Energy efficiency trends and policies in Finland

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EXECUTIVE SUMMARY

The National Energy and Climate Strategy was updated in 2013. It, together with Energy and Climate Roadmap 2050, lays down the roadmap for Finland to meet its targets for greenhouse gas reductions. In addition, 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 for the period 2010-2020. In 2013, Finland submitted its third National Energy Efficiency Action Plan to the European Commission, in context of the Energy Efficiency Directive.

The recession in Finnish economy continues with clear impact on energy consumption particularly in industry which – despite structural change towards services – continues to be largest energy consuming sector with 48% share. Within industry, the proportion of energy intensive pulp and paper industry has dropped from 63% in industrial energy consumption in 2000 to 43% in 2010 while the proportion of less energy intensive industries has grown. Normalized energy consumption for heating in the residential sector has increased in par with the floor area while electricity use for appliances and lighting has declined due to the Eco-design and Energy Labelling Directives. In the services sector, specific consumption (toe/m^2) has improved by 12% from 2000 to 2012.

Voluntary energy efficiency agreements and energy audits continue to be among the key policies with measurable and considerable savings in industry, municipalities and private services.

Building regulations continue to be one of the key policies in the household and service sectors; regulations for heat consumption were last updated in 2012 and the first energy efficiency regulations for buildings undergoing renovation took force in 2013. Full roll-out of smart meters for electricity has been implemented.

In the transport sector, European emission caps and emission dependent taxation have had a visible impact on energy consumption of new passenger cars alongside with 2007-2008 revision of car taxation which is based on CO_2 emissions. The energy efficiency agreements in the transport sector cover freight transport and logistics (2008-2016) and public transport (2008-2016).

Energy taxation aims to curb the growth of energy consumption and steer the production and use of energy towards alternatives sources with lower emissions.

1. ECONOMIC AND ENERGY EFFICIENCY CONTEXT

1.1. ECONOMIC CONTEXT

Finland has a relatively small population of 5.4 million. With a land area of 338 000 km^2 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 18% from 2000 to 2014. However, the growth has not been constant as a steep 8.3% drop was observed in 2009. Recovery of exports, domestic trade and household consumption stimulated economic growth in 2010-2011 but GDP declined again in 2012, 2013 and 2014. According to the Bank of Finland, it has long been possible to attribute the protracted recession of 2008–2014 mainly to the weakness of the international economy. Recently, however, the role of domestic supply and demand factors has become increasingly apparent.

The per capita output (in current prices) was 37 268 euros in 2014.

Table 1 Economic trends on Finland, 2000-2014

	2000	2005	2008	2009	2010	2014
GDP in M€ (€2010)	158 089	179 646	198 040	181 664	187 100	186 460
GDP annual change	5.6%	2.8%	0.7%	-8.3%	3.0%	-0.1%
Private consumption of households in M€ (€2010)	74 119	86 791	94 461	95 575	98 413	98 012
Private consumption of households, annual change	0.3%	1.3%	2.2%	1.2%	3.0%	-1.1%
Volume index of industry (2010=100)	91.2	100.0	115.6	94.7	100	93.8

Source: Statistics Finland

Trade is important with exports accounting 37.3% of GDP in 2014; the peak occurred in 2008 when the share of trade in GDP was 45.1%. 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.

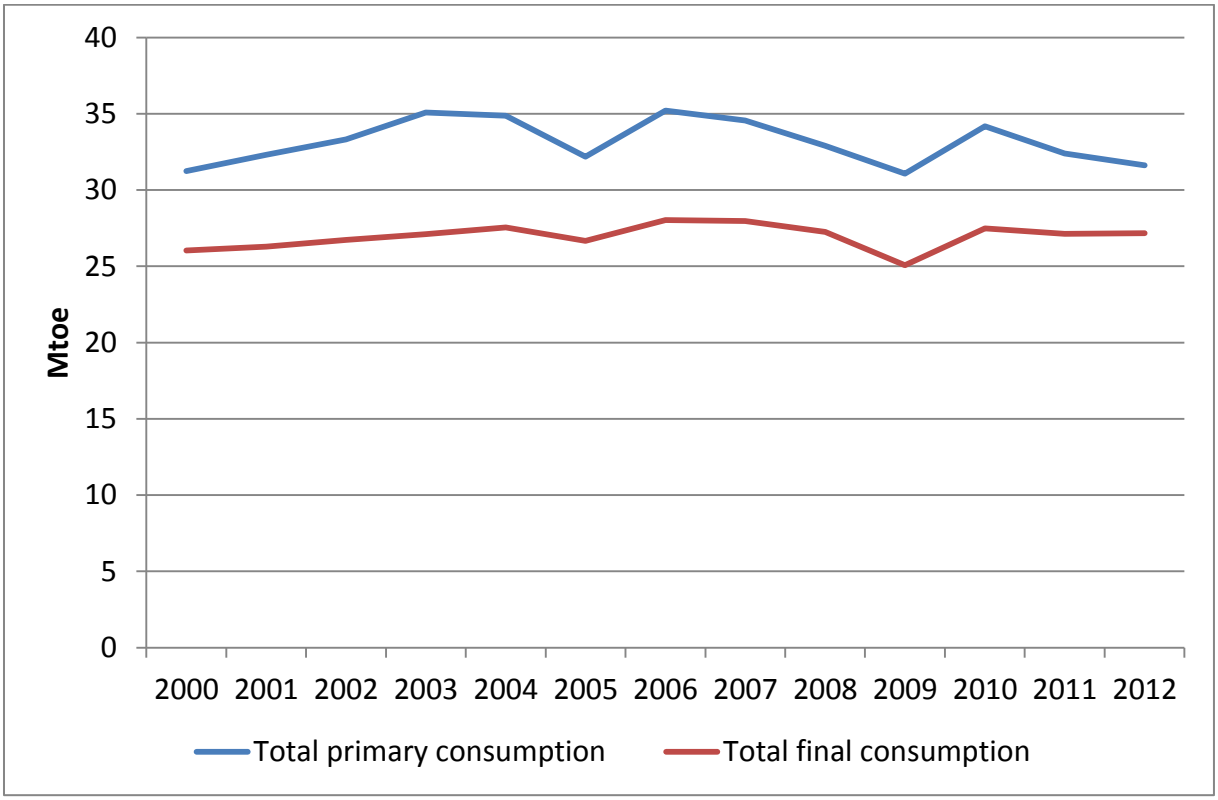
1.2. TOTAL ENERGY CONSUMPTION AND INTENSITIES

Total energy consumption in Finland was 31.6 Mtoe (381 TWh) and final energy consumption was 27.2 Mtoe (307 TWh) in 2012 (Figure 1). 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 economic 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 10% year on year. The main reasons for this growth were increase in industrial production that accompanied the economic recovery, and a very cold winter. From 2011 to 2014, total energy consumption has declined again each year with the exception of 2013 when 0.1% growth was observed.

Figure 1: Total and final energy consumption in Finland in 2000–2012

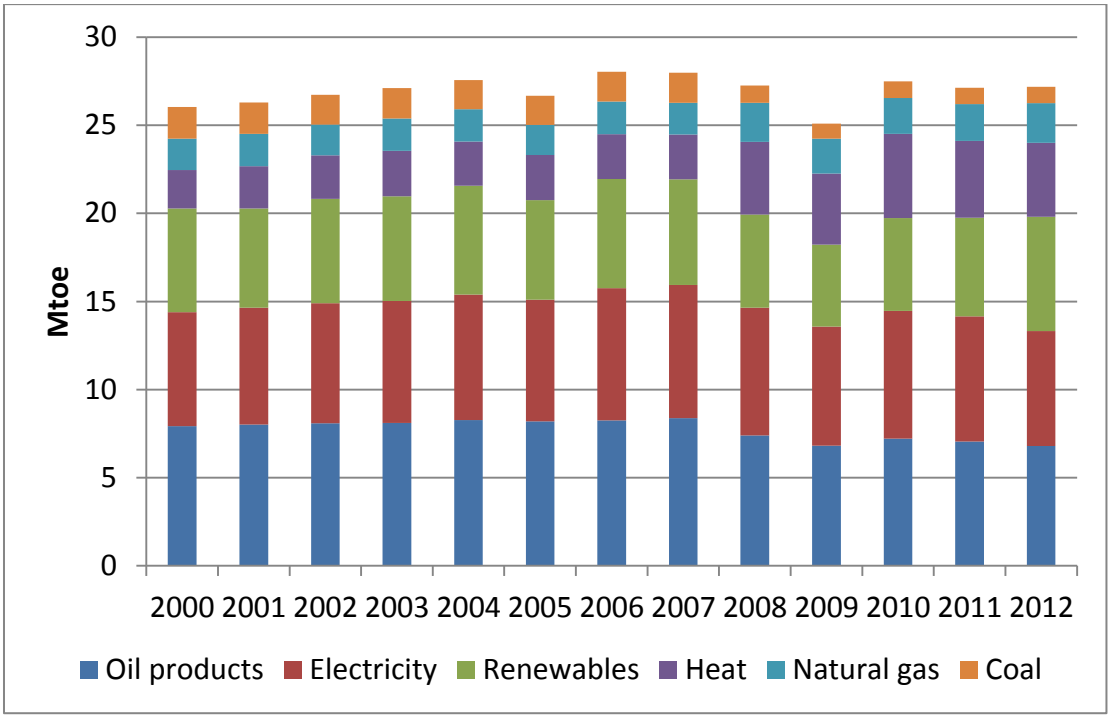


Source: Odyssee

In 2012, total energy consumption per capita was 69.6 MWh, meaning 1.8% total reduction since 2000. Energy end-use per capita was 56.5 MWh, equivalent to 1.3% total reduction over the same period.

There is no one dominant fuel in the final energy consumption but oil products, electricity and renewable energies are used in almost equal amounts (Figure 2). Also heat (district heating) makes a significant contribution while the use of natural gas and coal is smaller.

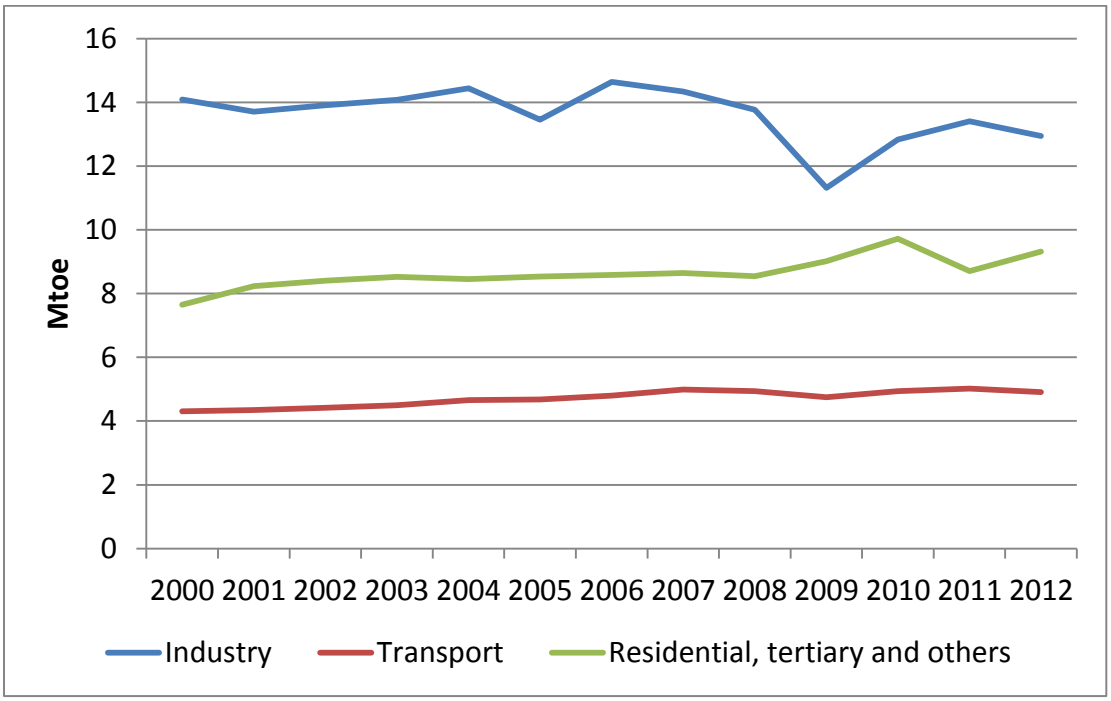
Figure 2: Final energy consumption by fuel in Finland in 2000–2012



Source: Odyssee

In Finland, industry is the largest energy consuming sector (48%). The share of transport is 18% while the residential, services, agricultural and other sectors account for 34% of the total (Figure 3).

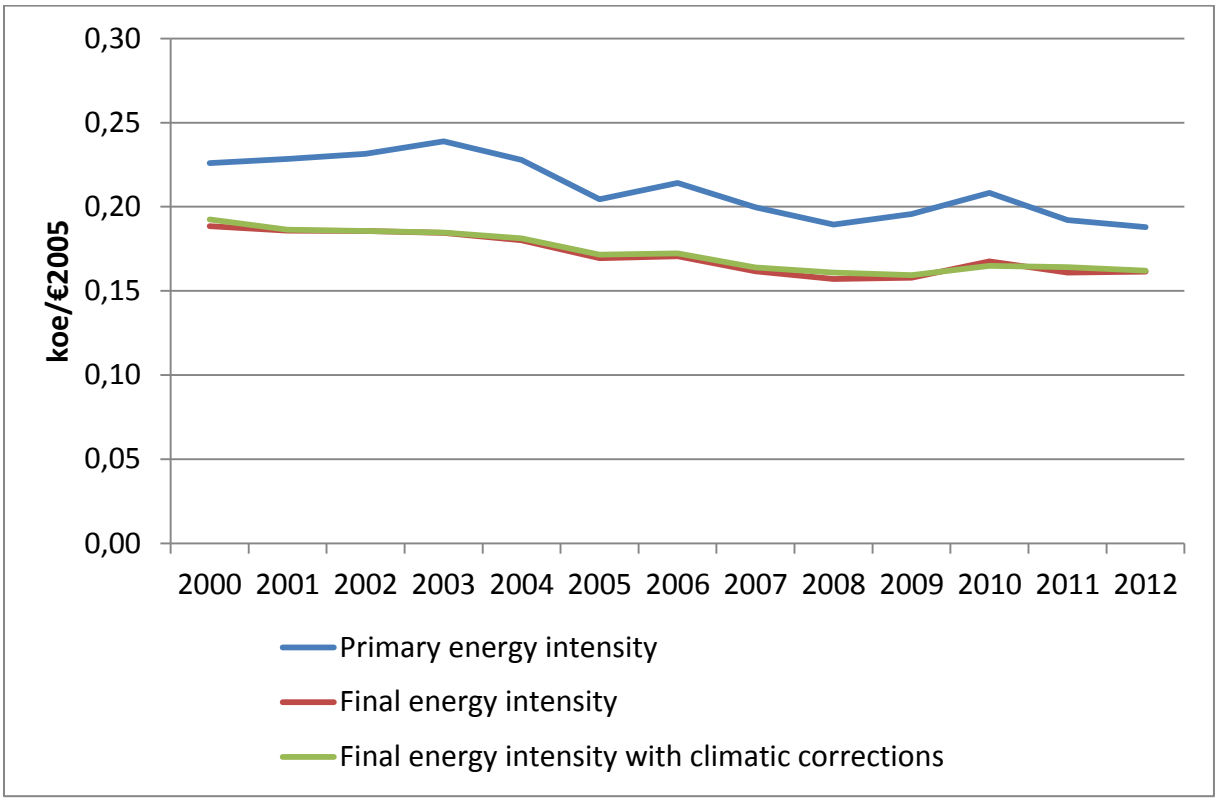
Figure 3: Energy end-use per sector in Finland in 2000–2012



Source: Odyssee

Figure 4 shows the trends in primary and final energy intensities. Both are at a lower level than in 2000 but the final energy intensity has stagnated since the beginning of the recession in 2008. The structural changes from industrial production towards services, as well as partial shift in industry away from energy-intensive production, have contributed to the overall reduction.

Figure 4: Energy intensity in Finland in 2000–2012



Source: Odyssee

1.3. ENERGY EFFICIENCY POLICY BACKGROUND

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.

Energy and Climate 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 Energy and Climate Strategy of 2013.

Prime Minister Jyrki Katainen's Government appointed a ministerial working group on energy and climate policy to update the National Climate and Energy Strategy, completed in 2008. Key objectives of the strategy update included ensuring that the national targets for 2020 are achieved and to prepare a pathway towards meeting the long-term energy and climate objectives set by the EU. As specified in the Government programme, the new strategy entails a programme to reduce oil dependence. The Government approved the

strategy update on 20 March 2013.

The 2008 climate and energy strategy set the energy savings target at 37 TWh (as calculated from final consumption) by 2020. Electrical energy accounted for 5 TWh of this target, and thermal energy and transport fuels for the rest. Final energy consumption would then amount to 310 TWh in 2020. With respect to electricity, this goal will be met primarily due to slower economic growth and structural changes in the economy. As regards other forms of energy, this target may not be met, in which case the final consumption target of 310 TWh will not be fully achieved. This is partly due to a change in statistical methods, which corrected the earlier underestimation of the historical energy consumption which was used as the basis for the preparation of the 2008 strategy.

The indicative objective, set out in the Energy Services Directive to enhance the efficiency of energy use by 9% by 2015, will be met. Even if no new measures are employed, energy savings exceeding 12% will probably be achieved. Since there are significant differences in how the objectives are defined in the 2008 climate and energy strategy and the Energy Services Directive, these are not directly comparable. New energy efficiency targets, such as the indicative national energy efficiency target for 2020, are included in the Energy Efficiency Directive replacing the Energy Services Directive, and in force as of December 2012.

Since the completion of the 2008 climate and energy strategy, several policy measures for energy efficiency and energy saving have been decided on and implemented. When factoring in the impact of previously decided measures, estimated final energy consumption in Finland would be 325 TWh in 2020. Due to a change in statistical methods, this figure is not, however, directly comparable with the figures presented in the 2008 strategy. Statistics Finland updates the time series for energy statistics when calculation methods change, or when it obtains more detailed or updated data. In the most recent energy statistics, final consumption for the previous years has been reviewed. For example, actual final consumption in 2006 was 11 TWh higher than assumed during the preparation of the 2008 strategy.

The strategy contains altogether 131 measures in the different areas of energy policy. The following three measures are stated with a view to EU energy and climate policy after 2020:

1) Emission reduction targets for the period after 2020 must be in line with the general objective of limiting global warming to two degrees Celsius. Preparations will be made for the discussion on setting an emission reduction target for 2030. In addition, it will be examined whether other, comparable targets are required for energy policy, alongside the emission reduction target.
2) Setting only one target which has the planned steering effect, that is, the emission reduction target is likely to yield the highest cost-efficiency. Targets set by the EU for renewable energy would bring predictability to investors and developers of technology. The renewable energy target, be it a common EU target or a member state-specific target, should be indicative or a moderate binding target, to allow for sufficient room for national energy policy and possible changes in national conditions. Three separate targets set at the EU level would prevent the optimisation of measures. For this reason, the possible EU energy efficiency target should be indicative, and Finland should be able to define its own national target. Energy efficiency is already widely promoted in the EU. In the future, common measures, such as energy-efficiency standards for equipment, will be employed to an increasing extent.
3) As steering methods for renewable forms of energy continue to be employed in the 2020s, EU-level harmonisation of legislation that steers support systems should be pursued, alongside improved cost-efficiency.

The energy efficiency measures are:

4) A target will be set to level off growth in final energy consumption, by improving energy efficiency

so that, in 2020, consumption will be 310 TWh at a maximum.

5) A national energy efficiency action plan will be drawn up in accordance with the Energy Efficiency Directive.
6) An energy efficiency act will be prepared, particularly for implementing the Energy Efficiency Directive. The Ministry of Employment and the Economy will be responsible for the preparation of the act in cooperation with the Ministry of Transport and Communications, the Ministry of Agriculture and Forestry, the Ministry of Finance, and the Ministry of the Environment.
7) The possibility of establishing an energy efficiency obligation scheme for energy companies, and combining this with other measures, will be examined without delay.
8) A long-term strategy on improving the energy efficiency of buildings will be prepared, observing the time limit set in the Energy Efficiency Directive.
9) In accordance with the Energy Efficiency Directive, an energy conservation plan for central government buildings will be prepared and its monitoring and implementation will be incorporated into corporate-level financial planning and management.
10) Energy efficiency will be implemented in public procurement by the central government, in accordance with the Energy Efficiency Directive. State organisations will be obligated to actively promote cleantech and green procurement. At local government level, a recommendation will be made for the promotion of cleantech and green procurement. The emergence of pioneering municipalities in energy efficiency will be promoted.
11) Energy efficiency agreements and energy programmes for the local government sector will be further developed as part of the Energy Efficiency Directive's implementation.
12) The emergence and growth of international energy efficiency business will be promoted. The energy efficiency agreement system and the strategic centres for science, technology and innovation will be harnessed in the development of new business. As part of the strategic programme for cleantech, operation models that could be exploited to boost business growth will be promoted.
13) An analysis will be conducted to examine the extent to which increasingly promoting the use of renewable energy in district heating plants is a more cost-efficient way of reducing emissions, in comparison to renovation investments that improve energy efficiency.
14) Opportunities for the more forceful promotion of improved energy efficiency in road transport will be assessed without delay, including energy subsidies to improve the energy efficiency of public transport and goods transport and to curb the increase in the cost of transport services, as well as incentives for the acquisition of vehicles that are more energy-efficient. This assessment will be carried out as part of the implementation of the programme to reduce mineral oil consumption.
15) Implementation of the national intelligent transport strategy will be ensured in different modes of transport, in order to improve the energy efficiency of the entire transport system.
16) Determined energy efficiency targets will be set for the energy consumption of information and communications networks and IT infrastructures, which is on the increase.
17) The sustainability of services based on information and communications technology will be assessed, as part of the energy efficiency commitments.
18) Farms will be encouraged to promote energy efficiency through various means, for example measures included in the Rural Development Programme.

Energy and Climate Roadmap 2050

As outlined in the Government Programme, the long-term goal is a carbon-neutral society, which can be achieved by following the roadmap towards 2050, involving an increase in energy-efficiency and the use of renewable energy and drafted on the basis of various strategies. Work on the roadmap begun in 2013 and it

was published on 16 October 2014; the preparation involved extensive consultation with interest groups and citizens.

The measures that Finland must take in any case in order to reduce the emissions of greenhouse gases by 80–95% are related to renewable energy, energy efficiency and cleantech solutions. Finland must increase the share of renewable energy in both energy production and consumption. The maximal use of domestic bioenergy must be secured, and the use of biofuels must be increased as the source of energy for transportation. In addition, other renewable energy forms must be increased. The potential of energy efficiency and the cleantech sector must be utilised in all sectors.

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 regularly coordinates and monitors the implementation of the measures set out in the resolution.

Institutional setting

The Energy Department of the Ministry of Employment and the Economy is the government body responsible for energy policy. Energy Authority started its operation at the beginning of 2014. Motiva Oy is a state-owned company that helps the government to implement its energy efficiency policies and measures.

1.3.1. ENERGY EFFICIENCY TARGETS

Finland submitted the first annual report for the Energy Efficiency Directive (EED) to the European Commission on 26 April 2013. In this report Finland set an indicative national target for the final energy consumption at 310 TWh in 2020. The corresponding primary energy consumption is 417 TWh. The national target was set in connection to the updating of the National Climate and Energy Strategy (see Chapter 1.3).

In the notification for Article 7 of the EED on 5 December 2013, final energy consumption calculated as average sales by retail companies to final users in 2010-2012 was 154.75 TWh of which 1.5% savings target is 2.32 TWh. Converted into cumulative energy savings, Finland's total energy saving target is 65.00 TWh_{kum} in the 2014-2020 period. Taking into the maximum 25% flexible mechanism in Article 2 and Finland's early actions, the cumulative energy savings target is 48.75 TWh_{kum} in the 2014-2020 period.

The indicative energy savings target established in accordance with the Energy Savings Directive is 17.8 TWh in 2016. The intermediate target for 2010 is 5.9 TWh while NEEAP-3 shows savings of 11.9 TWh for 2020. The savings estimate given in NEEAP-3 is 25.4 TWh in 2016 clearly exceeding the target.

2. ENERGY EFFICIENCY IN BUILDINGS

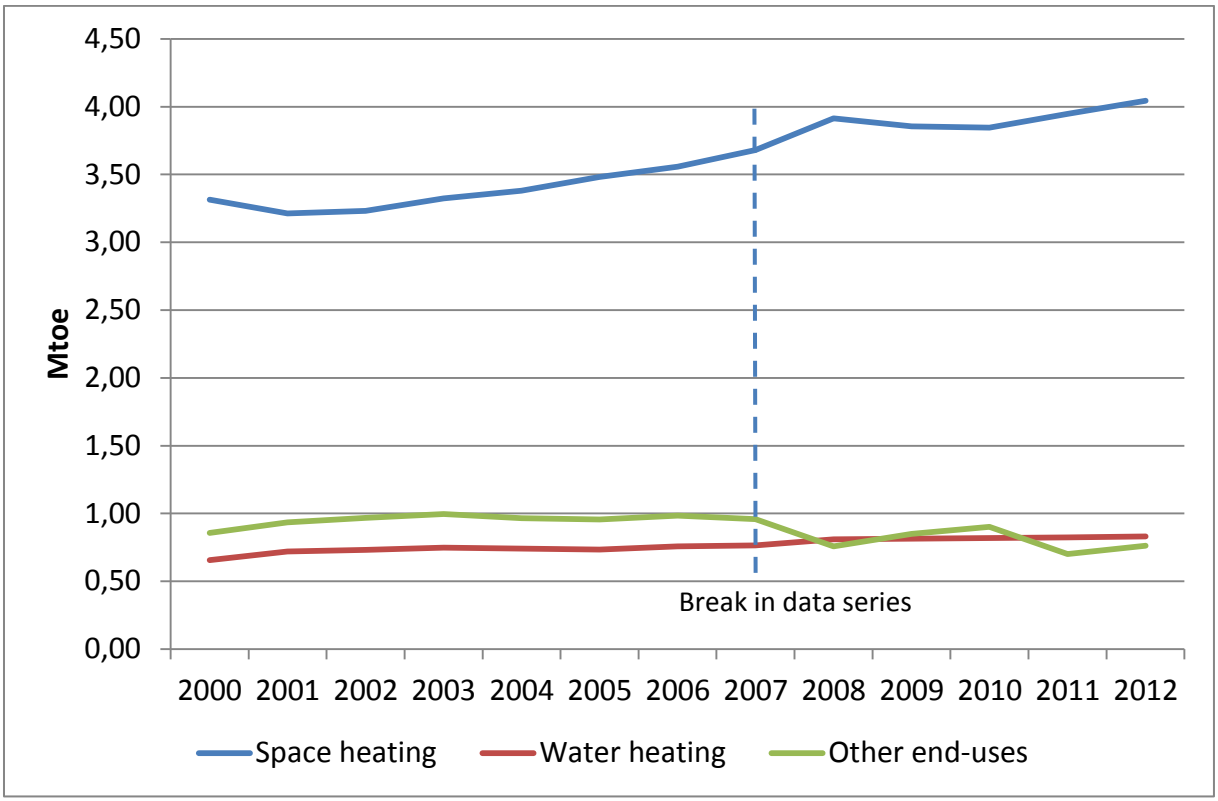
This section of the report covers energy use by the households and by public and private services. In public and private services there is also other energy use than that in buildings but also this is included in Chapter 2.

2.1. ENERGY EFFICIENCY TRENDS

In the household sector, space heating is the most significant use of energy. In 2012 it accounted for 72% of normalized TFC in the household sector while the proportion of water heating was 15% and other uses 14% (Figure 5). In the national energy statistics of Finland energy used for saunas is classified in space heating but in the Odyssee it is reported together with appliances and lighting. Energy use for heating and water heating has been growing almost constantly although that of lighting and appliances has declined due to eco-design and energy labelling.

Normalized energy consumption for heating in the residential sector has increased by 22.0% from 2000 to 2012 while heated floor area has grown 21.2% over the same period. This means that increase in heat consumption is almost totally explained by increased floor area.

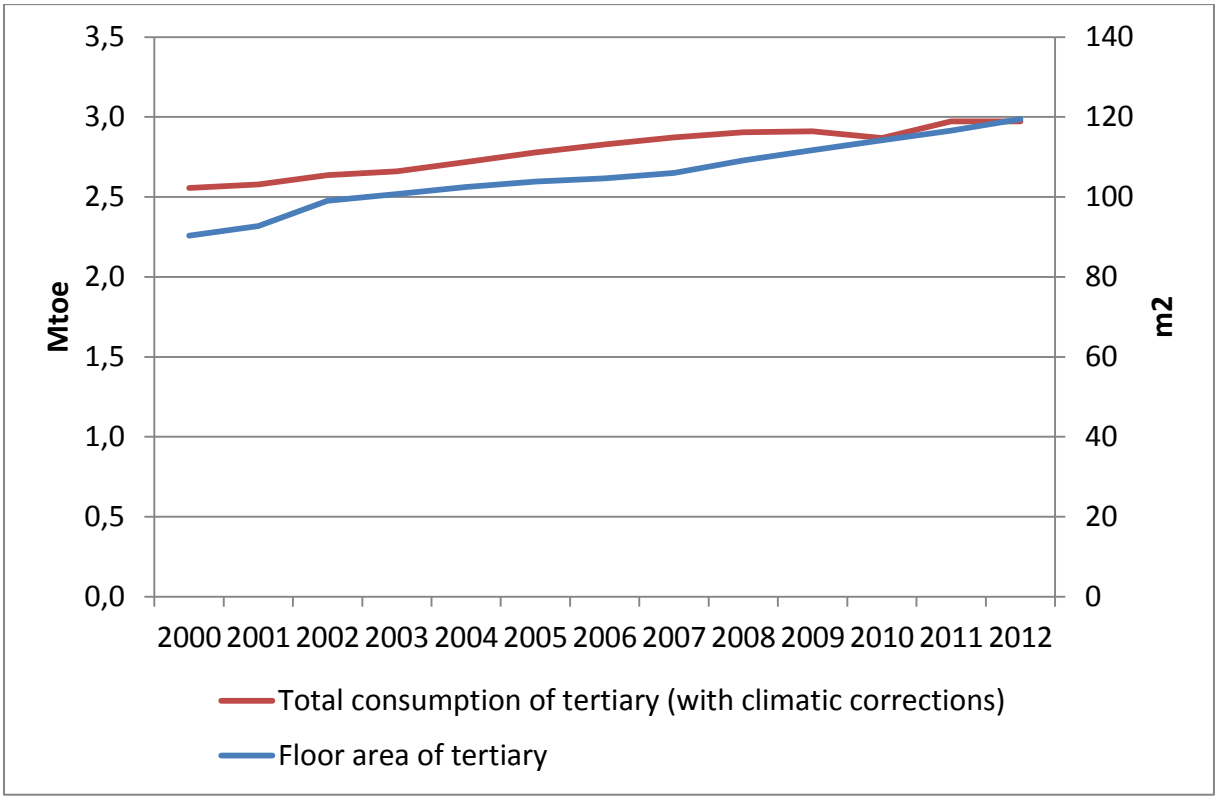
Figure 5: Energy consumption by households in Finland in 2000-2012 (with climatic correction for heating)



Source: Odyssee

Both final energy consumption and floor area have grown in the services sector since 2020, the former by 16% and the latter by 32%. This means that the specific consumption per floor area has decreased considerably.

Figure 6: Energy consumption and floor area in the tertiary sector in Finland in 2010-2012



Source: Odyssee

2.2. ENERGY EFFICIENCY POLICIES

Savings reported in the "buildings sector" are given in tables 2-5 based on Finland's NEEAP-3. Table 2 shows savings in the buildings, including those arising from building regulations in various sectors. Table 3 shows savings attributable to the public sector. Some of these savings occur in buildings, some in other operations. For example, in the municipalities there are other energy using activities such as street lighting. Table 4 shows savings attributable to the private services sector. These too occur partly in buildings, partly in other operations. Lastly, Table 5 shows the savings estimate for the Eco-Design Directive. Overlap in the saving estimates in the four tables has been removed, i.e., the savings results are additive.

Three measures showing largest savings in 2020 are increased use of heat pumps (7.7 TWh/a), building code for new buildings (7.1 TWh/a), and eco-design directive (4.2 TWh/a). Use of both air and ground source heat pumps has grown rapidly. The number of air-to-air heat pumps is already 457 000 (2013) compared to 1 560 000 dwellings in single family houses and terraced houses. Ground source heat pump is already the most common main heating system in new single family houses. Energy efficiency requirements for new buildings have been strengthened several times over the recent years and they are strictly enforced meaning that the buildings indeed need to conform to the regulations. However, annual surveys show that those building their own home often aim at even better level of energy efficiency. Energy statistics show clearly declining energy consumption for lighting in households, attributable to the Eco-design Directive.

In addition to measures with quantified savings, important measures without savings estimates have been implemented. Finland was one of the first countries to implement smart metering for electricity. Full roll-out of smart meters for electricity was achieved at the end of 2013. Over 80% of district heating meters are in the

sphere of remote reading. Natural gas is not used by households in Finland.

Energy efficiency in public procurement is promoted by many measures. There has been a series of government recommendations and resolutions over the past fifteen years and this is a major obligation in the energy efficiency agreements for municipalities. An advisory service for sustainable public procurement was established by the government in Motiva Oy in 2009.

Table 2 Energy saving estimates in buildings in NEEAP-3 of Finland

MEASURE	Energy savings		
	2010 GWh/a	Estimate 2016 GWh/a	Estimate 2020 GWh/a
Orders for energy efficiency in new buildings 2003, 2008, 2010 and 2012	1 923	4 925	7 085
Decree on improving the energy performance of buildings undergoing renovation or alteration	0	750	1 750
Subsidies for energy efficiency improvements	282	1 323	1 321
Promotion of heat pumps in small buildings	2 326	5 347	7 726
Mandatory water metering	0	74	128
Window energy labelling	52	66	93
Programme for energy conservation in oil-heated buildings, the “Höylä III” programme	1 988	2 297	2 476
Energy Efficiency Agreement of the Property and Building Sector - Rental Properties	44	299	430
TOTAL ENERGY SAVINGS (ESD SAVINGS)	**6 614**	**15 081**	**21 009**

Source: NEEAP-3 of Finland. Measures reported also in the MURE database.

Table 3 Energy saving estimates in the public sector in NEEAP-3 of Finland

MEASURE	Energy savings		
	2010 GWh/a	Estimate 2016 GWh/a	Estimate 2020 GWh/a
Energy Efficiency Agreement and Programme of the Municipalities	178	266	328
Energy audits – municipalities	97	125	112
Making the use of space more effective in central government	7	70	126
Renovation of state property stock	3	32	61
Improving energy efficiency in new construction for the state	1	10	21
Maintenance activity and user information for state property stock	107	171	194
TOTAL ENERGY SAVINGS IN MUNICIPALITIES (ESD SAVINGS)	275	391	440
TOTAL ENERGY SAVINGS IN CENTRAL GOVERNMENT (ESD SAVINGS)	118	283	402
TOTAL ENERGY SAVINGS	**393**	**674**	**842**

Source: NEEAP-3 of Finland. Measures reported also in the MURE database.

Table 4 Energy saving estimates in the private services sector in NEEAP-3 of Finland

MEASURE	Energy savings 2010 GWh/a	Energy savings Estimate 2016 GWh/a	Energy savings Estimate 2020 GWh/a
Energy audits – private services	141	118	108
Energy efficiency agreement – services	33	162	200
Energy Efficiency Agreement of the Property and Building Sector – Commercial Properties	15	153	198
TOTAL ENERGY SAVINGS (ESD SAVINGS)	**189**	**433**	**506**

Source: NEEAP-3 of Finland. Measures reported also in the MURE database.

Table 5 Energy saving estimates of the Eco-design Directive in NEEAP-3 of Finland

MEASURE	Energy savings 2010 GWh/a	Energy savings Estimate 2016 GWh/a	Energy savings Estimate 2020 GWh/a
Eco-design Directive	0	1 278	4 259
TOTAL ENERGY SAVINGS (ESD SAVINGS)	**0**	**1 278**	**4 259**

Note: No overlap with other measures (overlaps removed from results).
Source: NEEAP-3 of Finland. Measure reported also in the MURE database.

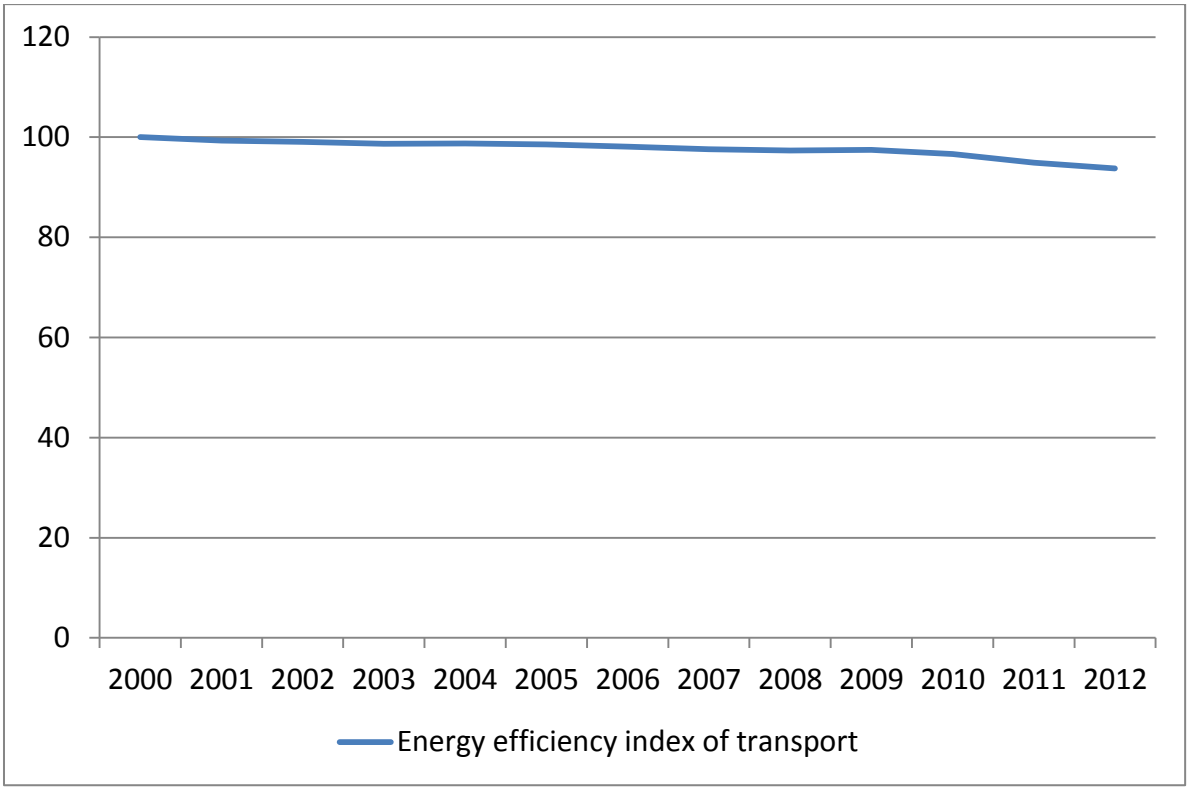
3. ENERGY EFFIENCY IN TRANSPORT

3.1. ENERGY EFFICIENCY TRENDS

Final energy consumption of transport increased by 14% from 2000 to 2012. However, the overall transport energy efficiency index (ODEX) for transport shows energy efficiency improvement since 2000 (Figure 7). This is mainly attributable to the improved energy efficiency of new passenger cars (Figure 8). There is also improvement in the energy efficiency of air transport but its share in the final energy consumption of transport is negligible.

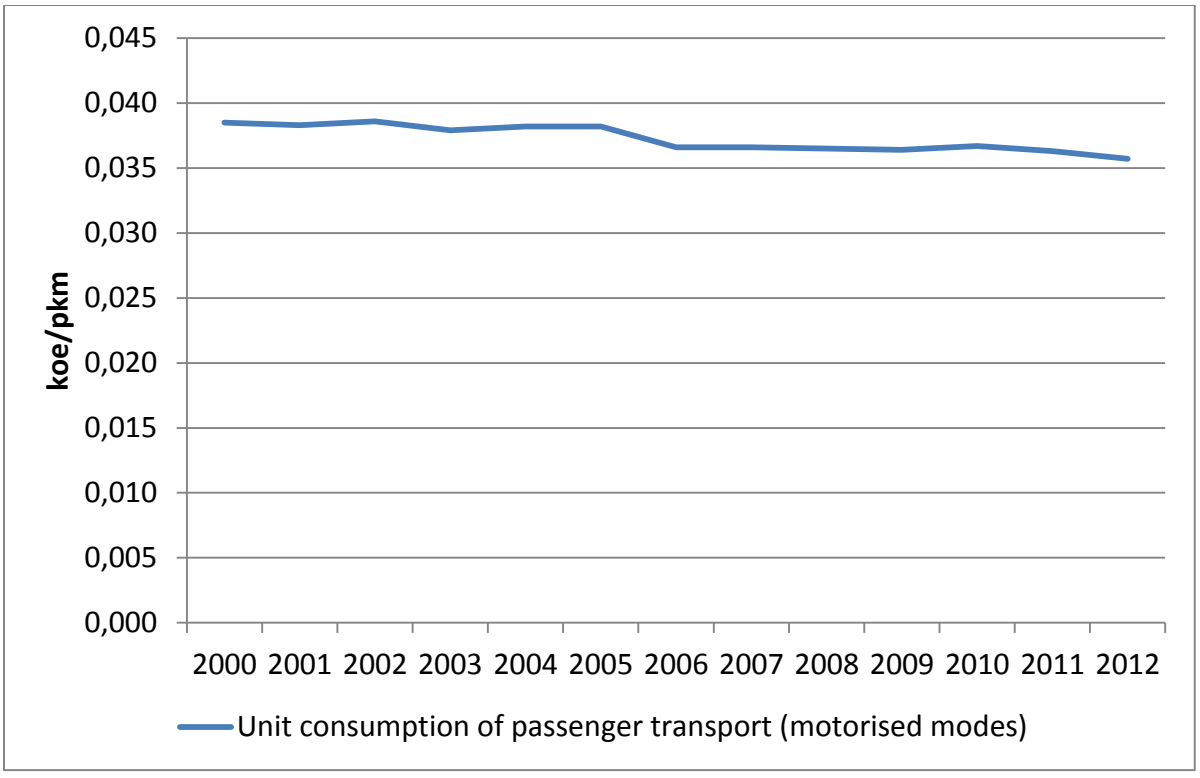
Energy efficiency of goods transport has deteriorated (Figure 9). One key reason is a shift from mass goods (e.g. paper) to parceled goods. Another reason is increased empty runs due to difficulties in logistics during recession and because of customer needs.

Figure 7: Energy efficiency index of transport



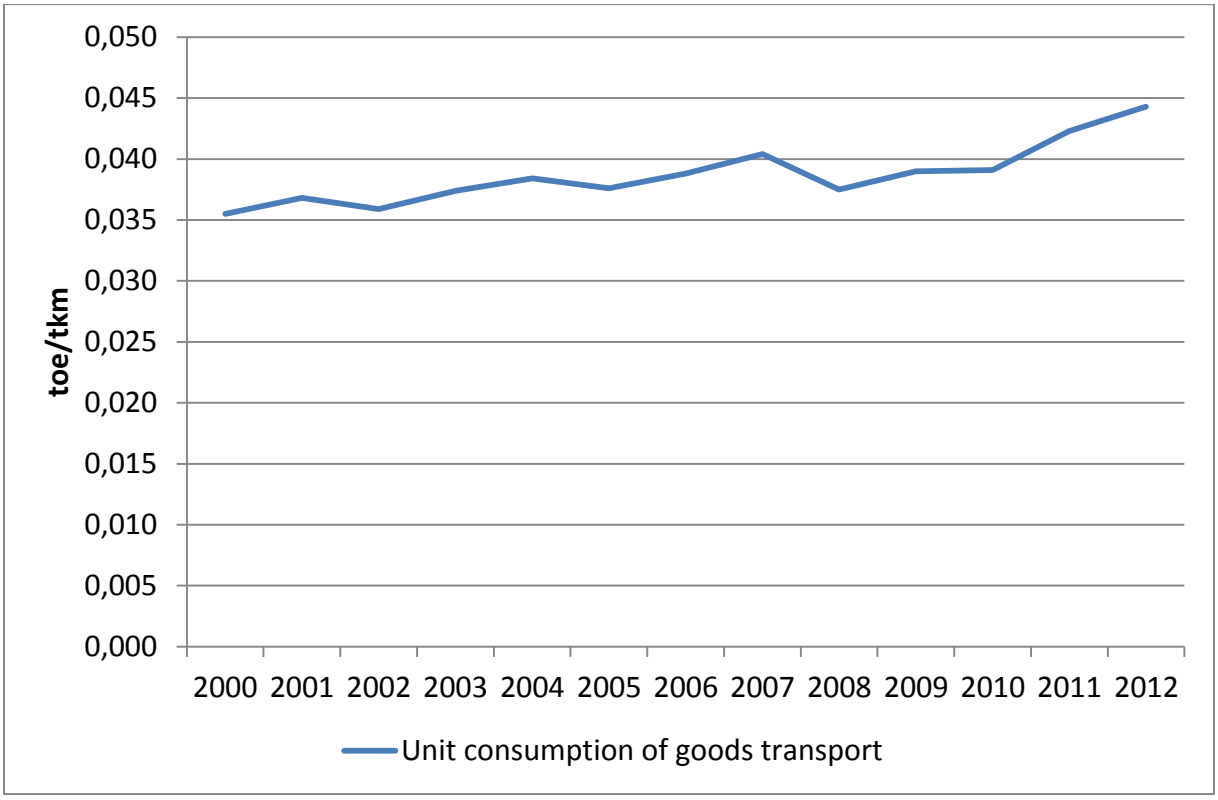
Source: Odyssee

Figure 8: Unit consumption of passenger transport



Source: Odyssee

Figure 9: Unit consumption of goods transport



Source: Odyssee

3.2. ENERGY EFFICIENCY POLICIES

The most important package of measures in terms of energy savings is the improvement of energy efficiency of new passenger cars. This package is composed of three measures, namely Euro norms on vehicles, revision of vehicle taxation and information measures, such as voluntary energy labelling of cars. Both the vehicle registration tax of a new vehicle (2008-) and annual tax on vehicle usage (2007-) are progressive based on CO_2 emissions of the car. Registration statistics show a rapid decline in the CO_2 emissions of new cars since the tax revision of 2008. The impact of the measure is somewhat eroded by the growing average age of the car fleet. Therefore, an experiment of a vehicle scrapping fee is underway from July 2015 to December 2015. The fee of 1500 euros (1000 euros state aid, 500 euros discount by the car dealers) is given when a car over 10 years is scrapped and a new car with CO_2 emissions lower than 120 g/km is purchased.

Eco-driving as well as promotion of public transport, walking and cycling are all expected to make a considerable contribution to savings. The impact of eco-driving of professional drivers was strengthened by the European directive on professional competence of truck and bus drivers. Eco-driving has become a popular module in the fulfilment of the periodical training requirements.

Transport distances in Finland are long. The increase of the maximum mass and dimension increases of heavy vehicles improve the energy efficiency on transport in terms of specific consumption (energy/tonne-km). Two of the transport measures are related to the harsh winters. In wintertime speed limits on motor ways are reduced from 120 km to 100 km and on highways from 100 km to 80 km. While it improves traffic safety it also reduces fuel consumption. Mandatory replacement of summer tyres by winter tyres warrants checking tyre pressures at least a few times a year.

There are also other measures in the transport sector but their savings have not been quantified. These include energy efficiency agreements, energy labelling of tyres (useful only in summer tyres), energy efficiency in public procurement of vehicles or transport services and energy efficiency of new vans.

Table 6 Energy saving estimates in the transport sector in NEEAP-3 of Finland

MEASURE	Energy savings 2010 GWh/a	Energy savings Estimate 2016 GWh/a	Energy savings Estimate 2020 GWh/a
Energy efficiency of new passenger cars	707	1 900	3 600
Eco-driving, passenger cars	186	241	271
Eco-driving, busses	43	55	53
Eco-driving, trucks	121	277	274
Promotion of public transport	38	40	100
Promotion of walking and cycling	38	190	460
Wintertime speed limits	165	165	165
Mass and dimension increases of heavy vehicles	0	400	550
Optimal tyre pressure in passenger car and van traffic	180	193	196
TOTAL ENERGY SAVINGS (ESD SAVINGS)	**1 478**	**3 461**	**5 669**

Source: NEEAP-3 of Finland. Measures reported also in the MURE database.

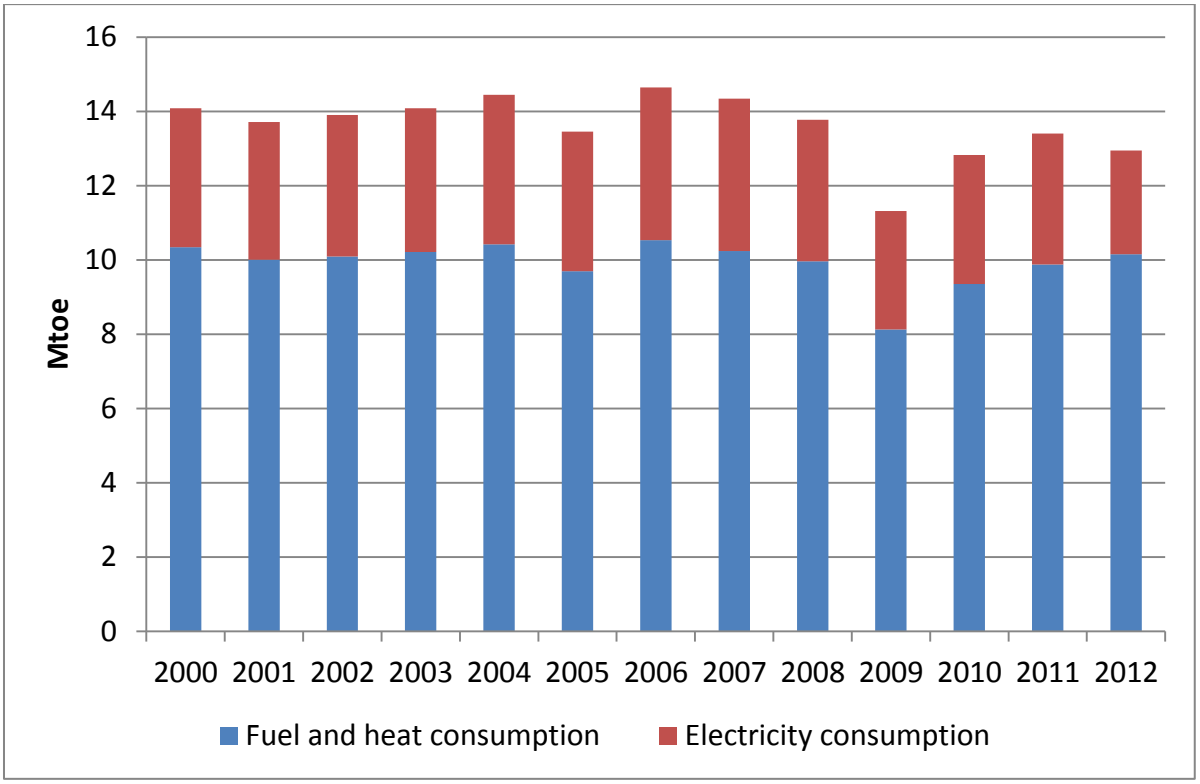
4. ENERGY EFFICIENCY IN INDUSTRY

4.1. ENERGY EFFICIENCY TRENDS

Final energy consumption of industry declined by 8% from 2000 to 2012 (Figure 10). There was even a stronger dip in 2009 due to the drop in production at the beginning of the recession followed by a small recovery in 2010.

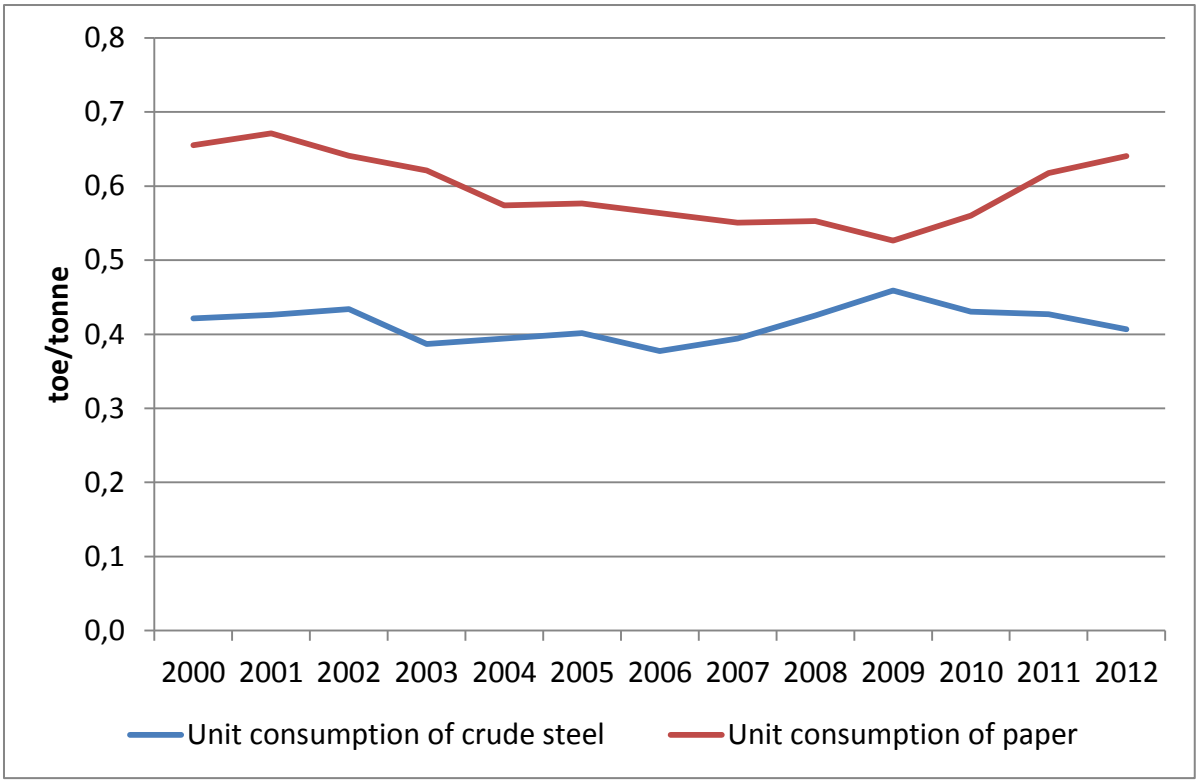
Finland still has significant energy-intensive industry but there have been clear structural changes in the industry sector. Paper and pulp production accounted for 43% of energy consumption by industry in 2013. However, the structural change in industry is apparent as the proportion was 63% in 2000. At the same time the share of other energy-intensive industries has remained quite steady, chemical industry at 11-12% and steel industry at 7-8%.

Figure 10: Final energy consumption of industry in Finland in 2000-2012



Source: Odyssee

Figure 11: Unit consumption of crude steel and paper production in Finland in 2000-2012



Source: Odyssee

4.2. ENERGY EFFICIENCY POLICIES

In Finland, the cornerstones of policy measures in industry have long been the energy efficiency agreements (since 1997) and energy audits (since 1992). Both schemes are subject to constant monitoring and evaluation which shows significant savings. The total energy savings for industry (10.8 TWh) correspond to 7.5% of TFC of industry. High savings results are partly attributable to the high coverage of the agreements; e.g. all energy intensive industries take part.

In the energy audit scheme there are different audit models available depending on the site. In addition, technology-based models have been developed for compressed air, refrigeration systems and steam condensate system and, in addition, a separate model for transport chains of industry.

In addition, subsidies are available for the implementation of measures but their impact was not evaluated in NEEAP-3 to avoid overlap in savings estimates.

Table 7 Energy savings in industry in NEEAP-3 of Finland

MEASURE	ENERGY SAVINGS		
	2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
Energy audits in industry, ESD area	851	955	986
Energy audits in industry, non-ESD area	1 930	704	655
Energy efficiency agreements – mid-sized industry, ESD area	290	540	712
Energy efficiency agreements – mid-sized industry, non-ESD area	48	116	130
Energy efficiency agreements – energy intensive industry, ESD area	821	650	698
Energy efficiency agreements – energy intensive industry, non-ESD area	6 866	8 873	10 022
TOTAL ENERGY SAVINGS (ESD SAVINGS)	**1 962**	**2 145**	**2 396**
TOTAL ENERGY SAVINGS (NON-ESD SAVINGS)	8 844	9 693	10 807
TOTAL ENERGY SAVINGS (ALL SAVINGS)	10 806	11 838	13 203

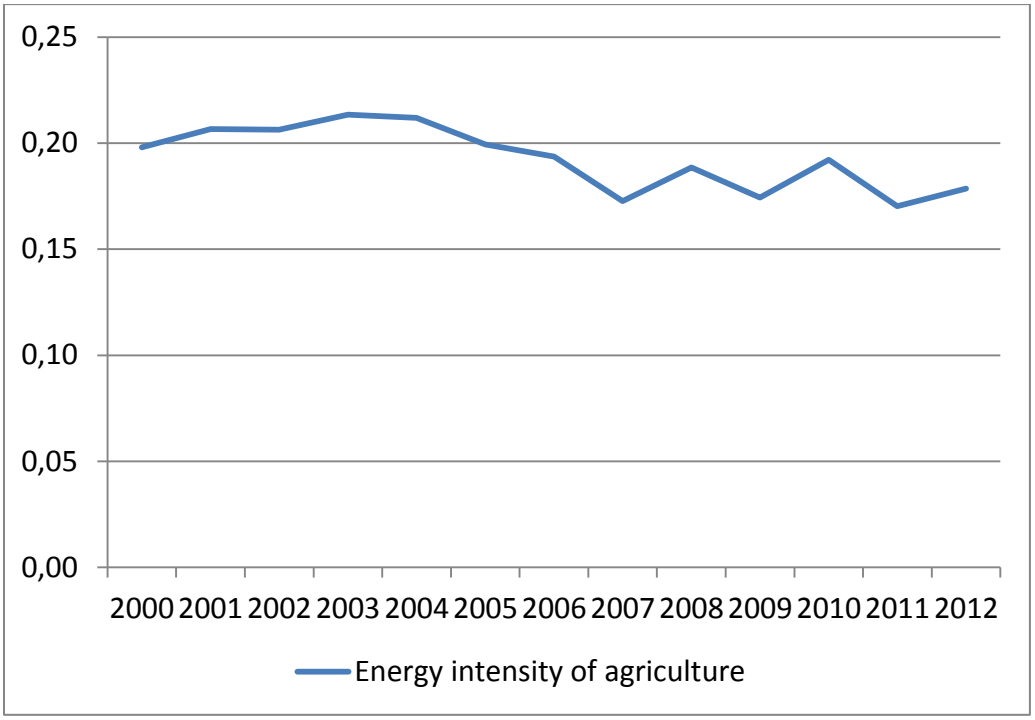
Source: NEEAP-3 of Finland. Measures reported also in the MURE database.

5. ENERGY EFFICIENCY IN AGRICULTURE

5.1. ENERGY EFFICIENCY TRENDS

Final energy consumption of agriculture has remained quite steady, growing by 3% from 2000 to 2012. The energy intensity declined by -10% over the same period (Figure 12).

Figure 12: Energy intensity in agriculture in Finland in 2000-2012



Source: Odyssee

5.2. ENERGY EFFICIENCY POLICIES

In agriculture, the measure with highest energy savings is the investment of heating plants using biomass instead of oil. In the ESD Directive renewable energy production from own energy sources (e.g. solar applications, biomass from own forest or fields) accounts for energy savings. Construction of fresh grain silos instead of drying the grain saves energy. The measure regarding cattle buildings and pig houses covers heat recovery from milk and pig slurry. Farm re-parcelling reduces need for transport between parcels. The Farm Energy Programme is a voluntary energy efficiency agreement for farms but in 2015 it is in the process of fundamental change.

Table 8 Energy saving estimates in agriculture in NEEAP-3 of Finland

	ENERGY SAVINGS		
	2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
Investments in biomass heating plants	1 201	2 131	2 458
Fresh grain silos	4	19	35
Energy efficiency of cattle buildings and pig houses	2	10	19
Farm land re-parcelling projects	15	97	156
Farm Energy Programme	0	59	228
TOTAL ENERGY SAVINGS (ESD SAVINGS)	**1 222**	**2 316**	**2 896**

Source: NEEAP-3 of Finland. Measures reported also in the MURE database.

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