



Motiva

Energy Efficiency Policies and Measures in Finland

ODYSSEE- MURE 2010

**Monitoring of EU and national energy efficiency
targets**

Motiva Oy

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1 Executive Summary

Energy efficiency's primary objective is the reduction of greenhouse gas emissions in a cost-effective way. The common EU goal is a 20 per cent increase in energy efficiency by 2020. Besides being part of climate policy, saving energy also remains important for traditional reasons, including securing the energy supply, reducing energy costs and from other environmental viewpoints.

In many energy conservation measures and in terms of the efficiency of energy use, Finland is among the leading countries in the world. Co-generation of heat and electricity, broad coverage of energy efficiency agreements, and the systematic implementation of energy audits are good examples of successful energy conservation measures.

On 4 February 2010, the Finnish Government passed a resolution on energy saving and energy efficiency measures for implementation during the current decade. This government decision is based on a June 2009 report by a broad-based Energy Efficiency Committee, appointed by the Ministry of Employment and the Economy. The energy efficiency measures implement the objectives of the Long-Term Climate and Energy Strategy.

In 2010, energy end-use was approximately 27.0 Mtoe (320 GWh), up by 7.7% from the 2000 level. The strategy sets an energy savings target of 37 TWh for energy end-use by 2020. If no action is taken, energy end-use is estimated to rise to 347 TWh by 2020, but the level of end-use will be 310 TWh under the strategy.

2 Key messages

- The impact of the 2009 economic downturn led to decrease in energy demand followed by instant increase driven by economic recovery. However, the longer-term 1990-2010 trend shows that the growth that has continued for a long time is at the very least being curtailed.
- The most significant change in energy end-use is the reduction in the relative proportion of industry as a result of structural change.
- The ODEX indices show improvement in energy efficiency in all sectors in Finland.
- Energy efficiency policies are defined in the national Long-Term Climate and Energy Strategy from 2008. Detailed new measures are set in the Government resolution on energy efficiency from February 2010. By and large, the same measures can be found in Finland's second National Energy Efficiency Action Plan of July 2011 together with the long-running key measures such as energy efficiency agreements and the Energy Audit Programme.
- Individual measures cannot meet the challenging objectives but the society as a whole must undergo fundamental change. Development is needed in many areas such as values, capacity building, sustainable community infrastructure, lifecycle thinking and science-research-development-innovation chain.
- The implementation of the proposed Energy Efficiency Directive will require significant additional effort in all sectors. However, some of the objectives of the Directive are at advanced stages, e.g., extensive use of CHP.

3 The Background to Energy Efficiency

3.1 Overall economic context

Finland has a relatively small population of 5.4 million. With a land area of 338 000 km² it is also very sparsely populated making transport distances long. Approximately one million people live in the Helsinki Metropolitan area. The climate is the coldest in Europe.

GDP (in constant 2000 prices) has grown by 22% from 2000 to 2011. However, the growth has not been constant as a steep 8.4% drop was observed in 2008. A recovery of exports, domestic trade, and household consumption stimulated economic growth in 2010. The per capita output (in current prices) was 35 150 euros in 2011.

Table 1 Economic trends in Finland, 2000-2011

	2000	2005	2008	2009	2010	2011
GDP in M€ (€2000)	132 195	150 524	166 035	152 164	157 842	162 348
GDP annual change	5.3%	2.9%	0.3%	-8.4%	3.7%	2.9%
Private consumption of households in M€ (€2000)	61 671	73 778	80 509	82 039	84 144	85 307
Private consumption of households, annual change	-0.5%	1.0%	2.4%	1.9%	2.6%	1.4%
Value added of industry M€ (€2000)	39 576	47 083	53 969	43 464	47 130	47 988
Value added of industry, annual change	10.3%	4.0%	-4.0%	-19.5%	8.4%	1.8%

Trade is important with exports accounting for over one third of GDP in recent years. Finland is strongly competitive in manufacturing - principally the wood, metals, engineering, telecommunications, and electronics industries. Finland excels in high-tech industry.

Except for timber and several minerals, Finland depends on imports of raw materials, energy, and some components for manufactured goods. Because of the cold climate, agricultural development is limited to maintaining self-sufficiency in basic products.

3.2 Energy consumption trends by fuel and by sector

Total energy consumption in Finland was 34.1 Mtoe (401 TWh¹) and end-use was 27.0 Mtoe (320 TWh) in 2010. Total energy consumption and end-use increased quite steadily until 2003. The data for 2005 reflect the lengthy industrial dispute in the forestry industry. In 2006–2009, total energy consumption and end-use clearly fell. Energy consumption in 2008 and 2009 shows the impact of the international financial crisis, which affected production in energy-intensive sectors in particular. In 2008, consumption also fell owing to an exceptionally mild winter. In 2010, total energy consumption rose by 9% compared to the previous year. The main reasons for this growth were the growth in industrial production that accompanied the economic recovery, and a very cold winter. Although there are clear reasons for the lower than normal level of total energy consumption in 2003–2010, it may be noted when examining the whole 1990–2010 period that the growth that has continued for a long time is at the very least being curtailed.

In 2010, total energy consumption per capita was 74.6 MWh, meaning 18% growth since 1990. Energy end-use per capita was 57.7 MWh, equivalent to 20% growth over the same period.

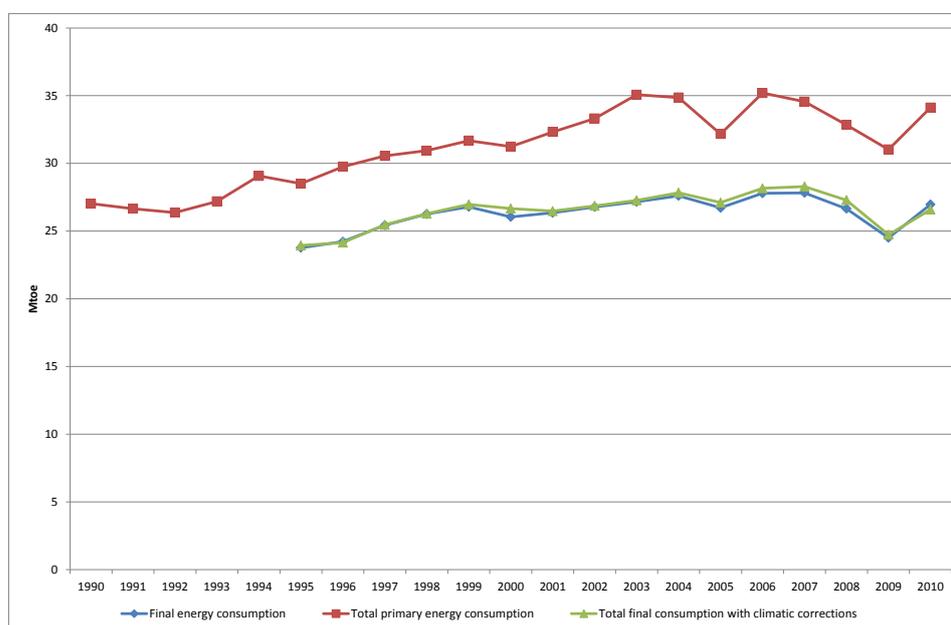


Figure 1 Total energy consumption and end-use in Finland in 1990–2010

¹ Terawatt-hour numbers given in brackets are taken from national statistics. Those in Mtoe are from the ODYSSEE database.

Energy supply in Finland is diversified with no single fuel dominating the fuel mix. Oil accounts for 24% of total energy consumption, wood fuels 21%, nuclear energy 17%, coal 13%, natural gas 10% and other energy sources and net imports of electricity a total of 15%.

The energy efficiency of electricity production in Finland is improved by the significant proportion of combined heat and power (CHP) in electricity production. Its share in electricity production has grown from 31% in 1990 to 36% in 2010 reaching the peak level of 28.1 TWh.

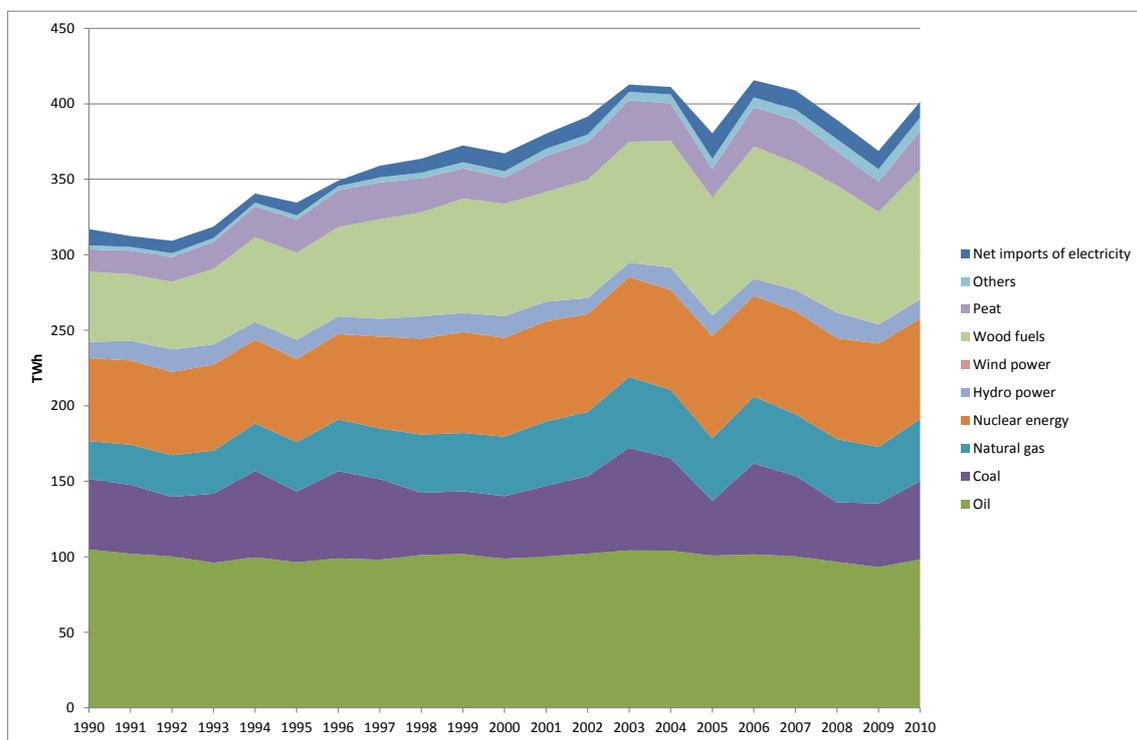


Figure 2 Total energy consumption by fuel in Finland in 1990–2010

Figure 3 shows the proportions of energy end-use per sector. The most significant change in energy end-use is the reduction in the relative proportion of industry as a result of structural change. As for 2010, the proportion of heating for buildings increased owing to a very cold winter.

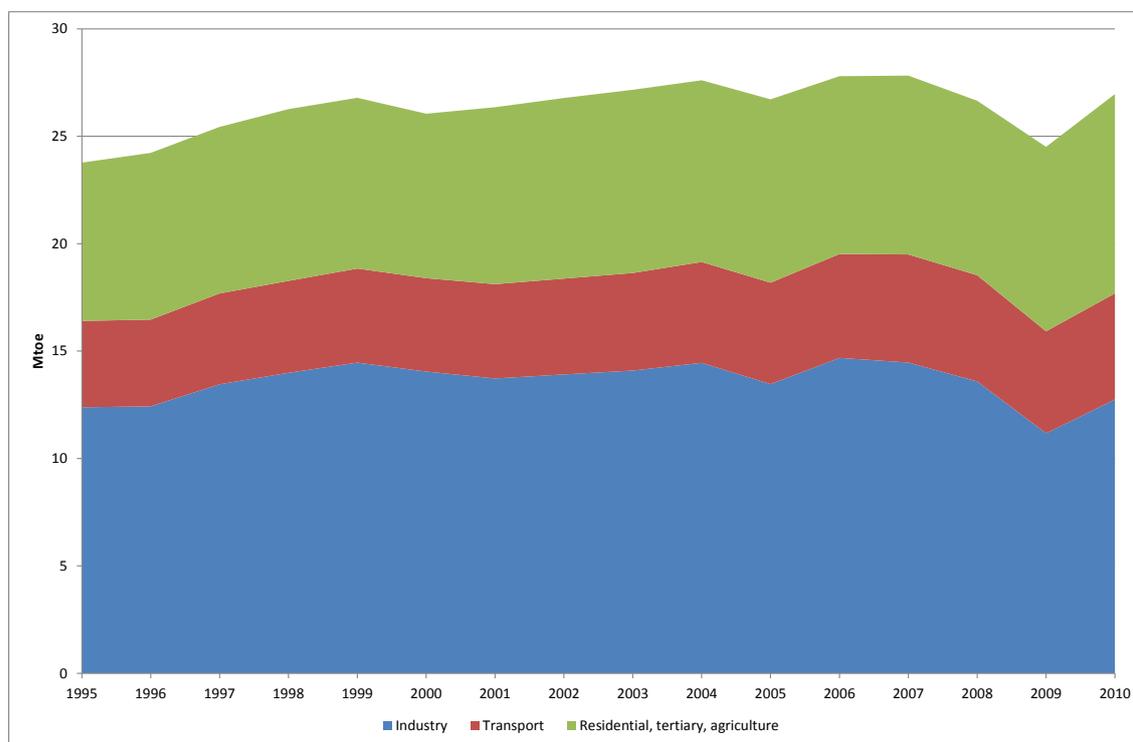


Figure 3 Energy end-use per sector in Finland in 1995–2010

3.3 The policy background to energy efficiency

Strategies and programmes for energy efficiency improvement are in place both at national and sectoral level. In addition, policy context is set in various Government resolutions. EU policies and regulations have a significant impact on energy efficiency targets, policies and measures. However, the focus of the following discussion is on national activities.

Long-term Climate and Energy Strategy

A series of energy saving programmes have been established since the early 1990s (in 1992, 1995, 2000 and 2002). Since 2005, energy saving and energy efficiency activities have been incorporated into national climate and energy policy strategies. The prevailing strategy is the Long-term Climate and Energy Strategy of 2008 but it is in the process of updating. The strategy sets out the guidelines approved by the European

Council in spring 2007 and the measures required by the climate and energy package presented by the Commission on the basis thereof in January 2008 with regard to, among other things, targets for reducing greenhouse gases, energy procurement, renewable energy and energy efficiency in Finland. The main emphasis of the strategy is on the guidelines up to 2020 and on the measures that they require. In addition to this, it sets out a vision right up until 2050.

Primary energy consumption for the target scenario in the strategy is 430 TWh in 2020. In comparison with the base scenario, the savings target for energy end-use is 37 TWh by 2020, according to the strategy, and 5 TWh for total electricity consumption. The reduction would be a total of 49 TWh, calculated in terms of primary energy. The longer-term target is that energy end-use would fall by another third of the 2020 level by 2050, and that electricity consumption would start to fall.

The target set for energy end-use is particularly important for Finland to achieve its renewable energy target of 38%. In order to ensure that this target is met, new targets were set in April 2010 for increasing the amount of renewable energy, using a benchmark of 327 TWh of energy end-use in 2020.

Foresight report on climate and energy policy

In addition to the long-term climate and energy strategy, a foresight report on climate and energy policy has been produced in 2009. In particular, this foresight report examined climate and energy policy, global development and preparation for the impact of climate change throughout the timeline for the strategy and extending up to the middle of the century and beyond, where necessary.

Government resolution on energy efficiency (February 2010)

In April 2008, the Ministry of Employment and the Economy founded a broad-based energy efficiency committee to prepare new activities relating to energy savings and energy efficiency. According to the Long-term Climate and Energy Strategy, the benchmark for the Committee's work was an energy saving of 37 TWh, including electricity savings of 5 TWh. The Committee's report, submitted in June 2009, describes 125 new or extended energy saving and energy efficiency measures. An impact assessment was also performed on the measures set out in the report in connection with the Committee's work.

On the basis of the report by the energy efficiency committee, Government passed a resolution concerning the energy efficiency measures on 4 February 2010. The Ministry of Employment and the Economy will regularly coordinate and monitor the implementation of the measures set out in the resolution. The individual measures in the resolution are the following:

A. Cross-cutting areas of activity

Basis for activities

- In 2011, an independent expert will evaluate the current status of this basis from the perspective of energy conservation and energy efficiency.
- The organisation of energy efficiency promotion will be developed.
- Including energy efficiency in the education programmes of educational institutions at all levels, as part of education on climate change and the promotion of sustainable development.
- Ensuring the operability of the science-research-development-innovation chain, in order to generate and commercialise new solutions.
- Reinforcing multidisciplinary research in such a way that different fields of scientific research develop their capabilities and produce basic information on structures, activities, consumer behaviour and creation of well-being in a society with significantly lower energy requirements.
- Developing indicators that measure the development of energy efficiency in various sectors.
- Enhancing cooperation between various authorities in order to increase cohesion in community structures.

Development of research and innovations

- Launching a network of various actors promoting energy efficiency innovation that seeks, screens and advances development ideas on energy efficiency.
- Launching a research programme or project entity with a strong focus on energy efficiency. Behavioural research will be tied to research on energy efficient technology and innovations.

Communication, advisory services and education

- A system for providing consumers with advice on energy-related matters will be introduced and a national coordination centre will be designated for it.
- The advisory network for renovation construction, as well as overall communications related to renovation construction, will be developed, taking account of the perspective of energy efficiency in buildings.
- Energy efficiency classifications for cars will be introduced in car retailing.
- Energy companies will be required to provide consumers with feedback information on their energy consumption.
- Ensuring the integration of energy efficiency and energy conservation skills in vocational additional and supplementary training in various fields.
- Energy efficiency practices and model solutions from various fields will be gathered and distributed for implementation elsewhere.

Public sector

- The public sector will serve as a strong example to others in the promotion of energy efficiency.
- A framework act and decrees on the energy efficiency of public sector will be enacted and implemented in a timely manner.
- By the end of 2010, the Ministry of Employment and the Economy will devise a plan for energy efficiency, which will serve as a model for other state organisations and municipalities. Plans for other administrative sectors will be completed during 2012.
- In public procurements, energy efficiency will be introduced as a central criterion in accordance with the Government's decision on promoting sustainability in public procurements.

B. Sectoral activities

Community structure

- Alternative energy and community technology solutions will be promoted.
- Drawing up regional climate and energy strategies and genuinely linking them to the steering of land use and the development of transport systems will be promoted.
- Assessment methods for evaluating the sustainability of the community structure, based on common concepts and indicators, will be developed to support decision making.
- Steering of the community structure will be made more effective. The necessary legislation and instruments for planning and implementation will be developed.
- The steering of the community structure of large urban regions and the preconditions for the coordination of land use and transport will be improved through legislation, taking all zoning levels into account.

Buildings

- Stricter energy regulations for new building projects will be implemented in phases.
- Renovation construction and, as part of this, the improvement of energy efficiency will be supported and encouraged through targeted economic steering and support measures.
- Statutes will be used to steer the installation of apartment-specific water meters in new buildings.
- Requirements will be extended to renovation construction on the basis of the directive under renewal on the energy performance of buildings.
- Adoption of life-cycle based tools for building planning, use and maintenance will be promoted.
- The development and implementation of operating models for the planning and customer-oriented realisation of renovation construction will be promoted, in cooperation with actors in the construction and real estate sector.

Transport

- Speeding up the renewal of existing car stock and promoting the adoption of new energy-efficient vehicle technology (incl. electric cars) introduced on the market. Central measures include developing taxation on cars, vehicles and fuel, and introducing energy efficiency classifications for passenger cars. These measures will be dimensioned so as not to stimulate an increase in the car stock.

Energy Efficiency Policies and Measures in Finland in 2012

- Public transport will be promoted on the basis of the Public Transport Act that entered into effect in December 2009 and the public transport development programme for 2009-2015. Public transport structures, its scope and quality, and feeder traffic will be developed and road investments that support public transportation realised.
- Preconditions will be created for improving the energy efficiency of goods traffic. Trouble-free traffic connections to central logistics hubs will be developed by taking advantage of e.g. the opportunities offered by an intelligent transport system.
- Drawing up an action and financing programme for increasing the popularity of light traffic and introducing service centres for transportation.
- The need and impacts of road pricing will be studied.

Households and agriculture

- Regulations concerning energy-efficiency standards for equipment will be implemented. Efficient implementation will be ensured by sufficient communication.
- An emphasis will be placed on promoting energy efficiency in outlining agricultural support systems.
- Promoting the introduction of energy efficient equipment in the market and investigating the adoption of even stronger economic incentives in order to increase energy efficiency measures.
- Ensuring that households have access to reliable, up-to-date, unbiased information on energy conservation measures which are genuinely advisable and cost-effective in the context of our overall energy system.
- Developing and introducing methods for metering and monitoring apartment-specific energy consumption. Consumers will be provided with comparable data on their energy consumption and on measures for improving its efficiency.
- Ensuring the systematic implementation of energy programme on farms.
- Energy efficiency requirements will be considered in regulations and stipulations concerning supported farm and rural building.

Industry and services

- Extensive implementation of the legislation concerning companies in the energy sector, which entered into force at the beginning of 2010 and ensuring energy efficiency services for energy users.
- The scope of application of energy efficiency subsidies for companies and organisations will be extended and financing models and business concepts will be developed.
- Energy efficiency agreements will be made substantially more ambitious and extensive than before, and will be linked to research and innovation activities. Energy auditing procedures in support of the agreements will be further developed.
- Devising models for including energy efficiency in various procurement processes and contracts.
- Launching a survey on the cost-effectiveness criteria that might be used for the more effective comparison of new investments in energy production and investments in end use.

Other government resolutions

Other energy efficiency relevant Government resolution are those on promoting sustainable choices in public procurement (8 April 2009) and on renovation of buildings (18 September 2008). In the resolution for public procurement, the Government required the central government to consider environmental perspectives in at least 70% of its own procurement in 2010, and in all its procurement in 2015. Government departments are committed to the targets of the resolution, and the targets are recommended for state-owned companies and local government. The obligations connected with energy efficiency relate to the procurement of public transport services, cars and equipment that uses energy, energy inspections of buildings, and new building and leased properties. The resolution on building renovations emphasises measures for improving the energy efficiency of building stock, reducing energy consumption and emissions by building stock, social integration through complementary construction, and improving information and expertise relating to renovations. The resolution is based on the Renovation Strategy 2007–2017, and a programme of measures has been based on it.

Institutional setting

The Energy Department of the Ministry of Employment and the Economy is the government body responsible for energy policy. Motiva Oy is a state-owned company that helps the government to implement its energy efficiency measures.

4 Overall Assessment of Energy Efficiency Trends

4.1 Overall trends in energy intensity

Following the recession of the early 1990s, the intensity of total energy consumption and end-use (koe/€₂₀₀₀) started to fall in Finland in 1995. Although energy consumption rose, gross domestic product grew even more robustly. The downward trend continued until 2008, after which intensity increased as a result of the latest recession. The intensity of total consumption fell by approximately 25% in 1994–2010 and the intensity of end-use by 22%.

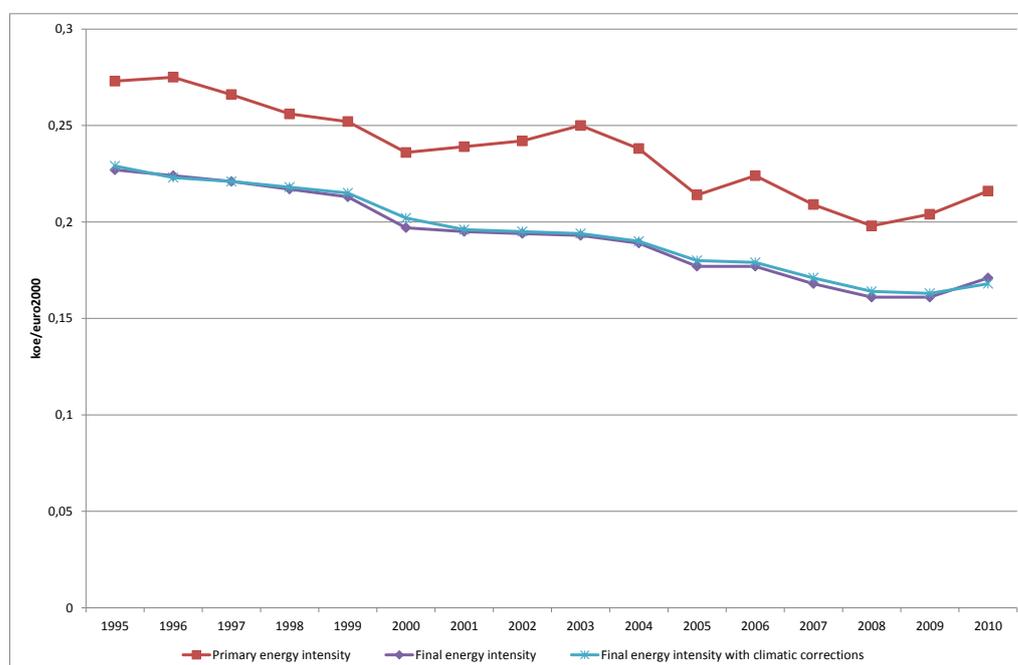


Figure 4 Primary energy intensity and intensity of end-use in Finland, 1995–2010

4.2 Industry

The growth of energy end-use of Finnish industry has stopped in the early 2000s. End-use was 12.7 Mtoe (145 TWh) in 2010. The trend in energy end-use shows the dramatic impact of the financial crisis on the quantities produced by energy-intensive industry at the end of the last decade. In 2009, end-use was 23% lower than in the years preceding the financial crisis and remained 5% under the 2008 level in 2010. When

examined per sector, the largest industrial energy users in 2010 were the pulp and paper industry (52%), steel industry (12%), oil refining (9%) and the chemicals industry (8%).

Industrial electricity consumption was 41 TWh in 2010, and has fluctuated significantly less than energy end-use over the last two decades.

Industrial energy intensity (koe/€₂₀₀₀) started to fall in 1995, and fell by 35% over the 1994–2010 period. Industrial added value grew significantly more quickly than energy end-use in the sector. As a result of structural change, more than half of the added value is generated in sectors that are not energy-intensive. Figure 5 shows the trend in energy intensity for the whole manufacturing industry, paper industry, chemical industry and primary metals. The trend in primary metals is erratic from 2008 to 2010 due to the plummeting value added in the sector in 2008 and 2009 and considerable growth in 2010.

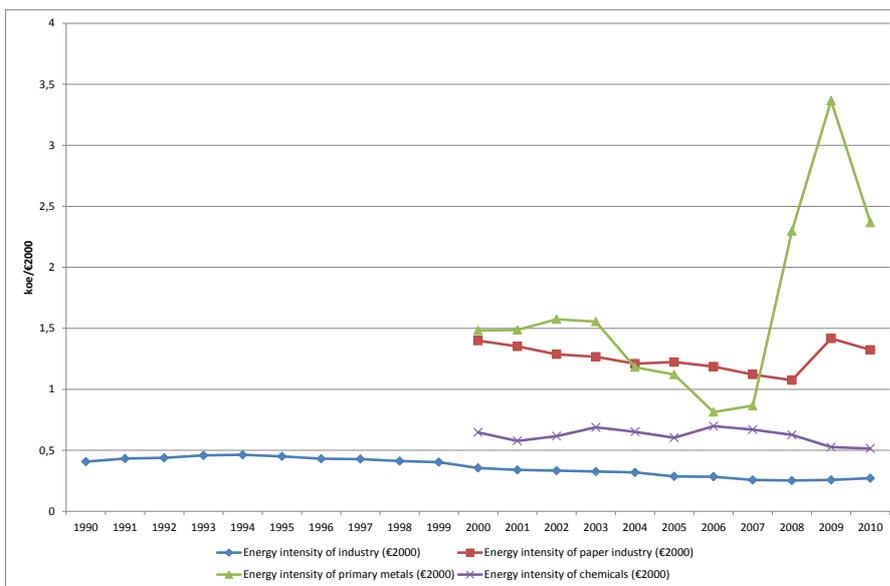


Figure 5 Energy intensity in industry

Figures 5 and 6 clearly demonstrate the deficiency of energy intensity as a metric for energy efficiency. While the specific consumption of steel production has remained quite level over the past years, the energy intensity of primary metals has fluctuated dramatically because the value added has plummeted due to the recent recession. It should be noted, however, that primary metals includes also other products but steel.

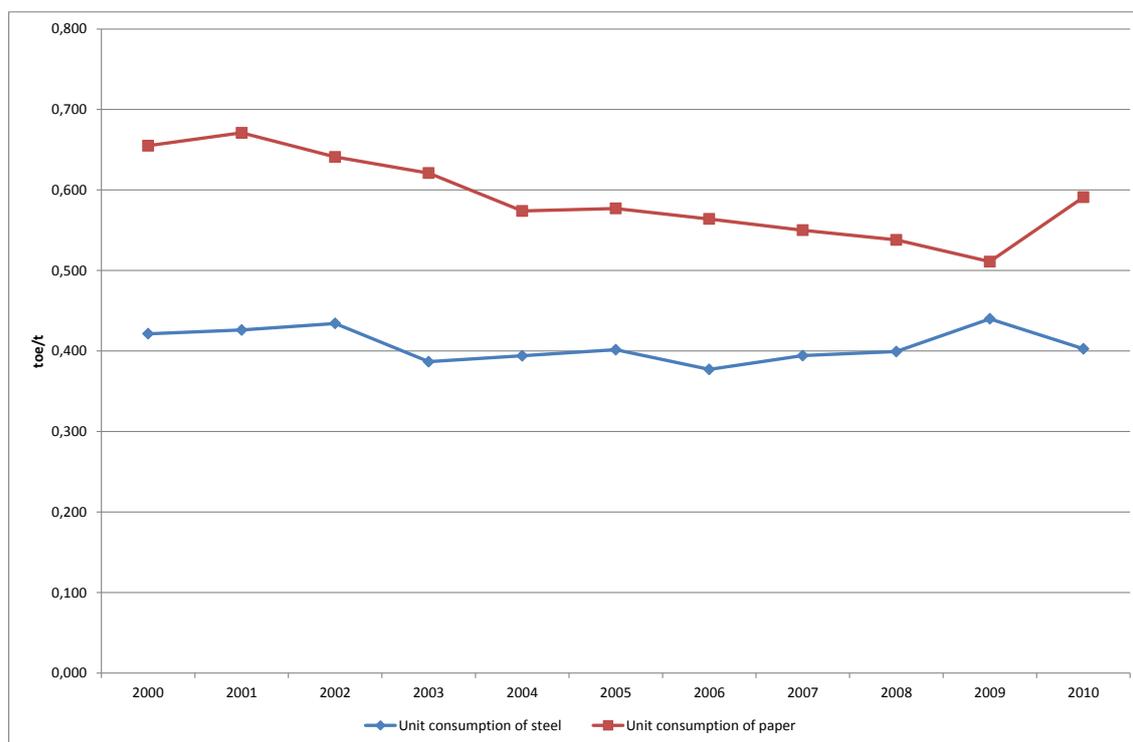


Figure 6 Specific energy consumption of paper and steel production

4.3 Households

The household sector accounted for 22% of Finland's total energy end-use in 2010. Energy consumption in the household sector was approximately 70 TWh according to the national statistics in 2010. According to the ODYSSEE database, the consumption of the residential sector was slightly lower, 5.4 Mtoe, which excludes energy used in summer residences and electricity used by the real estate sector (common areas of blocks of flats).

The current consumption levels correspond to an increase of 36% compared to energy consumption in 1995. However, the cold winter of 2010 had a significant impact on the increase accounting alone as much as 12 percentage points of the growth. Approximately 60% of energy is used for heating, roughly 15% for hot water production and about 15% for electricity for appliances and lighting. The rest is used in saunas (recently included in heating in the national statistics) and holiday homes. Total consumption in this sector can be calculated from 1995, because there is no information concerning the consumption of heating in the years prior to that.

Electricity consumption in the household sector was approximately 24 TWh in 2010, including household electricity (10.3 TWh), electricity for heating, electricity consumption of holiday homes, and electricity use by real estates.

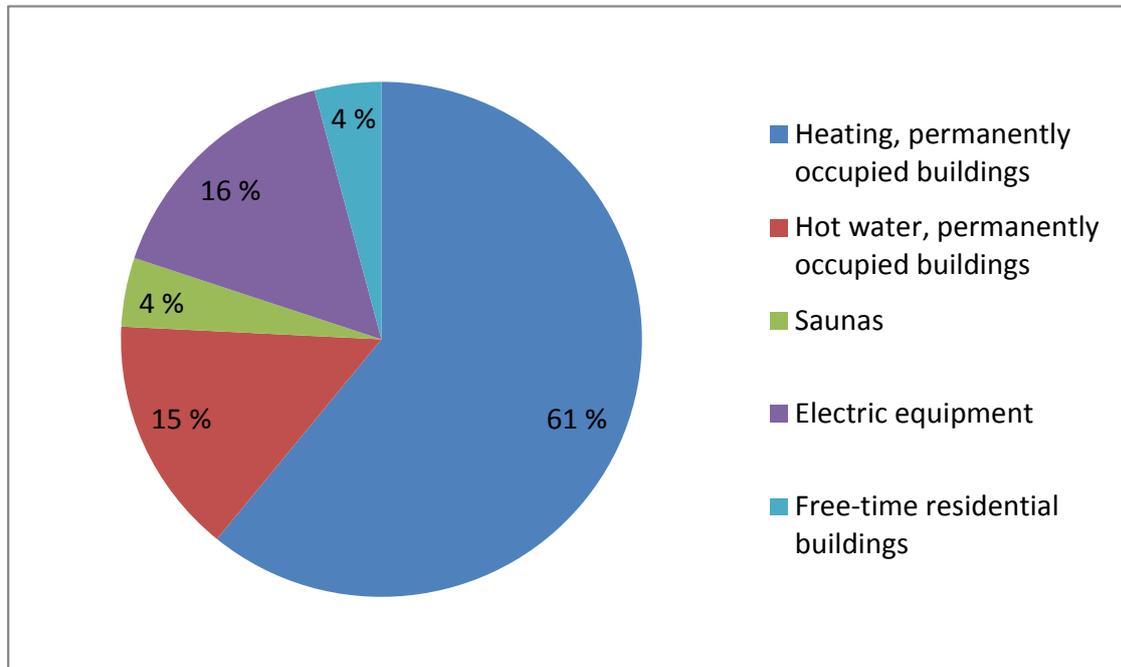


Figure 7 Energy end-use in the household sector in 2009

Net energy for household heating per home and in proportion to heating needs (kWh/home*degrees) has remained almost unchanged since 1995. However, electricity consumption per permanently occupied home has risen.

Unit consumption of heat per dwelling has grown until 2007 but declined thereafter (Figure 8), possibly due to a break in data series between 2007 and 2008. Statistics Finland has revised its household energy statistics and it has done so retrospectively until 2008. Unit consumption of heat for water heating per dwelling has been slightly decreasing, possibly driven by declining household sizes and efficient water using equipment.

Energy Efficiency Policies and Measures in Finland in 2012

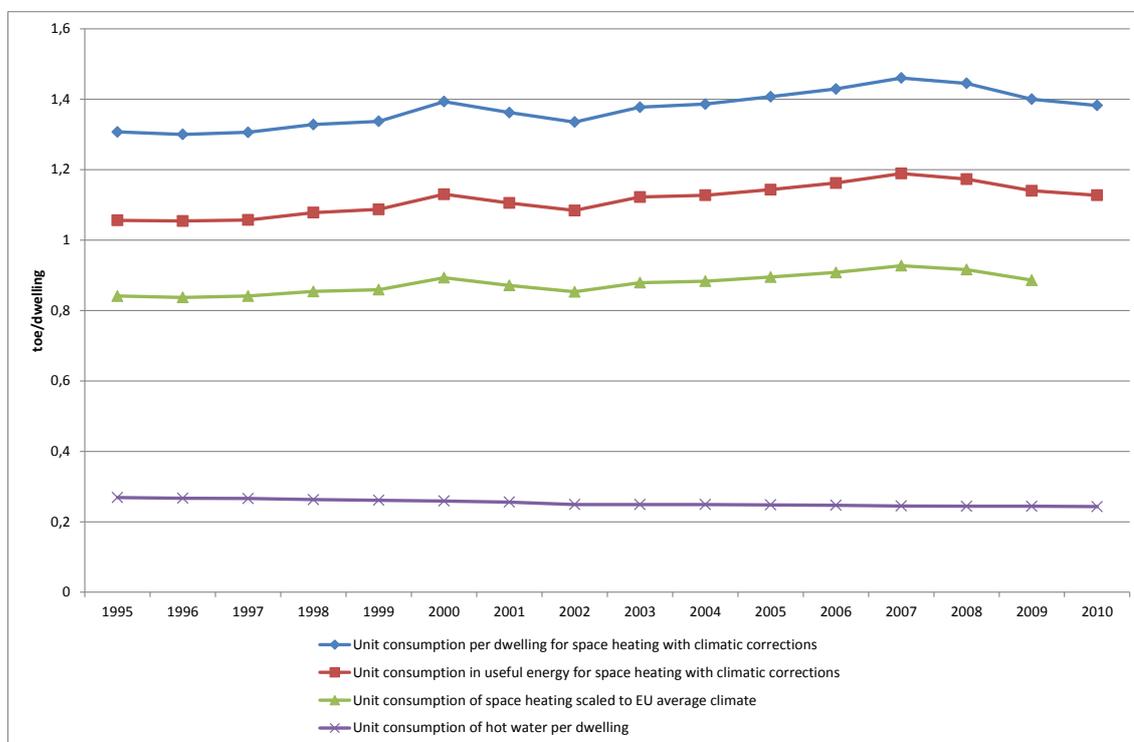


Figure 8 Unit consumption of heat in dwellings, toe/dwelling

Two surveys on electricity use per appliance group have been made with 1993 and 2006 data and there is an on-going project which investigates 2011 data. The 2011 results are not yet available but will be used in the forthcoming ODYSSEE updates.

Table 2 Household electricity use by group of appliances in 1993 and 2006, GWh

	1993		2006	
Cold appliances	2 215	30%	1 461	13%
Cooking	796	11%	653	6%
Dishwashing	125	2%	261	2%
Laundry and drying	316	4%	391	4%
TVs, set-top boxes, DVDs etc.	537	7%	834	8%
Computers			407	4%
Sauna stoves	606	8%	852	8%
HVAC ¹	483	6%	621	6%
Electric floor heating ²	0	0%	206	2%
Car heating	226	3%	218	2%
Lighting, indoors	1 541	21%	2 427	22%
Lighting, outdoors			89	1%
Other equipment	623	8%	2 572	23%
Total	7 468	100%	10 992	100%

¹ Ventilation, water circulation pumps, heat exchange centres

² Excluding electric floor heating in houses heated with electricity

³ In single-family houses, excluding blocks of flats and row houses

4.4 Services

In 2010, total energy consumption in the service sectors was approximately 3.0 Mtoe (36 TWh). The service sector accounted for approximately 12% of Finland's total energy end-use. End-use by the service sector increased by 40% over the 1995–2010 period. Total consumption by the service sector may be calculated from 1995 onwards, since there is no information about heating consumption in that sector in the years prior to that.

Electricity consumption in the service sector was 18 TWh in 2010, and has grown by nearly 3% per annum since 1990. It grew by 71% during the 1990–2010 period, and by 34% in 2000–2010.

There is very limited information available on the breakdown of the energy consumption into different branches because statistics are not available. Some data is available from the public sector. The energy use of buildings used by central government and of street lighting amounts to approximately 2.3 TWh. Energy use by municipalities and municipal federations is 11–12 TWh, approximately 88% of which is by buildings and approximately 12% of which is other consumption.

The annual energy consumption of farms – which is part of the tertiary sector in the ODYSSEE-Mure Project, is approximately 12 TWh, which is divided up into machinery fuel (33%), heating fuel (28%), grain dryer fuel (17%) and electricity (22%). This is not included in above information on energy consumption in the services sector because in Finland energy use in agriculture is not part of the services sector.

The energy intensity of services, corrected for temperature (kWh/€₂₀₀₀), has remained quite level most of the 1995–2010 period. Although energy consumption grew over that period, the added value of the services sector has grown as well.

Energy consumption in the agricultural sector, which is ODYSSEE is handled as part of the service sector, was 0.8 Mtoe in 2010.

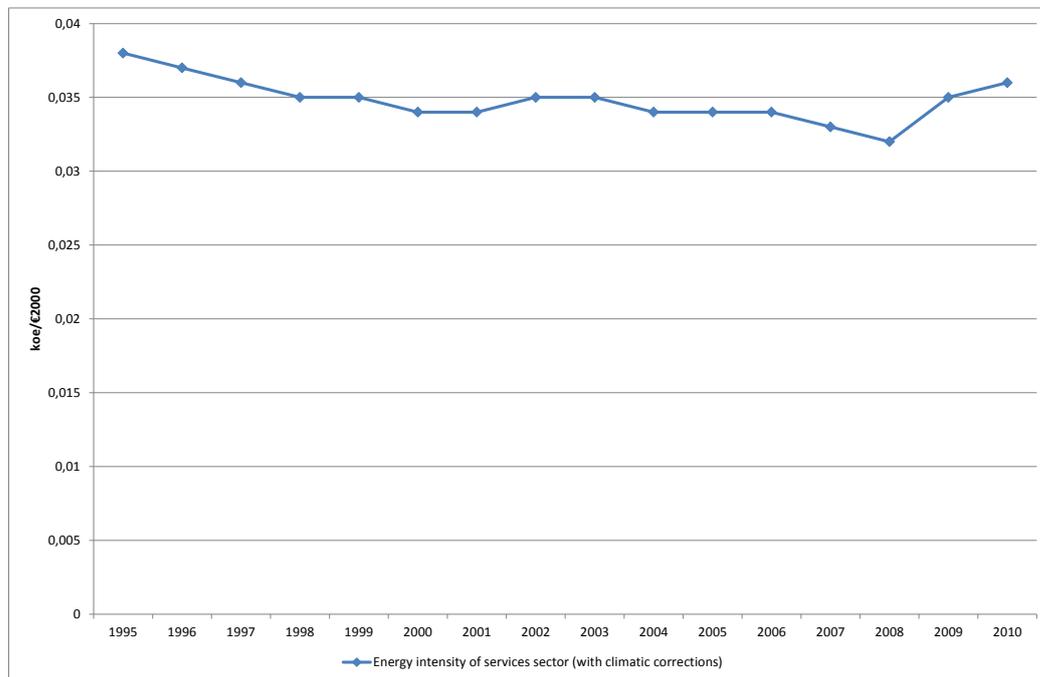


Figure 9 Energy intensity of the services sector, 1995-2000

4.5 Transport

According to the national transport emission calculation system (LIPASTO), energy consumption for transport in 2011 was approximately 222 PJ (61.7 TWh). Of this, road traffic accounted for approximately 168 PJ (46.7 TWh, 76%), waterborne traffic approximately 36 PJ (10 TWh, 16%), air traffic 12 PJ (3.3 TWh, 5.4%) and rail traffic 6 PJ (1.7 TWh, 2.7%). In comparison with emission reports for international purposes, the proportion of total energy consumption for transport accounted for by road traffic remains quite moderate in the LIPASTO system. LIPASTO also includes shipping traffic in Finland's exclusive economic zone and the energy production required for electric rail traffic as part of the traffic emissions in Finland. This particularly increases the proportion of consumption accounted for by waterborne traffic, but reduces that of road traffic. In the ODYSSEE database, transport energy consumption totalled 4.94 Mtoe in 2010 which corresponds to 57 TWh which is a bit lower than the consumption according to LIPASTO for the aforementioned reasons.

According to LIPASTO, the proportion of total energy consumption for transport accounted for by cars and vans is approximately 53% and that of heavy goods vehicles is approximately 17%. Journeys made by buses and coaches take less than 3% of all transport energy use, and the proportion of other forms of road transport, including motorcycles, is approximately 1%.

After the slump years of the 1990s, energy consumption for transport increased steadily right up until 2007. Energy consumption fell by approximately 13 PJ (3.6 TWh) between 2007 and 2009. A modest increase of 4 PJ (1.1 TWh) was observed between 2009 and 2011.

In passenger transport, specific consumption (MJ/passenger-km) in cars declined in the 1990s but remained quite steady in 2000s. In goods transport, specific consumptions (MJ/tonne-km) by trucks and rail have remained steady whereas there has been a growing trend for vans. 2010 data for rail transport is missing from the figures due to data problems which will be solved in the next ODYSSEE update.

Energy Efficiency Policies and Measures in Finland in 2012

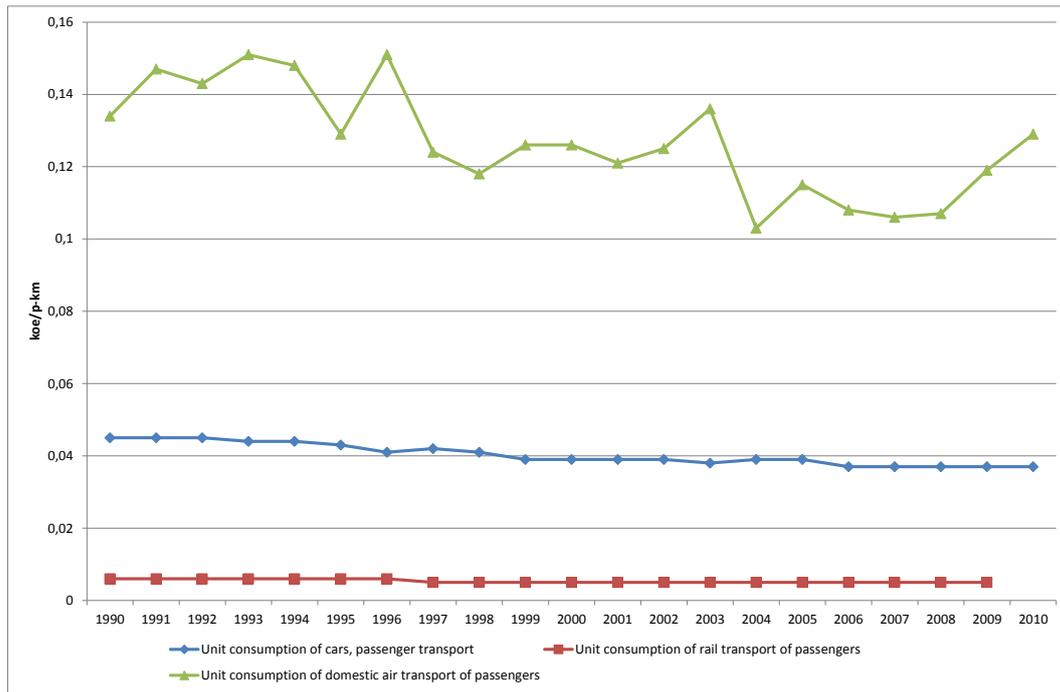


Figure 10 Unit consumption of different transport modes in passenger transport in Finland in 1990-2010, koe/passenger-km

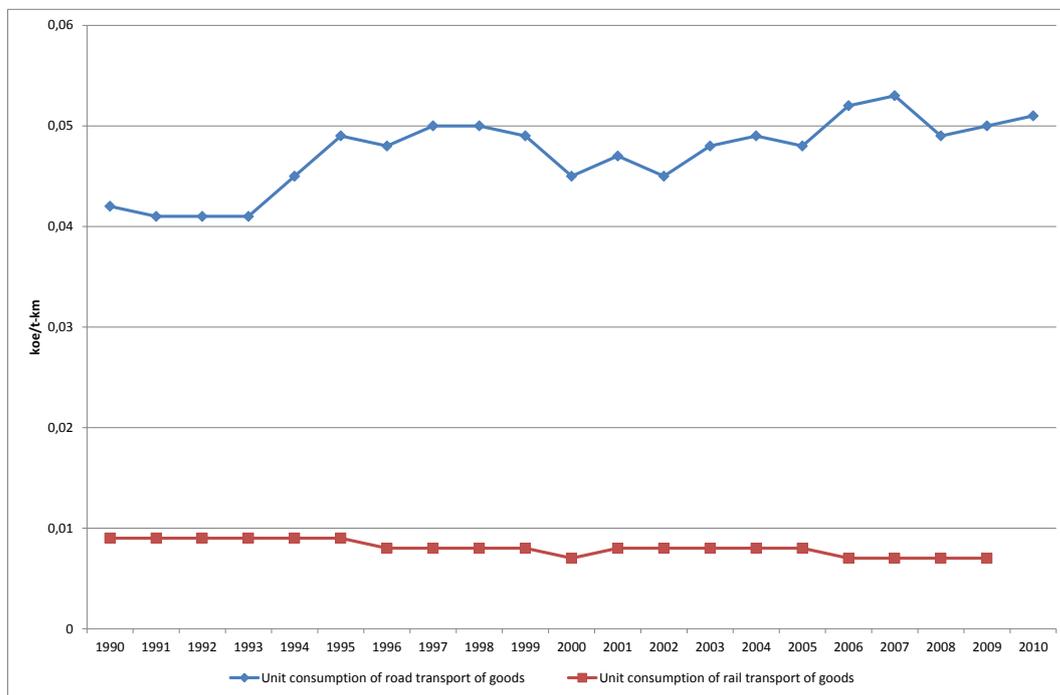


Figure 11 Unit consumption of road and rail transport of goods in Finland in 1990-2010, koe/tonne-km

Specific consumption in litre/100 km in the entire car fleet is not known. However, statistics on the specific consumption of new vehicles show a clear reduction by one litre between 2007 and 2010. The drop started in 2008 when taxes levied on new cars was revised so that it is now based on CO₂ emission levels of the cars. Despite the positive development, CO₂ emissions of new cars are still higher in Finland than in most other European countries.

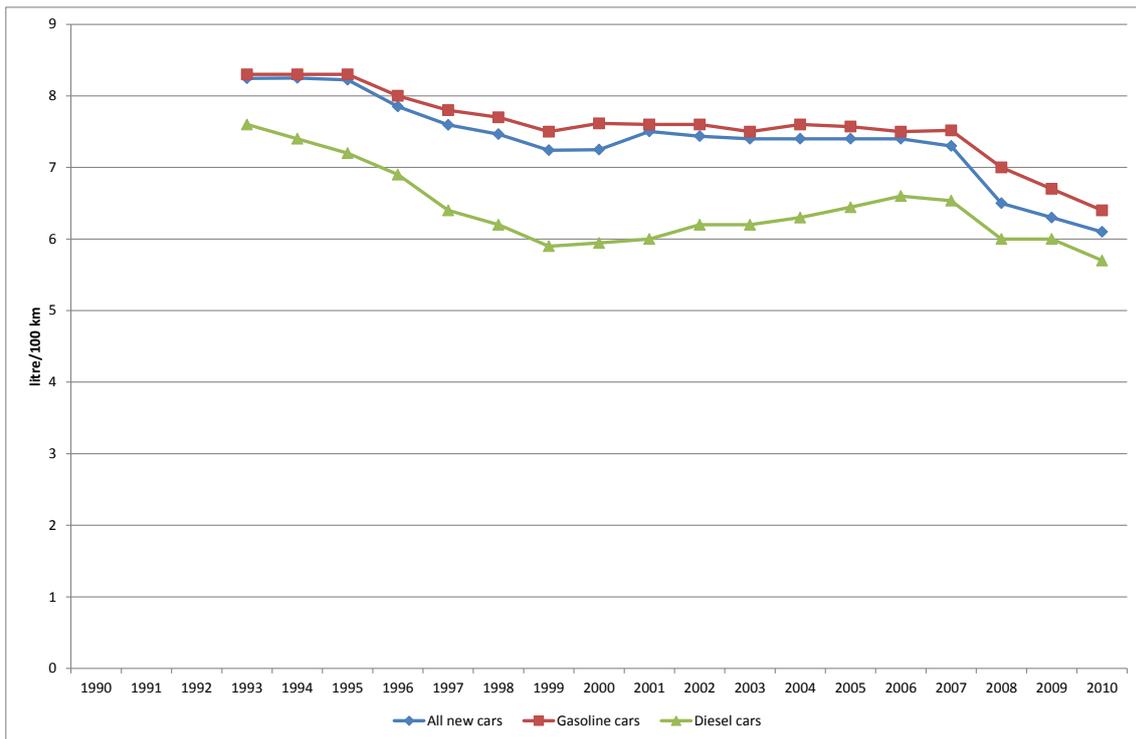


Figure 12 Specific consumption of new vehicles in Finland, 1990-2010

Good quality public transport is available in central areas of major cities. However, the scattering urban structure and low population density make it difficult to develop public transport in other areas and reduce the possibilities for walking and cycling.

Road and air transport are expected to grow. The role of rail transport is expected to remain at current level in the long run. Because the major part of imports and exports are transported via sea, the development of sea transport directly depends on the changes in the economy.

4.6 Assessment of energy efficiency/savings through ODEX: total and by sector

The overall energy efficiency index for Finland can be calculated only from 2000 to 2009 due to lack of earlier data in industry by branches. Since 2000 the energy efficiency index (ODEX) has decreased by 11%. This means that the energy efficiency has improved by 11% over the period 2000-2009.

In industry, the dominating role of paper industry is shown in the fact that the energy efficiency index for the total industry follows closely that of the paper industry, which is one of the major industries in Finland. The improvement in industry as a whole has been 14% from 2000 to 2009. The energy efficiency index cannot be calculated before 2000 due to lack of data.

Data for household sector ODEX calculation is available since 1995. The energy efficiency index of households has decreased by 4% from 1995 to 2009.

The overall energy efficiency of transport sector has improved by 25% from 1990 to 2009. Energy efficiency of all land transport modes and air transport improved significantly during the period 1990-2009.

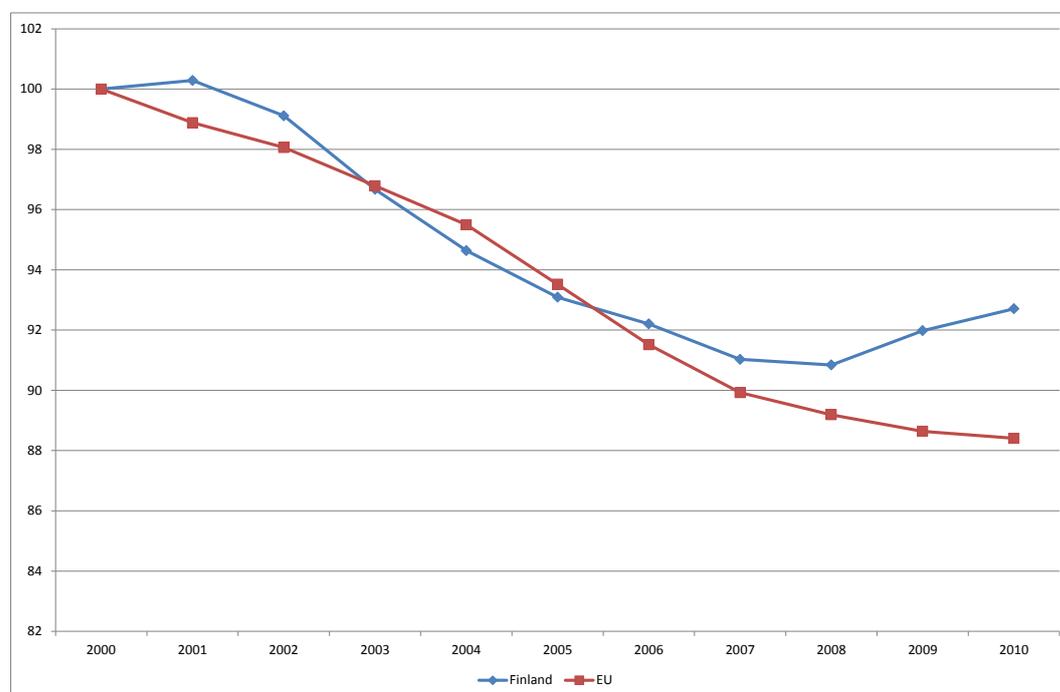


Figure 13 Energy efficiency index (ODEX) for all sectors in EU-27 and in Finland

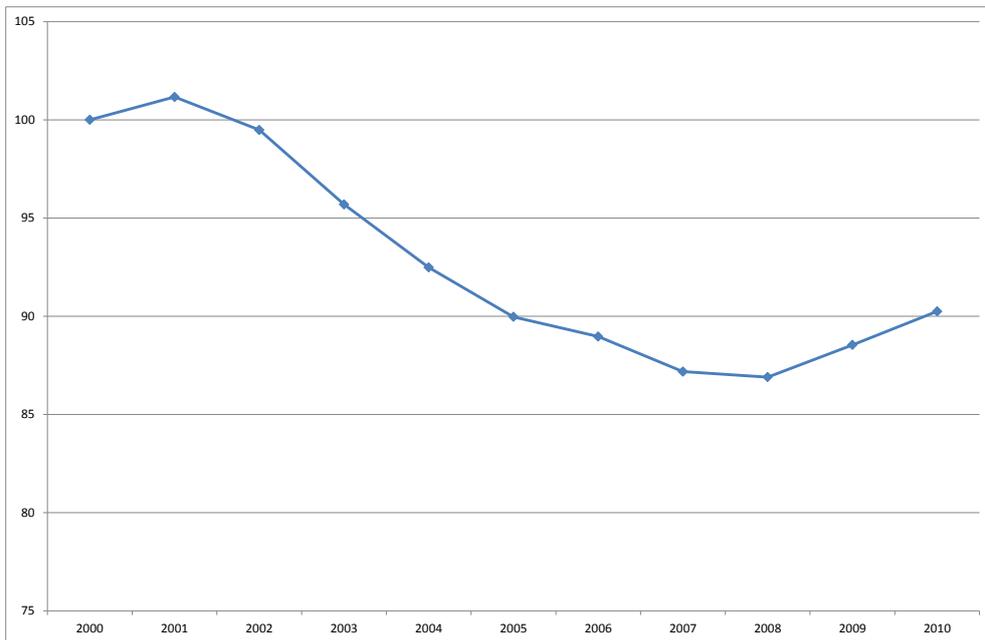


Figure 14 Energy efficiency index (ODEX) in industry in Finland

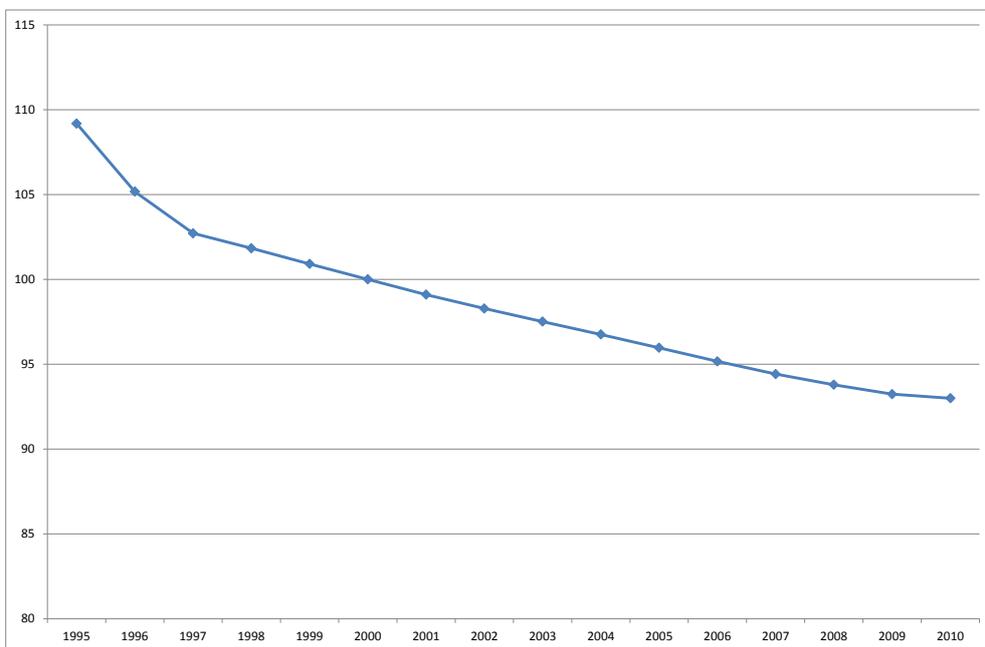


Figure 15 Energy efficiency index (ODEX) in households in Finland

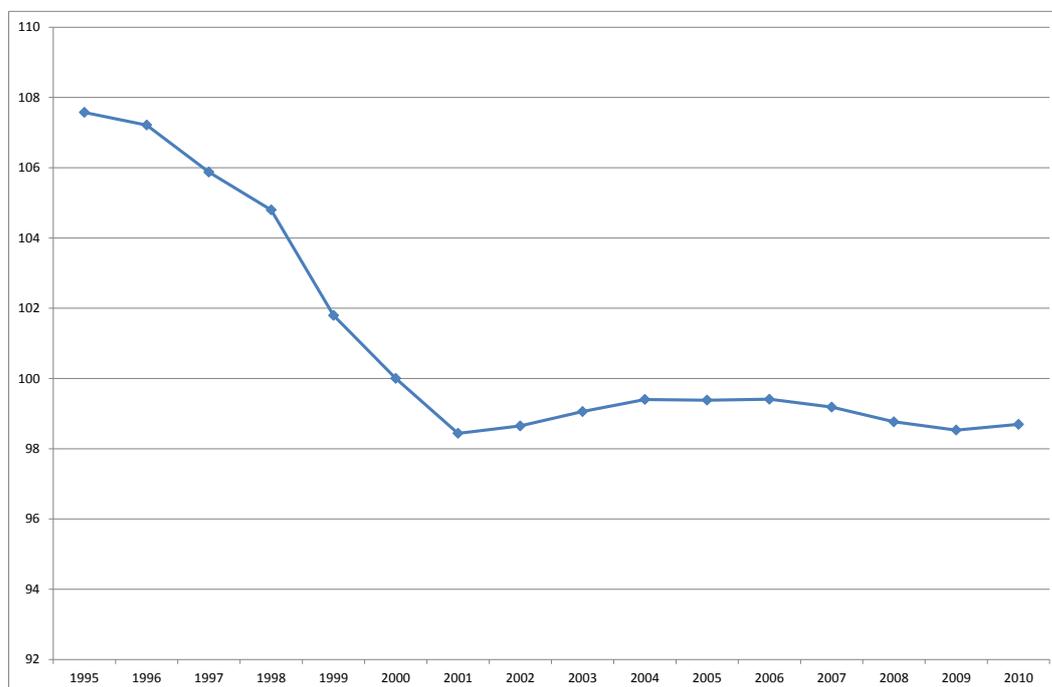


Figure 16 Energy efficiency index (ODEX) in transport in Finland

4.7 CO₂ emissions trends

According to Statistics Finland's data, greenhouse gas emissions from use of fossil fuels and peat totalled 53 million tonnes in CO_{2eq} 2011 which is equivalent to the 1990 levels. Fuel use accounts for approximately 80% of all CO₂ emissions. The rest is attributable to agriculture (8.8% in 2009), industrial processes (7.9%) and others (3.4%). In fuel use in 2009, the shares of different sectors were energy production 47.9%, transport 15.7%, energy production by industry 24.3%, households and the services sector 9.7% and others 2.4%.

Carbon dioxide emissions from the production and use of energy diminished by over 11% in 2011 because 11% less fossil fuels and 8% less peat were used. The use of renewable energy fell by 3%. According to preliminary data for 2011, renewable energy accounted for 28% of total energy consumption.

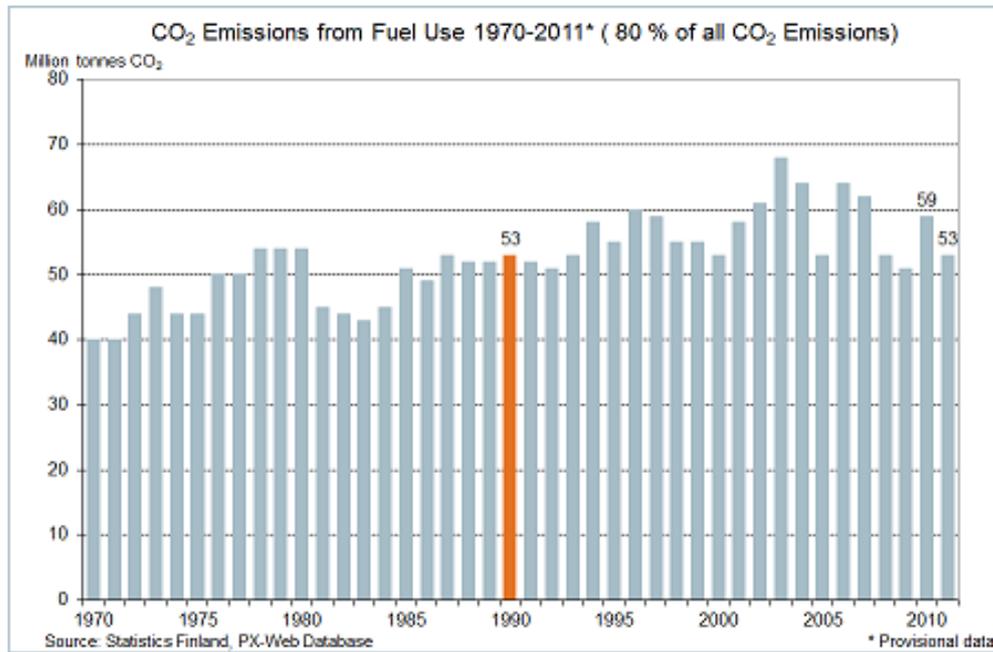


Figure 17 CO₂ emissions from fuel use 1970-2011

5 Energy efficiency measures

5.1 Recent Energy Efficiency Measures

Residential Sector

The energy efficiency of buildings has been guided by national building codes since 1976. In 2003, the energy requirements were made 25–30% more stringent than the level of the 1976 provisions. In 2008, the energy efficiency calculation was revised, so that the air tightness of the building envelope was considered as a new factor. The energy efficiency provisions were tightened up again in 2010, when they were made 30% more stringent than the 2003 level. Yet a new set of regulations was adopted at the beginning of 2012 improving the energy efficiency of new buildings by approximately 20%. They will also instigate a shift towards overall energy reviews. Under the new regulations, an upper limit is set for the building's total energy consumption (heating, cooling and electrical energy), depending on the type of building, and it is expressed using an "E ratio". The method employed to produce the energy used by the building is considered when calculating the E ratio. The calculation method advances the use of renewable energy and district heat and discourages the use of electricity for heating.

Energy efficiency in existing buildings is advanced through energy audits, subsidies, two voluntary agreements and energy advice. In addition, new legislation for regulating the energy efficiency levels to be achieved in building renovations is under way.

The Höylä III energy efficiency agreement (2008–2016) is a continuation of two preceding programmes, which promoted energy efficiency in oil-heated single-family dwellings between 1997 and 2007. The main areas for action in Höylä III are the improvement of the energy efficiency of oil-heated houses and oil-heating systems, the promotion of biofuel oils and solar-powered heating, and the provision of advice and information to energy end-users as required under the Energy Services Directive.

The energy efficiency agreement for the property sector includes two programmes of measures. Associations which own, e.g., rental properties are entitled to participate in the programme for residential lettings associations. Twenty-six companies have joined the operational programme (as at 1 July 2012), covering approximately 80% of the housing stock falling under the operational programme.

In white goods and electronics, Finland relies heavily on international initiatives such as the EuP Directive, Energy Star and energy labelling of equipment. These are estimated to bring considerable savings over time. For windows, there has been a national energy efficiency labelling scheme in place since 2006.

Consumers' need for energy advice is recognised by the national strategies and programmes. Energy advice is given to consumers under three far-ranging projects with the following names: consumer energy advice, travel guidance, and renovation advice. In December 2010, the Ministry of Employment and the Economy designated Motiva as a national coordination centre for energy advice for consumers. In 2010–2011, an exceptionally extensive consumer advice project was implemented in Finland with nearly EUR 4 million of funding for 13 pilot projects. The experience from the pilot projects will be used to develop a permanent programme of energy advice for consumers in an ongoing project in 2012-2013.

Transport Sector

A significant part of legislation and regulation in the transport sector is set at the international level and adopted nationally. However, there are also national measures in place to advance energy efficiency in transport. One of them is taxation. Transport tax comprises the car tax to be paid when a vehicle is first registered, the vehicle tax to be paid annually, and fuel tax on transport fuels. Transport tax is therefore directed at the procurement and availability of the vehicle, as well as its actual use. Car and vehicle tax are defined according to the vehicle's emissions, in addition to which fuel tax was also amended in 2011 so that it is now based on energy and carbon content.

Activities in mobility management are being strengthened. The Ministry and the Finnish Transport Agency launched a call for tenders for projects which form the Mobility Management Programme. The coordinator of the calls was Motiva Oy. As a consequence of the call for tenders, thirteen projects were launched for years 2010-2011. Two of the objectives of the Programme are to link regional mobility management as an integral part of the national mobility management and as a part of the coordinated energy advice given to the consumers. Furthermore, a Cycling and Walking Strategy was issued in 2011 and the National Action Plan for Cycling and Walking in March 2012. The objective of the strategy is that in 2020 the number of trips made by cycling, walking and by using public transport will be 20% higher than in 2005. The growth should come from modal shift from private cars. Trips made by cycling and walking should increase by 300 million trips per annum and their share among the different transport modes should increase from 32% to 35–38%.

Two voluntary agreements operate in the transport sector, one for freight transport and logistics (2008-2016) and another one for public transport (2008-2016).

Industrial Sector

Voluntary agreements and energy audits have continued to have a significant role in promoting energy efficiency in industry. The energy efficiency agreement for industries contains (2007-2016) five sector-specific operational programmes for small and medium-sized industrial energy users, and these programmes are managed by trade associations in each sector. There is one general operational programme for those businesses that have not had a specific operational programme prepared for their sector. 239 businesses (as at 1 July 2011) have joined these six operational programmes. Energy use by those who have joined the operational programme for medium-sized industry varies depending on the sector, and is on average 50–70% of the energy use in the ESD area for the sectors in question. Energy advice for small and medium sized industries, which started in 2009, is one of the activities which has been launched under the sphere of the energy efficiency agreements.

The energy efficiency agreement for industries (2007-2016) contains a dedicated operational programme for energy users in energy-intensive industry. This programme is joined by industrial businesses with at least one site with total energy consumption of more than 100 GWh/a. Thirty-eight businesses (as at 1 July 2012) have joined the operational programme accounting for practically all energy use in energy-intensive industry.

Tertiary Sector

The energy efficiency of buildings has been guided by national building codes since 1976. In 2003, the energy requirements were made 25–30% more stringent than the level of the 1976 provisions. In 2008, the energy efficiency calculation was revised, so that the air tightness of the building envelope was considered as a new factor. The energy efficiency provisions were tightened up again in 2010, when they were made 30% more stringent than the 2003 level. Yet a new set of regulations was adopted at the beginning of 2012 improving the energy efficiency of new buildings by approximately 20%. They will also instigate a shift towards overall energy reviews. Under the new regulations, an upper limit is set for the building's total energy consumption (heating, cooling and electrical energy), depending on the type of building, and it is expressed using an "E ratio". The method employed to produce the energy used by the building is considered when calculating the E ratio. The calculation method advances the use of renewable energy and district heat and discourages the use of electricity for heating.

Energy efficiency in existing buildings is advanced through energy audits, subsidies, voluntary agreements and energy advice.

The energy efficiency agreement for the property sector (2010-2016) contains an operational programme for office premises which may be joined by companies that own or use premises, or which manage premises under authorisation from the owner. Twenty-one businesses (as at 1 July 2012) have joined the operational programme since the start of 2011, covering more than half of the property stock falling within the scope of the programme. The energy efficiency agreement for industries (2007-2016) contains three sector-specific operational programmes for businesses in the service sector, and these programmes are managed by trade associations in each sector. Additionally, there is one general operational programme for those businesses in the service sector that have not had a specific operational programme prepared for their sector. Eighty-one businesses (as at 1 July 2012) have joined the programmes of measures for the service sector under the energy efficiency agreement for business, including nearly 3 000 premises. Yet another voluntary agreement is the Farm Energy Programme operating in the agricultural sector in 2010-2016.

In line with the stipulations of the Energy Services Directive, public sector shall show positive example in advancing energy efficiency. One area is public procurement. In the resolution that it approved on 8 April 2009, Government required the central government to consider environmental perspectives in at least 70% of its own procurement in 2010, and in all its procurement in 2015. Of the electricity purchased by central government, at least 30% in 2010 and at least 60% in 2015 is to be electricity produced using renewable energy sources. The advisory service for public environmental technology procurement has been running since September 2009. For new construction and new properties leased for public use by central government, the target is for these to be of energy efficiency class A in 2010, and for basic repairs to existing buildings to be of at least energy efficiency class C. The target is for houses built, repaired and leased after 2015 to be passive.

All state organisations are required to prepare their energy efficiency plans by the end of 2012. However, some delays are expected. All central government organisations were to introduce also an environmental scheme by 2010.

The Energy Efficiency Agreement and Programme for Municipalities runs from 2008 to 2016.

Cross-cutting measures

The strategies and programmes for energy efficiency are discussed in Chapter 3.3.

One important overarching measure is energy taxation. In addition to fiscal targets, energy tax also aims to meet energy and climate policy objectives. Energy taxes on

transport, heating and electricity were increased on average by 9.8% at the start of 2008, whilst keeping the tax structure unchanged.

Fixed subsidies for electricity produced from renewable energy have been used to promote renewables but they were abolished at the beginning of 2012. They coexisted for a year with feed-in tariffs which were introduced at the beginning of 2011, however, as mutually excluding schemes. In addition, investment subsidies are available. The objectives of the feed-in tariff scheme are to increase wind power generation by 6 TWh and electricity generation from wood chips by 22 TWh. CHP production is eligible for subsidised only when it uses biofuels and operates in small scale. Large-scale CHP is used extensively in Finland in a competitive manner without subsidies.

Research and development are part of building the foundation of energy efficiency. In December 2010, the Research and Innovation Council approved a new training, research and innovation policy report for 2011–15. This core document defines Finland's strategic priorities, which also include energy and the environment. There are three key public sources of funding for research, development and innovation activity in Finland, namely Tekes, the Academy of Finland, and Sitra.

5.2 Patterns and Dynamics of Energy Efficiency Measures

Following the work done by the Energy Efficiency Committee (see Chapter 3.3), new measures have been launched in all sectors. Considerable amount of measures have also been launched to strengthen the foundation of energy efficiency. These measures are not focused on individual sectors but advance energy efficiency through research and development or capacity building. Emphasis is given also to the development of spatial planning which is a prerequisite for effective measures in the transport and building sectors.

Finland has not been considering launching an energy obligations scheme. Instead, considerable energy savings are believed to be achieved with voluntary measures which are easier to implement and entail lower transaction costs.

Residential Sector

In the residential sector several updates to the building codes have been made since 1990 which can be seen in the increasing role of normative legislative measures. Also the role of information measures has been growing and financial measures have been used to encourage building renovation. Some legislative measures using information

instruments - which are still on-going - were introduced already in the 1990s. These include EU measures such as energy efficiency labels and minimum energy performance standards.

Quite often measures work as a package. Legislative measures are often supplemented by information activities. Examples include trading of salesmen regarding the energy labels and energy efficiency or supplementing the regulations for energy efficiency for windows in the building codes with voluntary window energy labelling. Energy advice and subsidies encourage energy efficiency renovations in buildings.

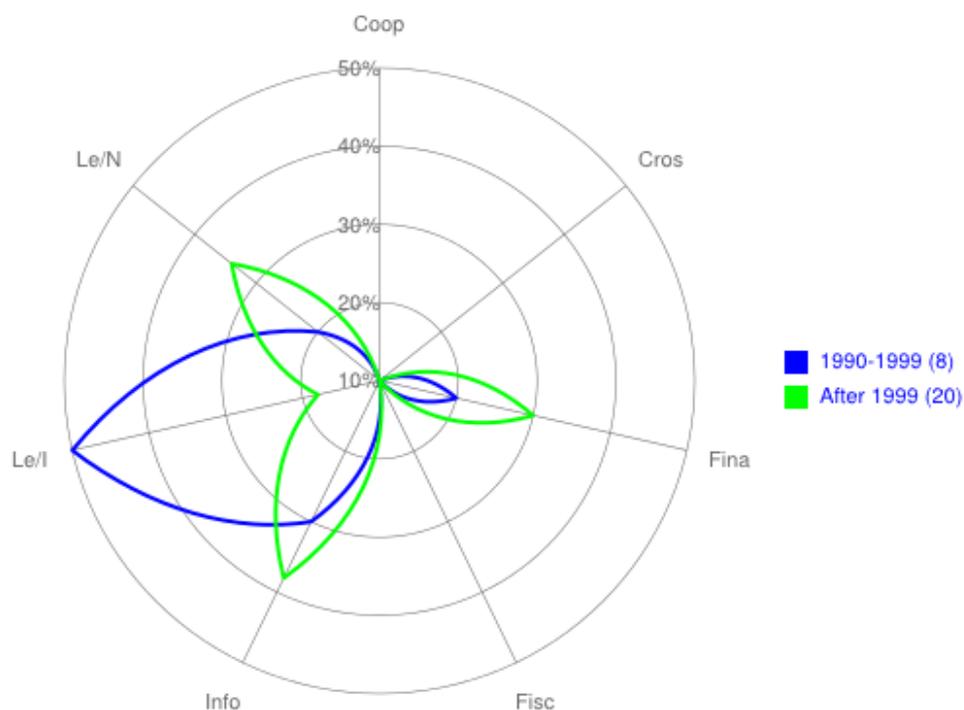


Figure 18 Measures for household in Finland, periods 1990-1999 and 2000-2011.

Transport Sector

In the transport sector normative legislative measures and information measures were in central role in the 1990s. However, sectoral measures are supplemented by energy taxation which is a cross-sectoral measure. Therefore, the role of fiscal measures is not quite correctly shown in Figure 19. In the 2000s, the new portfolio of policies and measures has become quite balanced consisting of several different measure types.

Voluntary agreements (co-operative measures) have been launched in passenger and goods transport, vehicle taxation has been made CO₂ dependent and mobility management programmes and walking and cycling strategies and action plans aim for modal shift. Most regulatory initiatives (emission performance standards, car energy labelling, energy labelling of tyres etc.) are now coming from the EU.

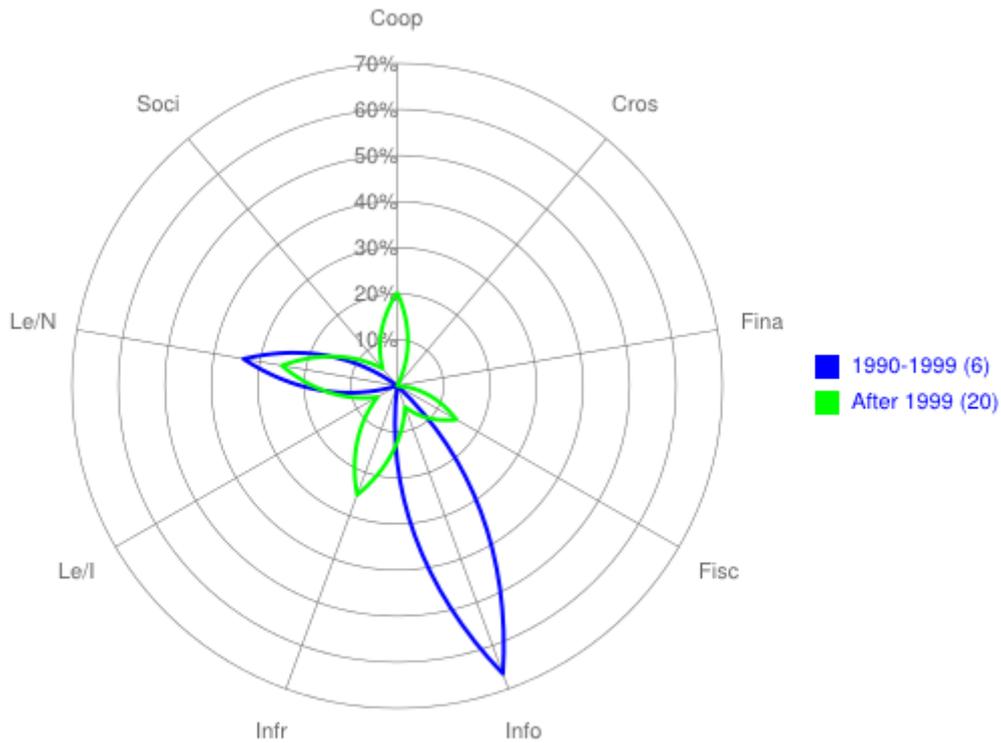


Figure 19 Measures in the transport sector in Finland, periods 1990-1999 and 2000-2011.

Industrial Sector

Despite the significance of EU measures for industry, such as the Emissions Trading Scheme, Finland has continued to implement and launch new national measures in industry.

In industry, Finland has relied on voluntary measures such as energy efficiency agreements and energy audit programmes. The first generation of voluntary agreements was launched in 1997 followed by the second generation at the end of 2007. After 2000, the role of information measures has increased. In recent years, advisory services have been developed for the SMEs in connection with the Energy Efficiency Agreements.

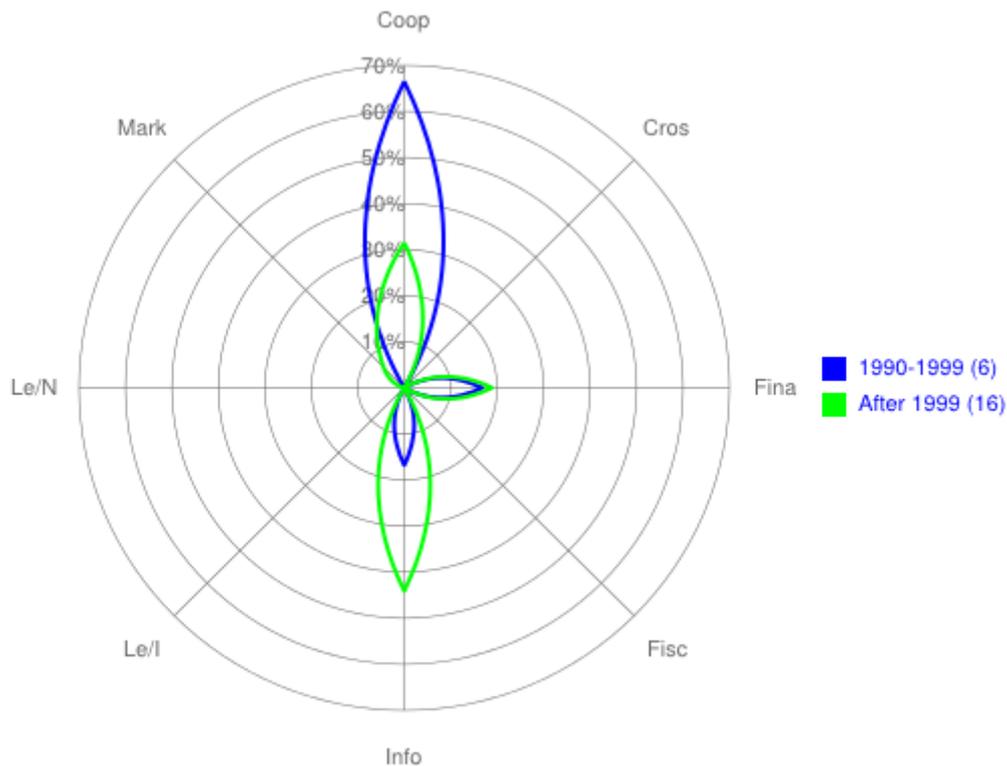


Figure 20 Measures in industry in Finland, periods 1990-1999 and 2000-2011.

Tertiary Sector

Several updates to the building codes, concerning also the services sector, have been made since 1990. In the 1990s subsidies were introduced for energy audits and energy efficiency investments and they still continue. The role of information measures has been growing rapidly. Tailored information is provided regarding various sub-sectors and end-uses such as professional kitchens, cold appliances in supermarkets, server halls, ski resorts and farms. Energy advisory services are provided to SMEs in connec-

tion with the voluntary agreements. The exemplary role of the public sector is portrayed in new measures such as more effective use of space, mandatory energy plans in the state sector and more attention to energy efficiency in public procurement.

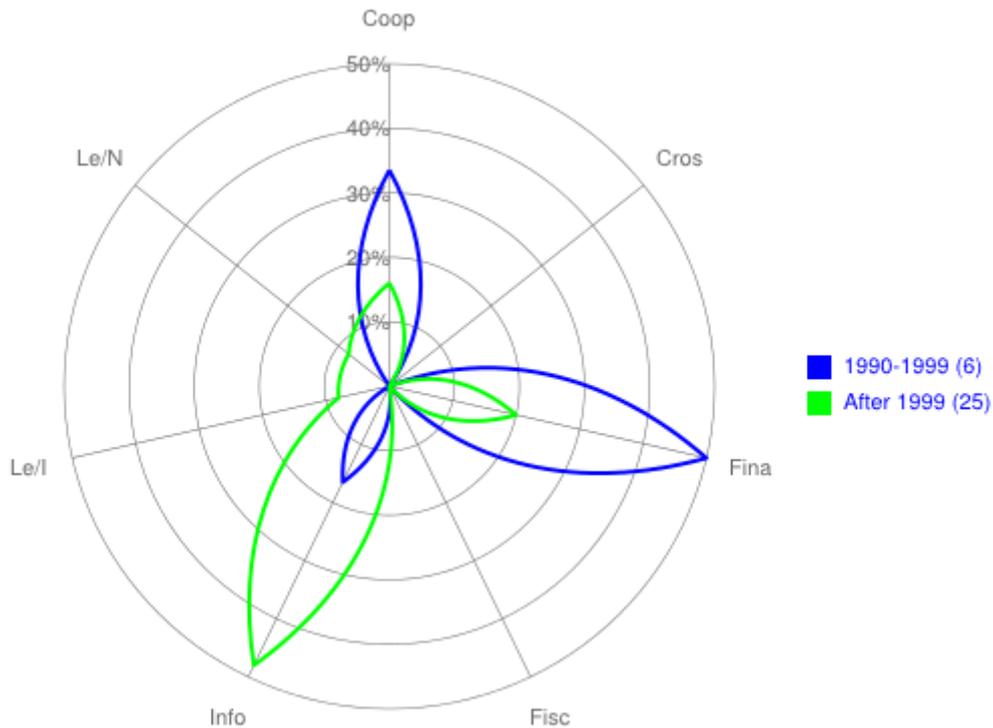


Figure 21 Measures in the services sector in Finland, periods 1990-1999 and 2000-2011.

Cross-cutting measures

A series of energy saving programmes have been established since the early 1990s (in 1992, 1995, 2000 and 2002). Since 2005, energy saving and energy efficiency activities have been incorporated into national climate and energy policy strategies. The prevailing strategy is the Long-term Climate and Energy Strategy of 2008 but it is in the process of updating.

Many cross-cutting measures have been in place already for some time. The national energy agency Motiva was established in 1993 and regional energy agencies in 1995. The energy awareness week has been running annually since 1996 and ESCOs have been in promoted since 2000. Subsidies have been available for renewables for quite a long time but feed-in tariffs were issued and the support schemes revised in 2011. The

significance of community planning for energy efficiency has been recognised already in the past but further emphasis has been given to it recently by introducing numerous new activities.

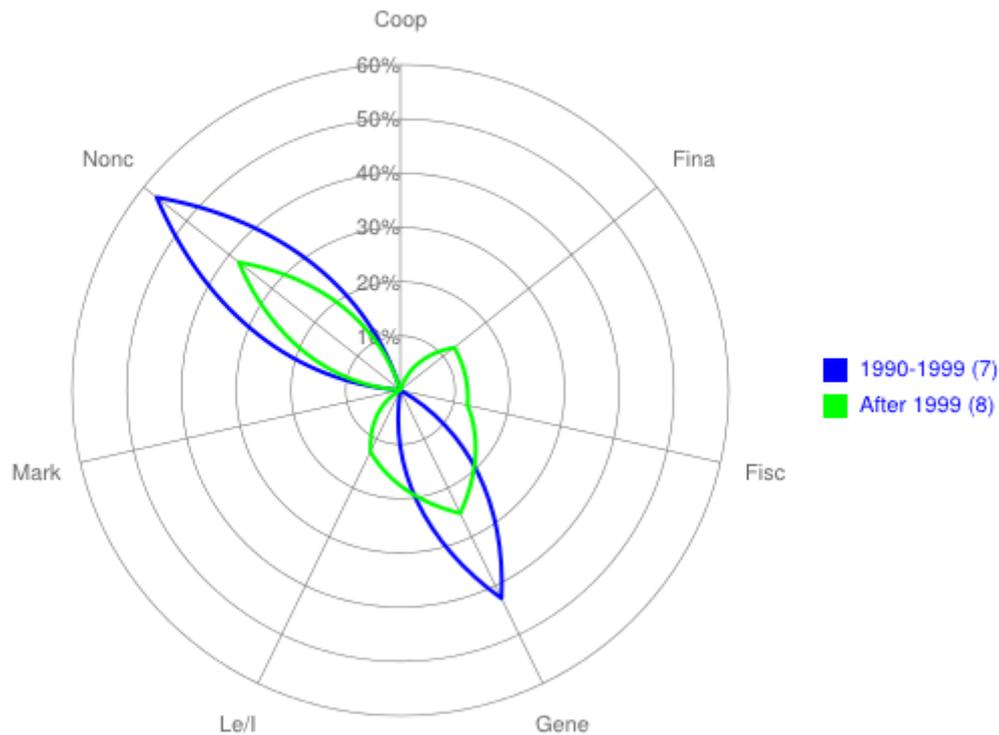


Figure 22 Cross-sectoral measures in Finland, periods 1990-1999 and 2000-2011.

5.3 Innovative Energy Efficiency Measures

The Energy Audit Programme (1992) and voluntary agreements (1997) were introduced quite early in European comparison regarding these measure types. Furthermore, the two measures are packages packaged together with investment subsidies and information measures. The energy audits and the voluntary agreements have been subject to vigorous monitoring and evaluation from the very beginning. Energy savings achieved have been measurable and significant, contributing towards the competitiveness of Finnish industry. However, while some agreements have attracted practically

the whole sector to join (e.g. energy-intensive industries), participation in some others the participation is still limited (goods transport and logistics, farms).

The voluntary agreements have been extended way beyond industry. The agreements cover the following sectors and sub-sectors:

- Industries
 - Energy intensive industries
 - Food and drink industries
 - Chemical industries
 - Plastic industries
 - Technology industries
 - Wood product industries
 - Other industries (industry – general)
- Energy sector
 - Energy production
 - Energy services
- Private services
 - Commerce sector
 - Hotel and restaurant sector
 - Motor trades and repairs
 - Other services (services – general)
- Property and building sector
 - Housing properties
 - Commercial properties
- Municipalities
- Oil sector
 - Heating oils and transportation fuels
- Transport
 - Goods transport and logistics
 - Public transport
- Farms

Numerous audit models have been developed for different sites and purposes. Audits implemented according to the models mentioned hereunder are eligible for audit subsidies.

- Building energy inspection
- Building energy audit

- Energy audit for blocks of flats and terrace housing
- Industrial energy audit
- Industrial energy analysis
- Process industry energy analysis
- Power plant energy analysis
- District heating energy audit
- Farm energy audit (in advanced stages of preparation)
- Energy audit for logistics chains
- Renewable energy municipal audit
- Post-acceptance audit
- Follow-up energy audit

In addition to the more comprehensive audits and analyses, analysis models have been developed for some important sub-systems, namely compressed air and refrigeration systems. They can be used individually or as a part of a more comprehensive audit or analysis.

The first regulations for energy efficiency in building were issued in 1976 and they have been subject to several updates. In the past, thermal insulation orders have been given to the different structural parts of the building but since 1 July 2012 this practice has been abrogated. Finland began to implement primary energy requirements as the general framework for the overall energy performance of buildings. This approach means a fundamental change in the design of buildings as much more freedom is given for design solutions to be used and taken into account in the compliance assessment. The primary energy criteria for common building types in the residential and service sectors are fixed, and the construction client is free to choose the best suitable measures for achieving the criterion. Total energy consumption of a building (E-Number) has to be calculated and its maximum level is regulated for each building type. The E-Number is the annually purchased amount of energy weighted by fuel-specific factors and divided by net heated area. The fuel specific factors encourage the use of renewables as well as district heating and cooling, and discourage the use of electricity.

The Ministry of Employment and the Economy has nominated Motiva Oy as the national coordination centre for consumer energy advice. At the same time, new energy advice projects have been launched. In an on-going development project internet-, telephone- and e-mail advisory services as well as field activities will be strengthened. Other key areas of activity are the development of advisor training, communications and marketing and monitoring and evaluation. The task of Motiva as the coordination centre is to ensure that various actors have up-to-date information and good tools in

their disposal. The coordinator also collects and evaluates the energy efficiency impacts of advisory activities.

Strengthening the activities in mobility management is part of the implementation of the National Long-term Climate and Energy Strategy and the Climate Policy Programme 2009-2020 of the Ministry of Transport and Communications. Two calls have been launched for tenders for projects which form the national Mobility Management Programme. The coordinator of the calls has been Motiva Oy. The first call of tenders was launched for the period 2010-2011 and the second for 2012-2013. Both calls resulted in the implementation of thirteen projects. In 2012-2013, the Mobility Management Programme develops measures and action models which will have an impact on the choice of transport modes which have health, security, economic and environmental benefits. Key themes are promotion of walking and cycling, and transport during the leisure time activities. The intentions are to link regional mobility management as an integral part of the national mobility management and as a part of the coordinated energy advice given to the consumers.

The Law on Car Tax was last revised on 21 December 2007 and took force on 1 January 2008 (Law on Car Tax 1292/2007). The revision made the car tax percentage of new passenger cars linearly dependant on the vehicle's specific carbon dioxide emissions. On 1 April 2009 the emission based car taxation was extended to new vans. The Law Tax was last revised on 1 April 2012. The tax tables for passenger cars and vans have been revised to strengthen the steering effect. The minimum car tax level was dropped from 12.2% to 5%, applicable when the vehicle's carbon dioxide emissions are 0 g/km. The maximum level has been increased from 48.8% to 50%, applicable when the emissions are 360 g/km or more. In practice, the tax level was lowered for cars with emissions no more than 110 g/km and increased for vehicles with emissions exceeding 110 g/km.

In addition to the Car Tax, also the annual Motor Vehicle Tax has been revised to become partly carbon dioxide emission dependent in March 2010. In 2012, the emission dependent part of the motor vehicle tax (so-called basic tax) can vary between 20 and 600 euros (CO₂ 66–400 g/km) but for approximately 80% cars the basic tax is between 70 and 160 euros.

Energy efficiency measures have been recognised to bring multiple benefits. Some of them have benefits beyond the conventional economic, environmental and security of supply benefits. While some measures entail considerable energy efficiency benefits, they may have been principally implemented to pursue other objectives. Farm re-parcelling is a social and economic measure which also directly reduces energy con-

sumption and improves road safety. In the transport sector vehicle inspections, lower wintertime speed limits and mandatory use of winter tyres have been introduced to enhance security of transport but also contribute to reductions in fuel consumption and emissions. Emission measurements are implemented in annual vehicle inspections, lower speed limits reduce fuel consumption and changing the summer tyres for winter tyres and vice versa practically always involves the checking of tyre pressure.

5.4 Energy efficiency measure evaluations

5.4.1 Semi-quantitative Impact Estimates of Energy Efficiency Measures

The semi-quantitative impact of each on-going measure is given in Annex 1. The following table briefly summarises these measures by impact category.

There are several high-impact measures in all sectors. Some of the most significant are the Energy Efficiency Agreements in several sectors and sub-sectors, the Energy Audit Programme (in industry and in the services sector), building codes (in the residential and the services sectors) and emission limits for cars. In the household sector one of the high impact measures is the promotion of heat pumps. In the transport sector the emission based car taxation has rapidly decreased the emissions of new cars. If a measure is estimated to have a high impact, the classification is typically based on quantitative evaluation results (e.g. those made in NEEAPs), and not on a subjective evaluation by the national team.

In Finland, there has not been an impact evaluation of the EU Emissions Trading Scheme whereby it has been classified to have an unknown impact. The strategies and government resolutions in cross-sectoral measures are typically classified to have high impact due to their overarching character. At the same time, there are quite many measures whose impact is not known because they work in combination with other activities. E.g. there are no models use to estimate the impact of energy taxation.

Table 3 On-going measures by sector and impact category in Finland

Sector	High impact	Medium impact	Low impact	Unknown
Households	4	4	5	6
Tertiary	5	7	10	1
Industry	6	1	5	1
Transport	5	6	5	3
Cross-sectoral	4		3	7
Total	24	18	28	18

5.4.2 Lessons from Quantitative Energy Efficiency Measure Evaluations

In Finland, practically all evaluations are based on bottom-up methodologies, however, the methods vary. In many cases (e.g. energy audits, energy efficiency agreements, investment subsidies) the evaluations are enhanced engineering estimates based on monitoring results. Modelling is used for some measures such as the building regulations or the impact of emissions limits for cars. It is also quite common to use deemed savings. These are applied to measures advancing, e.g., eco-driving, heat pumps, efficient windows (window energy rating), farm re-parcelling and lower driving speeds (wintertime speed limits).

The monitoring and evaluation systems for the energy audit programme and voluntary agreements (Energy Efficiency Agreements) were developed from the outset of these programmes. This has resulted in two major benefits. First, the measurable results, which are based on reliable monitoring and evaluation methods, have ensured the continuation of the two programmes for a considerable time, energy audits for 20 years and voluntary agreements for 15 years. Second, because results are known, Finland has been able to rely largely on voluntary approaches in the business sectors in order to meet its national and international policy objectives.

In the following, two examples of evaluations carried out in Finland's NEEAP-2 are presented. The results are reported in the MURE database.

Evaluation example of building regulations

For new construction, the energy consumption of buildings is guided by regulations and guidelines in the National Building Code of Finland. The energy efficiency of buildings

has been guided by national regulatory management since 1975. The regulations relating to energy efficiency were amended in 1978, 1985, 2003, 2008, 2010 and 2012. The 2008 amendment was structural, and did not involve any significant changes in terms of energy efficiency. In 2012, the overall structure of the regulations changed in addition to the level of efficiency required. Instead of regulating the energy efficiency of individual building parts, the overall consumption is capped and also the way in which energy is produced is taken into account.

The evaluation of the building regulation (e.g. in the NEEAPs) has been carried out using a calculation tool that has been financed by the Ministry of Environment and developed at the Tampere University of Technology. The model is used to define specific energy consumption for each part of a building, for each building type and age group, and considering any changes in heating methods. Total energy consumption by buildings in any given year is defined on the basis of specific consumption data, the amount of new production and renovation, and demolition of building stock. Due to the strict enforcement of the building code, it is assumed in the evaluation that all buildings comply with the building code.

In the calculations, the impact on savings achieved by making the thermal insulation regulations more stringent will last for the building's entire lifetime. The lifetime of building stock constructed after 2003 is assumed to be at least 50 years, and that of ventilation machinery equipped with heat recovery 20–25 years, which is the normal technical usable lifetime of such equipment in Finland. When equipment and structures are renovated and repaired, a product that is at least as good in terms of energy efficiency is nearly always selected.

The impact on savings that can be achieved in the specific consumption of heating energy in buildings has been calculated using the heating needs figures, weighted according to the volume of building stock and the location.

The amount of building stock for each house type and age group is based on construction statistics from Statistics Finland. It is estimated that the future quantitative trend for new construction will be the realised average of 10 years' production. The estimated impact on energy savings for 2010 is based on existing monitoring data on the quantitative trend in building capacity (ex-post), and the impact on energy savings for 2016 and 2020 is an estimate of future trends (ex-ante).

The impact of the July 2012 regulations will only be felt in new stock in 2013. The calculation has assumed that heating energy consumption by residential and service buildings will fall by 20% owing to the impact of the new regulations. The regulations will only apply to new construction, and the key change that they will bring about is a

switch to overall energy reviews, which will relate to all energy consumption in the building. It will therefore also consider, in addition to heating, all use of electricity and hot water that has not previously been included when defining whether new construction complies with the regulations. The impact on savings of the regulations for new construction in 2012 cannot yet be evaluated in any great detail, since the structure of the regulations will change to be based on primary energy, and savings will be calculated at building level. The change in the structure of the regulations will change heating choices, which will have a significant impact on energy savings.

Table 4 Energy savings, energy efficiency regulations for new construction, GWh/a

	2010	2016	2020
Energy efficiency regulations 2003, 2007, 2010	1 560	2 390	2 390
Energy efficiency regulations 2012	0	2 160	4 320
Total	1 560	4 550	6 710

Source: Finland's NEEAP-2

Evaluation example of energy audits in industry

The energy audit programme started in 1992. The energy audits include an assessment of the current situation of energy and water use, proposed measures relating to energy savings and the resulting estimated savings, as well as their reporting. For industry, there are three models in use for energy audits: industry energy audits, industry energy analyses, and a two-stage energy analysis of process industry. Industrial companies may also use other energy audit models, e.g., in their office buildings.

In monitoring, data is collected in three stages. First, some basic data is collected from the aid applications. Second, the energy-saving potential of the measures identified during energy audits is input into the energy audits database. Third, information on the implementation of measures is gathered annually from all those who are signed up to the energy efficiency agreement. They submit a report each year to the web-based monitoring system concerning their energy use, the energy-saving measures that they have implemented, and their fulfilment of other obligations connected to the implementation of the agreement. In recent years 85–90% of all industrial energy audits have been made by industries which have joined the energy efficiency agreements.

The information on the implementation of the measures is used to estimate the implemented portion of the energy-saving potential, from both energy audits and the potential under the energy efficiency agreement.

An impact evaluation for the energy audits was presented in Finland's NEEAP-2. The following calculation example is based on that evaluation. Because the assessment was prepared for NEEAP-2, it distinguishes between savings for premises within the scope of the ESD (ESD) and those within the scope of the emissions trading scheme (non-ESD) which is not usually done in national evaluations.

The energy-saving potential from audits in 2010–2011 has been estimated to be the average of the five preceding whole reporting years (2004–2008), 10% more than this in 2012–2016, and falling back down to the 2010 level in 2017–2020. The estimate is based on the number of audits started in 2009–2010 (2011 1st quarter) and on information from the previous agreement period (1997–2007) concerning the impact of the agreements on audit volumes and the trend in energy-saving potential.

The energy-saving potential and information on the implementation of the measures have been calculated separately for measures linked to operating technology and other measures, i.e. technical measures. The lifetime of individual technical measures is not estimated separately, but a mean lifetime of 12 years is used, which is still conservative compared to the lifetime of 15 years set out for many technical measures for industry in the Commission's calculation guidelines. The lifetime of measures linked to operating technology has been set at 5 years, based on good monitoring of consumption and reacting to deviations, which are one of the obligations of the agreement. Only 3–4% of the energy-saving potential from measures set out during industrial energy audits comes from measures linked to operating technology. The energy-saving impact of the measures proposed during the audits is assumed to be achieved in the year following the energy audit.

Table 5 Energy savings from industrial energy audits, GWh/a

	2010	2016	2020
Energy audits, ESD industry	1 435	1 119	1 074
Energy audits, non-ESD industry	1 348	848	857

Source: Finland's NEEAP-2

6 National Developments under the EU Energy Efficiency Directive and the 20% Energy Efficiency Target of the EU

Some of the requirements by the proposed Energy Efficiency Directive (as of 13 June 2012) are already partially fulfilled in Finland but considerable amount of additional effort will be required in all areas.

The proposed directive requires Member States to produce a long-term energy efficiency strategy for the public sector by 30 April 2014 and to update it every third year. In addition, 3% of state properties need to be renovated each year. In Finland, there is no specific energy efficiency strategy for the whole public sector but it is part of the national strategies and government resolution for energy efficiency. Some major activities conforming to the requirement in the proposed directive have been launched. The proportion of all state construction projects accounted for by repair projects is currently approximately 80%. Senate Properties, which manages the majority of state building stock, has an energy efficiency progress plan for construction investment in 2011–2020 where it establishes consumption targets for renovated buildings. Furthermore, Senate Properties and one of its principal capital tenants, the Defence Administration, have joined the energy efficiency agreement for the property sector. According to the agreement, the savings target for 2010–2016 is 6%.

Installation of electric meters with hourly data is underway and the installation shall be complete in 2014. Significant share of consumers already get monthly bills according to their consumption. District heating is not metered individually in blocks of flats. Half of single family houses are billed monthly according to consumption and the rest at least twice a year. Individual water metering is required in all new buildings.

CHP is used for electricity and heat production in large scale and most of its potential is already tapped.

At present, energy audits are voluntary and not required from large enterprises. An accreditation scheme is in place for the auditors.

In Finland, energy companies have already made considerable effort in advancing energy efficiency of their clients on voluntary basis. An energy efficiency agreement has been set up providing energy services. Finland considers that such voluntary approaches are more cost-effective and less intrusive than pursuing the same objectives through energy efficiency obligations.

Establishment of energy efficiency funds in Finland is difficult for constitutional reasons. Apart of tax deductions for households and subsidies, there are no other financing mechanisms for energy efficiency measures.

In Finland, a significant amount of new or strengthened measures were adopted in the government resolution for energy efficiency on 4 February 2010 (see Chapter 3.3). Most of these measures have been reported in NEEAP-2 and their implementation is underway. Therefore, few totally new national measures were announced in NEEAP-2 in June 2011.

According to the government resolution, challenging objectives cannot be attained by implementing individual measures alone, but society as a whole must undergo fundamental change. A range of conditions and measures must be in place for the achievement of such goals. These conditions form the broad based and far-reaching basis of all activities. In the report of the Energy Efficiency Committee, which formed the basis for the government resolution, this basis was being addressed as the stone pedestal of energy efficiency (see Figure 23).

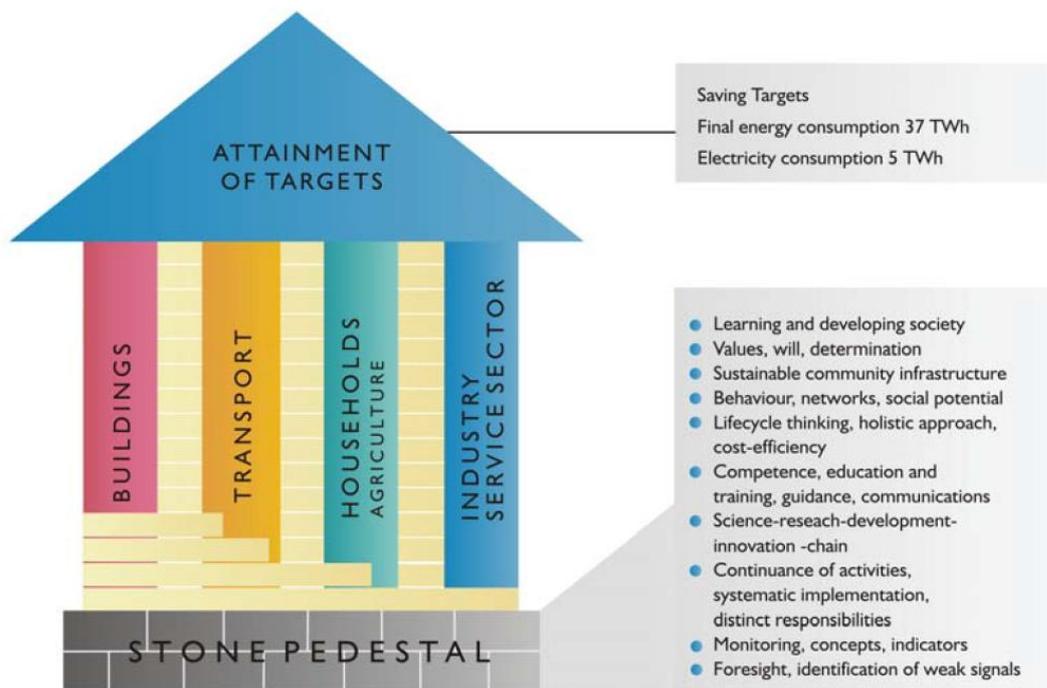


Figure 23 The stone pedestal of energy efficiency in Finland

Annex 1

Energy Efficiency Measure Summary by Country

Energy Efficiency Policies and Measures in Finland in 2012

HOUSEHOLDS

Code	Title	Status	Type	Starting Year	Semi-quantitative Impact	NEEAP Measure	EU-related Measure	Quantitative Evaluation
FIN3	Building code D3: Energy efficiency of buildings	Ongoing	Legislative/Normative	1979	High	Yes	No	YES
FIN11	Mandatory service book for buildings	Ongoing	Legislative/Informative	1994	Low	No	No	No
FIN16	EU-related: Energy Labelling of Household Appliances (Directive 92/75/EC) - Energy Labelling Law	Ongoing	Legislative/Informative	1995	Unknown	Yes	YES	No
FIN27	National theme week for second grade pupils	Ongoing	Information/Education	1996	Low	Yes	No	No
FIN6	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) - Building code D7: Orders for boiler efficiency	Ongoing	Legislative/Informative, Legislative/Normative	1998	Unknown	No	YES	No
FIN8	Promotion of wood pellet heating in buildings	Ongoing	Financial	1999	Unknown	No	No	No
FIN23	Household tax deduction	Ongoing	Fiscal/Tariffs	2000	Low	Yes	No	No
FIN30	Promotion of heat pumps	Ongoing	Information/Education	2000	High	Yes	No	YES
FIN17	Subsidies for energy audits and energy efficiency improvements	Ongoing	Financial	2002	Medium	Yes	No	YES
FIN4	Building code D2: Orders for indoor climate and ventilation in new buildings	Ongoing	Legislative/Normative	2003	Unknown	Yes	No	No
FIN18	Energy Audit Model for Residential Buildings	Ongoing	Unknown	2003	Unknown	No	No	No
FIN1	Window Energy Rating System	Ongoing	Information/Education	2006	High	Yes	No	YES
FIN21	Programme for energy conservation in oil-heated buildings, the Höylä III Programme	Ongoing	Information/Education	2007	High	Yes	No	YES
FIN24	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Periodic voluntary inspections of household boilers	Ongoing	Information/Education	2007	Low	No	YES	No
FIN31	Building code D5: guidelines on the calculation of power and energy needs for heating of buildings	Ongoing	Unknown	2008	Unknown	Yes	No	No
FIN32	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Mandatory energy efficiency certificates for buildings (dwellings)	Ongoing	Legislative/Informative, Legislative/Normative	2008	Low	No	YES	No
FIN7	Building codes C3 and C4: Thermal insulation	Ongoing	Legislative/Normative	2010	High	Yes	No	No
FIN28	Coordinated energy advice to the consumers	Ongoing	Information/Education	2010	Medium	No	No	No
FIN29	Energy Efficiency Agreement of the Property and Building Sector - Rental Property Action Plan	Ongoing	Unknown	2010	Medium	Yes	No	YES
FIN33	Building code D1: Water and Drainage Systems for Properties	Ongoing	Legislative/Normative	2011	Medium	Yes	No	YES

Energy Efficiency Policies and Measures in Finland in 2012

TRANSPORT

Code	Title	Status	Type	Starting Year	Semi-quantitative Impact	NEEAP Measure	EU-related Measure	Quantitative Evaluation
FIN30	Promoting public transport	Ongoing	Information/Education/Training, Infrastructure		High	Yes	No	YES
FIN20	Optimal tyre pressure in passenger car and van traffic	Ongoing	Information/Education/Training	1990	High	Yes	No	YES
FIN21	Wintertime speed limits	Ongoing	Legislative/Normative	1991	Medium	Yes	No	YES
FIN5	The annual vehicle inspection	Ongoing	Legislative/Normative	1993	Low	No	No	No
FIN12	Energy conscious driving education in driving schools	Ongoing	Information/Education/Training	1994	Medium	Yes	No	YES
FIN10	Energy conscious driving education programmes EcoDriving® and KEY	Ongoing	Information/Education/Training	1996	Medium	Yes	No	YES
FIN4	The network of Finnish cycling municipalities	Ongoing	Information/Education/Training	1997	Low	No	No	No
FIN7	International Car Free Day Campaign	Ongoing	Information/Education/Training	2000	Low	Yes	No	No
FIN11	Eco-Taxi environmental programme	Ongoing	Information/Education/Training	2000	Low	No	No	No
FIN13	EU-related: Passenger Car Labelling on fuel economy rating (Directive 1999/94/EC) - Mandatory CO2 label and voluntary energy label for new vehicles	Ongoing	Legislative/Informative	2001	Medium	Yes	YES	No
FIN23	EU-related: Speed limitation devices for certain categories of motor vehicles (Directive 2002/85/EC) - Speed limiter for lorries and busses	Ongoing	Legislative/Normative	2003	Unknown	No	YES	No
FIN18	Energy Efficiency Agreement for Freight Transport and Logistics 2008-2016	Ongoing	Co-operative Measures	2008	High	Yes	No	No
FIN19	Energy Efficiency Agreement for Public Transport 2008-2016	Ongoing	Co-operative Measures	2008	Medium	Yes	No	No
FIN22	Car Tax Revision	Ongoing	Fiscal	2008	High	No	No	No
FIN24	EU-related: Promotion of Biofuels or other Renewable Fuels for Transport (Directive 2003/30/EC) - Mandatory introduction of biofuels	Ongoing	Legislative/Normative	2008	Low	No	YES	No
FIN27	EU-related: Emission performance standards new passenger cars (Regulation 443/2009/EC) - Improving the energy efficiency of new cars	Ongoing	Legislative/Normative	2009	High	Yes	YES	YES
FIN25	Mobility Management Programme	Ongoing	Infrastructure	2010	Unknown	No	No	No
FIN32	Vehicle tax revision	Ongoing	Fiscal	2010	Low	No	No	No
FIN26	Promoting walking and cycling	Ongoing	Information/Education/Training, Infrastructure, SocialPlanning/Organisational	2011	Medium	Yes	No	YES
FIN29	EU-related: CO2 Standards for Light Duty Vehicles - Improving the energy efficiency of vans	Ongoing	Fiscal, Legislative/Normative	2014	Unknown	Yes	Yes	No

Energy Efficiency Policies and Measures in Finland in 2012

INDUSTRY

Code	Title	Status	Type	Starting Year	Semi-quantitative Impact	NEEAP Measure	EU-related Measure	Quantitative evaluation
FIN17	EU-related: Integrated Pollution Prevention and Control IPPC (Directive 2008/1/EC) - Energy efficiency requirements in environmental permits	Ongoing	Legislative/Normative		Low	Yes	YES	No
FIN3	Energy Auditing Programme in the Industry and Energy Sectors, the EAP	Ongoing	Financial, Information/Education/Training	1994	High	Yes	No	YES
FIN20	Subsidies for energy audits and energy investments (industry)	Ongoing	Financial	2002	High	Yes	No	No
FIN11	Compressed Air Efficiently - the PATE audit model	Ongoing	Information/Education/Training	2003	High	Yes	No	YES
FIN7	Recommendations for the procurement of high efficiency electric motors	Ongoing	Co-operative Measures	2004	Low	No	No	No
FIN13	Calculation Tool for Energy Efficiency Investments	Ongoing	Information/Education/Training	2004	Low	No	No	No
FIN12	Energy Audit Procedure for Transport Chains - KAEMUS	Ongoing	Information/Education/Training	2005	High	No	No	YES
FIN18	EU-related: EU Emission Trading Scheme (2003/87/EC) - EU Emissions Trading	Ongoing	New Market-based Instruments	2005	Unknown	No	YES	No
FIN14	Energy Efficiency Agreement of Industry 2008-2016	Ongoing	Co-operative Measures	2007	High	Yes	No	YES
FIN15	Energy Efficiency Agreement of Energy Production 2008-2016	Ongoing	Co-operative Measures	2007	High	Yes	No	YES
FIN16	Energy Efficiency Agreement of Energy Services 2008-2016	Ongoing	Co-operative Measures	2007	Medium	Yes	No	YES
FIN22	Analysis model for refrigeration systems (KYTE)	Ongoing	Information/Education/Training	2007	Low	No	No	No
FIN21	Energy Advice to SMEs	Ongoing	Information/Education/Training	2009	Low	Yes	No	No

Energy Efficiency Policies and Measures in Finland in 2012

TERTIARY

Code	Title	Status	Type	Starting Year	Semi-quantitative Impact	NEEAP Measure	EU-related Measure	Quantitative Evaluation
FIN34	Farm land reparation projects	Ongoing		1917	Medium	Yes	No	YES
FIN3	Energy Auditing Programme in the Service Sector	Ongoing	Financial, Information/Education/Training	1994	High	Yes	No	YES
FIN27	Investments in heating plants (agricultural sector)	Ongoing	Financial	1996	High	Yes	No	No
FIN8	Energy efficiency in public procurement	Ongoing	Co-operative Measures	2000	Medium	Yes	No	No
FIN25	Subsidies for energy audits and energy investments (the services sector)	Ongoing	Financial	2002	Unknown	Yes	No	No
FIN2	Model for Regional Survey of the Potential for Increased Use of Renewable Energy Sources	Ongoing	Information/Education/Training	2004	Low	No	No	YES
FIN13	Emission Calculator for offices and public events	Ongoing	Information/Education/Training	2005	Low	No	No	No
FIN26	Making the use of space more effective in central government	Ongoing	Unknown	2005	Medium	Yes	No	YES
FIN22	Training of environmental advisors in municipal organisations	Ongoing	Unknown	2006	Low	No	No	No
FIN31	Maintenance activity and user information for state property stock	Ongoing	Information/Education/Training	2006	Medium	Yes	No	YES
FIN15	Energy Efficiency Agreement for the Private Service Sector 2008-2016	Ongoing	Co-operative Measures	2007	Medium	Yes	No	YES
FIN17	Energy Efficiency Agreement and Programme of Municipalities 2008-2016	Ongoing	Co-operative Measures	2007	High	Yes	No	YES
FIN18	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Periodic voluntary inspections of boilers in the services sector	Ongoing	Information/Education/Training	2007	Low	No	YES	No
FIN19	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Periodic inspections of air conditioning systems	Ongoing	Legislative/Normative	2008	Low	No	YES	No
FIN24	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Mandatory energy efficiency certificates for buildings (services)	Ongoing	Legislative/Informative	2008	Low	No	YES	No
FIN32	Fresh grain silos	Ongoing	Financial	2008	Low	Yes	No	YES
FIN33	Unheated cattle buildings	Ongoing	Financial	2008	Low	Yes	No	YES
FIN29	Renovation of State Property Stock	Ongoing	Information/Education/Training	2009	Medium	Yes	No	YES
FIN30	Improving energy efficiency in new construction for the state	Ongoing	Information/Education/Training	2009	Low	Yes	No	YES
FIN35	Energy Advice for SMEs	Ongoing	Information/Education/Training	2009	Low	Yes	No	No
FIN20	Mandatory energy efficiency plans in the public sector	Ongoing	Legislative/Informative	2010	High	No	No	No
FIN21	Energy Efficiency Agreement of the Property and Building Sector - Commercial Property Action Plan	Ongoing	Co-operative Measures	2010	Medium	Yes	No	YES
FIN28	Building code D3: Orders for energy efficiency in buildings	Ongoing	Legislative/Normative	2010	High	Yes	No	No

Energy Efficiency Policies and Measures in Finland in 2012

GENERAL CROSS-CUTTING

Code	Title	Status	Type	Starting Year	Semi-quantitative Impact	NEEAP Measure	EU-related Measure	Quantitative Evaluation
FIN20	Energy education and training	Ongoing	Non-classified Measure Types		High	Yes	No	No
FIN24	Guidance to make community planning more energy efficient	Ongoing	Non-classified Measure Types		Low	Yes	No	No
FIN22	National Energy Agency Motiva	Ongoing	Non-classified Measure Types	1993	Unknown	Yes	No	No
FIN23	Tools, web-based services and information materials	Ongoing	Non-classified Measure Types	1993	Unknown	Yes	No	No
FIN15	Regional Energy Agencies	Ongoing	Non-classified Measure Types	1995	Unknown	Yes	No	No
FIN6	Energy Awareness Week	Ongoing	General Energy Efficiency / Climate Change / Renewable Programmes	1996	Low	Yes	No	No
FIN4	Energy taxation and tax subsidies	Ongoing	Non-classified Measure Types	1997	Unknown	Yes	No	No
FIN7	The ESCO Concept	Ongoing	Market-based Instruments	2000	Medium	Yes	No	YES
FIN11	Environmental classification of buildings (PROMISE)	Ongoing	Non-classified Measure Types	2002	Low	Yes	No	No
FIN10	Long-Term National Climate and Energy Strategy 2008	Ongoing	General Energy Efficiency / Climate Change / Renewable Programmes	2008	High	No	No	No
FIN12	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Ecological design of energy using products	Ongoing	Non-classified Measure Types	2009	High	Yes	YES	No
FIN14	Government decision on energy efficiency measures on 4 February 2010	Ongoing	General Energy Efficiency / Climate Change / Renewable Programmes	2010	High	No	No	No
FIN17	Law on energy efficiency services	Ongoing	Legislative/Normative Measures	2010	Unknown	No	Yes	No
FIN16	Feed-in tariffs for renewables	Ongoing	Fiscal Measures/Tariffs	2011	Unknown	No	No	No
FIN19	Fixed subsidies for electricity produced from renewables	Ongoing	Financial Measures	2011	Unknown	No	No	No

Annex 2

Country Profile



Energy Efficiency Profile: Finland

October 2012

Energy Efficiency Trends

Overview

Since 2000 the energy efficiency index (ODEX) has decreased by 7 points. This means that the energy efficiency has improved by 7% over the period 2000-2010.

Industry

In industry, the dominating role of paper industry is shown in the fact that the energy efficiency index for the total industry follows closely that of the paper industry, which is one of the major industries in Finland. The improvement in industry as a whole has been 10% from 2000 to 2010. The energy efficiency index cannot be calculated before 2000 due to lack of data.

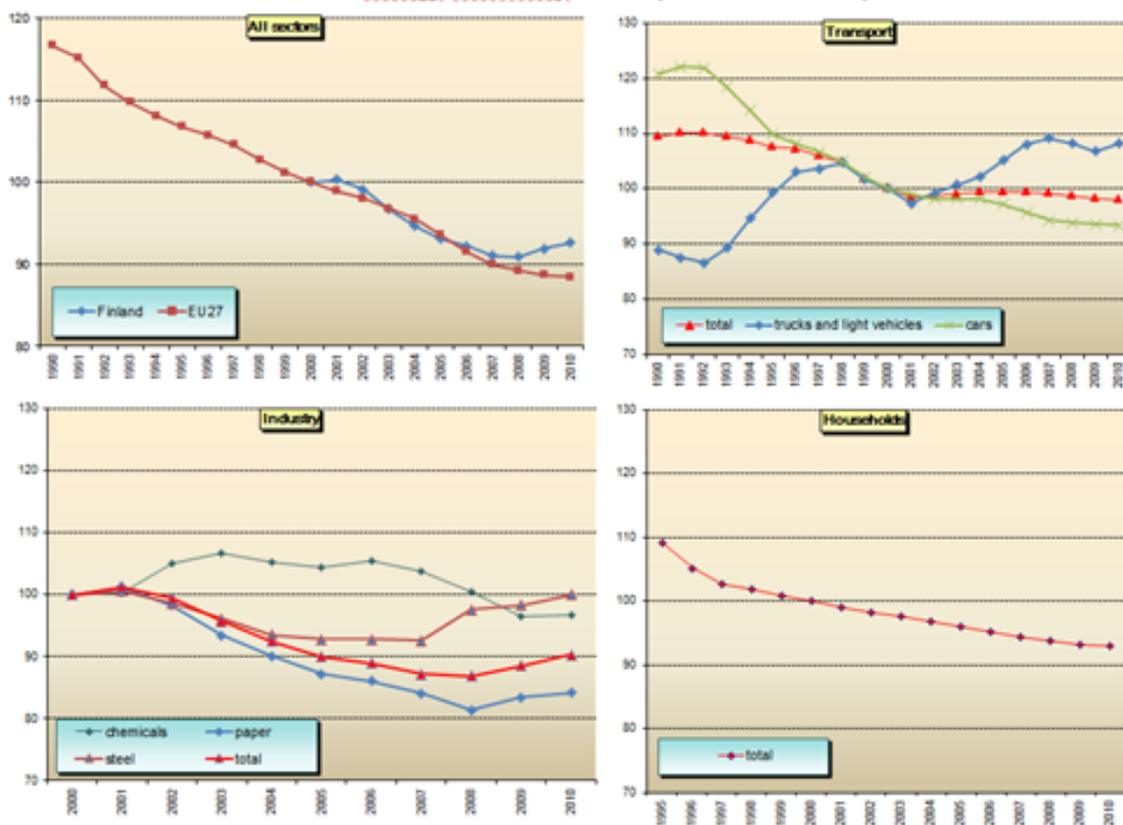
Households

The energy efficiency of the household sector is closely connected to the energy efficiency of space heating because of the cold and long winters. The energy efficiency index of households has decreased by 16 points from 1995 to 2010.

Transport

The overall energy efficiency of transport sector has improved by 11% from 1990 to 2010. Energy efficiency of land transport modes and air transport improved significantly, except for trucks and light vehicles most likely due to customer needs and less efficient fleet management.

Energy efficiency index (base 100=2000)*



* All indicators measured as a three-year moving average
Source: ODYSSEE
For more information: <http://www.odyssee-indicators.com/>

Energy Efficiency Policy Measures

Institutions and programmes

The **Long-Term Climate and Energy Strategy** adopted in 2008 updated the former strategy from 2005. It lays down the roadmap for Finland to meet its targets for greenhouse gas reductions. An action plan was adopted by the Government in February 2010 to define the energy efficiency measures over the next ten years to meet the energy efficiency targets of the Strategy for the period 2010-2020.

The Energy Department of the **Ministry of Employment and the Economy** is the government body responsible for energy policy. **Motiva Oy** is a state-owned company that helps the government to implement its energy efficiency measures.

Industry

In industry, voluntary agreements have been one of the major measures to pursue energy efficiency since 1997. The existing energy efficiency agreements extend over the 2008-2016 period. The voluntary agreements also boost energy auditing which, like energy efficiency investments, are promoted by subsidies.

Households, Services

In 2012, the Ministry of the Environment updated building regulations on heat insulation. They lead to 20% improvement in energy efficiency of new buildings succeeding to a 30% improvement from the 2010 update. In Finland, the building regulations are strictly enforced. Subsidies are available for households for improving heat insulation, renewing and repairing ventilation and heating systems and adopting renewable energy. Permanent consumer energy advice infrastructure is under development.

Several energy efficiency agreements are in place to improve energy efficiency in the household and service sectors. They cover municipalities (2008-2016); private services including commerce, hotels and restaurants and motor trades and repairs (2008-2016); the property and building sector (2010-2016); farms (2010-2016) and oil-heated buildings and distribution of liquid heating and transport fuels (2008-2016).

Transport

The energy efficiency agreements in the transport sector cover freight transport and logistics (2008-2016) and public transport (2008-2016). The latter comprises transport by buses and coaches, trams and local trains. The 2008 revision of the car tax made the taxes of passenger cars linearly dependant on their specific carbon dioxide emissions per km.

Energy prices and taxes

Energy taxation aims to curb the growth of energy consumption and steer the production and use of energy towards alternatives sources with lower emissions. Tax based on the energy contents of fuels is levied on oil products, coal and natural gas. In addition, a carbon tax based on the carbon content of the fuel is collected for all fossil fuels; however, at a lower rate for natural gas. The energy tax for electricity, peat and tall oil is not dependant on their carbon content.

Selected Energy Efficiency Measures

Sectors	Title of measures	Since
Industry and Services	The Energy Audit Programme	1992
Industry and Services	The Energy Efficiency Agreement for Industries and its predecessors	1997
Services	The Energy Efficiency Agreement and Programme for Municipalities and their predecessors	1997
Services and Households	Property and Building Sector Energy Efficiency Agreement (covering Rental Property Action Plan and Commercial Property Action Plan). Its predecessors date back to 2002 in the households sector and 1999 in the commercial and state properties	2010
Transport	Carbon emission dependent car taxation	2008
Households	Energy Efficiency Agreement for Oil-heated Buildings and Distribution of Liquid Heating and Transport Fuels (The Höylä III Programme and its predecessors)	1997
Households	Development of permanent consumer energy advice infrastructure	2011
Horizontal	Energy subsidy for energy audits and energy efficiency improvements	1992
Horizontal	Latest update of the thermal insulation regulations	2012

Source: MURE

For more information, see <http://www.muredatabase.org/>

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