETS consumption). Of the end-use of energy by industry, an average of 71% fell under the Emissions Trading Scheme in the 2000s. 29% of the end-use remained outside emissions trading and was therefore included in the scope of application of the ESD. All in all, two-thirds of end-use of energy in Finland falls under the scope of the ESD. Figure 4 shows the end-use of energy and Figure 5 the end-use of energy in 2005 by sector, showing separately for industry the ESD part and non-ESD part.

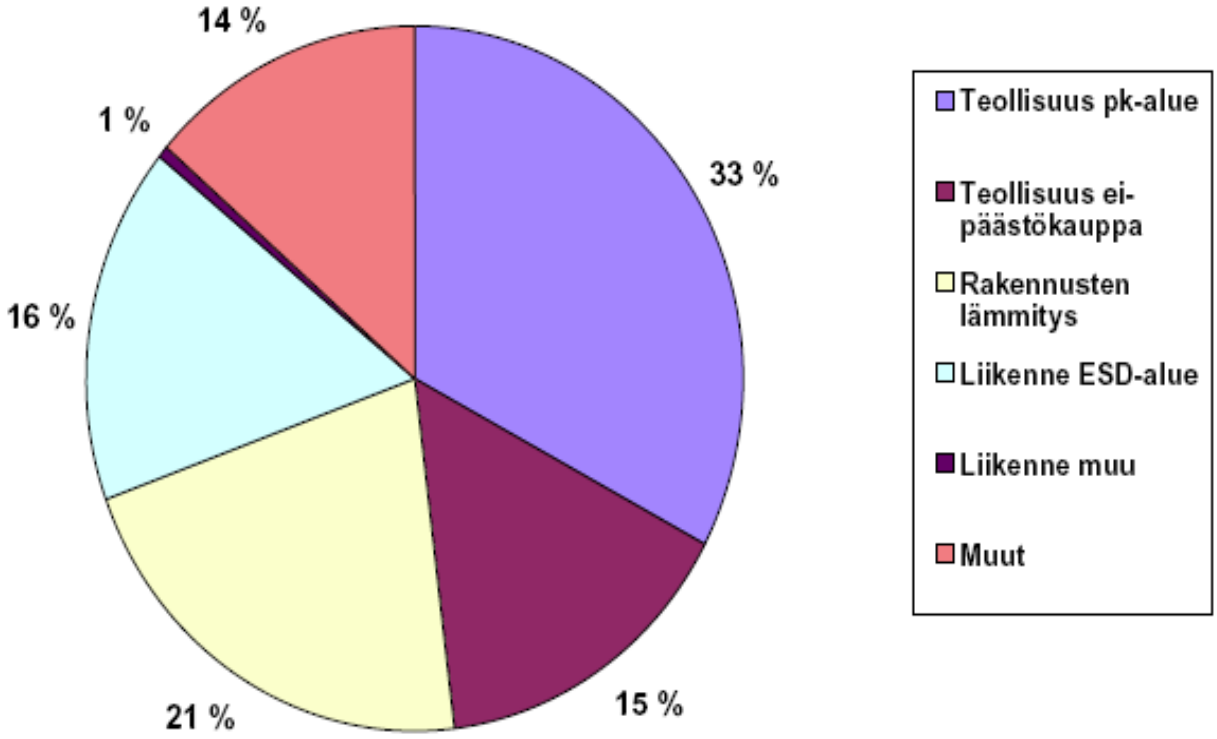

Figure 4. End-use of energy in Finland (301 TWh) by sector in 2005 (as percentages).

Industry, capital region
Non-ETS industry
Heating of buildings
Transportation under ESD
Transportation. other
Others

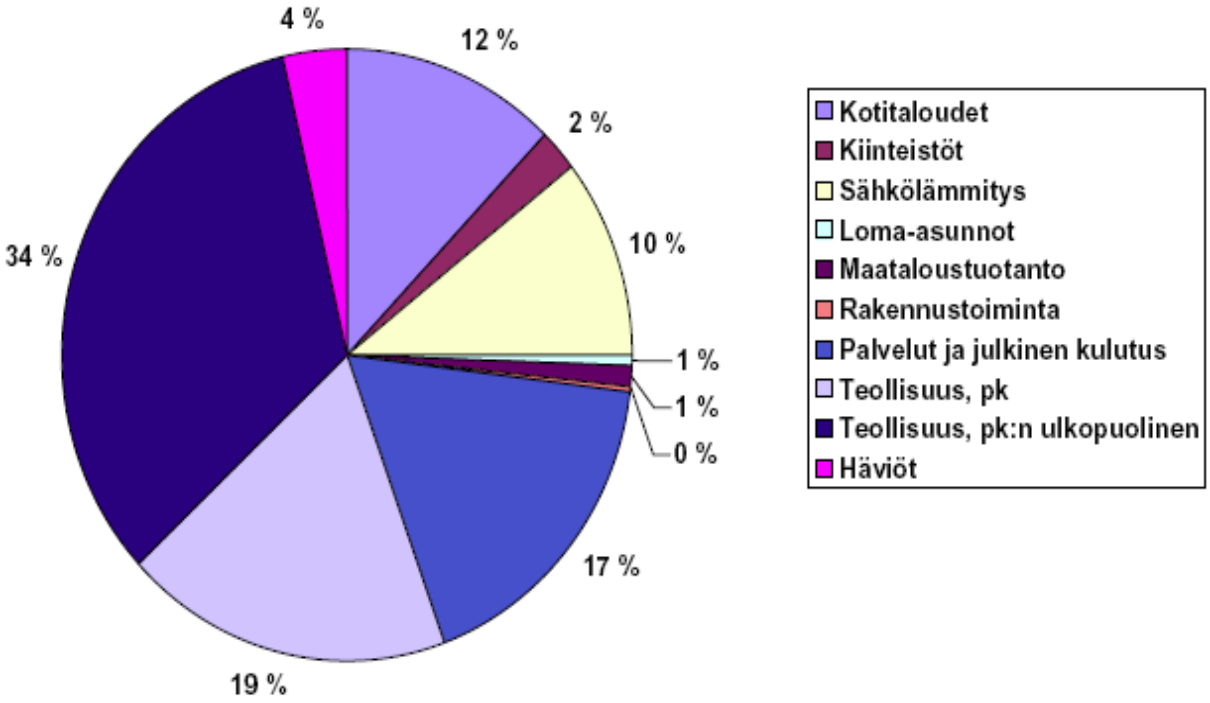

Figure 5. End-use of electricity in Finland by sector in 2005 (as percentages).

Households
Buildings
Electric heating
Holiday houses
Agriculture
Building construction
Services and public consumption
Industry, ETS
Industry, non-ETS
Losses

2.1.2 Energy savings and efficiency in Finland's energy policy

Energy savings and energy efficiency have been promoted in Finland before 1992 as part of energy policy programmes and strategies. Energy savings have been addressed as a clearly separate entity in conjunction with the oil crisis in 1974 and in the report of the Energy Savings Committee in 1980.

In 1992, the Government approved the first separate energy savings programme for 1992–1996. The goals of the action plan were set in the form of improving specific consumption , and 2005 was set as the target year for the programme. The targets for decreasing specific consumption varied between 10 and 15% depending on the sector of consumption. For the duration of the savings programme, an energy savings service centre was established under the name Motiva. Its purpose was to initiate and implement information dissemination and survey activities and to promote the entry into the market of new energy-efficient products and systems. As part of the Government's energy savings programme, a separate public sector energy savings programme (JUSO 1993) was initiated in 1993. Its energy savings target was a 10% reduction in the consumption of heating energy and a 10–15% reduction in the specific consumption of electrical appliances.

In 1995, the Government made a Decision in Principle concerning energy savings. It further enhanced the energy savings programme initiated in 1992. In the reformed energy savings programme, the target was set at a reduction of 10–15% in energy consumption by 2010 when compared to the development that would have taken place without the enhancing actions.

A new energy savings programme (ESO 2000) was prepared in 2000 under the leadership of the Ministry of Trade and Industry. Its purpose was to serve Finland's National Climate Programme that would be the prepared for the purpose of achieving the international targets for reducing greenhouse gas emissions. The so-called basic actions of the ESO 2000 programme were estimated to achieve a 4% saving in primary energy consumption during the period 2001–2010. Correspondingly, the deployment of more rigorous actions would achieve savings amounting to 8%. The ESO 2000 programme was updated in 2002.

The actions prescribed in the new ESO 2002 programme for 2003–2006 were calculated to achieve a maximum savings effect of a 6% reduction in primary energy consumption in 2010 when compared to a situation where no new actions were taken. The working group preparing the programme estimated that the practical savings to be achieved during the period 2001–2010 would, as a consequence of certain uncertainty factors, be between the targets of the ESO 2000 and ESO 2002 programmes, i.e. 0.4-0.6% annually. The follow-up information gathered from the annual reports (2005) of energy conservation agreements indicate that the savings in heating energy and fuels in industry during 2001–2006 were on a target track between the ESO 2000 and ESO 2002, while the savings in electricity exceeded the ESO 2002 target. In the service sector, the savings in electricity were on the target track but the savings in heating energy were clearly below the ESO 2000 level. As a whole, the situation has developed at an annual savings rate of 0.5%, i.e. in line with the 2002 estimate. Regarding savings, it must be noted, however, that the industry and service sectors are also implementing other actions than those reported under the savings agreements, and their savings effects are not monitored. No separate energy savings programme was drawn up as a continuation of the ESO 2002 programme because the promotion of energy savings and energy efficiency was included as a part of Finland's new National Energy and Climate Strategy. As a part of the preparatory work for the new National Energy and Climate Strategy, the energy savings programme will also be reformed by the end of 2008.

2.2 National targets

The target set in Finland's National Energy and Climate Strategy (2005) is that by efficiently implementing EU Directives and other energy conservation actions, energy consumption can be reduced by 5% in 2015 when compared to a situation in which no new actions were taken.

The new Government Programme issued in April 2007 includes the Government's intention to draw up a long-term climate and energy strategy at the beginning of the electoral period. Regarding energy savings and energy efficiency, the Government Programme includes a policy decision stating that the increase in energy consumption will be curbed by means of resolute actions, with the goal of stopping the increase in energy consumption. The Government Programme also takes into account the EU's target of achieving a 20% improvement in energy efficiency by 2020. The Government Programme includes, *inter alia*, the following measures for improving

energy efficiency:

- preparation of a new energy savings programme by the end of 2008
- securing supplementary funding for energy conservation purposes
- increasing citizens' awareness of energy efficiency issues
- promotion of the process of switching to remote metering of electricity and district heating consumption
- promotion of the energy efficiency of multi-storey residential houses through energy subsidies
- support to investments improving the energy efficiency of small residential houses
- promotion of low-energy building, by revising building regulations, improving the availability of information and by developing regional advisory services pertaining to renovation and energy issues.
- promotion of biodiesel fuel and biogas produced and used on farms through subsidies and decisions on tax, as well as an increase in resources for regional bioenergy advisory services for farms
- emphasis on environmental issues when developing the taxation system
- the taxation of vehicles and fuels is developed and excise duty is abolished with regard to the taxes levied on biofuels produced and used by farmers on their own farms. The duty on electricity levied on households and the tax levied on coal will be increased.
- improvement in the energy efficiency of vehicles by encouraging the transport industry to adopt voluntary energy conservation measures, by promoting public transport and by amending vehicle taxation in favour of lower emissions.

2.3 Overall target for energy savings

2.3.1 Calculation basis for the overall target

General

The end-use of energy coming under the scope of the ESD is shown in Finland's official statistics for all sectors excluding industry. Dividing the end-use of industry in the manner required by the Directive between the ETS sector and the non-ETS sector has required combining and comparing data collected from different sources.

According to the ESD, its scope of application does not include the end-use of energy by ETS companies. However, the line has not been drawn between individual companies when calculating the target; instead, only those industrial sites that were included in the scope of emissions trading in 2005 have been excluded. Adherence to this principle has been preliminarily agreed in the ESD Regulatory Committee. Excluding the entire energy usage of a company from the scope of the ESD on the grounds that the company has a single site falling under the scope of emissions trading would result in very different exclusions in different Member States. According to the Directive, air traffic and maritime traffic, as well as the energy end-use of the vehicles deployed by defence forces are excluded from the scope of application. In practice, the end-use of energy included in the scope of application of the ESD has been calculated by deducting the end-use of the above sectors from the total energy end-use in Finland.

Practical implementation of the calculation process and the associated

uncertainty factors

The bases used for calculating Finland's indicative energy conservation target were the "Ilmari" time series of Statistics Finland, which form the annual total material regarding fuel usage, and the 2005 data of the energy usage questionnaire (TEPO) sent to industry by Statistics Finland. For the calculations, use has also been made of the emissions trading -related information provided by the Energy Market Authority and the electricity consumption data collected by Adato Energia Oy from the national grid industry.

The Ilmari time series contains verified annual fuel consumption data for 3,000 boiler or process loading points used in calculating the greenhouse gas inventory. Inclusion to or exclusion from emissions trading is shown individually for each loading point. Each loading point is allocated with a code identifying the site and company, and these codes were used when combining data derived from different sources. The fuel end-use within the scope of application of the ESD is determined by deducting the following items of energy end-use from the total fuel consumption figures included in Ilmari:

- industrial and energy sites within the scope of emissions trading
- air traffic, maritime traffic and defence forces
- those non-ETS producers of electricity or district heating whose energy production is included in the calculation for total end consumption of electricity and heating energy.

Ilmari does not contain reliable and comprehensive consumption data for electricity, district heating and industrial steam. In order to establish the end consumption of electricity and heating energy, the data in Ilmari and the data in the 2005 data of the energy usage questionnaire (TEPO) sent to industry by Statistics Finland were combined, making use of the emissions trading material provided by the Energy Market Authority and the details on emission permits. At the same time, the inclusion in or exclusion from emissions trading of plants belonging to the same group of companies and located on the same industrial site were established. On the basis of linking the loading points and sites, the TEPO material of 2005 allowed the electricity, steam and district heating consumption data to be derived for the ETS plants.

For electricity and district heating, the end-use of energy is determined as the difference between total energy usage and the ETS sector. The exact figures for the end-use of industrial steam are not known, but the steam usage of non-ETS sites is obtained from the TEPO material with sufficient accuracy. This information has been verified by comparing it to the figures for sales of heating energy and steam obtained from the energy production questionnaire by Statistics Finland. Regarding electricity, the share of the ETS sector was compared with the electricity consumption data for the national grid industry collected by Adato Energia Oy for 2004 and 2005.

The largest uncertainty factors in determining the end-use of energy are related to the consumption of district heating energy and industrial steam. The total usage of district heating is fairly accurately known, but the share of ETS sites may involve problems related to the division of plants between ETS and non-ETS. For industrial steam, inaccuracies may be included both in total quantities and in the ETS - non-ETS division.

For electricity and district heating, the average for 2001–2005 was used as the consumption figure. The shares of the ETS sector and the non-ETS industry are based

on the data for 2005 only because verifying and processing the data for several years would have been a considerably arduous task. On the basis of the analyses carried out, using data covering the entire period 2001–2005 would not have significantly changed the national total target.

2.3.2 Finland's indicative total target for energy savings

The end-use of energy within the scope of application of the ESD is 197.7 TWh, and the resulting national 9% energy savings target of Finland is 17.8 TWh expressed in terms of energy. Table 1 shows the end-use of energy within the scope of application of the ESD by sector, and the amounts of energy corresponding to the indicative 9% savings target pro-rata for the sector-specific end-use.

Consumption sectors	Average end-use of energy during 2001-2005 (GWh)	Share of the indicative savings target of 9% (GWh)
Households	56,820	5,110
Transportation	47,210	4,250
Industry[1]	44,620	4,020
Services	30,940	2,790
Agriculture and Forestry	10,240	920
Construction and machinery	7,870	710
Total	**197,700**	**17,800**

Table 1. Sector-specific average figures of end-use of energy for the period 2001-2005 and the amounts of energy corresponding to the indicative 9% savings target.

[1] For industry, the consumption has been calculated on the basis of the 2005 energy usage figures of non-ETS sites.

2.3.3 Implementation of other objectives of the Energy Services Directive (2006/32/EC)

According to the ESD, Member States shall in their first EEAP describe how they intend to comply with the provisions on the exemplary role of the public sector and provision of information and advice to final customers set out in Articles 5(1) and 7(2) respectively.

Ensuring the exemplary role of the public sector (Article 5)

In the context of implementing the Directive, the term 'public sector' refers in Finland to the state administration and the municipal sector. State administration covers the ministries, state departments and state enterprises. The municipal sector covers the cities, municipalities and federations of municipalities. The exemplary role referred to in the ESD is considered as having been implemented primarily if an indicative energy savings target of 9% is set for most of the above public sector.

Municipal sector

The savings target is implemented on the municipal sector through voluntary energy efficiency agreements. The municipalities joining the agreement system (2008–2016) undertake to set themselves a minimum savings target of 9% in accordance with the ESD, to implement measures for achieving the savings target and to submit annual reports regarding the measures and results achieved by them. The agreement system contains, as a starting point, all measures related to public procurement set out in Annex VI to the Directive as measures binding on the municipalities. The agreement also contains an obligation for the municipalities to actively provide information on their actions stipulated in the agreement. In addition to voluntary agreements, obligations are also planned for the municipal sector in the form of regulations that would primarily apply to municipalities outside the agreements.

State administration

For state administration, the planning work for implementing the ESD starts in August 2007. The majority of the real estate property occupied by state administration is owned by Senaatti, a state enterprise. Negotiations will be initiated with Senaatti and major companies within the field of real estate management regarding the implementation of the obligations of the ESD through voluntary agreements. For the so-called user organisations within state administration, the obligations will probably be implemented through a Government decree.

Provision of information and advice to final customers of energy (Article 7)

The provision of information and advice to final customers is, in addition to the state administration's own actions, the responsibility of Motiva Oy, from which the

ministries order most of their targeted information projects falling within their respective areas of responsibility. The activities of Motiva are described in more detail in section 3.10.2.

The new energy efficiency agreement to be concluded with trade and industry (2008-2016) will include, as a separate area of activity, the provision of information and advice to customers of energy companies. Some of these obligations will also be imposed through regulations. One of the obligations imposed on the municipalities joining the energy efficiency agreement for the municipal sector (2008–2016) is that they must cooperate with the media and organisations responsible for promoting energy savings and organise exhibitions and other events for the purpose of conveying information to citizens and communities.

3 Sector-specific energy efficiency measures and programmes

3.1 Households

3.1.1 Description and energy usage of the sector

The increase in consumption of electricity by households in Finland is connected to the increase in housing standards, i.e. the increasing average floorspace of homes and the growing amount of equipment and domestic appliances. There are 2.4 million households in all, and the average floorspace of dwellings is currently 77 m^2. The average number of members in a household has dropped over the years so that it currently is 2.2, and the majority of households only have one or two occupants.

The electricity consumption of households was 10.3 TWh in 2005, approximately 12% of the total consumption in Finland. Consumption has increased by 50% during the period 1990–2005. During the same period, the consumption of electricity per household increased by more than 20% and was 4,200 kWh/household in 2005. In 2005, holiday houses consumed a total of 0.5 TWh of electricity.

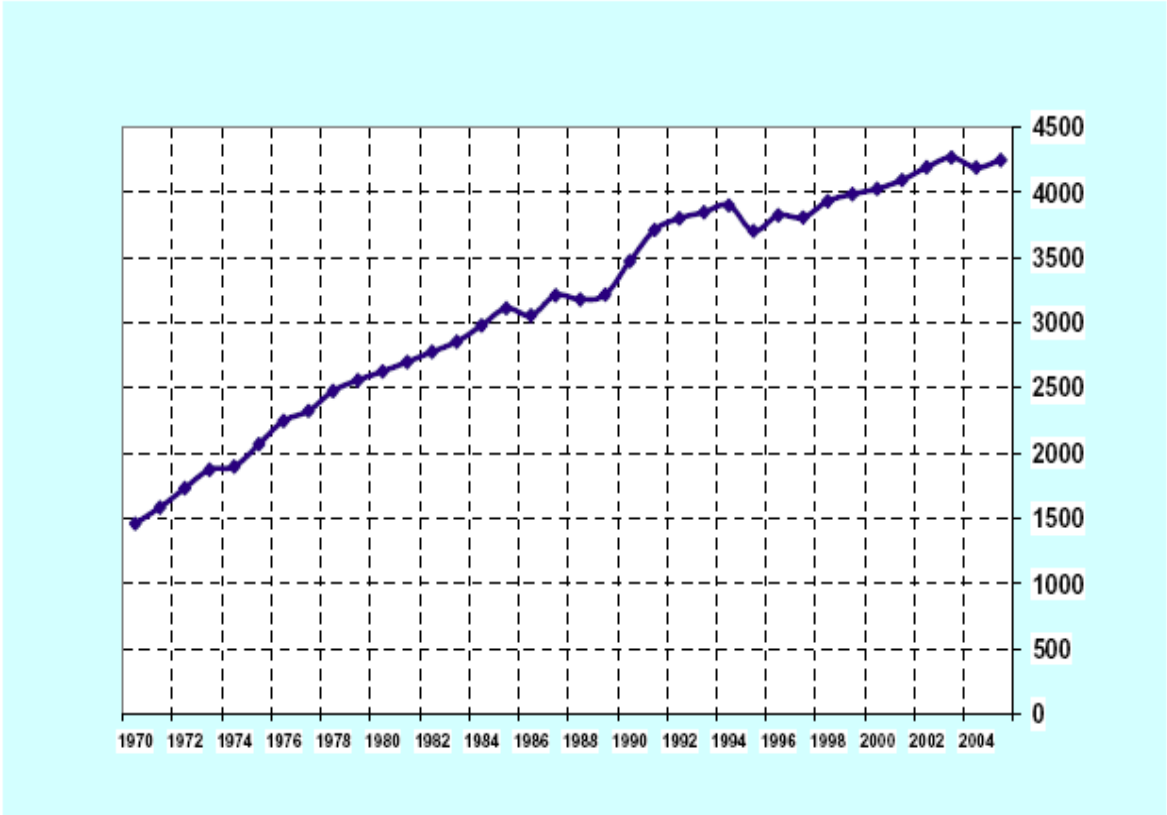

Figure 6. Average electricity consumption by households during the period 1970-2005 (kWh).

The main sources of electricity consumption were cold storage equipment, lighting, cooking, consumer electronics, electric saunas, washing machines and the HPAC equipment of small residential houses. Lighting and consumer electronics in particular are growing sources of consumption as the average floorspace of houses increases. Households have become better equipped during recent years; more than half of all households now have a dishwasher, and nearly two-thirds have a computer. There may also be several TV sets in one household. According to a household questionnaire, half of all households had two or more TV sets.

3.1.2 Measures and control methods

In Finland, the saving of electricity in households is a key objective of the energy policy, encouraged mainly through education and campaigns but also through school curriculums. Finland has participated in Nordic cooperation for introducing energy labelling since the 1980s.

Regulations and provisions

Measure: "Act (1241/1997) governing the energy efficiency of household appliances"

In the 1990s, EU membership brought with it regulations pertaining to the energy efficiency of domestic appliances, and in order to implement them, Finland enacted an act governing the energy efficiency of equipment in 1997. The act contains regulations on the conformity of equipment, its verification, the Notified Bodies and supervision. The suppliers of equipment are responsible for ensuring that the equipment and the information on their energy labels comply with the act and the requirements imposed pursuant to it. The Safety Technology Authority (TUKES) is the supervising authority.

Requirements regarding energy efficiency can be imposed on specific groups of equipment, or an energy label may be required from them.

Requirements regarding energy efficiency have been imposed on refrigeration equipment, hot water boilers and electronic ballasts for fluorescent tubes. The requirements are based on EC Directives. Imposing energy efficiency requirements on equipment allows the equipment with the poorest energy efficiency to be eliminated from the market and production.

Measure: "Energy labelling"

Compulsory energy labelling based on EC Directives has been introduced for cold storage equipment, washing machines, drum dryers, washing machines with a drying feature, dishwashers, lamps, electric ovens and air-conditioning equipment. The energy label is attached to the domestic appliances being sold, and it indicates the energy

consumption of the equipment during operation. The objective is to make consumers favour equipment that consume less energy.

New measures

The decision taken in 2005 regarding the Directive (2005/32/EC) on ecodesign requirements will provide a new framework for the regulations governing the environmental impact of equipment. The detailed regulations governing different product categories will be issued on the basis of this general framework. These products categories include lighting, domestic appliances, office equipment, consumer electronics and HPAC systems.

Economic control methods (MoE)

Measure: "Household tax deduction"

A household tax deduction has been available since 2000 for the labour costs incurred in replacing, upgrading and repairing the heating systems of small residential houses. According to the instructions issued in 2005 by the Tax Administration, 60% of the labour costs may be deducted. The maximum amount of household deduction is EUR 1,150 and the house owner bears the first EUR 100 of the labour costs. The household deduction is available for the taxation of both spouses. In 2006, the basis of the household deduction was amended so that both a household deduction and an energy subsidy are available for upgrading the heating system.

3.2 Buildings and construction

3.2.1 Description and energy usage of the sector

The building stock in Finland is very diverse and divided into many different combinations depending on the type of building, construction method, heating method and equipment installed. The buildings also have particular characteristics and materials typical of different eras and architectural styles. Three quarters of the residential and service buildings in Finland were built after 1960, and more than forty per cent after 1980. This means that the building stock in our country is relatively young.

The total volume of the entire building stock is approximately 1,800 million m^3, of which approximately 1,100 million m^3 are residential and service buildings. The industrial, warehousing and holiday buildings plus the buildings in agricultural, forestry or fishing use represent some 35–40% of the total volume of the building stock.

Annual building production varies in the range of 1.5–2.0% of the entire building stock. There is an annual 0.3–2% decrease in the building stock depending on the building type, on average slightly less than one per cent. This means that the building stock changes rather slowly.

It is forecast that the volume of new building construction will remain lower than it was in the 1970s and 1980s. There is no growth trend in the long-term horizon either because the population of Finland is expected to stop growing in the 2020s. The volume of new building construction in comparison to reconditioning operations has decreased, and the growing trend of reconditioning work seems set to continue. Reconditioning work is carried out every year in one building in every two or three.

The extent of work carried out varies greatly. Since housing construction is expected — based on surveys — to remain at the current level for some time to come, the total volume of housing, business and public premises will also remain fairly constant.

The annual end-use of energy in Finland is approximately 300 TWh. The energy consumption of buildings is of the order of 40% of this total usage, when the heating energy of residential and service buildings, the heating of industrial buildings and warehouses, the common premises electricity of all buildings and the energy consumption caused by manufacturing the building materials and the actual construction work are included. The heating of residential and service buildings represents some 20% of end-use of energy in Finland.

	Electricity, TWh/a	Heating, TWh/a	Total, TWh/a
Residential buildings	18.3	38.5	56.8
Service buildings	14.8	16.1	30.9
Total	**33.1**	**54.6**	**87.7**

Table 2. An estimate of the energy usage of residential and service buildings as average figures for 2001–2005 (GWh/a).

3.2.2 Measures and control methods

Regulations and provisions

Measure: "Building code regulations C3, C4, D2 and D5"

The intention is to restrict the energy consumption of new buildings through the regulation (C3) governing the thermal insulation of buildings, as well as through the regulations and guidelines (D2) regarding the indoor climate and ventilation of buildings, included in the National Building Code of Finland. The regulations and guidelines now in force became effective on 1 July 2003. They superseded the earlier C3 regulations dating back to 1985 and D2 regulations dating back to 1987. The goal was that the buildings complying with the regulations of 2003 would consume approximately 25–30% less energy than the buildings complying with the earlier regulations.

As part of the process of transposing the Directive governing the energy efficiency of buildings, the C3 regulations concerning thermal insulation are in the process of being updated. The regulations will be issued during June 2007, as will the new D2 regulations and guidelines regarding the indoor climate and ventilation of buildings, following the statutory waiting period observed in conjunction with announcing national regulations. These regulations and guidelines will become effective and binding on 1 January 2008. Updating the D3 regulations and guidelines on the energy efficiency of buildings and the D5 guidelines on the calculation of power and energy needs for heating buildings are also particularly related to the entry into force of the Directive. The intention is not to make the requirements regarding the energy consumption of buildings more stringent in connection with this reform, but merely to describe the requirement related to the energy consumption of the building and to present a method suitable for its calculation.

The savings effects of Building Code 2003 are presented in Annex YM-01.

New measures

The Ministry of the Environment is in the process of preparing the requirements for the energy performance of buildings also with regard to reconditioning, as part of the transposition process of the Directive governing the energy efficiency of buildings.

The Government Programme of the new Government states that the construction of low-energy buildings will be promoted by, among other things, reviewing the building regulations. The building regulations concerning the energy performance of new buildings will therefore probably be made more stringent during the validity of the ESD. At this stage, there is no detailed information available on the actions for making the regulations more stringent, nor of their degree and timing.

The savings effects of these measures can be included in the energy savings target later when more information becomes available on their degree of implementation.

Economic control methods

Measure: "Subsidy scheme for apartment buildings"

During 2003–2006, energy subsidies were granted, within the constraints of the appropriation decided in connection with the State Budget, for improving the energy performance of residential buildings. Subsidies have been granted for carrying out energy audits of multi-storey residential buildings and terraced houses, for improving the energy performance of the envelope of buildings, for adjusting, upgrading or repairing ventilation and heating systems, as well as for introducing renewable sources of energy. Some of the subsidised measures have been inter-linked in the terms and conditions for the subsidies so that a basic adjustment of the ventilation and heating system is required in conjunction with an improvement in the windows and walls, and a basic adjustment of the heating system is also required when installing a heat recovery system. The maximum subsidy amounted to 10–15% of the qualifying total cost. The maximum subsidy for energy audits was 40%.

A total of approximately EUR 64 million was granted as energy subsidies during the period 2003–2006. In 2007, subsidies were no longer granted to multi-storey residential buildings or terraced houses for investments, but the energy audits of buildings participating in savings agreements still qualify for subsidies. According to the Government Programme of the new Government, the repair and energy subsidies are used to support, among others, improvements to the energy performance of residential buildings. The continuation of the energy subsidy programme from 2008 onwards will therefore depend on future decisions concerning appropriations in the State Budget.

The savings effects of the energy subsidies granted to multi-storey residential buildings and terraced houses during the period 2003–2006 are presented in Annex YM-02.

Measure: "Subsidy scheme for detached and semi-detached houses"

The modifications of heating systems in small residential buildings have qualified for subsidies since 2006. Subsidies are granted for equipment investments and district heating connection charges when the heating system is upgraded to a emission-free or low-emission system. Subsidies may also be granted for the procurement cost of a separate solar energy collection system when it is connected as part of the main heating system.

Agreements

Measure: "Voluntary agreements on energy efficiency"

The Ministry of the Environment, the Ministry of Trade and Industry and ASRA ry, a residential building and property developers' association, signed a voluntary energy conservation agreement in November 2002. The current agreement remains valid until the end of 2012. The main objective of the agreement is to promote energy savings in residential buildings. The communities joining the agreement have qualified for an increased energy subsidy when committing to energy savings and regular reporting of the achieved savings. Approximately 60% of the residential buildings owned by the member communities of ASRA ry are currently within the scope of the agreement system.

Measure: "Höylä I and II programmes for oil-heated houses"

In 2005, there were approximately 250,000 oil-heated small residential buildings in Finland. The energy consumption of oil-heated small residential buildings and terraced houses (GWh/a) and the number of buildings are shown in Table 3. The number of oil-heated buildings and their energy consumption figures indicate that the energy consumption per building has decreased by about one quarter in 10 years.

	Year 1995	Year 2000	Year 2005
Detached houses	6,919 GWh	6,589 GWh	5,636 GWh
Linked small houses	1,114 GWh	1,083 GWh	953 GWh
Total energy	8,033 GWh	7,672 GWh	6,589 GWh
Number of houses	250,000	256,000	258,000

Table 3. Energy consumption and number of detached and linked small houses. (Source: Statistics Finland)

In 2002, the Finnish Oil and Gas Federation, the Oil and Gas Heating Association, the Ministry of Trade and Industry and the Ministry of the Environment initiated the Höylä II programme as a continuation of the Höylä I programme that was started in 1997. These programmes are cooperation programmes of the nature of voluntary energy conservation agreements, aimed at improving the energy performance of oil-heated buildings. The goal of the Höylä II programme is to decrease the specific consumption of oil heating systems so that the average efficiency in the existing building stock improves by 10% per annum from 1997 to 2010, and that the oil-heated boilers installed from 2003 in reconditioned buildings have at least a three-star rating according to the EU Directive (92/42/EEC) concerning the efficiency of hot-water boilers. Another goal of the programme is to improve the total energy economy of oil-heated buildings. The programme is also aimed at developing methods and procedures for combining oil heating and the use of renewable energy sources in an economical manner that is beneficial from the perspective of environmental impacts.

The programme has the quantitative target of refurbishing 100,000 oil heating systems by 2010, the interim target being 57,000 boiler replacements by 2006. Energy savings of 10–30% can be achieved by reconditioning individual heating systems.

The Höylä II programme has five key areas of activity:

- reconditioning of old oil heating systems
- integration of renewable energies with oil heating
- total energy economy thinking
- informing customers about energy conservation possibilities
- improvement and maintenance of the know-how of installation firms and educational institutes, training

Öljyalan Palvelukeskus, the service centre for the oil heating industry, annually publishes four issues of the Lämmöllä magazine. The magazine has a circulation of 250,000–280,000, and it reaches practically all oil heating customers in Finland, 500 installation and maintenance companies, the municipal planning authorities, 900 designers, 400 real estate agents and 400 salespersons and designers in the ironmongery business and housing industry. The magazine is the main channel for communicating the measures for improving the energy performance of oil-heated buildings. Several development and education projects have been implemented every year in the Höylä II programme. The integration of solar energy with oil heating systems has been a particular focus of activities.

A monitoring system has been used in the Höylä II programme since 2003. The monitoring system monitors boiler changes in oil-heated small buildings, structural reconditioning operations carried out for reasons of energy economy, and the number of solar panel installations. These data are used to calculate the annually achieved energy savings. In 2005, the annual energy savings resulting from measures carried out during the period 1997–2005 amounted to more than 1.4 TWh. If the current volume of measures carried out continued without significant changes in the market shares of different heating methods, the energy savings would increase to approximately 2.2 TWh in 2010 and to 3.0 TWh in 2016.

An estimate of the energy conservation effects of the Höylä I and II programmes is shown in Annex KTM-07.

New measures

The negotiations for the Höylä III programme for the period 2008–2016 started in May 2007.

Measure: "Procurement competition 'Renovation window'"

At the initial stages of Motiva's operations in 1993–1994, discussions took place regarding how Motiva's operations should be directed, and the energy conservation potential of new window technologies was brought up. Together with VTT Building Technology and the Tampere Technical University, Motiva organised a competition in 1995–1998 with the objective of inducing window manufacturers and reconditioning contractors to develop competitively priced energy conservation windows. The rationale behind the introduction of new types of windows was that even though the building regulations did not require the thermal insulation properties of windows to be upgraded in conjunction with reconditioning jobs, it would be sensible to select better windows at that time. In all, 28 entries were received at the first phase of the competition. During the second phase, prototypes of 14 windows were manufactured and tested. Two windows for new buildings and two for renovation objects were rewarded in the competition. 89 buildings were included in the initial buyers category,

63 of which took part in the initial trade. The total contract price of the initial purchases was EUR 5 million, of which state subsidies covered EUR 0.6 million. In all, more than 10,000 windows were installed. According to the estimate made at that time, the future need for window replacement during 2000–2015 amounts to 10-12 million square metres, and the savings potential using the new energy-efficient solutions is about 1.5 TWh/a. After the competition, the possibilities for promoting the use of energy conservation windows were studied as part of the LINKKI 2 programme (1997–2001).

Since no energy performance classification system covering the whole of the EC was created, the work for promoting the usage of energy-efficient windows in Finland continued by developing the energy performance classification and energy labelling systems on a national basis.

Measure: "Voluntary energy labelling for windows"

A voluntary national energy labelling scheme for windows was introduced in the autumn of 2006 in Finland. The foundation for the energy classification scheme was laid in the pilot project implemented by VTT and Motiva Oy and funded by the Ministry of the Environment, the Ministry of Trade and Industry together with eight major Finnish window manufacturers whose production covers about 80% of the total windows market in Finland. The purpose of the classification was to make comparisons between different windows easier, to provide information on the energy consumption relating to windows, and to guide the selection of windows in the direction of energy-efficient products. By the beginning of 2007, the eight largest window manufacturers had almost 200 classified window models. It is also expected that even smaller manufacturers will obtain energy classifications for their windows.

The energy performance of windows is an important factor in the energy consumption of the building because the windows account for about 15–25% of the total heating requirement, irrespective of the season. Windows are also manufactured in large numbers because they are required both for new buildings and for buildings being reconditioned. Only 20–30% of the double-glazed windows in the existing building stock have been replaced, which means that there are still a lot of windows with only two sheets of glass in use.

An estimate of the energy conservation effects associated with the improvement in energy performance of windows, relating to the energy labelling of the windows in this analysis, is presented in Annex KTM-05.

<u>Training</u>

Measure: "Energy Expert training scheme"

The Energy Expert scheme started in 1994 as an experiment by Motiva and VVO, a major owner of rented and partially-owned accommodation. By 2004, VVO alone had more than 700 trained Energy Experts.

Energy Experts are so-called active occupants who channel their activity towards promoting energy savings and comfortable living conditions. The Energy Expert distributes information and conveys it between the occupants, the board of the housing company, house manager and maintenance company. The Energy Expert uses his/her own initiative to study the energy usage and consumption of the building and any

possibilities for saving energy. Follow-up information from the Energy Expert scheme indicates that the average energy savings achieved have been in the order of 5%.

Other measures

Measure: "Heat pumps in detached houses"

Three types of heat pumps are used in small residential buildings in Finland. When used as the principal heating system, the geothermal heat pump can reduce the consumption of purchased energy by 60–70%, and the exhaust air heat pump by 30-40 %. The savings impact of air heat pumps used as support heating systems is approximately one quarter. Data on the sales of heat pumps is available from 1976. It was not until 2000 that the sales figures of heat pumps only started increasing significantly in Finland, when the Finnish Heat Pump Association and Motiva began promoting their use. While only a few hundred heat pumps per year were sold in the 1990s, a total of 8,000 geothermal heat pumps and 47,000 air heat pumps were sold in 2005 and 2006. Approximately 100 exhaust air heat pumps were sold annually before 2000, but by 2006 the number had gone up to 2,000.

The promotion of the heat pumps is part of the continuous promotion work undertaken by Motiva in partnership with other actors in the field with the aim of improving the energy performance of small residential buildings and promoting the use of renewable energy sources. The sales figures of heat pumps for small residential buildings are monitored annually, and the results are included in the official statistical information in Finland.

An estimate of the energy savings effects of heat pumps is presented in Annex KTM-02.

Measure: "Low-energy buildings"

There are no statistics on low-energy buildings, but their market share is approximately 5–10% of all new small residential buildings. Buildings that have an energy consumption not exceeding half of that for an ordinary building complying with current building regulations are deemed low-energy buildings.

Low-energy construction has been promoted in Finland since the mid-90s. The promotion of the introduction of voluntary energy labelling (energy certificate) for small residential buildings began in 1996. The energy certificate for small residential buildings was highlighted on several occasions at the Nationwide Housing Fair, an annual event with some 100,000–200,000 visitors. Even though the energy certificate did not become fully established on the market at that stage, the ground work for energy performance classification was done and public awareness of the energy performance of buildings and low-energy construction was increased.

A competition for commercialising low-energy buildings (the MotiVoittaja competition) was organised in 2000–2001 for the manufacturers of prefabricated houses. The task was to design a small residential building that would fulfil the competition requirements regarding indoor climate, energy performance, the water economy and environmental impact. The criteria for energy consumption was that the energy consumption level prescribed in the building regulations valid at that time should be halved. As a result of the competition, 10 industrially-produced house types fulfilling the requirements entered the market. A group of first-time buyers was

established for the winning house type, and four MotiVoittaja houses were built for the 2002 Housing Fair held in the City of Kotka.

As a continuation, a two-year campaign with the theme "Energy-efficient Home" was launched in 2005. Its purpose was to increase the market share of buildings with a low-energy classification to 10% by 2010. The campaign was implemented in co-operation with the Ministry of Trade and Industry, the Ministry of the Environment and several organisations and companies in the field of house equipment technology and the house manufacturing industry. The primary target groups for the campaign were property developers, the media and municipal building supervisors. Additional target groups included educational institutes for the trade, retailers of building materials, designers and contractors. The campaign will continue during 2007 and 2008. The campaign will highlight, in a neutral fashion, the various factors affecting energy performance.

3.3 Public sector — municipalities and federations of municipalities

3.3.1 Description and energy usage of the sector

At the end of 2005, there were 432 municipalities and some 200 federations of municipalities in Finland, whereas in 1995 there had been 455 municipalities. In 2007, there were 416 municipalities, and the number will further decrease with new mergers of municipalities. The total volume of the service building stock in the municipal sector is approximately 123 million cubic metres. The total volume of residential buildings in the municipal sector is approximately 17 million cubic metres. Measured in terms of inhabitants, Helsinki represents some 11% of the entire population. The five largest cities make up one quarter, the 28 largest cities half and 134 cities or municipalities 80% of the entire population of Finland. The average share of the building stock in major cities of the total building stock of the municipal sector is slightly more than the share of their population of the entire population.

Of the total energy usage of the service sector, 30–32 TWh/a, one-third, or 9-10 TWh/a, has been estimated as the share of the municipal sector. Estimated on the basis of average specific consumption figures, the energy consumption of the service buildings in the municipal sector is approximately 8 TWh/a, of which heating is 5.8-TWh/a and electricity 2.3 TWh/a.

3.3.2 Measures and control methods

Economic control methods

Measure: "Energy subsidies"

The Ministry of Trade and Industry has been supporting the energy audit activities of municipalities and federations of municipalities since 1992. The subsidy available for energy audits is 40% for all municipalities and federations of municipalities. For the municipalities and federations of municipalities that have joined the energy conservation agreements of the municipal sector, the subsidy is 50%. A total of EUR 5.1 million was granted in subsidies during the period 1992–2005. The effects of the audit subsidies granted are included as a whole in the evaluation of the energy audit activities.

The Ministry has been supporting the energy savings investments of municipalities and federations of municipalities since 1997. Support for projects involving new technologies, amounting to 25–35% as a rule, is granted to all municipalities and federations of municipalities. Support for projects involving conventional technologies, amounting to 15–20% as a rule, is only granted to companies that have joined the energy conservation agreements. The savings effects of the investment subsidies granted to the municipal sector have not been evaluated separately so far. It can be assumed that most of the effects will be reported through energy audits and the follow-up system of the energy conservation agreements.

The use of energy subsidies as an economic control method will also continue as part of the new energy-efficiency agreements planned for 2008–2016.

Energy audits

Measure: "Energy audits in municipal public buildings"

The energy audits of the municipal sector service buildings began in 1992. In 1997, the energy audits were made obligatory in the energy conservation agreements of municipalities. The administrative responsibility for the energy audits rests with the Ministry of Trade and Industry, but the energy subsidies are granted by regional Employment and Economic Development Centres. Motiva Oy is responsible for the practical organisation of energy audits; its duties include the promotion, development and follow-up of audit activities, as well as training of the auditors and quality assurance of the audits.
During the period 1992–2005, energy audits were carried out in a total of 3,700 buildings in the municipal sector; in some of them, the energy audit has already been repeated. Of the entire 123 million m^3 of service building stock in the municipal sector, 63 million m^3, or 51%, has been audited. The cumulative volume of the energy audits carried out in the municipal sector is shown in Figure 7.

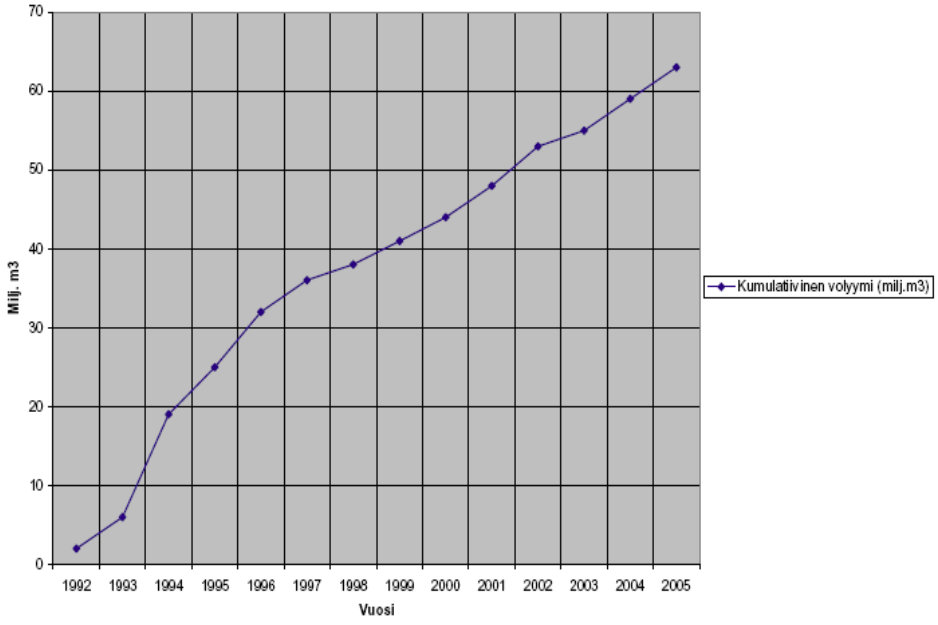

Figure 7. Cumulative volume of energy audit activities (millions of m^3) in municipal sector service buildings during 1992–2005.

Millions of m^3
Cumulative volume (millions of m^3)

On the basis of the 842 energy audits reported during 2000–2005, the energy savings potential in the service buildings of municipalities is 12.7% with respect to heating and fuel and 7.3% with respect to electricity. The savings potential with respect to heating and fuels in particular has steadily declined as the focus of the audits has shifted towards more recently built buildings which have better energy efficiency to start with. The implementation of the measures suggested in the energy audits is monitored both through the follow-up system of the energy audit scheme and through the follow-up system of the municipal energy conservation agreements. On average, more than 70% of the reported savings potential is realised in municipal service buildings. The data regarding the degree of realisation of the savings potential is updated annually on the basis of the annually reported data in the savings agreements.

Support for the municipal sector energy audits will be continued as part of the implementation of new energy efficiency agreements. Resources will be invested in developing the energy audit activities at least for the purpose of starting follow-up audits.

An estimate of the energy conservation effects of the energy audits carried out in the municipal sector is shown in Annex KTM-01.

Agreements

Measure: "Municipal sector energy conservation agreement and energy and climate agreement 1997-2007"

The extensive municipal sector energy conservation agreement scheme was initiated in 1997, with the Ministry of Trade and Industry in overall charge of the scheme. The Ministry has had an energy conservation agreement with the City of Helsinki since 1993. The first period of the current agreement scheme started in 1997 ended at the beginning of 2002. In October 2002, the scope of the agreement scheme was extended to include renewable energy sources as well. At the same time, the decision was taken to continue the agreement scheme until the end of 2005. During the second period of the agreement scheme in 2003–2005, there were two types of agreements in use in the municipal sector; the old energy conservation agreement (ESS) and the new energy and climate agreement (KEIS). The municipalities that joined the energy conservation agreement scheme before 2003 had the option of switching to the energy and climate agreement. Since 2003, new municipalities have only been able to join the energy and climate agreement. The decision was taken in the autumn of 2005 to continue the agreement scheme until the end of 2007.

By the end of 2006, 59 municipalities and 14 federations of municipalities had joined the agreement scheme. In terms of building volumes, they represent 56% of the entire building stock of the municipal sector. During the period 1997–2002, the number of municipalities in the scheme grew every year as new municipalities joined. When the agreement scheme was continued, a few municipalities dropped out in 2003 and 2005, but new municipalities also joined during the period 2003–2006. The coverage of the agreement scheme has not been significantly affected by these changes. Figure 8 shows the coverage of the municipal energy conservation agreements.

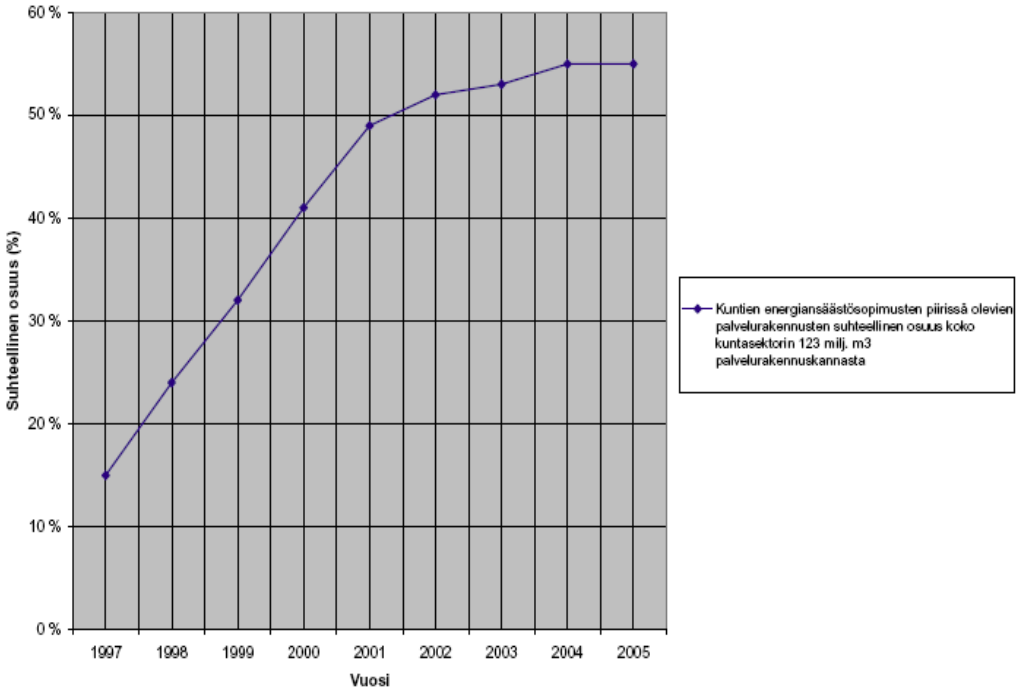

Figure 8. Relative share of the service buildings included in the scope of energy conservation agreements of the entire municipal service building stock of 123 million m^3.

Relative share (%)
Relative share of the service buildings included in the scope of energy conservation agreements of the entire municipal service building stock of 123 million m^3.

A target of 80% coverage by 2010 was set for the agreement schemes of the entire municipal sector for building consumption monitoring and the energy audits scheme. When joining the agreement, the municipalities have set their own municipality-specific targets for 2002 (interim target) and 2005. For the specific consumption of heating energy, the municipalities have set their efficiency improvement targets for 2001, 2005 and 2010. For electricity, the municipalities have set a target year by which the growth of specific consumption will be stopped and reverted to a downward trend. The municipalities have also had the obligation of preparing a status report on energy usage, together with an action plan for making it more effective, and to implement the measures recommended in the audits and to report their actions on an annual basis.

By the end of 2005, 53% of the total public building stock within the agreement scheme had been audited. The coverage of consumption monitoring in service buildings was 86% for heating and 82% for electricity. For residential buildings, the coverage rates were 71% and 69%, respectively. The coverage rates had improved by 1–4% from 2004.

New measures

The planning work for new municipal sector agreements was initiated in autumn 2005. The intention is to have a significant part of the municipal sector energy usage included in the scope of the new agreement scheme covering the period 2008–2016 by the end of 2007. Two agreement models have been drawn up for the municipal sector. Large and medium-sized municipalities will conclude an energy efficiency agreement with the Ministry. Small municipalities will use a less formal process and join the so-called municipal energy programme.

The new municipal sector agreement scheme aims to pay special attention to the ESD-derived obligations of the public sector. The municipalities joining the agreement set themselves an indicative energy conservation target of 9%. The main focus of activities will be in taking the energy efficiency aspects into account when making public procurements and carrying out energy audits.

Training

Measure: "Training campaign for maintenance personnel"

In 2001, the Ministry of Trade and Industry and the Association of Finnish Local and Regional Authorities initiated a training programme for personnel responsible for the maintenance of municipal buildings. The theme of the one-day training sessions was the correct operation and maintenance of buildings from an energy efficiency point of view. During 2001–2002, more than 1,650 persons were trained in 29 training events organised in Finland. Training has been continued on a commercial basis after the project funded by the Ministry of Trade and Industry.

Measure: "Training for energy conservation agreements"

As part of the municipal sector agreement scheme, municipality-specific training has been organised for the municipalities in the scheme. This training, consisting of two stages in most cases, has been organised in 48 municipalities during the validity of the agreement. The number of participants in the training sessions varied greatly with the size of the municipality. The participants included both elected officials and civil servants representing different fields of activities. The effectiveness and practical approach of municipality-specific training were further enhanced by the group work undertaken during the second day of training. All training events were documented, and a feedback summary was drawn up for them.

3.4. Public sector — state administration

3.4.1 Description and energy usage of the sector

Senate Properties, a state enterprise under the Ministry of Finance, is responsible for the management and leasing of the real estate assets of the state. The operations of Senate Properties are governed by the general act governing state enterprises and an enterprise-specific act and decree. Every year, Parliament and the Government set financial and operational targets for Senate Properties. In addition to the state-owned real estate assets managed by Senate Properties, the real estate properties in their own use are managed by the Ministry of Defence, the Finnish Rail Administration, Destia i.e. the Finnish Road Administration, the Border Guard, the Ministry of Education, the National Board of Antiquities, the Governing Body of Suomenlinna, the Finnish Forest Research Institute, Parliament, the Office of the President of the Republic of Finland, the Prime Minister's Office and the Ministry for Foreign Affairs.

In 2006, Senate Properties was managing 11,200 buildings and 8.2 million m^2, equivalent to approximately 85% of the total real estate assets of the state. In 2006, the heating energy consumption of Senate Properties was 1,184 GWh, while its consumption of electricity was 805 GWh. Senate Properties has committed itself to the common energy savings targets of the real estate and construction business through KRESS, the energy conservation agreement in this sector of business. Of the "net" tenants whose rent only covers fixed (capital) costs, the defence administration and the

Criminal Sanctions Agency have concluded their own agreements. The intention of Senate Properties is to decrease the specific consumption of heating energy to 10% of the 1998 level during 2007 at the latest and to stop the growth in specific consumption of electricity and to revert it to a downward trend. Another aim is to increase the coverage of energy audits to the level of 80% of the total building stock within the agreement.

By the end of 2006, energy audits had been carried out for 57% of the building stock, and the work for updating the earliest audits has started. During the period 2003–2006, the specific consumption of heating energy in the building stock managed by Senate Properties decreased and was 9.5% lower in 2006 (38.9 kWh/m^3) than in 2003 (43.0 kWh/m^3). The specific consumption of electricity has remained at the same level during the period 2004–2006.

No comprehensive compilation of monitoring data is available for other organisations managing the real estate assets of the state, but energy audits were carried out in late 90s for almost all of the building stock of that time within the framework of the co-operation scheme, preceded the KRESS agreement, of the Ministry of Trade and Industry and the state's real estate units. Traditionally, the real estate assets owned by the state have been managed at least to the same standard as in the private sector, if not better. Senate Properties, in particular, is a forerunner in the Finnish real estate sector.

3.5 Private services

3.5.1 Description and energy usage of the sector

The energy consumption of the service sector is monitored in official statistics on a rather general level, and no division between public and private services is made. Of the total energy usage of the service sector, 30–32 TWh/a, the private sector has been estimated to account for two-thirds, or 20–21 TWh/a.

However, itemised data indicating orders of magnitude is available as a cross-section view for the years 1998 and 1999 regarding the heating energy and electricity consumption of different service buildings.

	1998	1999	1998	1999
Service industry sectors	Heating GWh/a	Heating GWh/a	Electricity GWh/a	Electricity GWh/a
Hotels and restaurants	938	934	1,386	1,415
Offices and administration[2]	4,384	4,402	4,257	4,419
Trade and commerce	3,473	3,416	3,080	3,095
Total	**8,795**	**8752**	**8,732**	**8,929**

Table 4. Consumption of heating energy and electricity (GWh) in different sectors of the service industry in 1998 and 1999. (Source: Statistics Finland)

Private and public services occupy the same types of buildings, in part also the very same buildings. Similarly, a generalisation can be made that the most common heating method of service buildings is district heating (65%), in addition to which light heating

[2] The figures also include office and administration buildings of the public sector.

oil (17%) and electrical heating (7%) are the most common heating methods. Regarding the consumption of electricity, ventilation and lighting have been itemised as the most important uses that account for more than half (54%) of the total electricity consumption.

Another generalisation can be made by saying that the energy intensity is assumed to have developed in the same manner in both private and public services. The graph below shows the electricity of services compared to the added value of services during the period 1990–2004. The increase in the intensity in the early 1990s is to do with exceptional phenomena brought about by the economic recession, such as a reduction of personnel and hence also of salary revenues. In contrast, the factors behind the intensity of electricity consumption in the 2000s are the increased floorspace of service buildings, air conditioning becoming more commonplace and an increase in the numbers of electricity-consuming equipment.

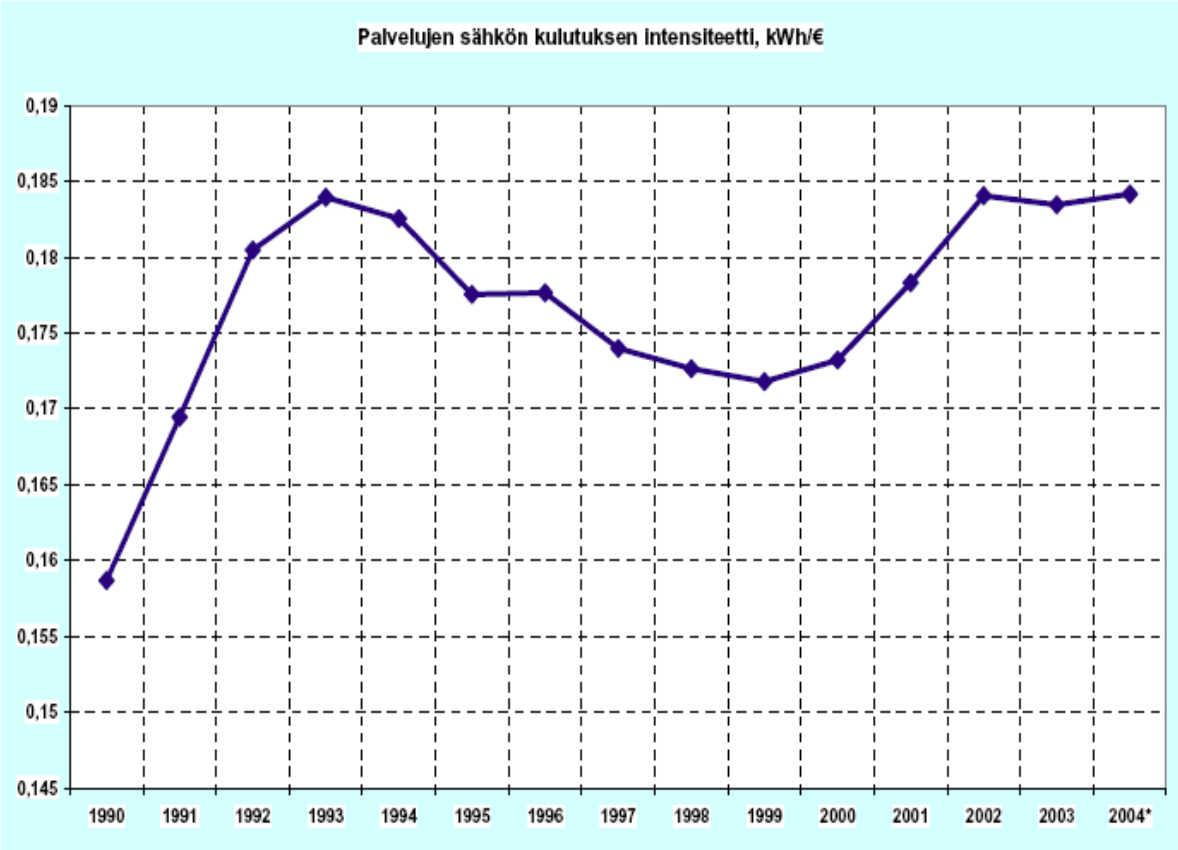

Figure 9. Intensity of electricity consumption by services (kWh/€).

Intensity of electricity consumption by services (kWh/€).

3.5.2 Measures and control methods

Economic control methods

Measure: "Energy subsidies"

The Ministry of Trade and Industry has been supporting the energy audit activities of private sector companies since 1992. Since 2002, the subsidies granted for energy audits have been 40% to all companies. During the years 1999–2001, 50% subsidies were granted to companies that had signed energy conservation agreements . A total of approximately EUR 3.4 million was granted as subsidies during the period 1992–2006. The effects of the audit subsidies granted are included in the evaluation of the energy audit activities.

The Ministry has been supporting the energy savings investments of companies in the private services sector since 1999. Support for projects involving new technologies, amounting to 25–35% as a rule, is granted to all companies. Support for projects involving conventional technologies, amounting to 15–20% as a rule, is only granted to companies that have joined the energy conservation agreements. The savings effects of the investment subsidies granted to the private services sector have not been evaluated separately so far. It can be assumed that most of the effects will be reported through energy audits and the follow-up system of the energy conservation agreements.

The use of energy subsidies as an economic control method will also continue as part of the new energy-efficiency agreements planned for 2008–2016.

Measure: "Energy audits in private sector buildings"

Energy audits of private service buildings began in 1992. In 1999, the energy audits were made obligatory in the energy conservation agreements of the real estate and construction industry. The administrative responsibility for the energy audits rests with the Ministry of Trade and Industry, and the energy subsidies are granted by regional Employment and Economic Development Centres. Motiva Oy is responsible for the practical organisation of energy audits; its duties include the promotion, development and follow-up of audit activities, as well as training the auditors and quality assurance for the audits.

During the period 1992–2005, energy audits were carried out in a total of 1,600 buildings in the private services sector; in some of them, the energy audit has already been repeated. Of the entire 237 million m^3 of the service building stock in the private services sector, 67 million m^3, or 28.3%, has been audited. The cumulative volume of the energy audits carried out in the municipal sector is shown in Figure 10.

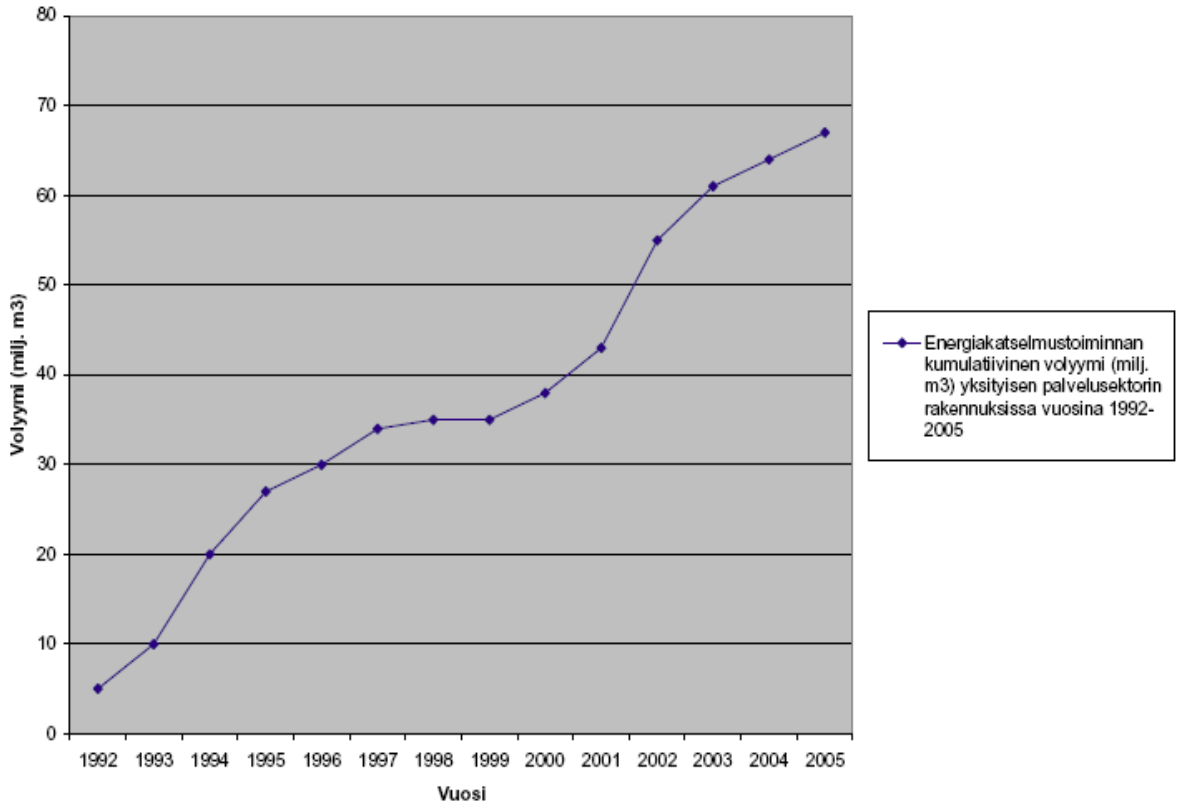

Figure 10. Cumulative volume of energy audit activities (millions of m^3) in private sector service buildings during 1992–2005.

Volume (millions of m^3)
Cumulative volume of energy audit activities (millions of m^3) in private sector service buildings during 1992-2005.

On the basis of the 842 energy audits reported during 2000–2005, the savings potential in the service buildings of the private sector is 16.3 % with respect to heating and fuel and 6.5 % with respect to electricity. The savings potential with respect to heating and fuels in particular has steadily declined as the focus of audits has shifted towards more recently built buildings which have better energy efficiency to start with. The implementation of the measures suggested in the energy audits is monitored both through the follow-up system of the energy audit scheme and through the follow-up system of the municipal energy conservation agreements. On average, 65–75% of the reported savings potential is realised in private services sector buildings. The data regarding the degree of realisation of the savings potential is updated annually.

Support for the private services sector energy audits will be continued as part of the implementation of new energy-efficiency agreements. Energy audits have only been carried out in approximately one quarter of the private services sector building stock excluding residential buildings. This means that there is still plenty of auditing work to be done.

An estimate of the energy savings effects of the energy audits in the private services sector is presented in Annex KTM-02.

Agreements

Measure: "Energy conservation agreement for the building and construction sector 1997–2007"

The extensive energy conservation agreements scheme for the real estate and construction industries, for which the Ministry of Trade and Industry bears the main responsibility, was initiated in 1999. In autumn 2002, this agreement scheme was extended to include the state's real estate units which, during the period 1997–2002, had had a separate co-operation programme with the Ministry for promoting energy savings. The decision was taken in the autumn of 2005 to continue the agreement scheme until the end of 2007.

At the end of 2005, there were 30 companies and real estate units of the state in the agreement scheme, 23 of which committed themselves to continue with the agreement until the end of 2007. The building stock included in the reporting at the end of 2005 accounted for 23% of the entire private and state-owned service building stock in Finland.

The goal of the agreement scheme was to have 80% of the participating companies included within the scope of consumption monitoring and have them audited by 2005. The companies joining the agreement scheme have been obligated to draw up a plan for improving the efficiency of energy usage, setting out the quantitative efficiency targets, as well as a plan for carrying out the energy audits and other measures. By the end of 2005, a total of 80% of the building stock included by the companies had been audited for the reporting in accordance with the agreement. The audited building stock is approximately one quarter of the total building stock occupied by the companies.

New measures

The parties currently joining the energy conservation agreement for the real estate and construction industries are in the new agreement scheme divided into two or three different agreement sectors. There will be 2 to 4 sector-specific action plans for the customer organisations within the private services sector in the framework agreement between the Ministry of Trade and Industry and the Confederation of Finnish Industries. Plans also exist for a separate agreement sector for Senate Properties, the state enterprise administering the state-owned buildings, and private companies within the field of real estate management. A possible third agreement sector would be one for companies that are not members of the Confederation of Finnish Industries nor included in the above group of real estate management companies.

Other measures

Measure: "Environmental labelling scheme for buildings (PROMISE)"

The real estate and construction sectors have jointly created the PROMISE environmental labelling scheme for office, commercial and residential buildings. Kiinteistö-PROMISE, the classification for existing buildings, was completed in 2002, and Hanke-PROMISE, intended for new buildings, in autumn 2004. A separate PROMISE system was created for offices, residential buildings and commercial buildings.

The environmental labelling of buildings helps in planning and building new buildings and in reconditioning the existing building stock. The PROMISE labelling tool helps in taking environmental aspects into account throughout the entire process. When PROMISE is used for setting environmental goals, the owner can steer the planning and design process and construction work by setting target levels for different parameters and actions. The labelling can be utilised during the process by property owners, property developers, designers and contractors.

The basic idea of environmental labelling is to assess the major environmental impacts of the building using simple indicators with different weightings. The indicators include the energy consumption of buildings and the resulting emissions; this parameter has a weighting of approximately 30%. Each assessed parameter is awarded a points score and the building is given an overall grade that describes the quality of its environmental properties. The labelling allows buyers or tenants to evaluate the "environmental friendliness" of buildings with an A, B, C, D or E label in much the same way as they can evaluate domestic appliances.

The labelling scheme has been applied since 2004 to hundreds of existing buildings and buildings in the design/planning stage, including residential, office and commercial buildings. Typically, the assessments have resulted in a class C or D label. Table 5 shows the numbers of buildings applying for and receiving PROMISE classification labels.

EXISTING BUILDINGS:	Labels applied for	Labels granted
Office buildings	490	273
Commercial buildings	133	87
Residential buildings	552	125
Total	1175	485
NEW BUILDINGS:		
Office buildings	374	189
Commercial buildings	49	22
Residential buildings	157	94
Total	580	305

Table 5. Buildings with a PROMISE classification 2004–2006.

It is difficult to estimate the importance of the PROMISE classification from the perspective of energy usage at this stage. The parameters to be assessed also include the quality of the indoor climate, the volume flow of ventilation and the filtration class, which tend to increase energy consumption. Therefore, the main advantage of the classification is the fact that it highlights the significance of different factors and emphasises environmental issues in the design/planning, contracting and maintenance of buildings.

3.6 Industry

3.6.1 Description and energy usage of the sector

In Finland, industrial energy usage has not been monitored separately using the division of the ESD into non-ETS and ETS sites. The total end-use of energy in Finnish industry in 2005 was approximately 164 TWh, of which heating and fuels accounted for 120 TWh and electricity for almost 44 TWh. The end-use of energy in industries falling under the scope of the ESD was 44.6 TWh, or 29% of the total end-use of energy in the industry.

The annual growth of electricity consumption in the industry has averaged 3% during the last ten years. A similar trend has applied to heating and fuels. Due to the large relative share of energy-intensive industries, changes in their capacity utilisation rates can cause large variations in annual statistics. The 2005 industrial dispute in the forestry industry, for example, can be clearly seen in the total energy consumption figures for Finland.

The three largest industries account for approximately 90% of the total industrial energy usage. The largest customer is the forestry industry with about 59%, the next is the metal industry with 17%, and the third is the chemical industry with a 14% share. These three industries also account for about 75% of the total consumption of heating energy and fuels.

3.6.2 Measures and control methods

Regulations and provisions

Measure: "Energy efficiency requirement in the environmental permit"

Energy efficiency should also be taken into account in the environmental permit process, as the Council Directive (96/61/EC) concerning integrated pollution prevention and control (the IPPC Directive) has stipulated that the energy efficiency of operations should also be taken into consideration when deciding on environmental permits.

Provisions on energy efficiency are included in section 43, subsection 3 of the Environmental Protection Act (86/2000), which states that the efficiency of energy usage must be taken into account when issuing the terms and conditions of the permit. The energy-efficiency thinking of the environmental permit is based on this point of law.

Section 19, subsection 3 of the Environmental Protection Decree contains a provision on how the energy conservation agreements should be taken into account when deciding on environmental permits:

Where necessary, the permit decision must also indicate how environmental management systems or measures and reporting based on energy conservation agreements have been taken into account in setting the terms of the permit.

The purpose of the provision is to ensure the proper rationale behind actions and to avoid futile work. If the operator is already carrying out certain procedures that can be utilised for the implementation and monitoring of the environmental permit, a provision for this should be made in the terms of the permit. The voluntary energy conservation agreements concluded between industry organisations and the Ministry of Trade and Industry and the actions associated with these agreements have laid a good foundation for measuring and assessing energy efficiency. For companies, joining the energy conservation agreement has been one way of demonstrating that they take energy efficiency into account in their operations.

Economic control methods

Measure: "Energy subsidies"

The Ministry of Trade and Industry has been supporting the energy audit activities of industrial companies since 1992. Since 2002, the subsidies granted for energy audits have been 40% to all companies. During the years 1997–2001, 50% subsidies were granted to companies that had signed energy conservation agreements . A total of approximately EUR 11.6 million was granted as subsidies during the period 1992-2006. The effects of the audit subsidies granted are included in the evaluation of the energy audit activities

The Ministry has been supporting the energy savings investments of industrial companies since 1998. Support for projects involving new technologies, amounting to 25–35% as a rule, is granted to all companies. Support for projects involving conventional technologies, amounting to 15–20% as a rule, is only granted to companies that have joined the energy conservation agreements. The savings effects of the investment subsidies granted to industrial companies have only been evaluated for the period 1997–2002 when the separate savings effects were about 500 GWh/a. The savings effects have so far not been evaluated separately for the industrial companies falling under the scope of the ESD. It can be assumed that most of the effects will be reported through energy audits and the follow-up system of the energy conservation agreements. Making a company- and site-specific analysis for evaluating the separate effects of energy subsidies is in any case an arduous task.

The use of energy subsidies as an economic control method will also continue as part of the new energy-efficiency agreements planned for 2008–2016.

Energy audits

Measure: "Energy audits in industry"

The energy audit and analysis programme for the industrial sector has been monitored for industry as a whole, without separating companies under the ETS scheme or the ESD. The energy conservation effects have been evaluated separately for companies coming under the scope of the ESD. In other respects, the information presented herein applies to the entire industrial sector.

The energy audits of industrial sector buildings began in 1992. In 1997, the energy audits were made obligatory in the energy conservation agreements concluded with industries. The administrative responsibility for the energy audits rests with the Ministry of Trade and Industry, and the energy subsidies are granted by regional Employment and Economic Development Centres. Motiva Oy is responsible for the

practical organisation of energy audits; its duties include the promotion, development and follow-up of audit activities, as well as training auditors and quality assurance for the audits.

During 1992–2005, energy audits have been carried out in a total of about 1,100 buildings in the industrial sector. Measured in terms of energy usage, the auditing activities had by 2005 covered about 76 TWh of heating and fuel consumption and about 33 TWh of electricity consumption. For electricity, this corresponds to some 70% of the total electricity usage by Finnish industry.

The relative share is somewhat less for heating and fuels. The volumes of energy audits and analyses carried out in industry are illustrated in Figure 11.

Of the industrial energy audits, the analyses for the process industry are carried out in two phases. First, a rough analysis of the energy usage and savings potential is prepared for the whole factory. In the second phase, a detailed energy analysis is carried out with respect to those areas of energy usage or systems where a savings potential has been identified in the first phase. By the end of 2005, some 58 TWh of heating and fuel usage and 19 TWh of electricity usage were subjected to the detailed phase two analyses.

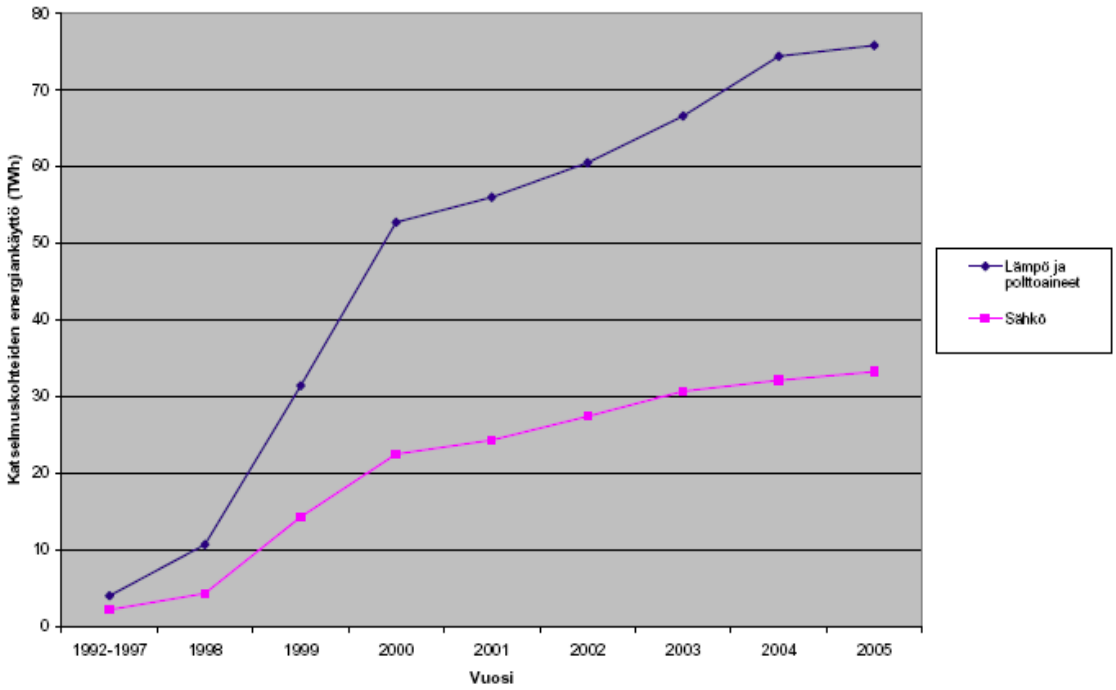

Figure 11. Cumulative volume of energy audits and analyses, measured in terms of energy usage (TWh), in the industrial sector during 1992–2005.

Energy consumption of audited buildings (TWh)
Heating and fuels
Electricity

For other than process industries, the implementation of the measures proposed in the energy audits is monitored both through the follow-up system of the energy audit

scheme and through the follow-up system of the energy conservation agreements. The energy audit activities in the process industry are only monitored through the follow-up system of the energy conservation agreements.

On the basis of the 119 energy audits carried out in ETS-industry companies (energy usage < 10 GWh/a) reported during 2000–2005, the energy conservation potential is 22.8% for heating and fuels and 6.9% for electricity. On the basis of the 64 energy audits carried out in industrial companies of a moderate scale (energy usage 10-70 GWh/a), the energy conservation potential is 16.6% for heating and fuels and 6.3% for electricity. On the basis of the 17 energy analyses carried out in large industrial companies (energy usage 70–500 GWh/a), the energy conservation potential is 8.8% for heating and fuels and 4.7% for electricity. The average energy conservation potentials were not calculated separately for companies consuming more than this. On average, 50-65 % of the reported savings potential is realised in the industrial sector in companies with an energy usage of less than 500 GWh/a. The data regarding the degree of realisation of the savings potential is updated annually.

Support for industrial sector energy audits and analyses will be continued as part of the implementation of new energy efficiency agreements.

The savings effects of the energy audits and analyses carried out in the industrial sector are presented in Annex KTM-03.

Agreements

Measure: "Energy conservation agreements for the industrial sector"

The scope of the industrial sector energy conservation agreement covers both the industrial companies within the scope of the ESD and the ETS companies outside it. Since the annual reports of the agreement scheme have so far not itemised the results on this basis, the agreement scheme activities are described here as one entity. The savings presented in the effectiveness assessment have only been calculated for the part of industry falling under the scope of the ESD and only to the extent that they do not overlap with the energy audit scheme.

The extensive industrial sector energy conservation agreement scheme was initiated in 1997, with the Ministry of Trade and Industry in overall charge of the scheme. The Ministry has had an energy conservation agreement with a few industrial companies since 1993. The first period of the current agreement scheme ended at the end of 2005. The decision was taken in the autumn of 2005 to continue the agreement scheme until the end of 2007. By the end of 2005, 192 companies had joined the agreement scheme. In terms of energy usage, they represent 85% of the entire energy usage of Finnish industries. The 80% coverage target set in the agreement scheme for 2005 was exceeded as early as in 2001. New companies have still joined the agreement scheme during 2007. The coverage of energy conservation agreements as a percentage of the total energy usage by Finnish industry is shown in Figure 12.

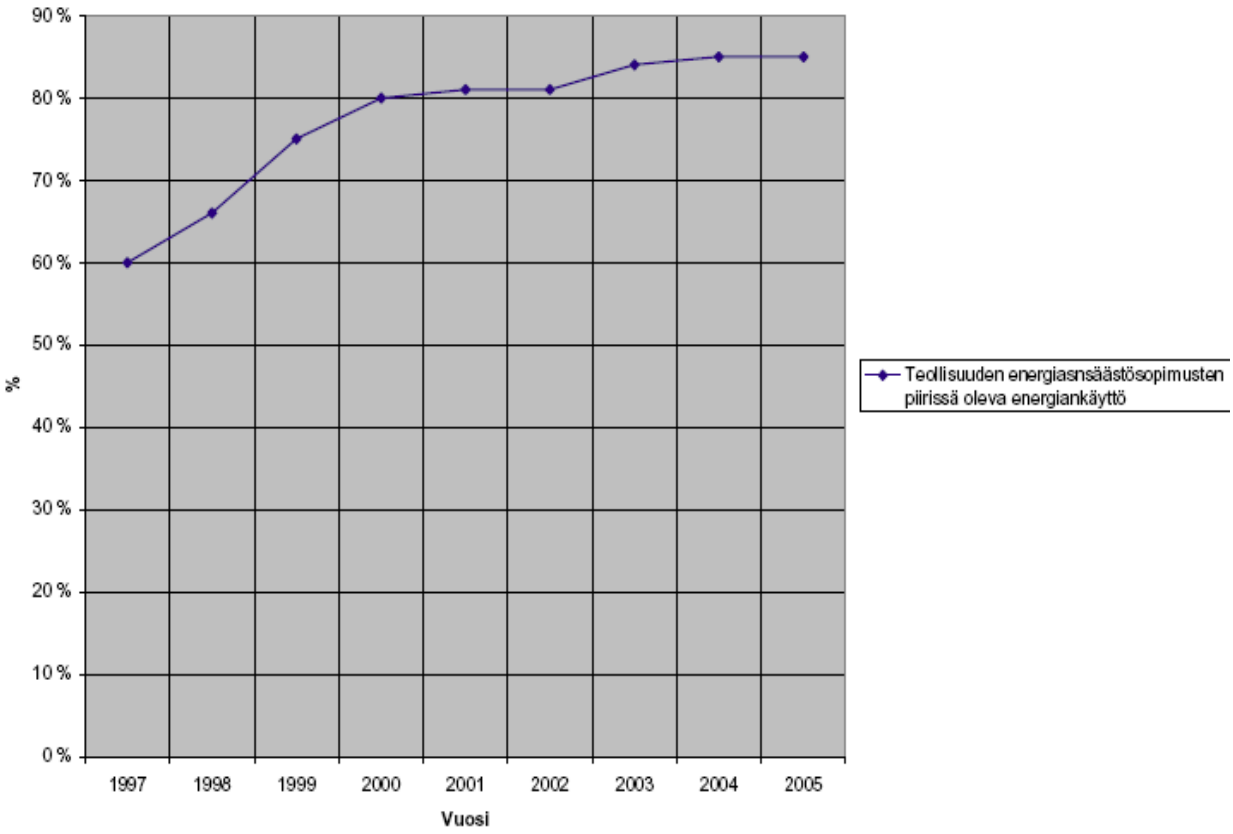

Figure 12. Energy usage included in the scope of industrial energy conservation agreements.

Energy usage included in the scope of industrial energy conservation agreements

The goal of the industrial energy conservation agreement scheme was to have 80% of the total energy usage of industry analysed through energy audits by the end of 2005 in order to survey the energy conservation potential. The companies participating in the agreement scheme have an obligation to prepare a status report of their energy usage and an implementation plan for energy audits and analyses, and they are also obliged to report their actions annually. The companies participating in the agreement scheme have exceeded the audit target with respect to electricity, but they fell slightly short of the target with respect to heating and fuel.

The effectiveness assessment regarding the industrial sector agreement scheme (1997-2007) for companies coming under the scope of the ESD is presented in Annex KTM-04.

New measures

The planning work for the new industrial sector agreement scheme started in early 2005 as part of the preparatory work for the extensive energy efficiency framework agreement between the Ministry of Trade and Industry and the Confederation of Finnish Industries. The intention is to have the majority of industrial energy usage within the scope of the new agreement scheme for the period 2008–2016 by the end of 2007. The implementation of the agreement is based on sector-specific action plans.

Energy-intensive industries and power generation that are excluded from the scope of the ESD will have their own action plans drawn up.

The industry federations participating in the framework agreement will set a quantitative target for sector-specific energy savings (9%) and for the agreement participation rate (60–80%). The companies joining the agreement scheme will set themselves a company-specific energy savings target that is in line with the sector-specific target. The functional focus of the new agreements will be on the continual improvement of energy efficiency and on introducing new technologies.

The new agreement scheme aims at a coverage rate of 85–90% measured in terms of total energy usage by industry. With respect to the companies coming under the scope of the ESD, 60–70% is likely to be a realistic target.

3.7 Transportation

3.7.1 Performance figures and energy usage by the sector

Transportation is a conveyance service that creates added value for other sectors in production and consumption by moving people and goods from one place to another. Hence, the demand for transportation and the traffic volumes will largely depend on general economic and social developments as well as on decisions taken in other sectors of the society. The development of traffic volumes, and hence also the energy consumption of transportation, have largely followed the development of GNP. During the years of recession in the early 1990s, traffic volumes did not decrease by as much as GNP, but traffic volumes have also not grown as fast as GNP during the rapid economic growth that started in the late 1990s, although an obvious correlation still exists.

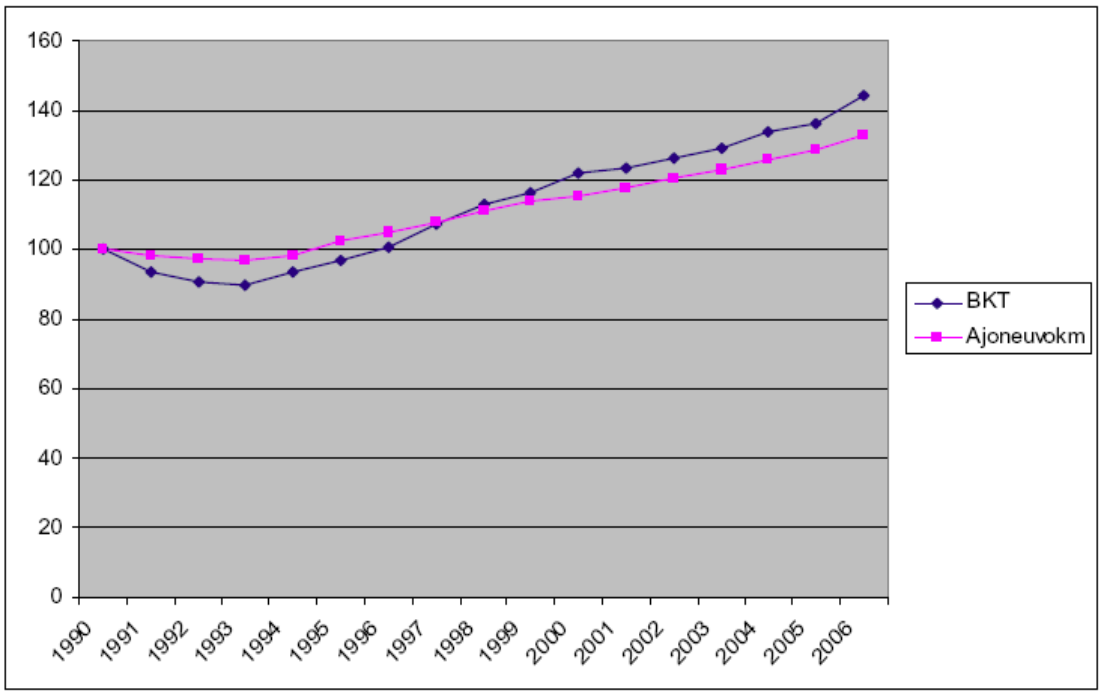

Figure 13. Vehicle mileage and GNP 1990–2006.

GNP
Vehicle-kms

Road transportation consumes more than 90% of the total energy consumption by transportation in Finland, and the energy consumption of road transportation is constantly increasing. Therefore, actions aimed at improving the energy efficiency of road transportation, and that of vehicles in particular, play a pivotal role when trying to promote energy savings and energy efficiency in the transportation sector. Ship transportation (mainly transportation by sea in the Finnish Economic Zone) and air traffic both account for 3–5% of the energy consumption of transportation. These forms of transportation are, however, not included in the scope of application of the ESD, which is why they are not discussed separately here. The energy consumption of rail traffic is just over one per cent of the total energy consumption of domestic traffic, and it has remained relatively stable even though the total performance figures of rail transportation, particularly for freight traffic, have increased. This would seem to indicate that the energy efficiency of rail traffic has improved during recent years.

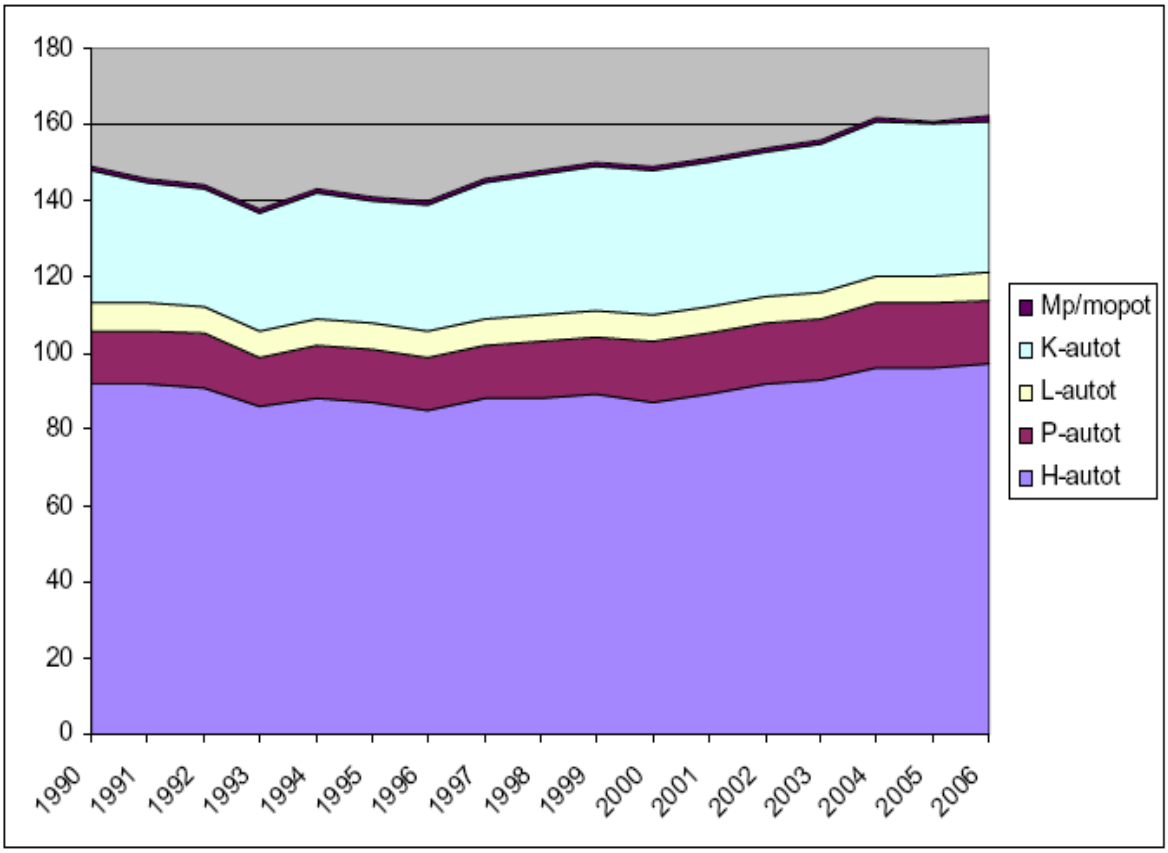

Figure 14. Average energy consumption of road traffic during the period 1990–2006 (PJ/a).

MCs/mopeds
Lorries
Buses
Vans
Cars

The energy consumption of road traffic has increased by almost 10% in the 2000s. Most of this increase is attributable to an increase in the energy consumption of car traffic. It is probable that the energy consumption of road transportation will continue to increase in the future even if the energy efficiency of vehicles improves. Even though the European Commission estimates that the energy efficiency of cars has improved by 12% since 1995 (and consequently, the average CO_2 emissions of new cars have decreased accordingly), the total energy consumption and CO_2 emissions of cars have increased in all EU Member States. The trend of improving energy efficiency of cars came to a halt in Finland at the turn of the millennium, and the average specific consumption of diesel-powered cars sold in recent years has taken an upward turn. Consumers have clearly switched their preference to bigger cars (large family saloons and SUVs).

In February 2007, the European Commission published its new strategy for reducing CO_2 emissions of cars. The Commission intends to make a proposal by the beginning of 2008 for a binding regulation that would limit the average CO_2 emissions of cars to 120 g/km (equivalent to approximately 5.1 litres per 100 kilometre for petrol-powered cars and 4.5 litres for diesel-powered cars) and to 175 g/km (7.3 litres per 100 km) for vans by 2012. These targets mean that the energy efficiency of cars should improve by an average of 25% by 2012 in the EU. The Commission has also set longer-term targets for the specific consumption of vehicles. By 2020, CO_2 emissions of new cars should not exceed 95 g/km and by 2015, CO_2 emissions of vans should not exceed 160 g/km.

Because about 80% of new cars sold in Finland are petrol-powered and more high-consumption cars than average are sold in Finland, achieving the EU level in Finland would require that the specific consumption figures of cars are improved by more than one-third.

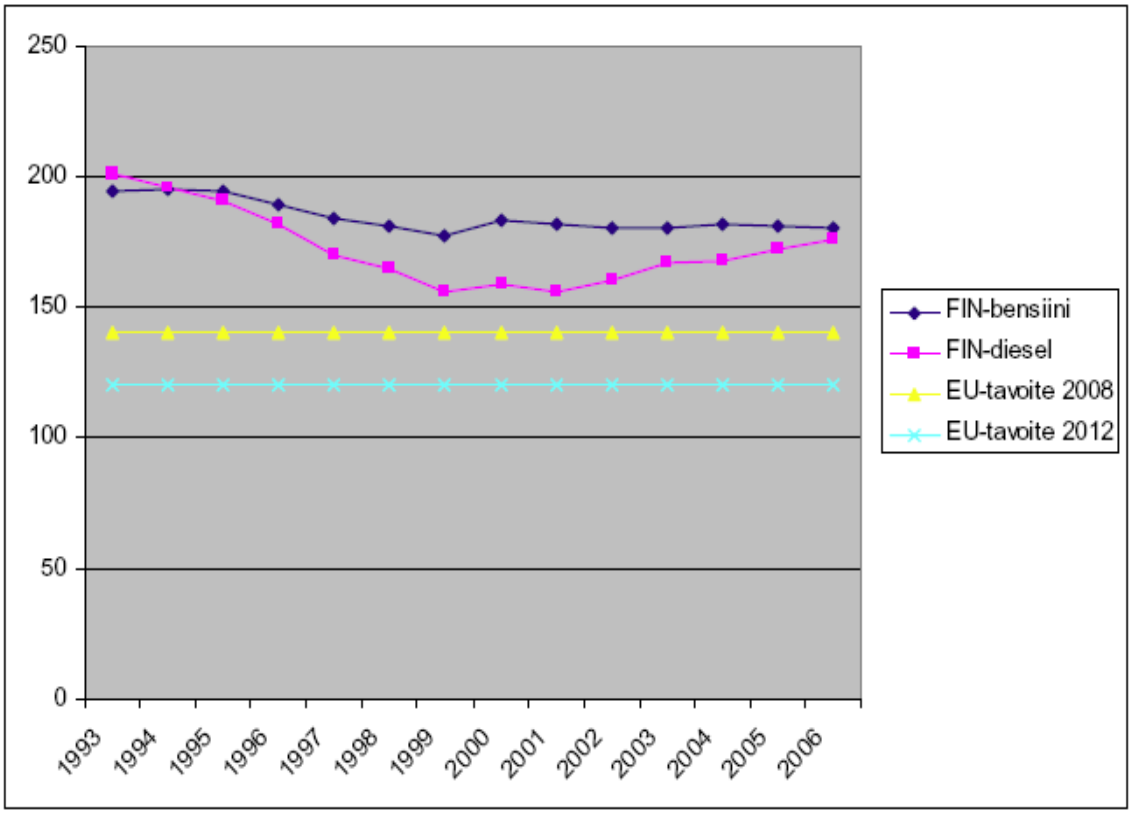

Figure 15. Specific consumption of vehicles during the period 1993–2006 (CO_2emissions).

FIN petrol
FIN diesel
EU target 2008
EU target 2012

3.7.2 Measures and control methods

General

The key control methods among the tools available for energy savings in the transportation policy are traffic system planning, voluntary energy conservation agreements in the transportation sector for lorry and van traffic as well as public transport, the promotion of economical driving habits, issues related to the choice of vehicles and their tyres, as well as driving speeds. It is difficult to present quantitative estimates of the energy conservation effects of these measures. Estimates of the effects of economical driving habits in car traffic, bus traffic as well as lorry and van traffic are presented in the Annexes.

Regulations and provisions

Measure: "Government Decree on the obligation to report the fuel consumption and CO_2 emissions of new cars (1247/2002)"

The Government Decree on the obligation to report the fuel consumption and CO_2 emissions of new cars (1247/2002) was issued on the basis of Commission Directive 1999/94/EC (as amended by Commission Directive 2003/73/EC). The Decree requires that details of fuel consumption and carbon dioxide emissions of every make of car must be displayed at the place where cars are sold. The poster and display board must be updated at least every six months. Information displayed on an electronic display board or computer screen must be updated at least every three months. AKE, the Finnish Vehicle Administration, must update the information in its own database.

Measure: "Wintertime speed limits"

Speed limits have been an important tool in traffic safety work since the beginning of the 1970s. A general speed limit of 80 km/h was in use due to the energy crisis in 1973. Reduced winter speed limits were first introduced in 1987, and they have been a permanent feature since 1991. The wintertime speed limit scheme means that the general speed limit of 100 km/h on most of the trunk road network is reduced to 80 km/h for the winter period (usually from October to beginning of April, depending on the weather conditions). On motorways where the summertime speed limit is 120 km/h, driving speeds are also limited to 100 km/h. Of the road-specific speed limits on main roads, the 100 km/h limit is left unchanged for the winter only on about 20% of the trunk road network.

The reduced winter speeds apply to 80% of the trunk road network. This network accounts for most of the transportation performance. During wintertime speed limits, a total of some 4 billion kilometres are driven on this trunk road network. Measurements indicate that the winter speed limits reduce actual driving speeds by an average of 10 km/h. Speed limits changing automatically according to the driving and weather conditions and traffic queues have also been introduced into actual or pilot use on the latest motorway sections. This means that during torrential rain, the speed limit signs may be lowered on a motorway from 120 km/h to 60 km/h, for example. The savings effects of wintertime speed limits have not been calculated so far.

New measures

The European Commission has announced that it will issue, in 2008 at the latest, a proposal on reforming the fuel consumption labelling of vehicles with the purpose of guiding the consumers' preferences towards more energy-efficient vehicles. National consideration is being given to the initiation of a project for reforming the fuel consumption labelling system of cars so that it would take into account, besides the requirements of EU legislation, also the experience gained of the energy labelling system (ABCDE) of domestic appliances that has also been used in the marketing of cars in a few EU countries (Great Britain, Denmark and the Netherlands). This type of project should also be combined with the plans to reform vehicle taxation. The Government Programme (the second cabinet of PM Vanhanen of 15 April 2007) also states that annual vehicle tax will be reformed to better take into account the specific consumption and carbon dioxide emissions of vehicles.

Energy conservation agreements

Measure: "Agreement on improving the fuel efficiency and reducing the CO_2 emissions of new cars (EU agreement)"

In 1995, the European Commission published its strategy for reducing CO_2 emissions of cars. The strategy was based on three sections:

- voluntary agreement with the car industry for reducing CO_2 emissions of new cars to 140 g/km by 2008 and to 120 g/km by 2012;
- information on fuel consumption data of cars (see above the Government Decree on the obligation to report the fuel consumption and CO_2 emissions of new cars (1247/2002)); and
- encouraging Member States to develop their financial guidance so that it would support the choice of energy-efficient vehicles.

The Commission took the view that this strategy failed to produce adequate results and this is why the Commission published its new strategy, based on more binding targets, in February 2007.

Measure: "Voluntary agreement on energy efficiency/lorry and van transport sector"

Lorry and van traffic have had a voluntary co-operation -based energy conservation programme since September 1999 when SKAL, the Finnish Transport and Logistics Association (at that time still called the Finnish Lorry Transport Association), the Ministry of Trade and Industry and the Ministry of Transport and Communications concluded an agreement on an energy conservation programme for the sector. The agreement was updated in March 2003, and consequently also by the continuation programme that became effective in the beginning of 2006, and covers the years 2006-2007. The target of the energy conservation programme for lorry and van traffic is to reduce the fuel consumption of transportation by 5% from the 2000 level by 2010. The total effects of the energy conservation agreement for lorry and van traffic on energy consumption are difficult to estimate accurately. This is why only the effects on fuel consumption of lorry and van drivers' economical driving habits have been estimated in this programme.

The key focal elements of the current programme period are customer co-operation with companies using transport services, training (in particular ecodriving training) and research and development activities (in particular the RASTU research project and development of the EMISTRA monitoring system). The intention is to reform the programme in 2007 by establishing the new programming period in compliance with the objectives and time schedules of the ESD. The programme is also to be developed so that it would be more clearly based on a "three-party approach" as follows:

- the customer companies needing transport services require logistics companies to undertake more energy conservation actions and report on them;
- logistics companies invest resources in energy savings and report them to customer companies and the public sector; and

- the public sector supports the implementation of the programme through research and development activities and invests resources in monitoring and reporting the programme.

An estimate of the savings effects of ecodriving training for the lorry and van transport sector is presented in Annex LVM-03.

Measure: "Voluntary agreement on energy efficiency/public transport"

An equivalent energy conservation agreement was concluded in the bus transportation sector in March 2001. A new energy conservation programme was conclude in March 2005 with LAL, the Finnish Bus and Coach Association and PLL, the Finnish Public Transport Association. With the new agreements, the Ministry of the Environment is now also a party to the energy conservation agreements of the bus transportation sector and the lorry and van transportation sector. The current programming period ends in 2010.

The target of the energy conservation programme of the bus transportation sector is to reduce the fuel consumption of transportation by 5% from the 2000 level by 2010. The actual quantitative effects of the energy conservation programme for public transport are difficult to estimate, and this is why only the effects on fuel consumption of bus drivers' economical driving habits have been estimated in this programme. The key focal areas include ecodriving training, the introduction of environmental and quality systems in public transport companies, and research and development projects (in particular the RASTU research project and development of the EcoTra monitoring system).

An estimate of the savings effects of ecodriving training for the bus transport sector is presented in Annex LVM-02.

New measures

Measure: EU's new CO_2 strategy for cars and vans and the associated EC regulation initiatives and national support activities

As stated above in the section "Agreement on improving the fuel efficiency and reducing CO_2 emissions of new cars (EU agreement)", the intention is to set a binding CO_2 emissions target for car manufacturers from 2012 on the basis of the new CO_2 strategy issued by the Commission in February 2007. That would require car manufacturers to achieve an average CO_2 emissions target of 120 g/km with the help of engine technology (130 g/km) and other supporting actions (consumption labelling, etc.). How this will be reflected at a national level in the car trade and in consumers' car preferences will largely depend on how financial control and consumer information are developed nationally.

Measure: Reform of the voluntary agreements on energy efficiency for the lorry and van transport sector and the public transport sector

A plan for reforming the energy conservation programme for the lorry and van transport sector into an energy conservation programme for the goods transport and logistics sector based on the "three-party approach" as described above. The

quantitative savings and efficiency targets of the programme will be set in compliance with the ESD targets.

An estimate will also be prepared during 2007 regarding the extent to which the current voluntary energy conservation agreement for the public transport sector covering the years 2005–2010 is to be reformed. The intention is to reform the programme at least so that the ESD target of a 9% improvement in energy efficiency is also taken as the basis for the energy conservation programme for the public transport sector. A more comprehensive review of the energy conservation programme for the public transport sector will be made in 2010 at the latest when preparatory work will be carried out for the new programming period, and at which point the new programming period (most likely 2011–2016) will be adjusted to support the energy conservation work of the two next three-year periods.

When reforming the energy conservation programmes for the goods transport and public transport sectors, use will also be made of the research knowledge generated in conjunction with the HDEnergia and RASTU research programmes. The RASTU research project that runs until 2008 and the preceding HDEnergia research projects have produced practical information on how the energy consumption of heavy vehicles can be reduced through actions related to the choice of vehicle and tyres, the maintenance of tyre pressures, driving habits and monitoring fuel consumption. The intention is to integrate these actions more closely as part of the new energy conservation programmes and their implementation.

Training and campaigns

Measure: "Ecodriving training for passenger car drivers"

Ecodriving training was promoted during 2005–2006 through a campaign entitled "Malttia ja viisautta teille" (moderation and wise attitudes for roads). The aim of the campaign was to increase the number of trained bus and lorry drivers by 1,000 and the number of trained car drivers by 1,500. The campaign was estimated to achieve energy savings amounting to some 32.5 GWh. In order to attain the target, the general awareness of different interest groups was enhanced regarding the advantages of economical driving from the perspectives of costs, traffic safety and the environment. Further, pilot projects based on new action models were initiated in selected target groups. The campaign was coordinated by Motiva Oy, and the following parties contributed to its funding and implementation: the Ministry of Transport and communications, the Ministry of Trade and Industry, AKE, the Association of Automobile Importers in Finland, the Finnish Central Organisation for Motor Trades and Repairs, EcoDriving Center Oy and KH Fin Oy.

Ecodriving training has a considerable energy conservation potential. According to the experience of ecodriving instructors, economical driving and foresight can reduce fuel consumption by 8–12% on average. As stated above, economical driving habits are a key issue in the energy conservation programmes for both the lorry and van transport sector and the public transport sector (LVM-02 and LVM-03). Annex Table LVM-01 also shows an estimate of the effects of ecodriving in car traffic. As a whole, ecodriving training (LVM-01, LVM-02, LVM-03) can achieve by 2016 the entire share of transportation of Finland's annual energy efficiency target in 2016.

An estimate of the savings effects of ecodriving training for car traffic is presented in Annex LVM-01.

Measure: "Optimal tyre pressure in passenger car and van traffic "

Most of the vehicles registered in Finland are used throughout the year. Therefore, they have to be fitted with tyres with a winter tread/spikes by December, which have to be changed back to summer tyres no later than a week from Easter, weather permitting (in any case by the end of April). This means that the tyres of nearly all cars and vans are changed twice every calendar year. Normally, the tyre pressure is checked at that time, either by the owner of the vehicle or the service station changing the tyres. In addition, matters related to vehicle safety (tyre tread grooves and roadholding in sudden curves) are checked in statutory annual inspections, and the tyre pressure is one of the points checked at that time.

In its Green Paper on energy efficiency, the European Commission (European Commission 2005: Green Paper on Energy Efficiency: Doing More With Less) has stated that friction between tyres and the road accounts for up to 20% of a vehicle's consumption. The Commission estimates that 45–70% of vehicles are driven with at least one tyre below the prescribed pressure, which causes 4% over-consumption. As tyre pressure is checked in Finland, as a rule, at least twice per year, only a small part of the vehicles in traffic have tyre pressure below the prescribed values. If these regular pressure checks in conjunction with tyre changes did not take place, 60% of vehicles in Finland would have underinflated tyres compared with the actual 10% thanks to the checks. Therefore, the regular checks of tyre pressure in cars and vans produce a significant savings effect (LVM-04).

New measures

Ecodriving training will be continued with the EcoDriven campaign during 2007–2008. Using the experience gained from the Moderation campaign, the campaign will be revised so that instead of merely disseminating information, vouchers will be made available in order to encourage people to seek ecodriving training.

Other measures

Measure: "Guidelines on environmental and energy efficiency aspects in the procurement of transportation services"

On 17 January 2007, the Ministry of Transport and Communications issued guidelines on how environmental and energy conservation aspects could be taken into account when procuring transportation services in compliance with the Public Procurements Act that was passed by Parliament on 10 January 2007 and which became effective on 1 June 2007. The guidelines provide public entities in particular, but also private companies and corporations, with practice-oriented models on how environmentally friendly and energy-efficient solutions can be favoured when procuring transportation services.

Measure: "Traffic system planning"

The purpose of traffic system planning is to affect the division between different forms of transportation, the demand for transportation, behaviour in traffic and the efficiency of transportation. Traffic system planning is one of the key tasks of transportation policy, and the goal is to promote the modes of traffic and transportation that are sustainable from the environmental and health point of view (and therefore also energy-efficient modes of transportation). In passenger traffic, such modes of transport

include public transportation, cycling and walking, and dedicated action plans have been prepared for promoting each of them. In goods transportation, energy-efficient modes of transport include, in particular, railway and waterway traffic (timber flotation, inland waterways traffic and sea transportation) as well as combined modes of transportation (at least part of the road transportation is replaced by rail transportation, for example by carrying containers, or by transportation on waterways).

1) Actions affecting the division between modes of transportation

a) In passenger traffic:

- subsidies for the public transportation system (such as procurement of basic services for public transportation and ticket subsidies)
- other development measures for public transportation (such as procurement of new and more attractive vehicles, provision of information regarding public transportation, travel centres, linking journeys)
- development of route networks for cycling and other types of light traffic
- investments in the rail traffic system (for example, the new direct line from Kerava to Lahti clearly improves the operating conditions for rail traffic, and hence of public transport, between Helsinki and Lahti) as well as other investments that improve the energy-efficiency and smooth flowing of traffic (such as junctions, roundabouts, control systems and road paving materials and their impact on energy-efficiency)
- various campaigns (such as public transport campaigns, cycling week, car-free day, development projects aimed at guiding transportation, model municipality projects for sustainable traffic, etc.).

b) In goods traffic:

- EC support for promoting combined modes of transport (via inland waterways and railroads)
- investments in the rail traffic system
- other investments that improve the energy-efficiency and smooth flowing of traffic (such as junctions, roundabouts, control systems and road paving materials and their impact on energy-efficiency)

2) Actions affecting the efficiency of transportation

a) In passenger traffic:

- development of travel centres
- improvement of information available on public transport (such as www sites, for example www.kulku.info)
- travel guidance activities

b) In goods traffic:

- investments in logistics and telematic systems (a new logistics program was completed in summer 2005)

3) Actions affecting behaviour regarding transportation particularly driving speeds and driving habits together with speed limits

Another important aspect of traffic system planning is the aim to integrate it, as effectively as possible, with other functions and social policy sectors affecting the demand for transportation, such as land use planning, housing, regional and industrial policies as well as financial control. It has been estimated, among others in conjunction with UN reports on greenhouse gas emissions (country reports submitted to the UNFCCC), that traffic system planning (the above actions) would reduce greenhouse gas emissions from traffic by about 1% compared to a situation where no attempt is made to affect the distribution between modes of transportation and the efficiency of transportation through traffic system planning. However, it is difficult to produce an accurate estimate of this.

3.8 Agriculture

3.8.1 Description and energy usage of the sector

General

In Finland, agriculture is based on family farming, which has been characterised by a large number and small average size of farms. In 2006, there were 69,071 producing farms in Finland with an average of some 31 hectares of fields. The average size of farms producing milk is about 18 cows. In 2006, the total amount of land available for agriculture was 2,307,004 hectares (about 8% of the total land area of the country).

In 2006, 49% of the farms were mainly growing plants while 29% were producing milk. Keeping other types of bovine cattle accounted for 7% and keeping pigs and/or poultry another 7% of farms. In 2006, the total area used for horticulture was 16,305 hectares, and the total area of greenhouses was 463 hectares.

Energy usage of farms

The annual energy consumption of farms is about 12,000 GWh, divided between agricultural machine fuels (33%), heating fuels (28 %), grain dryer fuels (17%) and electricity (22%). The most significant users of energy are agricultural machines (33%) and production farms (29%). Residential buildings (19%) and grain dryers (19% including electricity) consume roughly equal amounts of energy.

On cattle farms, electricity typically accounts for 20–30% of the total consumption. The relative share of electricity is highest in piglet-producing pig houses because heat lamps are used to keep the piglets warm. On chicken farms, electricity accounts for 12% and on crop-growing farms, about 8% of the total energy consumption.

The fuels used for heating account for 44–56% of energy usage on farms, with the exception of beef cattle farms (27%) and chicken farms (79%). Beef cattle farms have no heating, and chicken farms need a lot of heating due to the warm temperatures the chickens are reared in. With the exception of cattle farms, the share of agricultural

machine fuels varies between 9 and 25 per cent, depending above all on the field area, the crops grown and the consumption of heating and electricity.

The only significant consumers of energy among gardens are the greenhouses and warehouses with heating. The annual energy consumption of greenhouses (with heating, floorspace more than 1,000 m^2) is about 2,000 GWh, divided between heating fuels (75%), district heating (5%), electricity (19%) and fuels used for producing carbon dioxide (1%). Bottled gas has not been taken into account in the consumption figures for separate CO_2 production because its manufacture does not consume energy on farms.

According to a preliminary estimate, the total energy conservation potential in agriculture during the period 2008–2016 is 17% of the annual consumption. The biggest savings potential is in agricultural machine fuels. Other significant savings can be made in cattle sheds, residential buildings and grain processing. It should be noted that realising the entire potential will require significant changes in both the energy management processes of farms and technology, which is why it is impossible to predict at the moment how much of the savings potential will actually be achieved.

Building activities on farms

According to the ROTI report on the status of building assets, there were some 25 million square metres of agricultural production buildings in 2007 (as compared against, for example, industrial buildings which totalled about 20 million m^2). Of the building planning permissions granted during recent years, one in every ten cubic metres is to do with agricultural buildings, and the annual total value of subsidised building work is approximately EUR 350 million. Every year, the administrative branch of the Ministry of Agriculture and Forestry subsidises some 3,000 investments within traditional agriculture and some 2,000–3,000 rural development projects.

The actions indirectly promoting energy savings include increasing the unit size of animal husbandry buildings (the production becomes more mechanical and energy-efficient). Only drinking water has to be heated in cold cattle sheds without thermal insulation or heating. Buildings with curtain walls, representing a half-way between heated and cold cattle sheds, are also becoming increasingly common. The promotion of wood as a construction material also increases energy conservation effects because less energy is used in manufacturing and transporting the building materials. Energy savings can also be achieved by supporting basic renovation work and by utilising the existing building stock.

Heating plants on farms

Heating plants utilising renewable sources of energy built on farms increase the use of local (produced on the farm) energy, thus reducing energy losses caused by the transport of fuels produced elsewhere.

3.8.2 Measures and control methods

Regulations and provisions

There are no current instructions regarding energy conservation actions on farms. The strategy of the Ministry of Agriculture and Forestry for 2005 (9/2005) highlights the importance of planning and the quality of building renovation and new building

construction work as well as the utilisation of renewable natural resources for building and heating purposes on a general level. Instructions regarding energy conservation actions in construction work are issued in conjunction with the normal building regulations described in section 3.2.

New measures

The rural construction strategy of the Ministry of Agriculture and Forestry is being prepared, and it will address the energy issues in subsidised construction work.

Economic control methods

Financing is available from the partially EU-funded rural development programme (2007–2013) for implementing the future agricultural energy-efficiency programme (projects for organising energy conservation and energy audit activities).

National funding can be channelled to supporting agricultural energy conservation investments so that increased investment subsidies are paid to farms that have carried out an energy audit and concluded an energy conservation agreement, or so that farms are encouraged in other ways to have energy audits carried out and sign agreements.

Measure: "Investment subsidies for heating plants"

According to the decree issued (on 13 December 2006) by the Ministry of Agriculture and Forestry regarding the allocation of structural support for agriculture in 2007, subsidies can be granted for heating plants utilising renewable energy sources (excluding the heating plants that serve greenhouses).

The number of heating plant projects implemented as subsidised conventional agricultural investments or rural development projects was about 500 in 2005 and about 600 in 2006. The decree (No. 99/01) issued by the Ministry of Agriculture and Forestry contains provisions on the acceptable costs of buildings and on the determination of the acceptable costs of heating plants. The building works expert of the Employment and Economic Development Centre inspects the building plans before the subsidy is granted. Subsidies are only available for energy sources that are in keeping with the heating requirement calculations.

An estimate of the energy savings effects of heating plants on farms is presented in Annex MMM-01.

Agreements

There is no energy conservation agreement model for agriculture currently in use, but one of the goals of the agricultural energy programme is to create such an agreement scheme. The intention is to introduce the agreement model towards the end of 2008.

New measures

Measure: "Agricultural energy programme MENO"

The Ministry of Agriculture and Forestry and the Ministry of Trade and Industry have jointly funded the preparatory work for the agricultural energy programme since the beginning of 2006. The purpose of the agricultural energy programme is to implement the 9% energy conservation obligation of the ESD in the agricultural sector.

The programme aims to produce more in-depth information on the division of energy usage on farms representing different production sectors, to determine the most important means of saving energy, their costs and associated savings potential, and to develop the required models for monitoring energy management and savings.

The agricultural energy programme aims to improve the energy efficiency of heating energy and electricity usage on farms and to reduce the usage of fossil fuels by promoting the usage of domestic renewable energy sources and biofuels while also taking into account the objectives of silviculture. The programme implementation includes energy audits carried out on farms, and possibly also energy conservation agreements in the future.

According to the preliminary time schedule, the agricultural energy programme will be implemented in stages during 2008–2012 so that energy audits will have been carried out on 20% of farms in Finland by the end of 2012. 80% of farms will have been audited by 2015. The energy conservation target for agriculture is reported savings amounting to 9% in the agreement sector.

Training

New measures

The Government intends to enhance energy efficiency and energy savings of customers in the agricultural and forestry sectors by, among other things, providing farms with assistance and advice for carrying out energy audits and for solving farm-specific issues related to the production and use of bioenergy. Currently, the advisory and training services in this area are regionally fragmented, but the planning work for the practical organisation of a nationwide energy advice and expert organisation starts in summer 2007, and the network is scheduled to start operating from the beginning of 2008.

When organising the advisory and training services, particular attention will be paid to issues related to improving energy efficiency and increasing energy savings both in forestry and agriculture.

3.9 Energy sector

3.9.1 Measures and control methods

The actions taken in the energy sector have mainly been described in this action plan to the extent that the current or future actions have an impact on the energy efficiency of end customers of energy within the scope of application of the ESD. The obligations of the ESD do not apply to the efficiency of energy production or energy transfer.

Agreements

Measure: "Energy conservation agreements for the energy sector 1997-2007"

The energy conservation agreement scheme of the energy sector is divided into three agreement sectors: the power plant sector, the district heating sector and the electricity transfer and distribution sector. These agreements cover 68–91% of the total volumes in Finland. There have been significant variations in the numbers of parties joining the

agreements, but the main reason for this has been the corporate acquisitions, mergers and restructuring operations in the sector.

Power plant sector

In 2005, the power plant sector agreement covered 23 companies representing 91% of the total electricity production in Finland. The actions under the power plant sector agreements were mainly aimed at improving the efficiency of energy production and making the usage of internal energy more efficient. During the period 1998–2005, energy analyses were carried out in 31 power plants. A total of 37 other surveys and building energy audits have been carried out. The energy savings reported for the power plant sector during 2005 amounted to almost 480 GWh in heating and fuels and 485 GWh in electricity.

District heating sector

The district heating sector agreement covered 35 companies, representing 68% of the total sales of district heating energy in Finland. The actions under the district heating sector agreement are aimed at the production of district heating, the district heating network, the internal usage of energy by the companies, and at enhancing the efficiency of energy usage of district heating customers. During the period 1998–2007, energy audits complying with the district heating audit model were carried out in 30 district heating systems. A total of 6 other surveys and building energy audits have been carried out. In addition, a considerable number of audits have been carried out without support from the Ministry of Trade and Industry. When considering both the audits carried out in accordance with the district heating audit model and the audits carried out by the operators themselves, the audit scheme now covers about 70% of the entire district heating sector. The energy savings reported in the operations of companies in the district heating sector for 2005 amounted to almost 85 GWh in heating and fuels, and to 1.6 GWh in electricity.

District heating companies help their customers improve energy efficiency in several ways. On the basis of reports submitted under the agreement scheme, the companies in the scheme implement actions aimed at their customers as follows:

- 94% provide user guidance on district heating equipment
- 90% of the companies provide their customers with an energy consumption monitoring report
- 87% provide advice over the telephone
- 68% provide advisory services at their own premises
- 61% hand out energy conservation brochures to their customers
- 61% give feedback to customers on the basis of consumption monitoring
- 48% participate in the national Energy Conservation Week organised by Motiva Oy
- 45% provide auditing services for district heating equipment
- 42% provide schools with material related to energy conservation
- 35% provide energy conservation advice over the Internet
- 35% provide customers with an opportunity to monitor their own energy usage over the Internet
- 35% provide user training on district heating equipment
- 19% provide maintenance services for district heating equipment.

The energy conservation effects of these actions have not been estimated so far. On the other hand, reliable statistical data covering several decades are available for the energy consumption of buildings connected to district heating. Compared with the figures for the 70s, the specific consumption of heating energy has decreased by 35%.

Electricity transfer and distribution sector

In 2005, the electricity transfer and distribution sector agreement covered 36 companies, representing 81% of the total distribution of electricity in Finland. The actions under the electricity transfer and distribution sector agreement were targeted at the network and at improving the efficiency of energy usage, both with regard to the companies themselves and their customers. The energy savings reported in the operations of companies in the agreement sector for 2005 amounted to almost 4 GWh in heating and fuels, and to 67 GWh in electricity.

The companies in the agreement sector help their customers improve energy efficiency in several ways. On the basis of reports submitted under the agreement scheme, the companies in the scheme implement actions aimed at their customers as follows:

- 97% provide energy conservation advice over the telephone
- 91% lend consumption meters to their customers
- 91% provide energy conservation advisory services at their own premises
- 86% distribute energy conservation brochures to their customers
- 80% provide schools with material related to energy conservation
- 80% distribute energy conservation information over the Internet
- 77% publish texts promoting energy savings
- 74% participate in the Energy Conservation Week organised by Motiva Oy
- 74% apply hourly power metering

- 71% apply a pricing schedule that promotes energy savings
- 65% maintain energy conservation links on their Internet sites
- 57% provide households with energy consumption monitoring reports
- 51% provide teachers with energy conservation information
- 51% provide a PC-based electricity consumption calculation and comparison service
- 49% provide an Internet-based electricity consumption calculation and comparison service.

The energy conservation effects of these actions have not been estimated so far.

New measures

The new agreement scheme for the energy sector will be part of the extensive energy efficiency agreement covering Finnish industries. The intention is to have the majority of companies in the energy sector within the scope of the new agreement scheme for the period 2008–2016 by the end of 2007.

The implementation of the agreement is initially based on sector-specific action plans. Power generation will have its own action plan focused on improving energy efficiency in power generation. District heating, district cooling as well as the transfer, distribution and retail sales of electricity will have a dedicated action plan focused on

improving the energy efficiency of the companies' own energy usage, and on energy services offered to customers in particular.

A coverage of 85–90% of the energy sector is the target for the new agreement scheme. The objective of the "Energy services" action plan is to pay particular attention to the ESD obligations aimed at the energy sector.

3.10 Horizontal actions

3.10.1 Fiscal control

Outline of energy taxation in Finland

Energy taxation can be used to promote energy savings and energy efficiency. It can also be used to affect the position of different energy sources in power generation and consumption, for environmental reasons or reasons related to security of supply, through bases of taxation and direct subsidies associated with the system. Energy taxation is also an important source of revenue for the state. A total of almost EUR 2,950 million was collected in excise duties for energy products in 2006. Together they account for just under one-tenth of the total revenues of the state in Finland.

Energy taxation in the EU has been harmonised through the energy taxation directive (2003/96/EC). In Finland, excise duty is payable for electricity, natural gas, coal as well as liquid fuels such as petrol, diesel, heavy heating oil and pine oil. The taxation of and fiscal subsidies for peat were abolished on 1 July 2005.

The excise duty on energy products is a fixed tax collected on the basis of product quantities. The excise duty is not based on the value or energy content of the product. The excise duty collected on energy products consists of basic duty and additional duty. The basic duty is of fiscal nature, and it is collected on liquid fuels such as petrol, diesel and light heating oil. The additional duty is determined on the basis of the carbon content of the product, and currently the charge is EUR 18.05 per ton of carbon dioxide. Additional duty is collected on the above liquid fuels, heavy heating oil, combustible peat, natural gas and electricity. Pine oil is only subject to the basic duty.

Electricity tax is collected on all electricity irrespective of the generation method, and the tax is therefore not based on the carbon content of the fuels used to generate it. The fuels used for generating electricity are exempt from tax. However, when taxable fuels are used for heat generation, they are subject to excise duty. In combined electricity and heat generation, only the taxable fuels used to produce useful heat are taxed.

The excise duty on electricity is payable in two tax classes, the lower (II) and the higher (I). The lower tax class is applied to electricity used in industry and commercial greenhouse cultivation. This tax was decreased from 0.44 cents to 0.22 cents per kWh from 1 January 2007. Class I tax is payable for electricity used, for example, in private households, agriculture and forestry, the construction industry, the wholesale and retail trade, the hotel and catering sector and in the service sector in general.

According to the new Finnish Government Programme , the taxation of transportation and fuels will be developed with the aim of reducing emissions, saving energy and improving energy efficiency. The energy taxation of transportation and other non-ETS

sectors will be increased. The Ministry of Finance intends to increase the energy tax revenue by approximately EUR 300 million. The focus of tax increases is on non-ETS sectors.

Energy taxation subsidies

A tax refund system has been introduced for certain forms of electricity generation and uses. This subsidy system, included in energy taxation in addition to the two electricity tax classes, consists of certain subsidies for electricity generation and partial tax refunds payable to energy-intensive industries. The electricity generation subsidies are intended for promoting the use of renewable sources of energy.

The basic amount of subsidy is 0.42 c/kWh. In order to improve the competitiveness of electricity produced using wind power and wood chippings, a higher subsidy of 0.69 c/kWh is applied to it. The subsidy for electricity produced using recycled fuel is 0.25 c/kWh. In 2007, the electricity production subsidy system includes support for the following sources of energy: wind power, small-scale hydroelectric power, wood chippings, recycled fuel and biogas. Introducing these subsidies is subject to the Commission approving the state subsidies. The matter is pending with the Commission.

Energy-intensive companies receive a partial refund of the energy taxes they pay. Energy-intensive companies may receive tax refunds when the amount of excise duties they have paid exceeds 3.7 per cent of the value added. The companies are entitled to an energy tax refund of 85 per cent for the exceeding part. However, only the part exceeding EUR 50,000 of the refund thus calculated is payable. During recent years, the tax refunds of energy-intensive industries have varied in the range of EUR 13-19 million. The halving of electricity tax from the beginning of 2007 will have an impact on the refunds payable to energy-efficient industries; the refunds are estimated to amount to EUR 5 million from 2007.

In addition to the lower electricity tax rate (II), greenhouse farmers have been receiving refunds for taxes levied on light and heavy heating oil since 1997 pursuant to the act (1472/1994) governing the excise duties on liquid fuels. According to section 10 a of the act (204/2006) entering into force at the beginning of August 2006, professional greenhouse farmers receive as excise duty refunds 3.75 cent per litre on light heating oil and 1.75 cents per kg on heavy heating oil.

The tax refunds for energy products in agriculture are governed by the act (203/2006) on excise duty refunds for certain energy products used in agriculture. According to this act, professional farmers can apply for an excise duty refund of 3.75 cent per litre on light heating oil and 1.75 cents per kg on heavy heating oil for the fuels they use in agriculture. In addition, farmers receive an excise duty refund of 0.23 cents per kWh on the tax class I for electricity which means that the remaining excise duty is 0.50 cents per kWh . The actions relating to tax refunds for the energy products used in agriculture and the tax refunds for the heating oil used by professional greenhouse farmers have been reported to the Commission as state subsidies. The Commission has not made a decision on the matter.

Product	Tax rate	Tax revenues (EUR million)
Petrol	58.08 c/l	1,422
Diesel oil	31.59 c/l	767
Light fuel oil	6.71 c/l	157
Heavy fuel oil	5.68 c/l	48
Total		2,394
Electricity		
- Tax class I	0.72 c/kWh	272
- Tax class II	0.44 c/kWh (0.22 c/kWh from 1 January 2007)	191
Total		463
Coal	EUR 43.52 /ton	55
Natural gas	EUR 1.59 /nm^3	34
Total		89
Grand total		2,885

Table 6. Tax rates and tax revenues of energy products in 2006.

Taxation of biofuels

According to the energy tax directive, the products subject to excise duty include, besides mineral oils, also animal fats, vegetable oils (so-called biodiesel such as RME), alcohols (ethanol) and biogas when used as engine or heating fuels. The excise duty of energy products is a fixed tax collected on the basis of product quantities. Hence, the excise duty is not based on the value of the product, the emissions or the energy content of the product. Therefore, the alcohol added to petrol is subject to the excised duty levied on petrol, and the vegetable oil added to diesel oil is subject to the excised duty levied on diesel oil and payable per unit of volume pursuant to the directive. Similarly, the excise duty levied on light heating oil is also payable for bio-based heating and agricultural machine fuels.

The energy tax directive allows a reduction of the tax levied on biofuels under certain conditions. Firstly, the use of tax reductions is limited by the prohibition on overcompensation which means that the amount of tax reduction must not exceed the additional cost of using biofuels. Further, the tax reduction must not be discriminatory or favour domestic products. Application of the tax reduction is also conditional on adherence to the rules governing state subsidies, and therefore also subject to Commission approval. Tax reductions are always temporary measures. Finland has not introduced tax reductions to promote the use of biofuels in transportation; instead, their use is promoted through the so-called obligation to use biofuels.

Biogas

According to the energy tax directive, natural gas and other gaseous hydrocarbons, such as methane, are taxable products. Therefore, bio-based gases consisting of methane are basically also taxable products when used either for engine or heating fuel. On the other hand, the energy tax directive allows reduced taxation for methane-based gases, for example. The energy tax directive has been adhered to in Finland; in other words, no excise duty is levied on biogases in Finland.

According to the Vehicle Tax Act that entered into force at the beginning of 2004, cars and vans using fuel consisting of methane, including biogas, are not subject to the

annual propulsion tax which otherwise is payable when a vehicle uses a fuel that is subject to lower taxation than petrol. No fuel charge, as referred to in the act governing fuel charges, is payable by methane-powered cars, vans, lorries, buses or other vehicles which otherwise is payable when a vehicle uses fuel that is tax exempt or subject to lower taxation than diesel oil.

3.10.2 Provision of information, advice and motivation

Measure: "National Energy Agency Motiva"

Energy savings have been promoted in Finland in a diverse manner and with a long-term approach. One key actor in this field is Motiva Oy. In 1993, the Ministry of Trade and Industry established an energy savings service centre under the name Motiva which in 2000 became a state-owned enterprise with the name Motiva Oy. Motiva Oy assists the government and energy customers in promoting energy efficiency and new renewable sources of energy. In 2006, Motiva had almost 30 employees and a turnover of EUR 4.4. million while at the time of its establishment in 1993, it employed a staff of 5 and had a turnover of EUR 0.7 million. More than 70% of its invoiced revenues come from the Ministry of Trade and Industry. The key duties of Motiva are:

- coordination and monitoring of energy conservation agreements
- promotion of energy audit and analysis activities
- expedition of the introduction of energy conservation technologies
- increasing the use of renewable energies
- communication regarding energy efficiency and renewable energies
- monitoring and impact assessment regarding work aimed at affecting attitudes and consumption habits

The method of work involves integrating energy-efficient technologies, methods of energy usage and renewable energy and communication. In addition to the experts in energy usage and communications, a representative group of energy customers and parties utilising the actions are harnessed early on to plan and implement the actions. This ensures the expedience and effectiveness of actions and the commitment of users. As an independent party, the role of Motiva is to activate the actors in the field and establish networks between them.

A systematic long-term approach is necessary when promoting energy savings if the actions are to be implemented in practice. The effectiveness of all projects promoting energy savings is constantly evaluated. However, the effectiveness of horizontal, communication projects is usually difficult to measure directly in terms of the amounts of saved energy; instead, the meters deployed are activity-related, such as the numbers of brochures or participants.

Communications, the provision of information and training are required for putting into practice both regulatory control (such as building regulations) and voluntary actions (such as energy conservation agreements by companies or communities, affecting the purchase behaviour of consumers). Activities that are tailored to the needs

of the target groups and that utilise different communication channels will produce the best results.

Energy-efficient technology

Energy efficiency has been promoted, among other things, through commercialisation competitions, examples of which are the Renovation window competition organised in 1995–1998, and the MotiVoittaja competition for small low-energy houses organised in 2000–2001.

Long-term work for promoting energy labels has been in progress since 1995. The effects of the labelling scheme are clearly evidenced, among others, by the supply of domestic appliances and consumers' purchase behaviour. In Finland, the public authorities also supervise the displaying of labels and the correctness of information.

In addition to the energy labelling required by EU, work has also been carried out in Finland for developing a voluntary energy labelling scheme for small residential buildings and windows. Since 1996, the use of an energy certificate for small residential buildings has been piloted at several Nationwide Housing Fairs, an annual event with some 100,000– 200,000 visitors. Even though the energy certificate has not been established as existing practice yet, the pilot projects have done the groundwork and increased awareness regarding the energy efficiency of buildings and low-energy building designs.

The development and introduction of energy-efficient technologies have been expedited, *inter alia*, by various networking actions. In 1999, the Finnish Heat Pump Association (SULPU) was established following an initiative by Motiva. The association promotes the development of the field by disseminating information to end customers on energy and by training actors in the field.

Methods

The most important methods related to energy usage from a national perspective are the energy conservation agreements and energy audits described in earlier chapters.

An extensive development project was implemented in 1993–1997 with the objective of making basic adjustments to water circulation-based heating systems of buildings. Average energy savings of 14% were observed in the extensive measurement project covering more than 1,000 sites. Basic adjustment projects for buildings are still being implemented, in part using the training model produced in the development project.

One of the latest approaches is the "Paineilmaa energiatehokkaasti" (Pressurized air in an energy-efficient manner) concept that was developed under the guidance of Motiva in co-operation with actors in the field. The concept has so far been applied to dozens of sites, mainly in the industrial sector. Encouraged by the good results it has produced, concepts are also being developed for establishing the energy efficiency of other commodities, such as refrigeration systems.

Communications

Media is one indirect key actor in the field of energy savings; it is the channel for influencing other interest groups. Motiva serves and activates the media in many ways: by responding to reporters' requests for information, by issuing bulletins and by organising meetings for reporters and editors, for example through their associations.

Every year, there are on average over 150 contacts with reporters and editors, and Motiva and its partners issue dozens of press releases.

Motiva's www site is a popular source of information with some 650,000 visitors every year. The site contains diverse information on measures and tested methods for achieving energy savings and using renewable energy. It also contains services aimed at companies, communities, consumers and the media. According to a survey on Web services carried out at the end of 2005 by Taloustutkimus Oy, more than 80% of the respondents gave positive feedback about the site — a better than average result when compared to other similar surveys. As strengths of the Web service, the respondents mentioned its neutrality, business-like attitude and the fact that information is provided in layman's terms.

In spite of the increasing popularity of the Web service, it must be supplemented with various brochures, manuals and publications in order to ensure the practical realisation of energy savings. More than 200 different brochures related to energy savings and the use of renewable energy are available from Motiva. In 2006, more than 125,000 brochures were sent to different parties in need of information, an increase of 25% on the previous year. Motiva's own magazine, MotivaXpress, concentrates on communicating information related to energy efficiency and renewable sources of energy. It comes out four times per year and has a circulation of 6,500.

Various campaigns can be used to supplement communications on energy savings and to make it more focused, but campaigns are no substitute for the continuous communication and other promotion activities that Motiva targets at different end customer groups. Several campaigns promoting energy efficiency have been carried out under the guidance of Motiva in different end customer sectors. The campaigns have related to the procurement of equipment and systems, economical driving, living and building, premises maintenance, etc.

The National Energy Conservation Week (week 41) is a well-established campaign event that has been organised annually for over ten years. During the week, the issue of saving energy is highlighted in companies and communities around Finland in different ways that best suit each actor. The week is observed in more than 200 companies and communities, and it directly influences tens of thousands of people (for example in 2005, the companies participating in Energy Conservation Week had in all 30,000 employees and some 15,000 customers). Thanks to the active contribution of Motiva, the week and energy conservation issues received a lot of media coverage. In 2006, the week was covered by some 350 articles in the media. According to the feedback questionnaire sent annually to the actors participating in the week, for some 70% of the respondents the week is related to the company's environmental or energy programme or to the practical implementation of the energy conservation agreement.

The Climate Change Communication Programme implemented in 2002–2007 was part of the process of implementing the national Climate Strategy. The programme was aimed at increasing the citizens' awareness of climate change, its impacts and ways to control it. The work culminated in the EU-wide campaign aimed at citizens during 2006–2007. A total of 62 projects received funding from the programme during five years. The total budget was approximately EUR 2.5 million. The programme was implemented through the close co-operation of the Ministry of Trade and Industry, the Ministry of Transport and Communications, the Ministry of Agriculture and Forestry, the Ministry of the Environment and the Finnish National Board of Education. Its

practical implementation was coordinated by Motiva Oy. Evaluation of the project is in progress.

The foundation for consumption habits and behavioural patterns regarding energy are laid early, during childhood and adolescence. The inclusion of energy-related matters as a natural part of education at different levels is a national goal. The development and dissemination of action models supporting energy savings has been promoted in the educational and pedagogic sector in co-operation with the networks and actors in the sector. As an example, the Energy Savings Week for Second-graders concept was developed for eight-year old schoolchildren as early as in 1996 through the co-operation of several parties. The concept is still providing over 20,000 pupils every year, nearly half of all children of that age in Finland, with an opportunity to familiarise themselves with energy conservation issues.

Measure: "Regional Energy Agencies"

The eight Regional Energy Agencies around Finland form a national co-operation network whose operations are coordinated by Motiva Oy. The agencies promote the implementation of energy savings locally and regionally by putting developed methods and procedures into practice and by conveying valuable feedback information on users' experience and needs in order to better target future actions.

3.10.3 Other horizontal actions

Measure: "Promotion of ESCO operations"

The promotion of ESCO operations began in Finland in 1998. The objective was to improve the implementation results of the actions reported in energy audits. In 2000, a model was published for ESCO agreements, together with a report discussing the particular characteristics associated with the deployment of the ESCO concept. Increased investment subsidies have been granted since 2002 for energy conservation investments implemented using the ESCO concept. Finland has participated in the international development of ESCO operations through its participation in the IEA's DSM Agreement Task X project during 1999–2003, the Eurocontract project of the EIE programme of the European Commission during 2004–2006 and the IEA's DSM Agreement Task 16 project that began in 2006.

Nationally, ESCO operations have been promoted by producing marketing material, by organising annual ESCO seminars and by maintaining a register of ESCO projects on the Website of Motiva Oy. The Eurocontract project has developed the ESCO agreement model for the public sector in particular. A project was initiated in 2006 for developing and promoting ESCO operations in industry.

In 2007, there are five ESCO companies in Finland with permanent operations. In addition to this, there are some companies that occasionally make energy conservation investments using the ESCO concept. At the end of 2006, the ESCO project register contained 43 projects, in addition to which energy subsidies were granted for 8 projects in 2006. The total savings effect of these 53 ESCO projects is 294 GWh/a. The effective span of most investments lasts until 2016, but the industrial sector projects have not been separately divided between the ETS sector and the actors coming within the scope of the ESD. Some of the projects were also reported in connection with reporting for energy conservation agreements. Producing a separate

impact assessment in the next NEEAP will be taken into consideration.

The promotion of ESCO operations in Finland will be continued. As one action aimed as promoting the deployment of the ESCO concept, the obligation of ordering it and mastering its use is included in the new energy-efficiency agreements, as well as the obligation of using it when a profitable energy conservation investment would otherwise not be made in the absence of other funding.

4 Evaluation of the results of energy conservation actions

This section contains information of those actions that are either currently deployed in Finland or will be deployed in the future and have energy conservation effects that can be verified and measured or evaluated. Finland's national energy conservation target of 9% for 2016 equals 17,800 GWh. The 3% interim target for 2010, in line with the total target, therefore equals 5,900 GWh.

Through the actions currently known and adhering to the general framework of measuring and verifying energy savings set out in Annex IV of the ESD, the energy savings of 2016 will be 12,707 GWh, corresponding to approximately 71% of the total target. The estimate is that the shortfall in energy savings will be made up primarily through a new extensive energy conservation agreement scheme. Section 4.3 also sets out several actions the savings effects of which will be calculated when the harmonised calculation methods now being prepared by the Commission have been approved by the Regulatory Committee.

4.1 Summary of energy conservation effects

Table 7 shows the savings effects by sector achieved by the 14 most significant energy efficiency actions for which it has been possible to make an effectiveness assessment on the basis of the initial data available.

Sector	2007 GWh	2010 GWh	2013 GWh	2016 GWh
Households				
Buildings	3,960	5,934	7,863	9,573
Public sector/municipal sector	84	69	66	66
Public sector/state administration				
Private services sector	144	90	102	102
Industrial sector	1,286	1,307	743	640
Transportation	869	1,142	1,299	1,387
Agriculture	480	659	809	938
Energy sector				
Horizontal				
Total savings	**6,824**	**9,201**	**10,882**	**12,707**

Table 7. Summary of savings effects by sector (GWh/a).

Actions for making up the shortfall of energy savings

The new extensive energy conservation agreement scheme is a major new action for the period 2008–2016. Regarding the effects of this scheme, energy savings in the order of the 2,800–4,700 GWh can at this stage be presented on the basis of the coverage intended for those agreements where the principal responsibility lies with the Ministry of Trade and Industry, and the 9% energy conservation targets of individual agreements. These energy savings are additional to the total savings set out in Table 7 which would consequently increase to 15,500–17,400 GWh. No estimate is available yet for the order of magnitude of the effects of the new agreements in the transportation, agricultural and housing sectors.

The need and possibilities to enhance the present actions will be evaluated in conjunction with the preparatory work for the next NEEAP. Planning for the new actions is included in the new energy conservation programme to be drawn up by the end of 2008.

Default co-efficient for savings in electricity

According to Annex II of the ESD, the Member States may apply a default co-efficient of 2.5 for savings in electricity. The division between heating and electricity has not been made yet for all actions presented in this action plan or their effects. On average, savings in electricity have accounted for 20% of the total savings in Finland. Applying on this basis the default co-efficient 2.5 set out in the ESD to the energy savings of other sectors excluding the transportation sector, the savings effect presented in Table 7 increases to 16,100 GWh, and, when the effect of the new energy efficiency agreements referred to above is taken into account, to 19,400–22,200 GWh. The share of savings in electricity of the total savings will be further specified in conjunction with the report submitted in 2013 as far as possible.

4.2 Energy conservation effects by sector

4.2.1 Households

The savings effects regarding the consumption of electricity in households have not been estimated so far, and they can only be sensibly estimated once the Commission proposal for a harmonised calculation method is available.

4.2.2 Buildings and construction

Identifier	Buildings/actions	2007 GWh	2010 GWh	2013 GWh	2016 GWh
KTM-05	Energy labelling for windows	51	222	421	650
KTM-06	Heat pumps for small residential buildings	934	1,529	2,111	2,531
KTM-07	Höylä I and II programmes	1,766	2,232	2,639	2,959
YM-01	Building Code Regulations	1,029	1,771	2,512	3,253
YM-02	Energy subsidies	180	180	180	180
Total for buildings		**3,960**	**5,934**	**7,863**	**9,573**

Table 8. Summary of savings effects in the buildings and construction sector (GWh/a).

Voluntary energy labelling for windows

The calculations for the effectiveness assessment regarding the voluntary energy labelling scheme of windows are presented in more detail in Annex KTM-05.

Heat pumps in detached houses

The calculations for the effectiveness assessment regarding heat pumps installed in small residential buildings are presented in more detail in Annex KTM-06.

Höylä I and II programmes for oil-heated houses

The calculations for the effectiveness assessment regarding the replacement of heating systems in oil-heated houses and other repairs affecting energy efficiency are presented in more detail in Annex KTM-07.

Building code regulations C3, C4, D2 and D5

The calculations for the effectiveness assessment regarding the thermal insulation requirements of buildings that were made more stringent by the 2003 Building Code are presented in more detail in Annex YM-01.

Subsidy scheme for apartment buildings

The calculations for the effectiveness assessment regarding the energy subsidies granted to apartment buildings and terraced houses are presented in more detail in Annex YM-02.

4.2.3 Public sector — municipalities and federations of municipalities

Identifier	Energy efficiency measure	2007 GWh	2010 GWh	2013 GWh	2016 GWh
KTM-01	Energy audit scheme / municipal sector	84	69	66	66
	Total for public sector / municipal sector	**84**	**69**	**66**	**66**

Table 9. Summary of savings effects in the municipal sector (GWh/a).

Energy audit scheme / municipal sector

The calculations for the effectiveness assessment regarding the energy audits scheme in the municipal sector are presented in more detail in Annex KTM-01. The savings effects of the energy conservation agreement scheme (1997–2007) in the municipal

sector are included in this effectiveness assessment because all actions reported through the agreements are set out in conjunction with the energy audits, and the municipalities participating in the agreement are part of the entire municipal sector audit scheme.

New energy efficiency agreements for the municipal sector 2008–2016

The savings effects shown in Table 9 only concern the savings achieved in the municipal sector through the energy audit scheme for which savings effects have been calculated for the entire period 2008–2016 on the basis that the energy audit scheme in Finland will be continued and making certain forecasts regarding volumes. In the municipality sector, energy audits will also be carried out in companies outside the new agreement scheme.

The goal of the new energy efficiency agreements is to cover 60–80% of the entire energy usage in the municipal sector. Each municipality joining the agreement sets itself an indicative energy conservation minimum target of 9% in line with the ESD.

The total energy usage of the entire municipal sector is estimated to be one-third of the total energy usage of the entire services sector, or 9–10 TWh/a. Assuming that the target of 60–80% coverage is actually achieved for the new energy efficiency agreement, the energy savings effects corresponding to the 9% savings target would in the municipal sector be 450–650 GWh in 2016. Since this savings effect also includes the 66 GWh savings shown in Table 9 achieved through the energy audit scheme, the net effect of the new energy efficiency agreements will be 400–600 GWh in 2016. This savings effect has so far not been included in the total amount of energy savings shown in Table 7. The situation can be assessed in more detail in conjunction with the 2013 report when the actual coverage of the new energy efficiency agreements is known.

4.2.4 Public sector — state administration

The savings effects have not been monitored for state administration in the same manner as for other sectors, because energy subsidies are not granted for the government's own actions. If sufficient information can be collected on the government's own actions, an effectiveness assessment will be included in the next NEEAP.

The total energy usage in the state administration sector is estimated at 2,500–3,000 GWh/a. Since state administration must — as a key element of the public sector — set a good example in ESD-related matters, energy savings of 9% in 2016 have been set as the starting point for the actions aimed at state administration. In terms of energy, this translates into a savings effect of 220–270 GWh.

4.2.5 Private services

Identifier	Energy efficiency measure	2007 GWh	2010 GWh	2013 GWh	2016 GWh
KTM-02	Energy audit scheme / private services sector.	144	90	102	102
	Total for private services	**144**	**90**	**102**	**102**

Table 10. Summary of savings effects in the private services sector (GWh/a).

Energy audits in private sector buildings

The calculations for the effectiveness assessment regarding the energy audits scheme in the private services sector are presented in more detail in Annex KTM-02. The savings effects of the energy conservation agreement scheme (1997–2007) in the real estate and construction industries are included in this effectiveness assessment because all actions reported through the agreements are set out in conjunction with the energy audits, and the municipalities participating in the agreement are part of the entire sector audit scheme.

Private sector energy efficiency agreement / private services sector 2008–2016

The savings effects shown in Table 10 only concern the savings achieved in the private services sector through the energy audit scheme for which savings effects have been calculated for the entire period 2008–2016 on the basis that the energy audit scheme in Finland will be continued and making certain forecasts regarding volumes. In the private services sector, energy audits will also be carried out in companies outside the new agreement scheme.

The goal of the new energy efficiency agreements is that the agreement scheme would as such cover 60–90% of the energy usage of the industrial and private services sectors. The intention is to have at least 70% of the energy usage of the private services sector included in the scope of the agreement scheme. An indicative energy savings target of 9% is set, in line with the ESD, for each sector joining the agreement scheme, and the basic assumption is that each company joining the agreement scheme sets itself an indicative energy savings target of at least 9%.

The total energy usage of the entire private services sector is estimated to be two-thirds of the total energy usage of the entire services sector, or in the order of 20-21 TWh/a. Assuming that the target of 50–70% coverage is actually achieved for the new energy efficiency agreement, if the target is set at a minimum of 70%, the energy savings effects corresponding to the 9% savings target would in the private services sector be 900-1,300 GWh in 2016. Since this savings effect also includes the 102 GWh savings shown in Table 10 achieved through the energy audit scheme, the net effect of the new energy efficiency agreements will be 800-1,200 GWh in 2016. This savings effect has so far not been included in the total amount of energy savings shown in Table 7. The situation can be assessed in more detail in conjunction with the 2013 report when the actual coverage of the new energy efficiency agreements is known.

Early actions in the trade and commerce sector

In conjunction with the preparatory work for the private sector energy efficiency agreement, a comprehensive separate analysis was carried out in 2007 regarding the savings effects of the early actions taken by the three largest actors in the trade and commerce sector . The total energy savings effects of these three actors were 15% in electricity (213 GWh/a) and 39% in heating energy consumption (235 GWh/a). These energy savings amounting to a total of almost 450 GWh are not include in the total savings shown in Table 7 because the period in which the savings take effect has not

been separately estimated and it may therefore overlap, at least in part, with the 800-1,200 GWh energy savings of the new energy efficiency agreements discussed above. In connection with the analysis of the early actions taken by the actors in the trade and commerce sector, the top-down calculation method revealed that the energy efficiency of these three actors has considerably improved. Table 11 shows the factors describing the changes in energy consumption and trading volumes over the period 1995–2005 and the factors showing what the situation would be without the energy efficiency actions taken during the period 1995–2005.

Parameter	Change factor 1995–2005	Factor without actions being taken
Electricity consumption	2.86	(3.79)
Heating energy consumption	1.03	(2.67)
Total energy consumption.	2.00	(3.26)
Floorspace of shops	2.29	
Opening hours of shops	1.20	
Refrigeration equipment in the trade and commerce sector	1.70	

Table 11. Changes in energy consumption and volumes in the trade and commerce sector 1995–2005.

4.2.6 Industry

Identifier	Energy efficiency measure	2007 G	2010 GWh	2013 G	2016
KTM-03	Energy audit scheme / industry	759	846	604	640
KTM-04	Energy conservation agreements in the industrial sector	527	461	139	0
	Total for industry	**1,286**	**1,307**	**743**	**640**

Table 12. Summary of savings effects in the industrial sector (GWh/a).

Energy audit scheme / industry

The savings effects of the energy audits and analyses carried out in the industrial sector are presented in Annex KTM-03.

Energy conservation agreements in the industrial sector 1997–2007 (TESS)

By the end of 2005, 58% of the heat and fuel consumption and 70% of the electricity consumption of the industrial sector had been audited. The savings effect of the reported actions implemented during 1998–2005 was 5 TWh/a in heating and fuels and 0.9 TWh/a in electricity. The savings effect of the actions already decided will be 0.6 TWh/a in heating and fuels and 0.1 TWh/a in electricity. The savings potential of actions still under consideration at the end of 2005 is 4.2 TWh/a in heating and 1 TWh/a in electricity.

The effectiveness assessment regarding the industrial sector agreement scheme (1997-2007) for companies coming under the scope of the ESD is presented in

Annex KTM-04.

Private sector energy efficiency agreement / industrial sector 2008–2016

New savings are no longer calculated for 2008 with respect to the current industrial sector energy conservation agreement that ends in 2007. Due to the limited life-span of energy conservation actions, the industrial sector agreement scheme no longer results in any savings effects in 2016 (Table 12). The new energy efficiency agreement will start offsetting the reduction in savings effects of the current agreement scheme as early as in 2010. The entire savings effect for 2016 will be due to the new energy efficiency agreement.

The goal of the new energy efficiency agreements is that the agreement scheme would as such cover 60–90% of the energy usage of the industrial and private services sectors. The intention is to have at least 70% of the energy usage of medium-scale industries included in the scope of the agreement scheme. An indicative energy savings target of 9% is set, in line with the ESD, to each sector joining the agreement scheme, and the basic assumption is that each company joining the agreement scheme sets itself an indicative energy savings target of at least 9%.

The total energy usage of industries coming within the scope of the ESD was 44,620 GWh in 2005. Assuming that the target of 50–70% coverage is actually achieved for the new energy efficiency agreement, if the target is set at a minimum of 70%, the energy savings effects corresponding to the 9% savings target would in the industrial sector be 2,000-3,000 GWh in 2016. When taking into account the savings effect of 640 GWh that is estimated to be achieved through the energy audit scheme and is in practice included in these figures, the net effect of the new agreements will be 1,400-2,600 GWh in 2016. This savings effect has so far not been included in the total amount of energy savings shown in Table 7. The situation can be assessed in more detail in conjunction with the 2013 report when the actual coverage of the new energy efficiency agreements is known.

4.2.7 Transportation

Identifier	Energy efficiency measure	2007 GWh	2010 GWh	2013 GWh	2016 GWh
LVM-01	Ecodriving training for passenger car drivers	100	130	161	189
LVM-02	Ecodriving training for bus drivers	16	31	42	42
LVM-03	Ecodriving training for lorry drivers	21	188	251	262
LVM-04	Tyre pressure	732	793	845	894
Total for transportation		**869**	**1,142**	**1,299**	**1,387**

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able 13. Summary of savings effects in the transportation sector (GWh/a).

Ecodriving training for passenger car drivers

An estimate of the effects of ecodriving training for passenger car traffic is presented in Annex LVM-01.

Voluntary agreement on energy efficiency/public transport

An estimate of the effects of ecodriving training, implemented as part of the Public Transport Energy conservation Programme, is presented in Annex LVM-02.

Voluntary agreement on energy efficiency/lorry and van transport sector

An estimate of the effects of ecodriving training, implemented as part of the Lorry and Van Transport Energy conservation Programme, is presented in Annex LVM-03.

Tyre pressures of passenger cars and vans

An estimate of the effects of correct tyre pressures is presented in Annex LVM-04.

4.2.8 Agriculture

Identifier	Energy efficiency measure	2007 GWh	2010 GWh	2013 GWh	2016 GWh
MMM-01	Investment subsidies for heating plants	480	659	809	938
	Total for agriculture	**480**	**659**	**809**	**938**

Table 14. Summary of savings effects in agriculture (GWh/a).

Investment subsidies for heating plants

An estimate of the effects of heating plants on farms is presented in Annex MMM-01.

4.2.9 Energy sector

The savings effects of the actions taken by the energy sector have not been evaluated so far. The effects can only be sensibly estimated once the Commission proposal for a harmonised calculation method is available.

4.2.10 Horizontal actions

The effects of horizontal actions have not been estimated so far. Particularly with respect to fiscal control, the situation can only be sensibly assessed once the Commission proposal for a harmonised calculation method is available. The total effects of some horizontal actions are known, but there is some duplication with other actions regarding the savings, and a separate analysis is required.

4.3 Other energy conservation actions

This section discusses on a sector-specific basis actions, the savings effects of which are so far not included in Finland's national energy conservation target. An expert estimate in the order of magnitude of savings is attached to some actions, and some are accompanied by other factors related to achieving the savings target. The effects of these actions will only be taken into account in the 2011 report, provided that the

collection of initial data for calculations and the development of calculation methods allow this. The intention is also to supplement the list of early actions now presented in the next NEEAP if it is useful for the purpose of evidencing savings effects.

4.3.1 Households

- Energy labelling of domestic appliances

4.3.2 Buildings and construction

The actions in the field of buildings and construction for which the savings effects cannot be estimated at this stage include the following:

- Energy audit scheme for residential buildings

  The extent and effectiveness of the audit scheme is not monitored at the moment. If monitoring is deemed necessary, their results may be included in the 2011 report.

- Energy conservation agreement for residential buildings 2002–2010 (ASRA)

  Two annual reports have been published so far for the energy conservation agreements. There has been a slight reduction in the heating energy, electricity and water consumption of the residential buildings in the communities joining the agreement. However, the constant change in the housing stock of the communities has a balancing effect on the change in the consumption figures of the entire stock. The effects of the savings agreements will possibly be included in the 2011 report.

- New energy subsidies for apartment buildings and terraced houses (2008)

  The effects of these new subsidies will possibly be included in the 2011 report.

- Subsidy scheme for detached and semi-detached houses (2006–)

  The effects of these new subsidies will possibly be included in the 2011 report.

- Low-energy buildings

  For small residential buildings, the savings effect could be roughly calculated on the basis of the 5–10% market share and the heating energy consumption that is at least 50% lower than that prescribed in the regulations. The savings effect has not been calculated so far because it is partly included in the other actions aimed at small residential buildings.

- Building Code Regulations

  Improvements to the energy efficiency of buildings with the help of more stringent Building Code Regulations will be assessed as part of the energy and climate strategy to be reformed in accordance with the Government's Programme and as part of the more stringent energy conservation programme to be drawn up by the end of 2008.

- Energy Certificate (2002/91/EC)

  As part of the transposition process of the Directive governing the energy

efficiency of buildings, energy certificates will be introduced for buildings in Finland from the beginning of 2008.

- Basic adjustment of radiator networks

  The basic adjustment work of heating radiators in apartment buildings has been actively promoted in Finland since the 90s. Follow-up studies suggest that the savings effect is 5–15%. The savings effect has not been estimated in terms of energy so far. On the other hand, the life-spans of the savings effects will probably be determined to be so short that the effect of basic adjustments carried out before 2008 will probably no longer be valid in 2016.

4.3.3 Public sector — municipalities and federations of municipalities

- Energy subsidies

  The savings effects of energy subsidies not included in the effects of energy audits or energy conservation agreements will be presented in the 2011 report provided that the information on other subsidised energy conservation investments can be itemised.

- ESCO projects in the municipal sector

  20–30 significant energy conservation investments have been carried out in the municipal sector deploying the ESCO concept since 1995; the Ministry of Trade and Industry has granted energy subsidies for some of them. The use of the ESCO concept is expected to become more commonplace in the future. The savings effect cannot be presented at this stage because data is only available for part of the projects and the savings overlap at least partially with other actions reported for the municipal sector.

4.3.4 Public sector — state administration

- Promotion of energy efficiency in state administration during the period 2008–2016

  The intention is to achieve the 9% energy conservation target of the ESD by 2016 through actions aimed at state administration. More detailed regulations on the matter will be issued by 17 May 2008.

4.3.5 Private services

- The KYTE (Kylmää tehokkaasti, or Efficient Cooling) project

  An audit scheme will be developed in 2006–2007 for improving the energy efficiency of refrigeration systems. The KYTE analysis lends itself to the audits of refrigeration systems both in trade and commerce and industry.

- Building managers' energy efficiency agreement 2008–2016

  15–20 million m^2 of office and commercial buildings can be brought within the scope of the agreement scheme through property management companies. Part of this building stock will enter the agreement scheme through the user

organisations as part of the sector-specific action plans of the Confederation of Finnish Industries. Due to the current status of negotiations and the said duplication, the savings effect cannot be estimated yet.

4.3.6 Industrial sector

- Energy subsidies

  The savings effects of energy subsidies not included in the effects of energy audits or energy conservation agreements will be presented in the 2011 report provided that the information on other subsidised energy conservation investments can be itemised.

- ESCO projects in the industrial sector

  10–15 significant energy conservation investments have been carried out every year in the industrial sector deploying the ESCO concept for which the Ministry of Trade and Industry has granted energy subsidies. Some projects are also implemented without energy subsidies. Some of these saving actions have been reported through energy conservation agreements, and some companies come within the ETS. The savings effect cannot be presented at this stage due to overlapping energy savings.

- The PATE (Paineilmaa tehokkaasti, or Efficient Pressurized Air) project

  An audit scheme was developed in 2003-2004 for improving the energy efficiency of pressurized air systems. The pilot projects suggest that the savings potential is about 20%. Some 30 PATE analyses have already been carried out during 2005-2007. The savings effect cannot be presented at this stage due to overlapping energy savings.

4.3.7 Transportation

- Traffic system planning

  The effects of actions affecting the distribution between different modes of transport, logistics, driving speeds or other traffic behaviour have not been assessed so far.

- Procurement of transportation and traffic services

  The effects of the guidelines for taking environmental or energy conservation aspects into account when procuring transportation services have not been assessed yet.

- Wintertime speed limits

  Wintertime speed limits reduce actual driving speeds by an average of 10 km/h which means that the resulting savings effect is at least 10 million litres and can be as much as 35 million litres.

4.3.8 Agriculture

- Agricultural energy programme MENO

  The purpose of the agricultural energy programme is to implement the 9% energy

conservation obligation of the ESD in the agricultural sector.

4.3.9 Energy sector

- Invoice feedback by energy companies

  According to a survey carried out by Helsinki Energy and the Ministry of Trade and Industry, feedback provided with invoices produces a savings effect of approximately 2%. Similar effects have been observed in studies carried out in Sweden and Denmark.

- Switching from oil heating to district heating

  District heating companies have records of the buildings that have changed from oil heating to district heating, as well as details of the heat energy consumption of these buildings after the change. The savings effect in terms of end use of energy is in the order of 10–20%.

- Customer advisory services by energy companies

  In Finland, energy companies have a tradition of actively advising their customers. Individual surveys have been carried out regarding the effects of customer advice, but the savings effects cannot be stated yet in terms of energy.

4.3.10 Horizontal actions

- Fiscal control

  The effect of fiscal control on the energy savings achieved in Finland have not been calculated so far. Since fiscal control affects the implementation of other actions laid out in this EEAP, the savings effects of other actions must be taken into account when calculating its particular effect.

- Energy efficiency in procurement

  Taking energy efficiency into account in procurement will be one of the focal areas of the new actions in Finland. The particular emphasis will be on public procurement, but the guidelines drawn up for the public sector in compliance with the obligations of the ESD will, where applicable, also be utilised as part of the implementation of new energy efficiency agreements in the industry and private services sectors. The energy conservation potential in public procurement has been studied in the JUHA project (2006–2007). The work for drawing up the actual procurement guidelines will commence during 2007. Further development of existing WWW equipment databases will also be linked to the procurement guidelines. The most significant equipment categories for which the savings effects could be assessed in the future are as follows:

  a) office computer equipment
  b) frequency converters
  c) energy-efficient lighting solutions
  d) electronic ballasts
  e) energy-efficient motors (EFF1)

f) vehicles

- Communication actions and campaigns

  Every year, plenty of communications and campaigns take place in Finland relating to the promotion of energy savings and efficiency. Even though the savings effects have not been assessed separately for communication actions in this EEAP, they are necessary from the perspective of the entire operations for increasing public awareness. The most significant communication actions for which the savings effects could be assessed in the future are as follows:

  a) Energy Conservation Week
  b) Car-free Day and Physical Exercise Week
  c) Eco-car of the Year
  d) CFL campaigns
  e) Heating system selection guide for small residential houses
  f) Customer information services of energy companies as an on-going operation

- Consumption monitoring

  Energy consumption monitoring on a monthly basis is extensively undertaken in Finland. This is aided by the increasing popularity of remote reading of energy meters. Consumption monitoring can be estimated to have at least a 2% effect in preventing the uncontrolled increase of consumption.

- Monitoring the fuel consumption of new cars

  The Finnish Vehicle Administration monitors developments in the specific fuel consumption and CO_2 emissions of new cars and maintains a register of these data. This monitoring is based on EC legislation (Council Decision 1999/296/EC) In addition, the Vehicle Administration maintains the so-called EKOAKE database where it collects information on the specific fuel consumption and other technical properties of different car models in co-operation with car importers. The improvement in the fuel consumption of new cars has not been estimated so far.

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Annexes:

KTM-01 (KU_KAT), Energy audit scheme for the municipal sector
KTM-02 (PY_KAT), Energy audit scheme for the private services sector
KTM-03 (TE_KAT), Energy audit scheme for the industry sector (non-ETS sector)
KTM-04 (TE_ESS), Energy conservation agreement scheme for the industrial sector (non-ETS sector)
KTM-05 (Ikkunoiden energiamerkintä), Energy labelling for windows
KTM-06 (Pientalojen lämpöpumput), Promotion of heat pumps in small residential buildings
KTM-07 (Höylä I & II), Reconditioning of oil-heated small residential buildings

LVM-01 (HA, tal. ajotapa), Ecodriving training for car drivers
LVM-02 (LA, tal. ajotapa), Ecodriving training for bus drivers
LVM-03 (KA, tal. ajotapa), Ecodriving training for goods vehicle drivers
LVM-04 (Rengaspaineet), The effect of tyre pressure on the energy consumption of cars and vans
YM-01 (Lämermäär), Thermal insulation regulations 2003
YM-02 (Eneavust), Energy subsidies for residential buildings

MMM-01 (Lämpökesk), Heating plant investments

Energy audit scheme for the municipal sector KTM-01 (KU_KAT)

DESCRIPTION OF THE ACTION

The energy audit activities supported by the Ministry of Trade and Industry have had a pivotal role in Finnish energy conservation activities since 1992. Energy audits have also been an essential part of the Energy Conservation Programme 2003-2006 and the Energy and Climate Strategy adopted by the Government in November 2005. Energy audits are one obligation included in the municipal sector energy conservation agreement (1997-2007), and they will also be included as one action in the new energy efficiency agreements for 2008–2016 now in the negotiation stage.

Energy audits include an assessment of the current status of energy and water consumption, action proposals and savings estimates regarding energy conservation actions as well as their reporting. Energy audits are carried out by energy auditors authorised by Motiva.

Four different energy audit models for buildings are used in the municipal sector: the building energy review, building energy audit, building follow-up audit and building commissioning audit. So-called municipal audits have also been carried out in the municipal sector since 2005 for surveying the possibilities for increasing the use of renewable energy in the municipality.

ASSESSMENT OF EFFECTS

Basis of calculations
Information on the subject of the audit is collected by the energy audits monitoring system in three stages.

1. From the application and subsidy decision:
   - general details (such as building volume, year of construction, type of building, details of joining the savings agreement scheme, etc.)
   - the granted audit subsidy, audit-related costs
2. From the energy audit report:
   - general details (review/supplement)
   - energy and water consumption details for the preceding year
   - for each proposed action:
     - short description / name of action
     - savings in heating, electricity and/or water expressed in units of energy (kWh/a)
     - savings in heating, electricity and/or water expressed in terms of money (€/a)
     - possible savings in power surcharges (€/a)
     - change in carbon dioxide emissions (tCO_2/a)
     - value of investment and the direct pay-back time of the action (€, a)
     - information on whether the proposed actions have been carried out (implemented= T, decided = P, under consideration = H, abandoned = E)
3. Information on the implementation of actions proposed in conjunction with the energy audits is collected from the municipality-specific annual reports associated with the energy conservation agreement:
   - update to the implementation details (T, P, H, E) of saving actions proposed in audits

The information is compiled in the energy audit monitoring system at Motiva (Access database). The information collected regarding applications and subsidy decisions is received as paper copies and entered manually in the database. The information collected from the energy audit reports consists of details established and/or measured by the authorised energy auditors on site, and calculations carried out on their basis. The energy auditor suggests an order of implementation for the savings actions proposed for the site, taking into account at that stage any overlapping of the effects of individual actions.

- the monitoring information is transferred to the energy audit monitoring system (Motikyttä, Access database) electronically from the set-format (Excel) table supplied by auditor
  - the order of magnitude of the submitted information is automatically checked in connection with the transfer
- the accuracy of savings calculations corresponds to the accuracy achievable in normal field work
  - some initial information is design data or estimates because measurements are not always possible
- the savings achieved through the savings actions are, as a rule, not verified by measurements carried out afterwards
  - measurements are often difficult in practice and incur additional costs
- the estimates given by the energy auditors regarding the energy savings are realistic because the parties ordering the audit or the auditors have no reason to report excessive savings

Updating the implementation status of actions:

- the implementation status information is initially obtained from the energy audit report prepared by the auditor on the basis of the information given by the party ordering the audit in the hand-over meeting held in conjunction with completion of the energy audit — the update to the implementation status is obtained annually from the party ordering the audit during the audits associated with the energy conservation agreement and annual reporting

The savings potential of the audits during 2006-2016 is estimated to be of the same order than on average during 2003-2005.

Assessment of effects

The annually produced new energy conservation effect (ES) of municipal sector energy audits is assessed using total savings potential (KSP) regarding heating energy and electricity achievable by the savings actions proposed in the annually reported energy audits in the subject area and the implementation status information (TA) on the savings actions proposed, and updated annually through the annual reports of the municipal sector energy conservation agreements.

The actual savings effect (ES) is assumed to materialise during the year following the energy audit and to have a life-span of six years. The calculation of the annual total savings effect (KES) using a life-span of six years for savings effects is a somewhat conservative approach, but the duration of savings effects of individual actions is not estimated separately.

Information is sought on each action proposed in the audit for the annual reports of energy conservation agreements regarding whether the action has been implemented (T), its implementation has been decided upon (P), it is under consideration (H) or whether it has been abandoned (E). On the basis of this information, the degree of realisation (TA) is calculated for the actions proposed in the energy audit separately for actions to save heating energy and actions to save electricity:

$$TA\ [\%] = T+P+1/3*H$$

According to the latest update (2005 data), the degree of realisation thus calculated for the municipal sector is 73% for heating energy-related actions and 76% for electricity-related actions. The energy audit sites used for calculating the degree of realisation cover 70–90% of the audits (varying year by year) reported during the period. One-third of the savings of the actions under consideration are taken into account as realised savings when calculating the degree of realisation.

The new energy savings (ES) realising from the total savings potential (KSP) of an individual year being monitored is calculated for each year as follows:

ES [GWh/a] = TA(heat)*KSP(heat) + TA(electricity)*KSP(electricity)

The total energy conservation effect (KES) for each year shown in the table below is obtained by subtracting the annual savings effects (ES) valid for each year on the above grounds.

Municipal sector energy audit scheme — effectiveness estimate for 2007, 2010, 2013 and 2016

Municipal sector energy audit scheme		**2007 GWh/a**	**2010 GWh/a**	**2013 GWh/a**	**2016 GWh/a**
KTM-01	**Kunta_KAT**	84	69	66	66

Energy audit scheme for the private services sector
KTM-02 (PY_KAT)

DESCRIPTION OF THE ACTION

The energy audit activities supported by the Ministry of Trade and Industry have had a pivotal role in Finnish energy conservation activities since 1992. Energy audits have also been an essential part of the Energy Conservation Programme 2003-2006 and the Energy and Climate Strategy adopted by the Government in November 2005. Energy audits are one obligation included in the building and construction sector energy conservation agreement (1999-2007), and they will also be included as one action in the new energy efficiency agreements for 2008–2016 now in the negotiation stage.

Energy audits include an assessment of the current status of energy and water consumption, action proposals and savings estimates regarding energy conservation actions as well as their reporting. Energy audits are carried out by energy auditors authorised by Motiva.

Four different energy audit models for buildings are used in the private services sector: the building energy review, building energy audit, building follow-up audit and building commissioning audit.

ASSESSMENT OF EFFECTS

Basis of calculations
Information on the subject of the audit is compiled in the energy audits monitoring system in three stages.

1. From the application and subsidy decision:
   - general details (such as building volume, year of construction, type of building, details of joining the saving agreement scheme, etc.)
   - the granted audit subsidy, audit-related costs
2. From the energy audit report:
   - general details (review/supplement)
   - energy and water consumption details for the preceding year
   - for each proposed action:
     - o a short description / name of action
     - o savings in heating, electricity and/or water expressed in units of energy (kWh/a)
     - o savings in heating, electricity and/or water expressed in terms of money (€/a)
     - o possible savings in power surcharges (€/a)
     - o change in carbon dioxide emissions (tCO_2/a)
     - o value of investment and the direct pay-back time of the action (€, a)

o information on whether the proposed actions have been carried out (implemented= T, decided = P, under consideration = H, abandoned = E)

3. Information on the implementation of the actions proposed in conjunction with the energy audits is collected from the municipality-specific annual reports associated with the energy conservation agreement:
   - update to the implementation details (T, P, H, E) of saving actions proposed in audits

The information is compiled in the energy audit monitoring system at Motiva (Access database). The information collected regarding applications and subsidy decisions is received as paper copies and entered manually in the database. The information collected from the energy audit reports consists of details established and/or measured by the authorised energy auditors on site, and calculations carried out on their basis. The energy auditor suggests an order of implementation for the savings actions proposed for the site, taking into account at that stage any overlapping of the effects of individual actions.

- the monitoring information is transferred to the energy audit monitoring system (Motikyttä, Access database) electronically from the set-format (Excel) table supplied by the auditor
- the order of magnitude of the submitted information is automatically checked in connection with the transfer
- the accuracy of savings calculations corresponds to the accuracy achievable in normal field work
- some initial information is design data or estimates because measurements are not always possible
- the savings achieved through the savings actions are, as a rule, not verified by measurements carried out afterwards
- measurements are often difficult in practice and incur additional costs
- the estimates given by the energy auditors regarding the energy savings are realistic because the parties ordering the audit or the auditors have no reason to report excessive savings

Updating the implementation status of actions:

- the implementation status information is initially obtained from the energy audit report prepared by the auditor on the basis of the information given by the party ordering the audit in the hand-over meeting held in conjunction with completion of the energy audit — the update to the implementation status is obtained annually from the party ordering the audit during the audits associated with the energy conservation agreement and annual reporting

The savings potential of the audits during 2006-2016 is estimated to be of the same order as the average during 2003-2005.

Assessment of effects

The annually produced new energy conservation effect (ES) of private services sector energy audits is assessed using the total savings potential (KSP) regarding heating energy and electricity achievable by the savings actions proposed in the annually reported energy audits in the subject area and the implementation status information (TA) on the savings actions proposed, and updated annually through the annual reports of the building and construction sector energy conservation agreements.

The actual savings effect (ES) is assumed to be realised during the year following the energy audit and to have a life-span of six years. The calculation of the annual total savings effect (KES) using a life-span of six years for savings effects is a somewhat conservative approach, but the duration of savings effects of individual actions is not estimated separately.

Information is sought on each action proposed in the audit for the annual reports of energy conservation agreements regarding whether the action has been implemented (T), its implementation has been decided upon (P), it is under consideration (H) or

whether it has been abandoned (E). On the basis of this information, the degree of realisation (TA) is calculated for the actions proposed in the energy audit separately for actions to save heating energy and actions to save electricity:

TA [%] = T+P+1/3*H

According to the latest update (2005 data), the degree of realisation thus calculated for the private services sector is 79% for heating energy-related actions and 71% for electricity-related actions. The energy audit sites used for calculating the degree of realisation cover about 80% of the audits reported during the period. One-third of the savings of the actions under consideration are taken into account as realised savings when calculating the degree of realisation.

The new energy savings (ES) realising from the total savings potential (KSP) of an individual year being monitored is calculated for each year as follows:

ES [GWh/a] = TA(heat)*KSP(heat) + TA(electricity)*KSP(electricity)

The total energy conservation effect (KES) for each year shown in the table below is obtained by subtracting the annual savings effects (ES) valid for each year on the above grounds.

Private services sector energy audit scheme — effectiveness estimate for 2007, 2010, 2013 and 2016

Private services sector energy audit scheme		**2007 GWh/a**	**2010 GWh/a**	**2013 GWh/a**	**2016 GWh/a**
KTM-02	**PY_KAT**	144	90	102	102

Energy audit scheme for the industrial sector (non-ETS sector)
KTM-03 (TE_KAT)

DESCRIPTION OF THE ACTION
The energy audit activities supported by the Ministry of Trade and Industry have had a pivotal role in Finnish energy conservation activities since 1992. Energy audits have also been an essential part of the Energy Conservation Programme 2003-2006 and the Energy and Climate Strategy adopted by the Government in November 2005. Energy audits are one obligation included in the industrial sector energy conservation agreement (1999-2007), and they will also be included as one action in the new energy efficiency agreements for 2008–2016 now in the negotiation stage.

Energy audits include an assessment of the current status of energy and water consumption, action proposals and savings estimates regarding energy conservation actions as well as reporting same. Energy audits are carried out by energy auditors authorised by Motiva.

Three different energy audit models are used in the industrial sector: the industrial energy audit, industrial energy analysis and two-stage energy audit for the process industry. Industrial companies can also use energy audit models developed for the services sector when auditing their ordinary buildings such as offices.

ASSESSMENT OF EFFECTS
Basis of calculations

Information on the subject of the audit is compiled in the energy audits monitoring system in three stages.

1. From the application and subsidy decision:
   - general details (such as building volume, year of construction, type of building, details of joining the saving agreement scheme, etc.)
   - the granted audit subsidy, audit-related costs
2. From the energy audit report:
   - general details (review/supplement)
   - energy and water consumption details for the preceding year
   - for each proposed action:
     - o a short description / name of the action
     - o savings in heating, electricity and/or water expressed in units of energy (kWh/a)
     - o savings in heating, electricity and/or water expressed in terms of money (€/a)
     - o possible savings in power surcharges (€/a)
     - o change in carbon dioxide emissions (tCO_2/a)
     - o value of investment and the direct pay-back time of the action (€, a)
     - o information on whether the proposed actions have been carried out (implemented= T, decided = P, under consideration = H, abandoned = E)
3. Information on the implementation of the actions proposed in conjunction with the energy audits is collected from the municipality-specific annual reports associated with the energy conservation agreement:
   - update to the implementation details (T, P, H, E) of saving actions proposed in audits

The information is compiled in the energy audit monitoring system at Motiva (Access database). The information collected regarding applications and subsidy decisions is received as paper copies and entered manually in the database. The information collected from the energy audit reports consists of details established and/or measured by the authorised energy auditors on site, and calculations carried out on their basis. The energy auditor suggests an order of implementation for the savings actions proposed for the site, taking into account at that stage any overlapping of the effects of individual actions.

- the monitoring information is transferred to the energy audit monitoring system (Motikyttä, Access database) electronically from the set-format (Excel) table supplied by the auditor
  - the order of magnitude of the submitted information is automatically checked in connection with the transfer
- the accuracy of savings calculations corresponds to the accuracy achievable in normal field work
  - some initial information is design data or estimates because measurements are not always possible
- the savings achieved through the savings actions are, as a rule, not verified by measurements carried out afterwards
  - measurements are often difficult in practice and incur additional costs
- the estimates given by the energy auditors regarding the energy savings are realistic because the parties ordering the audit or the auditors have no reason to report excessive savings

Updating the implementation status of actions:

- the implementation status information is initially obtained from the energy audit report prepared by the auditor on the basis of the information given by the party ordering the audit in the hand-over meeting held in conjunction with completion of the energy audit — the update to the implementation status is obtained annually from the party ordering the audit during the audits associated with the energy conservation agreement and annual reporting

The total savings potential of the industrial energy audit scheme used for this

assessment does not include the energy auditactions carried out on sites included in the scope of the EU's Emissions Trading Scheme, only the energy audit actions carried out on sites included in the scope of the EDS.

The savings potential of the audits during 2006–2016 is estimated to be approximately 20% smaller than the average during 2003–2005.

Assessment of effects

The assessment concerns the effects of energy audits carried out on non-ETS sites. The annually produced new energy conservation effect (ES) is assessed using the total savings potential (KSP) regarding heating energy and electricity achievable by the savings actions proposed in the annually reported energy audits in the subject area and the implementation status information (TA) on the savings actions proposed, and updated annually through the annual reports of the industry sector energy conservation agreements.

The actual savings effect (ES) is assumed to be realised during the year following the energy audit and to have a life-span of eight years which is in line with the conservative savings life-span suggested in CEN/CWA27 for the technical actions proposed in it for the industry. More than 95% of the actions suggested in industrial energy audits are technical in nature, and their life-span is, as a rule, considerably longer than the said eight years. In future effectiveness assessments, adjusting the life-span to better correspond to reality will be considered. The duration of savings effects of individual actions will not be estimated separately.

Information is sought on each action proposed in the audit for the annual reporting of energy conservation agreements on whether the action has been implemented (T), its implementation has been decided upon (P), it is under consideration (H) or whether it has been abandoned (E). On the basis of this information, the degree of realisation (TA) is calculated for the actions proposed in the energy audit separately for actions to save heating energy and actions to save electricity:

TA [%] = T+P+0,05*H

According to the latest update (2005 data), the degree of realisation thus calculated for the industrial sector is 52% for heating energy and fuel-related actions and 59% for electricity-related actions. The energy audit sites used for calculating the degree of realisation cover 90% of the audits reported during the period. Five per cent of the savings of the actions under consideration are taken into account as realised savings when calculating the degree of realisation.

The new energy savings (ES) realising from the total savings potential (KSP) of an individual year being monitored is calculated for each year as follows:

ES [GWh/a] = TA(heat)*KSP(heat) + TA(electricity)*KSP(electricity)

The total energy conservation effect (KES) for each year shown in the table below is obtained by subtracting the annual savings effects (ES) valid for each year on the above grounds.

Industrial sector (non-ETS) energy audit scheme — effectiveness estimate for 2007, 2010, 2013 and 2016

Industry sector (non-ETS) energy audit scheme		**2007 GWh/a**	**2010 GWh/a**	**2013 GWh/a**	**2016 GWh/a**
KTM-03	**TE_KAT ei päästök**	759	846	604	640

Energy conservation agreement scheme for the industrial sector (non-ETS sector) KTM-04 (ESS-TE ei päästök)

DESCRIPTION OF THE ACTION

Energy conservation agreements have had an important role in the implementation of Finland's Climate Strategy (2001) and the associated Energy Conservation Programme (2003–2006). The updated Energy and Climate Strategy adopted by the Government in November 2005 also deems energy conservation agreements to be an important vehicle for achieving the climate-related goals, and the preparatory work for the new generation (2008–2016) agreements is expected to progress rapidly.

The industrial sector energy conservation agreement (1997–2007) is a framework agreement jointly concluded by the Ministry of Trade and Industry, the Confederation of Finnish Industries and companies and communities. In 2006, the agreement covered about 85% of industrial energy consumption. This effectiveness assessment only takes into account those industrial sites in the industrial sector energy conservation agreement that are not included in the Emissions Trading Scheme.

The Confederation of Finnish Industries is committed to promoting energy savings and having its members join the energy conservation agreement. The companies joining energy conservation agreements commit themselves to having energy audits or analyses carried out in their premises and production plants, to drawing up energy conservation plans and to implementing profitable conservation actions. The Ministry of Trade and Industry, in turn, commits itself to supporting energy audits and analyses as well as energy conservation investments that meet certain criteria. Motiva Oy is responsible for the agreement monitoring systems and for preparing the annual report of the industrial sector energy conservation agreement scheme on the basis of information reported annually by the companies on a site by site basis regarding energy conservation actions and their implementation a well as other issues related to energy consumption and energy efficiency.

The energy conservation actions reported as carried out in the annual site-specific report of the energy conservation agreement scheme can be either savings actions identified in the energy audits or actions that the companies have themselves identified in some other manner. The effects of companies' energy conservation actions that are observed in energy audits and which belong to this effectiveness assessment target group are not included in this assessment because they overlap with the assessment of the industrial sector energy audits. This assessment only includes actions other than those observed in the energy audits and reported as having been carried out.

ASSESSMENT OF EFFECTS

<u>Basis of calculations</u>
Each company that has joined the agreement reports the following annually on a site by site basis:

- general details (such as contact details sector of industry, is the site included in the ETS, etc.)
- detailed information on energy usage
- main products and their production volumes, details of buildings (number, volume, floorspace area)
- information relating to energy efficiency operating systems
    - o energy consumption monitoring
    - o information relating to the energy efficiency plan
    - o the current environmental protection system
- other issues, such as
    - o have fossil fuels been replaced by renewable fuels
    - o are procurement guidelines for energy-efficient motors (eff1) being observed

    - has energy efficiency-related training (for example ecodriving, environmental issues) been organised for the personnel
    - has the company participated in the national Energy Conservation Week
    - obligations to subcontractors to be included in the energy conservation agreement (e.g. transport)
- information on whether the energy conservation actions proposed in the energy audit have been carried out (implemented= T, decided = P, under consideration = H, abandoned = E)
    - the information on the implementation status is transferred to the monitoring database as feedback information.
- implemented energy conservation actions identified in other ways than during energy audits
    - estimated energy savings (electricity, heating energy, fuels)
    - investment required by the action, year of implementation and pay-back period
- environmental investments that have an impact on energy consumption ((+ or -) and the related information (investment, energy effect)

Of the sites in the agreement, 92–100% have submitted reports during the term of the agreement, representing 97–100% of the total energy usage.

The monitoring information is compiled in the energy conservation agreement scheme monitoring system at Motiva (Access database).

- the data is transferred electronically from the annual reporting forms of set format (Excel) filled in by the companies.
  - before transferring the data, it is checked for the correct order of magnitude and other details
- the accuracy of savings calculations corresponds to the accuracy achievable in normal field work
  - some initial information is design data or estimates because measurements are not always possible
- the savings achieved through the savings actions are, as a rule, not verified by measurements carried out afterwards
  - measurements are often difficult in practice and incur additional costs
- the reported estimates of energy savings are deemed to be realistic
  - the companies have no reason to report excessive savings

Updating the implementation status of actions:

- the implementation details (T, P, H, E) of each energy conservation action is updated in the site-specific annual report

<u>Assessment of effects</u>

The assessment concerns the non-ETS sites of companies that have joined the energy conservation agreement. The energy conservation actions reported as implemented (T) for each year (1996–2005) that were identified in other ways than as part of energy audits are also included in the assessment.

The current conservation agreement has not been assumed to produce new savings after 2007. The new energy efficiency agreements (2008–2016) start in 2008, and their effects are not assessed in this calculation. The savings effect for 2006 and 2007 has been estimated to be equal to the average for 2003–2005.

The energy savings (ES) produced each year is based on the reported energy conservation effects (electricity, heating energy + fuels) of the action reported by the companies as implemented (T) during that year. The actual savings effect (ES) is assumed to start during the year following the energy audit and to have a life-span of eight years which is in line with the conservative savings life-span suggested in CEN/CWA27 for the technical actions proposed in it for the industry. Nearly all of the actions taken by industry are technical in nature, and their life-span is, as a rule,

considerably longer (15–25 years) than the said eight years. In future effectiveness assessments, adjusting the life-span to better correspond to reality will be considered. The duration of savings effects of individual actions will not be estimated separately.

The energy savings are calculated using the formula
ES[GWh/a] = ES(heat + fuels) + ES(electricity)

Industrial sector (non-ETS) energy conservation agreement scheme — effectiveness estimate for 2007, 2010, 2013 and 2016

Industrial sector energy conservation agreement scheme, non-ETS		2007 GWh/a	2010 GWh/a	2013 GWh/a	2016 GWh/a
KTM-04	**ESS-TE ei päästök**	527	461	139	0

Duplication with energy audit effects have been eliminated (does not include actions identified in energy audits).

Energy labelling for windows
KTM-05 (Ikkunoiden energiamerkintä)

DESCRIPTION OF ACTION

A voluntary energy labelling scheme was introduced in Finland in October 2006 as a result of the development project funded by the Ministry of Trade and Industry, the Ministry of the Environment and private sector companies. The purpose of the scheme is to make comparisons between different window solutions easier for building and reconditioning contractors. In the labelling scheme, the windows are divided into different categories from A to G in the same manner as domestic appliances. A comparison index will also be calculated for the window; it indicates the amount of heating energy the window needs in one year.

The energy performance of windows is an important factor in the energy consumption of a building because the windows account for about 15–25% of the total heating requirement, irrespective of the season. Windows are the weakest link in the thermal insulation of buildings. Windows are also manufactured in large numbers because they are required both for new buildings and for buildings being reconditioned. Only 20–30% of the double-glazed windows in the existing building stock have been replaced which means that there are still a lot of windows with only two sheets of glass in use. (VTT/Hemmilä K. & Saarni R. Ikkunaremontti (Window reconditioning), 2001)

ASSESSMENT OF EFFECTS

Basis of calculations

The effectiveness is assessed on the basis of the following data and assumptions (the source used for other details except the heating requirement index is the publication VTT/Hemmilä K. & Saarni R. Ikkunaremontti (Window reconditioning), 2001):

Estimate of the manufacturing volume of windows (separately for new buildings and reconditioning purposes)

- Estimate of the U value of double- and triple-glazed windows used for reconditioning purposes
- Estimate of the average U value of windows on the market
- Estimate of the impact of energy labelling on the U value of windows on the market (separately for new buildings and reconditioning purposes)

- The average heating requirement index in Finland, weighted with the number of residents

Normally the energy efficiency of windows is described using its thermal transmittance coefficient, or the so-called U value. In addition to that, the relevant factors include the air-tightness of the window construction and the chosen materials and designs. The energy labelling scheme for windows takes into account all the above factors and gives an unambiguous and comparable overall indication of the properties of the window. However, in the absence of certain initial data, the following analysis only discusses the impact of the energy label on the U value.

Initial data

The window reconditioning publication (2001) contains an estimate that 1.2 million m² of windows are manufactured annually, corresponding to an average window size of 0.9 m² when the annual production is 1.35 million windows. According to an expert estimate submitted orally (Hemmilä K. /VTT, 2007), annual production has in 2007 increased to 1.5 million windows . Of these, half (750;000) will be used for new buildings and the other half (750;000) foe reconditioning.

The volume of new building construction is assumed to remain at the current level during the period under review. This means that 675,000 m^2 of new windows are required every year. According to the current Building Code Regulations, the maximum U value allowed for windows is 1.4 W/m^2K. However, the prevailing practice is that the average U value of windows sold is slightly better than that, which is why a U value of 1.2 W/m^2K is used in the estimate to describe the baseline for the entire period under review. The energy labelling of windows is expected to guide the consumers' choice so that the average U value related to the prevailing practice will steadily decrease from the current level to 1.0 W/m^2K by 2016. The achieved savings are accrued through the difference between the baseline and this implementation scenario. The heating requirement index was taken as the resident-weighted average in Finland for 1971–2000, 4,608 Kd (Source: Odyssee database). Therefore, the savings in 2016, for example, are obtained as follows: 675,000 m^2 • 0.2 W/m^2K • 24 h/d • 4,608 Kd = 14.9 GWh.

The total number of windows used for reconditioning is expected to increase to 1 million windows per year by 2016. Therefore, 675,000 m^2 of windows is required in 2007 and 900,000 m^2 in 2016. The assumption was made for the analysis that initially, 80% of the windows being replaced would have two panes of glass (U value 2.1 W/m^2K) and 20% would have three panes of glass (U value 1.8 W/m^2K). The situation is assumed to be the opposite at the end of the period under review, i.e. 80% of the windows being replaced are triple-glazed and 20% double-glazed. The U value is estimated to develop slightly slower for replacement windows than for new building windows. It has been assumed for replacement windows that the average U value will steadily decrease from the 2006 level of 1.4 W/m^2K to 1.2 W/m^2K by 2016 as a result of the energy labelling scheme. However, the energy savings will be greater because the comparison level is poorer than in new buildings. The savings are accrued through the difference in U values of the existing windows and their replacements. The heating requirement index was taken as the resident-weighted average in Finland for 1971-2000, 4,608 Kd (Source: Odyssee database).

Assessment of effects

An estimate of the energy savings brought about by the energy labelling scheme in reconditioned and new buildings is shown in the table below. Window replacements in reconditioned buildings make up more than 85% of the total savings.

Energy labelling for windows — effectiveness estimate for 2007, 2010, 2013 and 2016

Energy labelling for windows	2007 GWh/a	2010 GWh/a	2013 GWh/a	2016 GWh/a
KTM-05 Energy labelling for windows	51	222	421	650

Promotion of heat pumps in small residential buildings
KTM-06 (Pientalojen lämpöpumput)

DESCRIPTION OF THE ACTION

In Finland, the use of heat pumps as the principal or additional form of heating for small residential houses started becoming considerably more popular during the period 1999–2000 through heat pump promotion activities. Since then, heat pumps have been one focal point of Motiva Oy's programme of providing information for the purpose of promoting energy savings and the use of renewable energy sources. The Finnish Heat Pump Association (SULPU ry) and equipment manufacturers are very active in marketing heat pumps.

The range of heat pumps in use in Finland includes geothermal (ground) heat pumps, exhaust air heat pumps and outdoor air heat pumps. All heat pump types have been subsidised since 2000 through the household tax deduction available for the labour content of the investment. Heat pumps have also been subsidised since 2006 through an energy subsidy available for the equipment costs.

ASSESSMENT OF EFFECTS

Basis of calculations

A geothermal heat pump used as the principal heating system for the house can reduce the need for purchased energy to approximately one-third. Exhaust air pumps reduce the need for purchased energy by about half. The savings effect achieved with outdoor air pumps is about one quarter.

The following data are used for determining the annual savings:
- the numbers of heat pumps sold each year, itemised by type of heat pump
- the average savings effect (kWh/a), estimated for each heat pump type, regarding the amount of energy purchased for a small residential house
    - geothermal heat pump 18 MWh/house, life-span of savings 25 years
    - exhaust air heat pump 10 MWh/house, life-span of savings 15 years
    - outdoor air heat pump 6 MWh/house, life-span of savings 10 years

Every year, Statistics Finland publishes the numbers of heat pumps sold on the basis of information provided by the Finnish Heat Pump Association. These official data include both new buildings and changes of heating methods for existing small residential houses. New buildings account for 75–80% of the sales of heat pumps.

Assessment of effects

The total number of heat pumps used for the assessment of effects is in keeping with the official statistics published for 1995–2006 which means that the savings effect for 2007 is a final figure. In the estimates for 2010, 2013 and 2016, the assumption was made that the annual sales figures of heat pumps will be somewhat lower than the 2003–2006 average. The effectiveness estimate will be reviewed each year as official statistics become available.

Assumptions made for the calculations:

- The comparison service for heating systems of small residential buildings (Motiva Oy) was utilised for the savings effects of exhaust and outdoor air heat pumps. An approximately one-third higher savings effect was assumed for geothermal heat pumps because they are installed in larger-than-average houses, and because the 61% savings estimate quoted by the comparison service is very conservative.

- The savings effect is assumed to remain constant throughout the period under review. The small decline in the heat coefficient will be compensated by an equivalent improvement in the heat coefficients of new pumps.

Heat pumps for small residential buildings — effectiveness estimate for 2007, 2010, 2013 and 2016

Heat pumps in detached houses		2007 GWh/a	2010 GWh/a	2013 GWh/a	2016 GWh/a
KTM-06	**Pientalojen lämpöpumput**	934	1 529	2 111	2 531

The savings shown are in the energy used for heating the rooms and tap water, most of which is electrical energy.

Reconditioning of oil-heated small residential buildings
KTM-07 (Höylä I & II)

DESCRIPTION OF THE ACTION

In 2002, the Ministry of Trade and Industry, the Ministry of the Environment, the Finnish Oil and Gas Federation and the Oil and Gas Heating Association initiated the Höylä II programme as a continuation of the Höylä I programme that was started in 1997. These programmes are partnership programmes of the nature of voluntary energy conservation agreements, aimed at improving energy performance.

The goal of the Höylä II programme is to decrease the specific consumption of oil heating systems so that the average efficiency of the existing building stock improves by 10% per annum from 1997 to 2010 and that the oil-heated boilers installed from 2003 in reconditioned buildings have at least a three-star rating according to the EU Directive (92/42/EEC) concerning the efficiency of hot-water boilers. The programme is also aimed at improving the overall energy economy of oil-heated buildings and at developing methods and procedures for combining oil heating and the use of renewable energy sources in an economical manner that is beneficial from the point of environmental impacts.

The Höylä II programme has five key areas of activity: 1) reconditioning of ageing oil heating systems, 2) the integration of renewable energies with oil heating, 3) overall energy economy thinking, 4) informing consumers about energy conservation possibilities and 5) improving and maintaining the know-how of installation companies and educational institutes, as well as training.

The programme has the quantitative target of refurbishing 100,000 oil heating systems by 2010, the interim target being 57,000 boiler replacements by 2006. Energy savings of 10–30% can be achieved by reconditioning individual heating systems. The Höylä II programme ends at the end of 2007, but there are plans to continue it with the Höylä III programme for the period 2008–2016; the effects of that programme have been estimated on the basis of the current programme.

Household tax deductions are available for the labour content of refurbishing oil heating systems. The household deduction was available in certain regions of the country during 1997–2000, and the scheme was extended to cover the entire country in 2001. Energy subsidies have also been available for equipment purchases since 2006. The prerequisite for qualifying for an energy subsidy for oil heating is that the new system also utilises solar energy.

ASSESSMENT OF EFFECTS

Basis of calculations

The energy performance of oil-heated small residential buildings is improved by replacing the oil-heated boiler and the oil burner with its control equipment, by replacing the pumps and pipe fittings and by installing thermal insulation around the pipes, tanks and valves in the heat distribution room. At the same time, the heat distribution system is usually fitted with thermostatic radiator valves. In some small residential houses, the thermal insulation properties of the building are improved by replacing the windows and improving the standard of insulation in walls and the ceiling. The increasing use of solar energy is also reducing the amount of purchased energy. The basis for calculating the savings effects is the computational energy consumption determined on the basis of the year that the building was built (five categories). The savings effects are calculated separately for buildings in each of the five age categories on the basis of the numbers of measures implemented in them and the unit savings calculated for each type of measure.

Assessment of effects

The annual surveys carried out by Rakennustutkimus RTS Oy, with some 2,000 respondents involved in reconditioning small residential buildings, are used for assessing the effects. Oil-heated small residential buildings are treated as a separate category. The annual sales data for oil-heated boilers and oil burners is compared to the number of oil-heated boiler replacements. The energy savings for 1997–2005 are based on the data obtained through annual surveys. In the estimates for 2010, 2013 and 2016, the assumption was made that the annual new energy savings will be 10% lower than the 1997-2005 average. Since the effective life-span of all actions taken since 1997 extends to 2016, the total of savings shown for 2007 in the effectiveness estimate is in principle already achieved for 2016. The effectiveness estimate will be reviewed annually on the basis of results from the surveys carried out by Rakennustutkimus RTS Oy.

A study was carried out in 2006 in which the effects of replacing an oil-heated boiler were verified by field measurements. The study report for the "Tuula" project was published by Suomen Lämmitystieto Oy. In 2007, Senewa Oy used the results of this study to check the calculation basis of the savings effects for the Höylä II programme.

The following initial values and assumptions have been used when calculating the savings effects for the Höylä I and II programmes:

1. The age categories of buildings and the corresponding heating energy consumption figures:
the 1950s (45.1 MWh/a), 1960s (39.1 MWh/a), 1970s (37.6 MWh/a), 1980s (29.1 MWh/a) and the 1990s (26.0 MWh/a)

2. The total effect of repairing oil-heated boilers and burners and other parts of the heating system on the consumption of heating energy: the 50s (28.0%), 60s (29.4%), 70s (29.7%), 80s (29.9%) and the 90s (19.3%)

3. The effect of improving the thermal insulation in the ceiling; the change in the U value roughly corresponds to an additional insulation layer of 200 mm: the 50s (8.5%), 60s (5.3%), 70s (4.4%), 80s (4.7%) and the 90s (3.5 %)

4. The effect of improving the thermal insulation in the walls; the change in the U value roughly corresponds to an additional insulation layer of 100 mm: the 50s (8.5%), 60s (5.8 %), 70s (4.4%), 80s (3.1 %) and the 90s (3.5 %)

5. The effect of replacing windows: For buildings built in the 50s, 60s and 70s, the U value of new windows is taken as 1.4 in line with the 2003 Building Code Regulations, while the value 1.1 was used for buildings built in the 80s or 90s. The 50s (9.0%), 60s (12.8%), 70s (9.5%), 80s (11.7%) and the 90s (11.2%)

6. The addition of a solar heating system (utilised for heating tap water): the 50s (6.7%), 60s (7.7%), 70s (8.0%), 80s (10.0%) and the 90s (12%)

The annual savings effects were estimated by Risto Pääjärvi/Senewa Oy. The figures shown in this action description for 1997–2010 were taken directly from the reports submitted by Senewa Oy. A very conservative estimate of new annual savings was used for the period 2011–2016. The effectiveness assessment does not take into account any decline in the savings effect or any other factors possibly affecting the amount of savings.

Oil-fired heating systems refurbishment in small residential buildings — effectiveness estimate for 2007, 2010, 2013 and 2016

Measure		2007	2010	2013	2016
KTM-07	**Höylä I and II programmes**	1 766	2 232	2 639	2 959

Ecodriving training for car drivers
LVM-01 (HA, tal. ajotapa)

DESCRIPTION OF THE ACTION

Economical driving and foresight can reduce the fuel consumption of vehicles. The basics of economical driving are included in the basic driving school instruction consisting of two stages, but more comprehensive ecodriving training usually requires taking a separate course (hereinafter referred to as "further training").

Basic ecodriving training has been included in basic driving school training as a compulsory element since 1994. So-called second-stage ecodriving training has been organised as part of basic driving school training since 1997. The collection of statistical information on further ecodriving training started at the same time.

ASSESSMENT OF EFFECTS

Basis of calculations

The assessment of effects takes those who have completed basic driving training and those who have completed further training separately into account. The assessment is based on the following data:
the number of trainees (statistics of past numbers and an estimate of future numbers, divided between drivers of petrol-powered and diesel-powered cars)

- the annual fuel consumption without training (division petrol/diesel, taking into account the effect of future emission restrictions)
- an estimate of the savings (as a percentage) achieved through the training and its decrease over time
- an attempt was made to estimate how many of the drivers who have completed basic training actually observe ecodriving principles.
- duplication between basic training and further training has been eliminated for the analysis.

Initial data

The number of persons completing the training and tests for class B (car driving license) or higher for each year is used as the number of persons with basic ecodriving training. The data were obtained by a separate query from the Vehicle Administration. During the period 2000–2006, the number of persons obtaining a driving license has been 61,000–63,600 per annum. From 2007 onwards, the average for the period 2000-2006, 62,700, was used.

The table below shows the number of drivers receiving further ecodriving training during the period 1997–2006 (source: Motiva Oy):

1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
202	**646**	**314**	**2,203**	**1,333**	**1,338**	**3,300**	**3,171**	**2,932**	**2,932**

From 2007 on, the number of drivers receiving further training has been taken as 3,000, making the assumption that the number of trainees per year would remain at the same level as in the last few years.

It should be noted that the number of drivers receiving further training includes, besides actual further training, also more intense training during the basic training. This is because eight driving schools have provided more intense ecodriving training, comparable to further training, during the second stage of basic training. These drivers account for approximately half of those shown above as receiving further training. In order to eliminate duplication, only half of the energy savings achieved by those with further training is taken into account when estimating the total effect of ecodriving.

The calculations are carried out separately for petrol and diesel car drivers. The share of diesel car drivers was taken to be the same as the share of diesel-powered cars of the entire passenger car stock as shown in the Motor Vehicle statistics of Statistics Finland. For example, in 2006 the share of diesel-powered cars was 13.3%. It was estimated that the share would increase by 0.5 percentage points per year during the period 2007–2016 (estimate by Mikael Rehula/Autotuojat, 2007) which would mean that their relative share would be 18.3% in 2016.

The average annual mileage of petrol-powered cars was taken as 17,423 km and that of diesel-powered cars as 27,746 km for all the periods under review. These are the average figures for 1998–2003 used in the LIISA vehicle exhaust gas emission calculation system developed by VTT. The analysis does not take into account the fact that the average mileage of diesel cars may decrease if they are purchased as replacements for petrol cars that cover a smaller average mileage. There is no survey-based information on the average consumption of petrol and diesel (litres/100 km) in the entire vehicle stock. The average consumption used in this effectiveness assessment is based on an expert estimate by Motiva where the indicative starting points were the average consumption figures calculated using the LIISA calculation system by VTT and the data obtained from the Vehicle Administration on the average consumption figures of new cars entered into the vehicle register. The average consumption for the period 1995–2007 was taken as 7.5 l/100 for petrol and 7.7 l/100 km for diesel. The EU strategy for reducing CO_2 emissions of cars has the goal of achieving a significant reduction in the fuel consumption of vehicles by 2012 (a reduction of up to 25–30% from the current average consumption of cars; the goal equals average CO_2 emissions of 120g/km). The goal only applies to the average emissions of new cars. The improving energy efficiency of vehicles is likely to result in the average consumption of new cars decreasing in Finland also. The magnitude and timing of this effect will largely depend on how vehicle taxation and possibly other financial control of transportation is developed at the national level (i.e., new actions). The analysis assumes that the average petrol consumption of new cars will reduce to 6.5 l/100 km in 2010 and to 6 l/100 km in 2015. Similarly, the average future consumption figures for diesel are estimated at 6.4 l/100 km and 6 l/100 km, respectively. This means that the average consumption will start decreasing from 2010 through the process of old cars being replaced by new. According to the Autoalan Faktat 2007 (Car Industry Facts 2007) publication of the Finnish Information Centre

of the Automobile Sector (AuT), the average age of cars sent for scrapping is 18.4 years. The average scrapping age is somewhat increased by vehicles that have not been scrapped yet but are used very little or not at all. Therefore, the average scrapping age is taken as 16 years which means that 6.3% of the vehicle stock is replaced every year.

The mileage and average consumption figures have been used to calculate the average annual energy consumption per driver (litres/year and MWh/year) without ecodriving training, i.e., the so-called baseline. This approach is associated with the uncertainty factor that the effect of drivers already trained reduces the average energy consumption. This uncertainty factor results in a slight underestimate of the achieved savings.

According to the observations of ecodriving instructors, economical driving and foresight can reduce fuel consumption by 8–12% on average, and by up to 20% immediately after the training. There are no exact data available on the permanent effects of ecodriving training, but the effect is estimated to fall by 50% over time. In the effectiveness assessment, the energy-saving effect of further training was estimated at 10% for the first year, 8% for the second, 6% for the third and 4% for the fourth year and onwards, calculated from the average annual consumption per driver.

When estimating the savings effect of the so-called second stage of basic training, the initial assumption is that the average savings effect of basic ecodriving training is less than half of the savings effect of the more comprehensive further ecodriving training, i.e., 4% for the first year, 3% for the second, 2% from then on. The savings effect of the one-stage basic training during the period 1994–1996 has not been estimated because it is probably rather small. The assumption was made for the calculations that not all new drivers who have received ecodriving training will observe ecodriving principles. Motiva has estimated that at most 40% of drivers with ecodriving training will observe the principles until 2006, 45% during 2007–2008, 50% during 2009–2010 and 55% from 2011 on. The relative share of those observing ecodriving principles is estimated to increase over time, among others as a result of the citizens' increasing willingness to participate in fighting climate change.

Assessment of effects

For basic ecodriving training, the savings are estimated at 77 GWh in 2007 and 174 GWh in 2016. For further training, the savings are estimated at 16 GWh in 2007 and 29 GWh in 2016. For the purpose of estimating the total effect, duplication was eliminated by deducting half of the effects of further training. An estimate of the energy savings achieved by ecodriving is shown in the following table:

Ecodriving training for car drivers — effectiveness estimate for 2007, 2010, 2013 and 2016

Ecodriving training for passenger car drivers		2007 GWh/a	2010 GWh/a	2013 GWh/a	2016 GWh/a
LVM-01	**HA, tal. ajotapa**	100	130	161	189

Ecodriving training for bus drivers
LVM-02 (LA, tal. ajotapa)

DESCRIPTION OF THE ACTION

Economical driving and foresight can reduce the fuel consumption of vehicles. Bus drivers have been provided with ecodriving training since 1997.

EU legislation requires that all drivers of heavy vehicles are trained in a session of at least 7 hours' duration every five years. The training starts in 2007 and covers both ecodriving and safety training.

ASSESSMENT OF EFFECTS

Basis of calculations

The assessment of effects takes drivers usually driving in urban traffic and those driving in non-urban traffic separately into account. The assessment is based on the following data:

- the number of trainees (statistics of past numbers and an estimate of future numbers, divided between drivers in urban traffic and non-urban traffic)
- the annual fuel consumption without training (division urban/non-urban traffic, taking into account the effect of future emissions restrictions)
- an estimate of the savings (as a percentage) achieved through the training and its decrease over time.

Initial data

The table below shows the number of drivers receiving ecodriving training during the period 1997–2006 (source: Motiva Oy): Ecodriving instructors have estimated that about 30% of the trained drivers drive in urban traffic.

1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
417	**1,870**	**688**	**760**	**1,160**	**539**	**407**	**131**	**281**	**443**

The compulsory training programmes for heavy vehicle drivers will be approved in Finland in August 2007, and the training commences in September 2007. Since the training only starts late in 2007, the number of trainees in 2006 (443) was also used for 2007. With respect to the years 2008–2016, the estimate is that the number of trainees will be 2,200 per annum, i.e., one-fifth of all drivers. There are about 11,000 bus drivers in Finland (Mikko Saavola/the Finnish Bus and Coach Association); the figure includes the drivers of member companies of both the Finnish Bus and Coach Association and the Finnish Public Transport Association. The number has remained roughly constant during the whole period under review, and it is not expected to change in the future.

The average mileage covered by bus drivers was taken as approximately 41,000 km per annum both for urban and non-urban traffic. Since the annual mileage of one bus is on average made up of the total mileages of 1.4 drivers (Mikko Saavola/the Finnish Bus and Coach Association), the annual mileage covered by one bus is therefore about 57,400 km. This vehicle-specific mileage was not used in the assessment of effects, but it was estimated for the purpose of assessing whether the estimate of average mileage is realistic with a view of the actual vehicle-specific mileage figures. The mileage figures used in the assessment were taken from the Public transport mileage statistics 1997–2005 published by Statistics Finland, and the mileage figure for 2005 was also used for the following years from 2006 onwards. The estimated figure of 11,000 was used as the number of drivers for the entire period under review. Since there are no statistical data available regarding the division of mileage between urban and non-urban traffic but it is generally estimated that the majority of mileage is driven in non-urban traffic, a 60–40 split was made. According to a rough estimate by the YTV (Helsinki Metropolitan Area Council), the mileage of urban traffic buses is split fifty-fifty between urban streets and non-urban roads.

There is no survey-based information on the average consumption of diesel (litres/100 km) by the entire bus stock. The average consumption used in the assessment was 39.9 l/100 km for urban street traffic and 28.9 l/100 km for non-urban road traffic during the period 1997–2008. These are averages of average consumption figures estimated for 1997–2005 using the LIISA calculation system developed by VTT for estimating the exhaust gas emissions of vehicles. For the sake of comparison, the average consumption of buses reported by the companies joining the energy conservation agreement for the public transport sector was 45.6 l/100 km for urban street traffic and 28.9 l/100 for express bus traffic (primarily non-urban road traffic) (Annual report of the energy conservation agreement scheme for the public transport sector 2005).

VTT has estimated that the average consumption of new buses will decrease by 0.5-1% when the new exhaust gas emission norms become effective (VTT, report published in 2005 regarding measures to improve the energy performance of heavy vehicles). For the assessment, the average consumption of new buses was assumed to be 0.5% lower than the 2008 level during 2009–2012 and 1% lower than the 2008 level during 2013–2016. The service life of vehicles was taken as 9 years for non-urban road traffic and 6 years for urban street traffic (Motiva's expert estimate based on the established practices of operators in the business).

The mileage and average consumption figures have been used to calculate the average annual energy consumption per driver (litres/year and MWh/year) without ecodriving training, i.e., the so-called baseline. This approach is associated with the uncertainty factor that the effect of drivers already trained reduces the average energy consumption. This uncertainty factor results in a slight underestimate of the achieved savings.

According to the observations of ecodriving instructors, economical driving and foresight can reduce the fuel consumption of buses by 4% on average. There are no exact data available on the permanent effects of ecodriving training, but the effect is estimated to fall by 50% over time. In the effectiveness assessment, the energy-saving effect was estimated at 4% for the first year, 3% for the second, 2% for the third and 1.5% for the fourth year and onwards, calculated from the average annual consumption per driver. This approach was used for calculating the savings effects of training provided during the period 1997–2007 during that same period.

The energy-saving effect of compulsory further training commencing in 2008 was estimated at 4% for the first year, 3.5% for the second, 3% for the third and 2.5 % for the fourth and fifth years, calculated from the average annual consumption per driver. The effect of training is expected to decrease somewhat slower than before 2008 because ecodriving is expected to more easily become part of the corporate culture when more drivers are trained. Duplication was eliminated for the analysis, i.e., it was estimated that the savings effects of training provided in 1997–2007 will gradually vanish as the drivers participate in compulsory further training. However, there is no duplication to be eliminated during 2008–2009 because it has been assumed that the compulsory further training begins with drivers who have not previously received ecodriving training (some 4,300 drivers).

Assessment of effects

An estimate of the energy savings achieved by ecodriving in bus traffic is shown in the following table. Since it is assumed that the number of drivers will not change after 2006, the number of drivers trained annually will remain constant after 2008 and the savings effects will also be constant from 2012 onwards when all drivers will regularly participate in the obligatory training.

Ecodriving training for bus drivers — effectiveness estimate for 2007, 2010, 2013 and 2016

Ecodriving training for bus drivers		2007 GWh/a	2010 GWh/a	2013 GWh/a	2016 GWh/a
LVM-02	**LA, tal. ajotapa**	16	31	42	42

Ecodriving training for goods vehicle drivers
LVM-03 (KA, tal. ajotapa)

DESCRIPTION OF THE ACTION
Economical driving and foresight can reduce the fuel consumption of vehicles. Lorry drivers have been provided with ecodriving training since 1996.

EU legislation requires that all drivers of heavy vehicles are trained in a session of at least 7 hours' duration every five years. The training starts in 2007 and covers both ecodriving and safety training.

ASSESSMENT OF EFFECTS

Basis of calculations
The effectiveness assessment takes separately into account lorries, articulated lorries and trailer combinations. The assessment is based on the following data:

- the number of trainees (statistics of past numbers and an estimate of future numbers, divided between drivers of different vehicle types)
- the annual fuel consumption without training (taking into account the effect of future emissions restrictions)
- an estimate of the savings (as a percentage) in fuel consumption achieved through the training and its decrease over time.

Initial data
The table below shows the number of drivers receiving ecodriving training during the period 1996–2006 (source: Motiva Oy):

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
120	**222**	**381**	**1,514**	**1,091**	**1,112**	**945**	**1,013**	**1,025**	**666**	**649**

The distribution of trained drivers between lorries without trailers, articulated lorries and lorry-trailer combinations was estimated to be the same as that for the vehicles themselves (Statistics Finland/Statistics of goods transport on roads). Of the drivers trained in Finland in 2006, for example, 76% would therefore be drivers of lorries without trailers, 7% drivers of articulated lorries and 17% drivers of lorry-trailer combinations.

The compulsory training programmes for heavy vehicle drivers will be approved in Finland in August 2007, and the training commences in September 2007. Since the training only starts late in 2007, the number of trainees in 2006 (649) was also used for 2007. With respect to the years 2008–2016, the estimate is that the number of trainees will be 14,000 per annum, i.e., one-fifth of all drivers whose total number was about 70,000 (estimate by SKAL, the Finnish Transport and Logistics Association/Timo Airila). The number of drivers and trainees is expected to increase in the future at the same pace as the total mileage, i.e., by 1.5% per annum (estimate of 1–2% per annum by SKAL/Timo Airila, 2007).

The annual total mileages of different vehicle types were taken from the Statistics of goods transport on roads compiled by Statistics Finland. The mileage is estimated to increase by 1.5% per annum starting from 2006. The driver-specific mileage figures were estimated by dividing the total mileage for each year by the estimated number of drivers. The assumption is that the number of drivers (70,000) will change from 2005

onwards at the same pace as the total mileage. The historical trend was calculated on the basis that there were 10,000–20,000 drivers fewer in 1996 (rough estimate by SKAL/Timo Airila, 2007); the number used for the assessment is 15,000. The average annual total mileage of lorry drivers in 2005 was taken as 20,300 km, that of articulated lorry drivers as 49,000 km and that of drivers of lorry- trailer combinations as 82,200 km.

There is no survey-based information on the average consumption of diesel (litres/100 km) by the entire lorry stock. The average fuel consumption during the period 1996–2008 used in the assessment was 26.5 l/100 km for lorries, 36.1 l/100 km for articulated lorries and 43.2 l/100 km for lorry- trailer combinations. These consumption figures were estimated using the VEMOSIN simulation software (Olavi H. Koskinen/Finnish Road Administration, 2007). The simulation was carried out for a 170 km distance on a section of road (No. 7) between Helsinki and Vaalimaa which corresponds to an average road in Finland; a small addition for idling was included in the total consumption. The lorry was assumed to have the following characteristics: engine displacement 11 litres, power 250 kW, total weight 20 tons, 3-axle construction. The articulated lorry was assumed to have the following characteristics: Scania DT1203, engine displacement 12 litres, power 309 kW, total weight 35 tons, 5-axle construction. The lorry-trailer combination was assumed to have the following characteristics: Scania DT1203, engine displacement 12 litres, power 345 kW, total weight 50 tons, 7-axle construction. For the sake of comparison, the average consumption of lorries reported by the companies joining the energy conservation agreement for lorries and vans was 27.2 l/100 km for lorries, 35.5 l/100 for articulated lorries and 44.6 l/100 km for lorry-trailer combinations (Annual report of the energy conservation agreement scheme for lorry and van transport sector 2002)..

VTT has estimated that the average consumption of new lorries will decrease by approximately 0.5–1% when the new exhaust gas emission norms become effective (VTT, report published in 2005 regarding measures to improve the energy performance of heavy vehicles). For the assessment, the average consumption of all new lorries was assumed to be 0.5% lower than the 2008 level during 2009–2012 and 1% lower than the 2008 level during 2013–2016. According to the Autoalan Faktat 2007 (Car Industry Facts 2007) publication of the Finnish Information Centre of the Automobile Sector, the average age of lorries sent for scrapping is about 15 years.

The annual mileages and average consumption figures were used to calculate the average annual energy consumption per driver for each vehicle type (litres/year and MWh/year) without ecodriving training. This approach is associated with the uncertainty factor that the effect of drivers already trained reduces the average energy consumption. This uncertainty factor results in a slight underestimate of the savings.

According to the observations of ecodriving instructors, economical driving and foresight can reduce the fuel consumption of lorries by 4% on average. There are no exact data available on the permanent effects of ecodriving training, but the effect is estimated to fall by 50% over time. In the effectiveness assessment, the energy-saving effect was estimated at 4% for the first year, 3% for the second, 2% for the third and 1.5% for the fourth year and onwards, calculated from the average annual consumption per driver. This approach was used for calculating the savings effects of training provided during the period 1996–2007 during that same period.

The energy-saving effect of compulsory further training commencing in 2008 was estimated at 4% for the first year, 3.5% for the second, 3% for the third and 2.5 % for the fourth and fifth years, calculated from the average annual consumption per driver. The effect of training is expected to decrease somewhat slower than before 2008 because ecodriving is expected to more easily become part of the corporate culture as more drivers are trained. Duplication was eliminated for the analysis, i.e., it was estimated that the savings effects of training provided in 1996–2007 will gradually vanish as the drivers participate in compulsory further training. However, there is no duplication to be eliminated during 2008–2009 because it has been assumed that the compulsory further training begins with drivers who have not previously received

ecodriving training (some 60,000 drivers).

Assessment of effects
An estimate of the energy savings achieved by ecodriving in lorry traffic is shown in the following table. The effect increases rapidly after the start of the obligatory further training but the change slows down when all drivers have been trained. Towards the end of the period under review, savings are primarily achieved through the increasing number of drivers.

Ecodriving training for goods vehicle drivers — effectiveness estimate for 2007, 2010, 2013 and 2016

Ecodriving training for goods vehicle drivers		2007 GWh/a	2010 GWh/a	2013 GWh/a	2016 GWh/a
LVM-03	**KA, tal. ajotapa**	21	188	251	262

The effect of tyre pressure on the energy consumption of cars and vans
LVM-04 (Rengaspaineet)

DESCRIPTION OF THE ACTION

Most of the vehicles registered in Finland are used throughout the year. Therefore, they have to be fitted with tyres with a winter tread/spikes by December, which have to be changed back to summer tyres no later than a week from Easter, weather permitting (in any case by the end of April). This means that the tyres of nearly all cars and vans are changed twice every calendar year. Normally, tyre pressure is checked at that time, either by the owner of the vehicle or the service station changing the tyres. In addition, matters related to vehicle safety (tyre tread grooves and roadholding in sudden curves) are checked in statutory annual inspections, and the tyre pressure is one of the points checked at that time.

In its Green Paper on Energy Efficiency, the European Commission (European Commission 2005, Doing More with Less) has stated that friction between tyres and the road accounts for up to 20% of a vehicle's consumption. The Commission estimates that 45–70% of vehicles are driven with at least one tyre below the prescribed pressure, which causes 4% over-consumption. As tyre pressure is checked in Finland, as a rule, at least twice a year, only a small number of the vehicles in traffic have tyre pressure below the prescribed values.

ASSESSMENT OF EFFECTS

Basis of calculations

The effectiveness is assessed on the basis of the following data and assumptions:

- Details of registered vehicles (petrol and diesel cars and vans).
- Fuel consumption of vehicles (petrol and diesel cars and vans).
- Estimates of the European Commission regarding the excess consumption of fuel caused by too low tyre pressure and the relative share of vehicles with at least one tyre with its pressure below the prescribed value.
- An estimate of the number of vehicles in Finland that have their tyre pressure below the prescribed value.

Initial data

The calculations are carried out separately for petrol and diesel cars and diesel vans.

The number of petrol-powered vans is very small, so they have been omitted from the analysis. The numbers of vehicles in 1991–2006 were obtained from Statistics Finland (StatFin Information Service). In 2006 for example, there were 2.5 million cars and some 280,000 vans registered in Finland. The share of diesel car drivers was taken to be the same as the share of diesel-powered cars of the entire passenger car stock as shown in the Motor Vehicle statistics of Statistics Finland. For example, in 2006 the share of diesel-powered cars was 13.3%. It was estimated that the share of diesel-powered cars would increase by 0.5 percentage points per year during the period 2007–2016 (estimate by Mikael Rehula/Autotuojat, 2007) which would mean that their relative share would be 18.3% in 2016.

The average annual mileage of petrol-powered cars was taken as 17,423 km and that of diesel-powered cars as 27,746 km for all periods under review. These are the average figures for 1998–2003 used in the LIISA vehicle exhaust gas emission calculation system developed by VTT. The average annual mileage of vans was taken as 14,641 km; the figure was calculated as an average of the data obtained from Statistics Finland regarding the numbers and mileage figures of cars during 1990–2005 (Statistics Finland, Statistical Year Book of Finland 2006).
The average consumption of passenger cars for the period 1995–2007 was taken as 7.5 l/100 for petrol and 7.7 l/100 km for diesel.
These average consumption figures used in this effectiveness assessment are based on an expert estimate by Motiva where the indicative starting points were the average consumption figures calculated using the LIISA calculation system of VTT and the data obtained from the Vehicle Administration on the average consumption figures of new cars entered in the vehicle register. This is because there is no survey-based information on the average consumption of petrol and diesel (litres/100 km) by the entire vehicle stock in Finland. The EU strategy for reducing CO_2 emissions of cars has the goal of achieving a significant reduction in the fuel consumption of vehicles by 2012 (a reduction of up to 25–30% from the current average consumption of cars; the goal equals average CO_2 emissions of 120g/km). The goal only applies to the average emissions of new cars. The improving energy efficiency of vehicles is likely to result in the average consumption of new cars decreasing in Finland as well. The analysis assumes that the average petrol consumption of new cars will reduce to 6.5 l/100 km in 2010 and to 6 l/100 km in 2015. Similarly, the average future consumption figures for diesel are estimated at 6.4 l/100 km and 6 l/100 km, respectively. This means that the average consumption will start decreasing from 2010 through the process of old cars being replaced by new. According to the Autoalan Faktat 2007 (Car Industry Facts 2007) publication of the Finnish Information Centre of the Automobile Sector (AuT), the average age of cars sent for scrapping is 18.4 years in Finland. The average scrapping age is somewhat increased by vehicles that have not been scrapped yet but are used very little or not at all. Therefore, the average scrapping age is taken as 16 years which means that 6.3% of the vehicle stock is replaced every year. A rough estimate of the average diesel consumption of vans was obtained from the LIISA system; the figure used for the entire period of this assessment is the average of urban and non-urban traffic for 2005, 10 l/100 km.

The effect of low pressure on average consumption was estimated using the above average consumption figures and the estimate by the European Commission according to which low pressure in one tyre alone is sufficient to cause excess consumption of four per cent. The excess consumption would then be 0.3 l/100 km for petrol-powered cars, 0.3 l/100 km for diesel-powered cars and 0.4 l/100 for vans in 2007. The mileage figures and these excess consumption figures were used to calculate the annual effect for each vehicle with tyres that have low pressure (litres/year and MWh/year).

The effect for the entire vehicle stock was estimated by utilising the estimate by the European commission according to which 45–70% of vehicles are driven with at least one tyre below the prescribed pressure. The assumption was made that in spite of the

compulsory tyre changing operation that takes place twice a year, 10 per cent of vehicles in Finland have tyres below the prescribed pressure. This means that the pressure checks made at the time of changing tyres reduce the number of vehicles driven with low pressure tyres by 35–60 percentage points compared with the EU average. A reduction of 50% is used for the assessment. In other words, the assumption is made that if these regular pressure checks in conjunction with tyre changes did not take place, 60% of vehicles in Finland would have tyres with low pressure compared with the actual 10% thanks to the checks. The savings effect was calculated using these estimates, the number of vehicles and the above described effect of low-pressure tyres on the annual energy consumption of individual vehicles.

Assessment of effects

An estimate of the energy savings brought about by the regular checks of tyre pressure in cars and vans is shown in the table below. For example in 2007, savings of approximately 732 GWh were achieved in the entire vehicle stock of Finland because the car and van tyres are changed and their pressure checked twice a year.

Tyre pressure — effectiveness estimate for 2007, 2010, 2013 and 2016

The effect of tyre pressure on the energy consumption of passenger cars and vans		2007 GWh/a	2010 GWh/a	2013 GWh/a	2016 GWh/a
LVM-04	**Rengaspaineet**	732	793	845	894

Thermal insulation regulations 2003
YM-01 (Lämermäär)

DESCRIPTION OF THE ACTION

The energy efficiency implications of building construction work are regulated in Finland by regulations and guidelines issued by the Ministry of the Environment. The regulations define, among other things, the minimum level of thermal insulation in new buildings.

In order to improve the energy efficiency, the Ministry of the Environment has issued new Building Code Regulations in Finland governing the thermal insulation of buildings (C3), guidelines on thermal insulation (c4) as well as regulations and guidelines regarding the indoor climate and ventilation of buildings (D2). The regulations and guidelines became effective on 1 July 2003, and they apply to all new buildings for which the planning permit application was filed after that date.

The goal was that the buildings complying with the new regulations would consume about 25–30% less energy than the buildings built in compliance with the previous regulations (C3 issued in 1985 and D2 in 1987).

The most significant differences in the new 2003 regulations when compared with the regulations that became effective in 1985 are the improvement of the U values of structures (external walls, ceilings, floors and windows) and the requirement of having a heat recovery system in all ventilation systems irrespective of their size (earlier only compulsory for systems with an air flow exceeding 1 m^3/s).

ASSESSMENT OF EFFECTS

Basis of calculations

The following data are used for determining the annual savings:
- the annual total volumes of new buildings by building type (building m^3)
- the energy-saving effects, shown as a change in the specific consumption of heating energy (kWh/rm^3/a) achieved by the 2003 regulations when compared with earlier regulations.

Statistics Finland publishes quarterly the building volume data (building m^3) of completed buildings that require a planning permit. In addition to new buildings, these official statistics include the extensions of existing buildings but not building refurbishment works.

VTT Technical Research Centre of Finland has calculated the specific heating energy consumption figures for different types of buildings built either in compliance with earlier Building Code Regulations or the 2003 Regulations. The building types chosen for the analysis are:
a small one-storey residential building, small two-storey residential building, a terraced house, a multi-storey residential building and an office building. The energy savings effect was determined on the basis of the calculations and expressed as the change in specific heating energy consumption (kWh/rm^3/a) for each type of building.

The total effect of the thermal insulation regulations of 2003 was calculated by multiplying the total volume of buildings completed each year by the change in the specific heating energy consumption for the respective building type. For the year of completion, 50% of the savings effect calculated for the total volume completed that year is taken into account, whereas the full savings effect is taken into account for all subsequent years.

Assessment of effects

The total volume of buildings constructed was taken for the assessment from the official statistics published for 2004–2006.

In the estimates for 2010, 2013 and 2016, the assumption was made that the annual volume of building construction will remain at the 2006 level and that no new regulations governing thermal insulation will be issued. The effectiveness estimate will be reviewed each year as official statistics regarding the actual building volumes become available. If new regulations governing thermal insulation are issued during the period 2008–2016, their effect will be assessed separately.

Assumptions made for the calculations:

- The assumption is made that all buildings are built to precisely comply with the prevailing regulations, both old and new. The effects of construction methods that exceed the Building Code standard cannot be included in the effects of building regulations; instead, these effects must be accounted for in conjunction with the effects of other actions. Due to the good standard of official supervision of building works in Finland, there is no need to take into account any sub-standard building work.

- The savings effect achieved in the heating energy consumption of the type buildings has been calculated for the climatic zone of Southern Finland. Most of the new buildings are built in the southern or central parts of the country. For buildings built in

colder regions, the actual savings effect will be greater than the calculated effect which creates further confidence in the overall results of the calculations.

- The change in specific consumption calculated for office building has been deemed accurate enough to be used as the default value for other service buildings (educational buildings, transportation sector buildings, care sector buildings etc. as well as the building sites entered in the statistics under "other buildings"). This results in a minor inaccuracy in the savings estimate.

- Agricultural buildings have been omitted from the analysis because the assumption is made that most of them do not have any heating. The total volume of those new buildings completed each year has not been included in the savings effect calculations. Of the annually completed new industrial buildings, 50% have been taken into account in the savings effect calculations because some buildings have no heating at all and some industrial buildings are included in the Emission Trading Scheme (i.e., not within the scope of the ESD). The savings shown for this part is probably slightly underestimated. When more accurate annual data regarding new building volumes becomes available, this assumption will also be reviewed.

- The savings effects achieved through more stringent Building Code Regulations lasts throughout the service life of the building. The service life of the building stock built after 2003 is assumed to be at least 50 years, and that of ventilation equipment equipped with heat recovery systems to be 20–25 years, a typical technical service life of equipment in Finland.

- The annual savings effect is assumed to remain constant. A slight deterioration in the energy efficiency of windows may take place as the seals get older. The assumption was made for the calculations that service and maintenance of the windows and heat recovery equipment will prevent any deterioration in energy effeiciency to a degree that would have to be taken into account in an analysis spanning to 2016.

Thermal insulation regulations 2003 — effectiveness estimate for 2007, 2010, 2013 and 2016

Thermal insulation regulations 2003		2007 GWh/a	2010 GWh/a	2013 GWh/a	2016 GWh/a
YM-0l	Lämermäär	1,029	1,771	2,512	3,253

The savings shown are in the energy used for heating, much of which is electrical energy, particularly in small residential buildings. The share of electricity of the savings is assumed to be 36% in 2004, 38% in 2005 and 39% from 2006 onwards. Most of the new buildings completed every year are connected to district heating.

Energy subsidies for residential buildings
YM-02 (Eneavust)

DESCRIPTION OF THE ACTION

In line with the Energy Conservation Programme of 2003–2006, the granting of energy subsidies started at the beginning of 2003 for improving the energy performance of residential buildings. Initially, the subsidies were restricted to residential building consisting of a minimum of three residences. The report submitted by the Government to Parliament in 2005 regarding the implementation of the Kyoto Protocol stated that the Government considers it important to expedite the introduction of emission-free and low-emission heating methods to small residential buildings. At the beginning of 2006, small residential buildings were also included in the scope of

energy subsides.

Energy subsidies are granted within the constraints of the appropriation decided in connection with the State Budget. The responsibility for legislation governing energy subsidies rests with the Ministry of the Environment. The Housing Fund of Finland (a government agency) provides municipalities with instructions on how to apply for subsidies as well as on how they are granted and paid, and supervises the application of the system in municipalities. The applications for energy subsidies are submitted to the municipality that makes the subsidy decisions within the constraints of the appropriation allocated by the Housing Fund.

Subsidies have been granted since 2003 for carrying out energy audits, for improving the thermal insulation of residential buildings, for upgrading and energy efficiency-related repairs and adjustments of ventilation and heating systems, as well as for introducing renewable sources of energy. The energy conservation actions qualifying for subsidies are set out in a decree issued by the Ministry of the Environment. There are in all 18 subsidised energy conservation actions including energy audits. The maximum subsidy can be 10–15% of the qualifying total cost. An exception to this are energy audits where the subsidy may be up to 40%.

Energy subsidies are granted to small residential buildings for equipment investments and district heating connection charges when the heating system is upgraded to an emission-free or low-emission system. The subsidy is 10–15% of the equipment investment costs, depending on the action taken.

ASSESSMENT OF EFFECTS

Basis of calculations

The duties of the Housing Fund of Finland include that of maintaining follow-up statistics on subsidy funding and subsidy decisions. The data in the statistics are based on the information submitted by municipalities regarding the subsidy decisions taken.

The Housing Fund of Finland collects the following data each year:
- the number of sites receiving energy subsidies, itemised by type of energy conservation action (18 listed actions, of which the additional insulation of external walls is divided in two groups depending on the thickness of the insulation layer. For the basic adjustment of heating networks inside buildings, the buildings in which radiators and adjustment valves were also replaced are listed separately.) In addition, energy audit sites are shown divided into three categories depending on the floorspace area of the building.
- the number of residences receiving energy subsidies, itemised by type of energy conservation action (18 listed actions, itemised as above)
- the total amount of subsidies granted, itemised by type of energy conservation action (18 listed actions, itemised as above)

The buildings receiving subsidies fill in a follow-up form containing details of energy consumption for the purpose of allowing the energy-saving effects to be assessed. The follow-up form is returned to the municipal subsidy authorities one year after the energy conservation action was implemented.

The information submitted by the recipient of the subsidy or the expert deployed in the process will be used for monitoring and follow-up of the implementation of actions. The following information, among other things, is compiled for the subsidised buildings using the follow-up forms:
- building type
- year of completion
- actions carried out using the energy subsidy and their timing

- the annual consumption data on heating energy, electricity and water, both before and after the repairs.

Reliability of information

The consumption data are reasonably reliable. Almost all multi-storey residential buildings in Finland are connected to district heating, and the amount of energy used in each property is measured. The consumption of electricity is also measured for each residence and property. Building management in multi-storey residential buildings is usually the responsibility of professional housing managers, and their duties include monitoring and reporting the consumption of energy. Energy consumption data are also available from the energy companies that maintain statistics of their customers' consumption figures. The monitoring does not take account of the effect of other variable factors on the consumption (number of residents, use of saunas, etc.).

Effectiveness estimate

A sample consisting of more than 700 buildings was compiled of the follow-up forms by the Tampere University of Technology for the purpose of assessing the energy-saving effects. Unreliable and incorrectly filled forms were eliminated from the sample using several criteria (for example cases where the consumption details were missing or were obviously incorrect). The energy-saving results were compared to action-specific energy-saving results received from other sources. The action-specific energy-saving results calculated on the basis of the sample were of the same order of magnitude as the values obtained from other sources.

The energy-saving effects were only assessed for those energy conservation actions that required investment costs. The energy-saving effects of energy audits were not assessed. The assessment did not include the effects of energy subsidies granted to small residential buildings. The savings effect of the actions is assumed to remain constant throughout the period under review.

The effectiveness assessment was carried out on the basis of the energy savings and changes in heating methods calculated on the basis of the sample under normal conditions for each action and action category. Using the information obtained from the Housing Fund of Finland, the sample was expanded to cover all sites receiving energy subsidies. A calculation model for the energy consumption of building stock was deployed in the calculations and results checking; its building stock data are based on the data obtained from Statistics Finland.

Savings effect for 2007, 2010, 2013 and 2016

The assumption is that subsidies will not be granted after 2006.

Energy subsidies to residential buildings		**2007 GWh/a**	**2010 GWh/a**	**2013 GWh/a**	**2016 GWh/a**
YM-02	**Eneavust**	180	180	180	180

The subsidies may be reinstated in 2008, but their effect has not been taken into account.

Heating plant investments
MMM-01 (Lämpökesk)

DESCRIPTION OF THE ACTION:

The Ministry of Agriculture and Forestry is developing the building processes related

to agriculture, other rural businesses and rural living as well as the built-up rural environment. The objective is to create buildings that are economical and suitable for their intended purpose as well as a good rural environment. The intention is to achieve these objectives by guiding building operations receiving public subsidies, by co-operation between authorities and by guiding research and development activities.

The Ministry of Agriculture and Forestry is promoting the use of wood and other materials and energy sources based on renewable natural resources in building construction. Many farms are self-sufficient regarding the production of wood chippings, and changing the heating method is usually a profitable investment. Other biofuels created in agriculture are also utilised. Since 1996, the ministry has been granting investment subsidies for constructing heating plants in conjunction with switching from fossil fuels to biofuels.

The investment subsidies are granted either in the form of subsidised interest loans (maximum amount 50–80% depending on the building) or direct subsidies (maximum 15–30% of costs qualifying for subsidies). The subsidy applications are submitted to the rural departments of Employment and Economic Development Centres. The subsidies are paid as the work progresses, in a maximum of five instalments against receipts for actual costs.

As an action, this falls under the category of "domestic generation of renewable energy sources, whereby the amount of purchased energy is reduced".

ASSESSMENT OF EFFECTS

Basis of calculations

The Ministry of Agriculture and Forestry collects the data on subsidy applications. The application shows the magnitude of the project (the heating plant power to be replaced), the estimated costs, details of the applicant as well as the submission date. The decision regarding the subsidy and any relevant information are recorded in the same database.

The following information was extracted from the applications:
- during 1996–1999, some 330 applications were filed per year (a total of 1,344); the total power to be replaced in the applications was about 22 MW, an average of some 5.5 MW per year
- during 2001-2005, 200–300 applications were filed per year (a total of some 1,350) and the total heating plant power to be replaced in them was about 28 MW each year (a total of some 140 MW during 2000-2005), the applications concentrated on plants of the order of 60 kW

Effectiveness estimate

The following assumptions were made for assessing the effects:
- the biofuel heating plants proposed in the applications replace, besides heating plant power produced by oil, also some older boilers using wood or wood chippings; their share is assumed to be 15% of projects
- the time that bio-fuel boilers are annually operated at full capacity is approximately 4,500–5,000 hours; biofuel boilers are seldom dimensioned according to the computational maximum capacity, and farms probably use oil-heated boilers in addition to biofuel boilers during cold spells (and the oil-heated boiler also serves as a backup system)
- it is assumed that 85% of the heating plant refurbishment projects applied for are actually implemented
- some applicants cannot produce the fuel on their own farms and the heating plant is operated using purchased fuels (pellets, purchased chippings and similar); it is assumed that 80% of plants use the farmers' own fuels

- the assumption was made for the assessment that 30% of the projects applied for during a given year will be implemented by the end of that year and the rest during the following year
- the savings effect for 2007 was calculated using 2006 data
- the heating plant power shown in the applications is assumed to decrease by 5% per annum starting in 2007

Heating plant investments on farms — effectiveness estimate for 2007, 2010, 2013 and 2016

Replacement of heating plants at farms		**2007 GWh/a**	**2010 GWh/a**	**2013 GWh/a**	**2016 GWh/a**
MMM-Ol	**Lämpökesk**	480	659	809	938