Finland's National Energy Efficiency Action Plan NEEAP-4

28 April 2017

Report to the European Commission pursuant to Article 24(2) of the Energy Efficiency Directive (2012/27/EU)

CONTENTS

FOREWORD

The Energy Efficiency Directive (2012/27/EU) had to be fully transposed into national legislation by 5 June 2014. Earlier deadlines had been laid down for the implementation of certain obligations or reporting thereon. In Finland, the Directive was mainly implemented within the deadlines laid down in it. The final points were included in the amendments of the Finnish Energy Efficiency Act (*Energiatehokkuuslaki* 1429/2014), which entered into force at the beginning of 2017.

The reporting obligations laid down in the Energy Efficiency Directive comprise an annual report to be submitted every year and a National Energy Efficiency Action Plan (NEEAP) to be submitted every three years. At the beginning of 2014, responsibility for the implementation of these reporting obligations was transferred from the Finnish Ministry of Economic Affairs and Employment to the Finnish Energy Authority.

In Finland, the implementation of the Energy Efficiency Directive's obligations involves the administrative sectors of several ministries. In principle, each ministry is responsible for production of the text and other information needed for the report with respect to its policy measures. Cooperation between the ministries and agencies as well as Motiva, a company of experts that plays a key role in the sector, has traditionally been smooth. In this respect too, the fourth extensive NEEAP reporting round implemented in 2017 was carried out flexibly and efficiently.

ABBREVIATIONS

ARA	Housing Finance and Development Centre of Finland[1]
BU	Bottom-up (analytical approach)
CHP	Combined Heat and Power
EPBD	Energy Performance of Buildings Directive (2010/31/EU)
EED	Energy Efficiency Directive (Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC)
EPC	Energy Performance Contract
ESCO	Energy Services Company
ESD[2]	Energy Services Directive (Directive 32/2006/EC on energy end-use efficiency and energy services)
non-ESD	Energy consumption and savings not governed by the Energy Services Directive (energy production and industrial premises governed by the Finnish Emissions Trading Act (*Päästökauppalaki* 311/2011))
ELY Centre	Centre for Economic Development, Transport and the Environment
KTM	Finnish Ministry of Trade and Industry (Ministry of Employment and the Economy as of 1 January 2008, currently Ministry of Economic Affairs and Employment)
LVM	Finnish Ministry of Transport and Communications
Mavi	Maaseutuvirasto [Finnish Agency for Rural Affairs]
MMM	Ministry of Agriculture and Forestry
Motiva	Motiva Oy
OKM	Finnish Ministry of Education and Culture
PPP	Public Private Partnership
NEEAP-1	First National Energy Efficiency Action Plan pursuant to the ESD (26 June 2007)
NEEAP-2	Second National Energy Efficiency Action Plan pursuant to the ESD (27 June 2011)
NEEAP-3	First National Energy Efficiency Action Plan pursuant to the EED (29 April 2014)
NEEAP-4	Second National Energy Efficiency Action Plan pursuant to the EED (28 April 2017)
Sitra	Finnish Innovation Fund Sitra
NBCF	National Building Code of Finland
TD	Top-down (analytical approach)
SYKE	Finnish Environment Institute
TEKES.	Finnish Funding Agency for Technology and Innovation
TEM	Finnish Ministry of Economic Affairs and Employment (formerly the Ministry of Employment and the Economy, Ministry of Trade and Industry until 31 December 2007)
Finnish Transport Safety Agency	Finnish Transport Safety Agency
TUT	Tampere University of Technology
VM	Ministry of Finance
YM	Finnish Ministry of the Environment
VTT	VTT Technical Research Centre of Finland Ltd

1 The former Housing Fund of Finland split into a government agency and a fund on 1 January 2008. The government agency was named the Housing Finance and Development Centre of Finland and the fund retained the name of the Housing Fund of Finland.

2 The Commission also uses the abbreviation ESD to refer to the so-called "Effort Sharing Decision" (406/2009/EC) associated with the European Climate and Energy Package.

1 INTRODUCTION

One of the key obligations laid down in the European Energy Efficiency Directive (2012/27/EU), which entered into force in December 2012, is the drawing up of National Energy Efficiency Action Plans every three years (NEEAP). The obligation was already included in the European Energy Services Directive (2006/32/EC). Finland submitted its NEEAP-1 report to the Commission on 26 June 2007 and its NEEAP-2 report on 27 June 2011, as required by the Energy Services Directive. NEAAP-3, the first report drawn up pursuant to the Energy Efficiency Directive, was submitted to the Commission on 29 April 2014. The reports drawn up pursuant to the Energy Services Directive (ESD, 2006/32/EC) focused on descriptions of energy efficiency measures and energy savings. In the reports drawn up pursuant to the Energy Efficiency Directive (EED, 2012/27/EU), more attention is paid to describing the implementation of specific obligations laid down in the Directive.

This NEEAP-4[3] report describes the implementation of the EED in accordance with the action plan template[4] provided in the Commission Implementing Decision (2013/242/EU). As regards the ESD, the report includes information about national energy efficiency measures and their impacts on energy consumption in 2010, 2016 and 2020. These energy savings relate to the indicative 9% energy saving target laid down in the Energy Services Directive, which must be achieved by 2016 and be reported on in accordance with the provisions of the Energy Efficiency Directive in this 2017 NEEAP. Information on the cumulative end-use energy savings target laid down in Article 7 of the Energy Efficiency Directive for the period 2014–2020 is provided in the context of the EED annual report. The EED Annual Report 2017 is annexed to this NEEAP-4 report.

In addition to the comprehensive NEEAP reports that need to be submitted to the Commission at three-year intervals, the EED obligates Member States to submit EED annual reports based on indicators and changes in such indicators; such reports are used to monitor and evaluate the development of energy consumption and energy efficiency in the Member States. The first EED annual report was submitted to the Commission on 26 April 2013. The EED annual report annexed to this NEEAP-4 report is the fifth. (Annex 1 Annual Report on the EED 2017 of 28 April 2017).

The key conclusion to be drawn from the EED annual report is that Finland's primary energy consumption decreased by 4.8% from 2014 to 2015 and energy end-use by 1.3%. By sector, energy consumption decreased by 3.4% in households and by 5.4% in the service sector. According to Eurostat, energy consumption remained at the 2014 level in industry, while according to the corresponding data by Statistics Finland, it decreased by 3.1%. Energy consumption in transport increased by 0.7%, as a result of growth in freight and passenger transport.

Finland's national indicative 9% energy savings target for 2016, as laid down in the NEEAP-1, equates to 17.8 TWh in energy. The interim target set for the year 2010 was 5.9 TWh. The actual energy savings calculated for 2010 amounted to 11.5 TWh, which was almost double the interim target. The energy saving of 24 TWh projected for the year 2016 exceeds the ESD target by 35%. The energy saving projection of 35.5 TWh for the year 2020 equates to an energy saving of almost 18%[5] when calculated across the energy services governed by the ESD.

Finland's national binding cumulative energy savings target for the period 2014−2020, in accordance with Article 7 of the Energy Efficiency Directive, is 48.99 TWh_{cum}. The cumulative energy savings achieved are presented in the EED annual reports. The actual cumulative savings for 2014–2015 in 2020 total almost 40 TWh_{cum}. The total cumulative energy savings to be achieved across the entire period 2014−2020 are estimated at 92 TWh_{cum}.

3 The Second National Energy Efficiency Action Plan drawn up pursuant to the EED is also referred to here as the Second EED NEEAP.

4 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:141:0048:0053:FI:PDF

5 The calculations included in the NEEAP-4 do not cover all energy efficiency measures across the ESD sectors. These kinds of measures are discussed in e.g. Annex 3 to the NEEAP-4. When all measures are factored in, Finland is on course to achieve an energy saving of -20% in 2020.

The preparation of Finland's NEEAP-4 report was coordinated by Heikki Väisänen of the Finnish Energy Authority and Ulla Suomi of Motiva. In addition, the following experts contributed to the report: Saara Jääskeläinen from the Finnish Ministry of Transport and Communications, Veli-Pekka Reskola from the Finnish Ministry of Agriculture and Forestry, Paavo-Petri Ahonen from the Finnish Ministry of Education and Culture, Pentti Puhakka from the Finnish Ministry for Economic Affairs and Employment, Hannu Koivurinta, Pauliina Pekonen and Veli Auvinen from the Finnish Ministry of Finance, Juha-Pekka Maijala from the Finnish Ministry of the Environment and Maija Mattinen from the Finnish Environment Institute, Katja Lohko-Soner and Laura Riipinen from the Finnish Transport Safety Agency Trafi, Pia Outinen, Juha Toivanen, Ville Väre, Kaisa-Reeta Koskinen and Maria Holmi from the Finnish Energy Authority as well as Lea Gynther and Päivi Laitila from Motiva. Several other individuals from the aforementioned organisations also produced information for the report. In addition, Minna Niininen from Statistics Finland and Mirja Tiitinen from Finnish Energy (ET) contributed to the drawing up of the EED Annual Report.

Ulla Suomi coordinated the assessment of the impacts of energy efficiency measures. The following experts contributed to calculating energy savings: Ulla Suomi, Saara Elväs and Lea Gynther from Motiva, Heikki Väisänen from the Finnish Energy Authority, Maija Mattinen from the Finnish Environment Institute, Juhani Heljo from Tampere University of Technology, Juhani Laurikko from VTT Technical Research Centre of Finland Ltd and Tapio Jalo from Senate Properties. Several other parties also helped to gather information for the report.

2 OVERVIEW OF NATIONAL ENERGY EFFICIENCY TARGETS AND SAVINGS

2.1 National 2020 energy efficiency target

Finland submitted its first annual report pursuant to the Energy Efficiency Directive (Annex 1 EED Annual Report of 30 April 2014) to the Commission on 26 April 2013. At that time, Finland disclosed an indicative national energy efficiency target according to which Finland's absolute final energy consumption would be 310 TWh in 2020. This corresponds to an absolute level of primary energy consumption of 417 TWh. Finland's national target was set in connection with a review of the energy and climate strategy[6]. Revisions to the strategy were drawn up under the guidance of the ministerial working group on energy and climate policy and a Government report (VNS 2/2013 vp) on the updates was submitted to the Parliament of Finland on 20 March 2013.

The national energy efficiency target set for 2020 was not revised in the new 2016 energy and climate strategy, on which a Government report (VNS 7/2016 vp) was submitted on 24 November 2016[7]. This national strategy outlines the actions that will enable Finland to attain the targets specified in the Government Programme and adopted in the EU for 2030, and to make systematic progress towards achieving an 80−95 percent reduction in greenhouse gas emissions by 2050.

2.2 Target pursuant to Article 7

Finland submitted a notification of the implementation of Article 7 of the Energy Efficiency Directive to the Commission on 5 December 2013[8]. The notification was supplemented on 30 January 2014, after the 2012 energy statistics required for the notification had become available, and on 5 June 2014 in connection with a notification of transposition regarding Community legislation. In addition, the target was raised by a letter of 10 August 2015, due to an error of interpretation made in a definition related to the energy statistics. This change had a marginal impact on the target level (+0.5%).

Average final energy consumption in 2010–2012, corresponding to energy sales by retail energy sales companies to end users as per Article 7 of the Directive, amounts to 155.53 TWh. The annual new energy saving of 1.5% calculated on the basis of this figure is 2.33 TWh. Finland's total cumulative energy saving target for the years 2014–2020 would be 65.32 TWh_{cum}.

According to paragraph 3 of Article 7 of the Directive, Member States may apply the mechanisms referred to in paragraph 2 of the Article, but the application of these mechanisms must not lead to a reduction of more than 25% of the total energy saving target. With regard to such mechanisms, Finland generally applies the so-called early actions provided for in sub-paragraph d, whose cumulative energy saving effect amounts to almost 90.71 TWh_{cum}, which is clearly above the permitted maximum level of 25%. Considering the ceiling of 25% set for these mechanisms, the cumulative energy saving target for the period 2014–2020 comes to 48.99 TWh_{cum}.

More detailed information about the implementation of Article 7 is included in the notification submitted on 5 December 2013 and the supplementary information submitted on 30 January 2014, the notification of transposition submitted on 5 June 2014 and Finland's response of 10 August 2015 to the Commission's inquiry (EU PILOT Ref. No 7644/15/ENER).

2.3 Additional energy efficiency targets

Finland has only set sector-specific energy efficiency targets with regard to transport. As regards policy measures, targets have been set for energy efficiency agreements.

Energy efficiency agreements

Finland's extensive energy efficiency agreement scheme for 2008−2016 was initially aimed at achieving the 9% energy saving target for 2016, as laid down in the Energy Services Directive. These energy

[6] National Energy and Climate Strategy, VNS 2/2013 vp

[7] Government report on the National Energy and Climate Strategy for 2030, VNS 7/2016 vp

[8] http://ec.europa.eu/energy/efficiency/eed/doc/article7/2013_fi_eed_article7_en.pdf

efficiency agreements, which expired at the end of 2016, and the new energy efficiency agreements negotiated for 2017–2025 now play an important role in the implementation of the binding energy savings target laid down in Article 7 of the Energy Efficiency Directive. The revised energy efficiency agreement scheme covers multiple sectors of the economy (industry, the energy sector and private services), local government, the property sector and the oil industry[9].

A letter of intent concerning the renewal of two energy efficiency agreements for businesses and local governments relating to the implementation of Article 7 of the Energy Efficiency Directive, which were signed in December 2013, set a cumulative energy saving target of 31 TWh_{cum} for the period 2014–2020, representing almost 2/3 of Finland's total energy saving target.

Since the beginning of 2017, the energy efficiency of road transport enterprises has been promoted as part of the responsibility model of the Finnish Transport Safety Agency (Trafi)[10]. The model takes account of the financial, safety, environmental and quality perspectives, and has been developed in cooperation with operators in the sector.

Transportation

The Finnish Ministry of Transport and Communications published its environmental strategy for the years 2013–2020[11] in December 2013. The environmental strategy for transport lays down the key targets for environmental action and priorities for all modes of transport. It also includes an updated version of the climate policy of Finland's transport administration (Climate Policy Programme, 2009[12]). With regard to energy, the environmental strategy aims to halt the increase in energy consumption and to bring about a decrease before 2020. In 2020, the final energy consumption of domestic transport must not exceed 48 TWh (currently around 49 TWh).

Halting the growth in energy consumption in transport will require changes in both the modal split and in the volume of car traffic, as well as in the choice of fuels and vehicle technologies. According to the strategy, reaching the target will require new means of financial steering, such as road tolls or incentives for investing in low-emission technology.

Agriculture

A sector-specific agreement on a Farm Energy Programme was signed in January 2010 between the Finnish Ministry of Agriculture and Forestry and the national organisations of agricultural and horticultural producers. This voluntary energy efficiency agreement for the agricultural sector was revised in the autumn of 2016, with the addition of a new sector-specific agreement. The aim of the agreement is to implement measures in the agricultural sector that will help to meet the energy efficiency targets set in the Energy Efficiency Directive, the Finnish Energy Efficiency Act and the national energy policy, and to increase the production and use of renewable energy on farms. Key measures include the provision of energy consultancy and farm-specific energy plans, implemented as part of the Rural Development Programme for Mainland Finland, and aid for energy efficiency and renewable energy investments.

2.4 Primary energy savings

In the previous NEEAP reports, Finland provided information about some savings not included in the scope of the Energy Services Directive (ESD). These measures are being monitored, but their energy saving effects are not governed by the ESD. Of these savings, some are primary energy savings reported annually by businesses that are implementing the Energy Production Action Plan and that have signed up

[9] http://www.energiatehokkuussopimukset2017-2025.fi/en/

[10] https://www.trafi.fi/en/road/commercial_transport/responsibility_model_for_road_transport_enterprises

[11] Environmental Strategy for Transport 2013-2020

[12] Ministry of Transport and Communications' Climate Policy Programme 2009-2020

to the energy efficiency agreement scheme. These primary energy savings have been converted into final energy in Table 1 in Section 2.5 and in Table 10 in Section 5.1.2, using the default coefficient of 2.5 given in the Energy Services Directive.

The primary energy savings reported under the Energy Production Action Plan are shown in Table 10 in Section 5.1.2 and amounted to 0.27 TWh/a in 2010. It is estimated that primary energy savings will amount to 1.71 TWh/a in 2016 and to 2.52 TWh/a in 2020.

2.5 Final energy savings

Finland's energy saving target for 2016 pursuant to the Energy Services Directive (ESD) is 17.8 TWh. The interim target set for the year 2010 was 5.9 TWh. The combined energy saving effect of the measures discussed in this report amounted to 11.5 TWh in 2010 (estimated at 11.9 TWh in the NEEAP3). It is estimated that the energy saving effect will be 24.04 TWh by 2016 (25.4 TWh in the NEEAP-3), which would mean that, according to the updated estimate, Finland would exceed its energy saving target for 2016 pursuant to the ESD, which includes the actual saving achieved by 2015, by 35%.

It is estimated that the energy saving effect will rise to 35.5 TWh by 2020 (37.3 TWh in the NEEAP-3), which equates to an energy saving of almost 18%. As the NEEAP-4 report does not include an estimate of all energy efficiency measures by volume of energy, it is highly likely that the 20% energy saving target in the sectors governed by the ESD will be met. Some of the measures whose energy saving effects have not been evaluated are discussed in the annexes (Annex 3 Description of energy efficiency measures – excluding impact assessment).

The ESD energy saving calculations presented in the NEEAP-4 are mainly based on the same national methods as those used in the three previous NEEAP reports. The ESD calculation systems and the associated baseline data and assumptions are explained in connection with each of the energy efficiency measures described in the annexes (Annex 2 Description of energy saving measures pursuant to the ESD). In addition, descriptions of measures notified for the implementation of Article 7 of the EED and calculations of the related cumulative energy saving effects are presented in the annexes to the EED Annual Report 2017, annexed to this report as Annex 1.

A summary of the energy saving effects relevant to the Energy Services Directive in 2010, 2016 and 2020 is shown in Table 1. The table also includes some non-ESD energy saving effects, in so far as these have been evaluated.

Table 1. Summary of impacts on energy consumption relevant to the ESD

SECTOR	ENERGY SAVING		
	2010 GWh/a	ASSESSMENT 2016 GWh/a	ASSESSMENT 2020 GWh/a
ESD:			
Buildings	6,665	14,156	19,248
Public sector	399	695	813
Services – private	114	483	513
Industry	957	1,193	1,188
Transportation	1,084	3,156	6,055
Agriculture	1,222	2,074	2,391
Horizontal measures	0	1,278	4,259
Energy sector, customers	1,061	1,003	995
NON-ESD:			
Industry	9,157	11,131	12,046
The energy sector	463	1,946	2,837
TOTAL ENERGY SAVING – ESD	**11,502**	**24,037**	**35,462**
TOTAL ENERGY SAVING – NON-ESD	9,621	13,077	14,882
TOTAL ENERGY SAVING – ALL	21,122	37,115	50,344

3 EFFICIENCY OF ENERGY USE – IMPLEMENTATION OF THE ENERGY EFFICIENCY DIRECTIVE

3.1.1 Energy performance of buildings – Articles 4 and 5

Long-term strategy for mobilising investment in the renovation of buildings – Article 4

Article 4 urges Member States to take measures to encourage investment in the deep renovation of both public and private residential and commercial buildings.

Member States must establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private. Annex 5 includes Finland's national strategy for building renovations, which satisfies the requirements a)–e) laid down in Article 4:

a) an overview of the national building stock based, as appropriate, on statistical sampling; Annex 5, Section 2 – Overview of Finland's building stock
b) identification of cost-effective approaches to renovations relevant to the building type and climatic zone; Annex 5, Section 3 – Cost-effective deep renovations suitable for Finland's climate
c) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations;
   Annex 5, Section 4 – Policies and measures that promote deep renovations
d) a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions; Annex 5, Section 3 – Implementation and financing of renovations and
   Annex 5, Section 4.3 – Digitality, innovations and business
e) an evidence-based estimate of expected energy savings and wider benefits; Annex 5, Section 5 – Scenarios and impacts

In connection with the transposition of the Energy Performance of Buildings Directive (EPBD), Finland introduced cost-optimal levels of minimum energy performance requirements by issuing Decree No 4/13 of the Finnish Ministry of the Environment on improving the energy performance of buildings in connection with renovations and alterations (*Ympäristöministeriön asetus rakennuksen energiatehokkuuden parantamisesta korjaus- ja muutostöissä*). The decree requires energy performance improvements in connection with the renovation of a building, changes to its intended use and the replacement of its technical systems. The Finnish Ministry of the Environment also promotes the objectives of the Renewable Energy Sources (RES) Directive with regard to buildings undergoing a thorough renovation.

Comprehensive requirements, with regard to energy performance, have been set for the renovation of the building stock. Rather than setting requirements, Article 4 of the EED has been designed to find ways of mobilising investment in the energy efficiency of public and private residential and commercial buildings and to implement these in a systematic and timely manner in connection with renovations.

3.1.2 Central government buildings – Article 5

Instead of the 3% renovation obligation applicable for central government buildings, Finland has decided to implement Article 5 by means of an alternative approach for reaching the required energy saving target. Finland submitted a notification of this[13] to the Commission on 18 December 2013.

To satisfy the 3% renovation target for central government buildings, the energy saving that must be achieved during the period 2014–2020 amounts to 8,225 MWh. The notification submitted to the Commission included eight energy-saving measures that will help to achieve the energy saving target. The total energy consumption of Senate Properties, which manages the Finnish State's building stock, fell by

[13] http://ec.europa.eu/energy/efficiency/eed/doc/article5/2013_fi_eed_article5_en.pdf

19% during the period 2012–2015. Information on the saving effects of measures reported for the implementation of Article 5 of the EED is provided in the context of the EED annual report. The EED Annual Report 2017 is annexed to this NEEAP-4 report as Annex 1.

3.1.3 Buildings of other public bodies – Article 5

All of the measures listed in paragraph 7 of Article 5 of the Energy Efficiency Directive are included in the local government sector energy efficiency agreement and the associated energy programme (2008–2016):

- adopting an energy efficiency plan that includes specific energy saving and efficiency objectives and actions (a)
- setting an energy saving target of at least 9% for the year 2016 and an interim target for the year 2013 (a)
- providing instructions on the supervision of engineering and construction in new development and renovations, so that technological choices are based on life cycle economy and energy efficiency wherever possible (a)
- carrying out energy audits so that 80% of local government building stock has been audited by the end of 2013, as well as commissioning audits in new buildings and follow-up audits as needed (b)
- setting a target of 80% for the coverage of monthly consumption monitoring by 2013 and of 90% by 2016, and making active use of monitoring data (b)
- using the expertise of ESCOs to implement investments, identifying and eliminating barriers resulting from the administrative and decision-making processes of local governments, and making use of ESCOs whenever a shortage of funds prevents the execution of cost-effective investments (c)

A total of 132 local authorities and joint authorities signed the energy efficiency agreement for local governments (2008–2016). Relative to population, the agreement covers approximately 77% of all Finnish municipalities. Based on the annual reports, 80% of large and medium-sized local governments and 63% of small local governments had drawn up an action plan by the end of 2015. At the end of 2015, energy audits covered 44% of the service building stock and 51% of the buildings of local governments that had signed the agreement. The average coverage of consumption monitoring at the end of 2015 was 90% for large and medium-sized local governments and 80% for small local governments.

A new energy efficiency agreement for local governments, which extends to the year 2025, was launched on 1 January 2017. A total of 35 local authorities had joined the new agreement by 31 March 2017. Relative to population, the agreement covers 49% of all Finnish local governments. All of the measures listed in paragraph 7 of Article 5 of the Energy Efficiency Directive are included in the agreement:

- adopting an energy efficiency plan to implement the agreement, or updating an existing plan, and submitting it to the responsible local body for approval (Article 5(7)(a))
- setting an energy saving target of at least 7.5% for the year 2025 and an interim target of 4% for the year 2020 (Article 5(7)(a))
- providing instructions for the supervision of engineering and construction in new development and renovations, so that technological choices are based on life cycle economy and energy efficiency wherever possible (Article 5(7)(a))
- carrying out comprehensive energy audits systematically, including energy audits and follow-up audits in existing buildings, commissioning audits in new buildings and the

identification of energy saving potential in energy consumption other than that of buildings (Article 5(7)(b))

- organising energy consumption monitoring and the related personnel training and increasing the coverage of monitoring that is performed on at least a monthly basis in the building stock and in other consumption (Article 5(7)(b))
- ensuring that energy-efficient equipment and systems can be purchased in new developments and renovation projects, regardless of the investment budget, and acquiring expertise from PPP, EPC and ESCO services, for example (Article 5(7)(c))

Senate Properties, which manages the Finnish State's building stock, implements the Commercial Property Action Plan associated with the energy efficiency agreement for the property sector, the obligations of which are largely consistent with those laid down in the energy efficiency agreement for local governments. In practice, most state-owned public organisations rent their premises from Senate Properties.

The Government Resolution of 4 February 2010 on energy efficiency measures obligated public bodies to draw up an energy efficiency plan by the end of 2012. The plan of the Finnish Ministry of Economic Affairs and Employment (then known as the Finnish Ministry of Employment and the Economy) was drawn up and approved in May 2011. Specialist training events were organised concerning the drawing up of energy efficiency plans for four years (2011, 2012, 2013 and 2014). Motiva's website provides guidance on the drawing up of energy efficiency plans and presents TEM's plan as an example. Various ministries have urged their departments to draw up energy efficiency plans through their respective performance management processes.

State-run public bodies have no obligation to make their action plans available to the public, but some have done so and others have voluntarily submitted their plans to the Finnish Ministry of Economic Affairs and Employment or to Motiva. Of the public bodies included in the central government list, 40 public bodies have a separate plan (a Green Office or energy efficiency plan, or both) and a further 34 public bodies are covered by a wider plan drawn up in their respective administrative sectors.

3.2 Purchasing by public bodies – Article 6

3.2.1 Central government purchases

Provisions on the energy-efficiency requirements laid down in the Directive and relating to purchasing by central governments are issued in the Finnish Energy Efficiency Act. According to an amendment which entered into force at the beginning of 2017, central government authorities may only purchase products, services and equipment with high energy-efficiency performance, insofar as the contract has a value greater than the EU thresholds laid down in the Procurement Directive.

In accordance with Annex III to the Energy Efficiency Directive, the Act refers to the products mentioned in the Energy Labelling Directive, appliances governed by the Ecodesign Directive and Energy Star office equipment. The Act also lays down provisions on the energy efficiency of tyres, services and buildings.

In addition to the Energy Efficiency Act, provisions on public procurement are laid down in the Government Resolution on Energy Efficiency Measures (*Valtioneuvoston periaatepäätös energiatehokkuustoimenpiteistä*, 14 February 2010) and the Government Resolution on the Promotion of Sustainable Environmental and Energy Solutions (Cleantech Solutions) in Public Procurement (*Valtioneuvoston periaatepäätös kestävien ympäristö- ja energiaratkaisujen (cleantech-ratkaisut) edistämisestä julkisissa hankinnoissa*, 13 June 2013).

Central government authorities will be comprehensively notified of these new, legislative energy-efficiency obligations during the spring of 2017. All central government authorities will be sent a letter and a supplementary memorandum on the new obligations. They will also be reminded of the guidance

on public procurement and energy efficiency updated by the Finnish Ministry of Economic Affairs and Employment in January 2016. In addition, Motiva Oy will continue to organise annual training events focussing on the energy-efficiency requirements of purchasing by central government authorities.

Public procurement practices are being revised due to the obligations of the new Procurement Directive. Once introduced, the new electronic practices will enable more detailed reporting on energy efficiency.

3.2.2 Purchasing by other public bodies

Observance of energy efficiency principles in public procurement is promoted by a number of means in Finland.

The cleantech procurement advice service[14] set up in connection with Motiva in 2009 is continuing its work as a consultancy service and promoter of sustainable purchases for public procurement units. Motiva disseminates information about best practices in energy-efficient procurement and organises training.

The eco-procurement network[15] set up by public procurement units in 2002 promotes cooperation between public procurement units on environmentally friendly procurement. The promotion of energy-efficient procurement is taken into account as part of sustainable development. Motiva participates in the work of the network.

The guidelines of the Finnish Ministry of Economic Affairs and Employment on energy efficiency in public procurement were revised in 2015[16]. Training on the guidelines has been organised for public procurement units in central government and three regional training events have been held for local government units. TEM and Motiva have communicated on the guidelines on their websites. In addition, targeted information on the guidelines has been sent to the local governments that have signed the energy efficiency agreement and to more than 1,400 procurement experts.

The Government Resolution of 13 June 2013[17] covers not only central government, but also the purchases of all procurement units of the Finnish State: energy, products and equipment, deliveries and transport, as well as buildings and services. Compliance with the Government Resolution is regularly monitored and evaluated by the ministerial working group on energy and climate policy.

Measures pursuant to paragraph 3 of Article 6 of the Energy Efficiency Directive are among the key contractual obligations laid down in local government energy efficiency agreements (2008–2016). Annual reports indicate that compliance with the energy efficiency guidelines issued for public procurement continued to improve throughout the contracting period 2008–2016. By the end of 2015, a total of 87% of large local governments and 78% of small local governments were observing the energy efficiency guidelines. The figures were 81% and 58% respectively in 2012, and 44% and 33% respectively in 2008.

During the contracting period 2017–2025, factoring energy efficiency into public procurement will continue to be one of the key obligations laid down in the energy efficiency agreement for local government.

3.3 Energy efficiency obligation schemes – Article 7

Finland has chosen to implement Article 7 of the Energy Efficiency Directive by means of other policy measures, as provided in paragraph 9 of the Article. The potential of adopting an energy efficiency obligation scheme for energy companies was studied in the autumn of 2013. Experts concluded that the scheme would have been administratively burdensome and difficult to implement in a cost-effective manner in Finland. The alternative policy measures adopted are laid down in Finland's National Energy

[14] http://www.motivanhankintapalvelu.fi/in_english
[15] http://www.motivanhankintapalvelu.fi/hankintapalvelu/ekohankintaverkosto
[16] Energiatehokkuus julkisissa hankinnoissa, Työ- ja elinkeinoministeriön ohjeet
[17] VnP kestävien ympäristö- ja energiaratkaisujen (cleantech-ratkaisut) edistämisestä julkisissa hankinnoissa

Efficiency Programme (KETO); the Commission was notified of them in the notification of transposition of 5 December 2013 regarding Article 7 of the EED. Information on the saving effects of the measures notified with respect to the implementation of Article 7 of the EED is provided in the context of the EED annual report[18].

3.3.1 Calculating the energy saving effects

Finland uses the so-called straight-forward principle in calculating cumulative energy savings pursuant to Article 7. When calculating the cumulative energy saving effect attributable to early actions[19], only measures whose energy saving effects extend to the year 2020 were included.

With regard to far-reaching energy efficiency measures implemented between 2014 and 2020 (whose energy saving effects extend beyond the year 2020), the cumulative energy saving effect has been calculated using cumulative coefficients up to the year 2020. With regard to short-term energy efficiency measures (whose energy saving effects expire before the year 2020), the cumulative energy saving effect in 2020 has been calculated according to the lifetime of each measure. More detailed descriptions of how the cumulative energy saving effects of each measure have been calculated pursuant to Article 7 are included in the annexes (Annex 1: Annual Report on the EED 2017, Annex 3).

Where necessary, the national coefficients used are shown in the annexes (Annex 5: Energy content of selected fuels for end use – conversion table).

3.3.2 Alternative policy measures

Finland's National Energy Efficiency Programme (KETO), which implements the obligations listed in paragraph 9 of Article 7 of the Energy Efficiency Directive, incorporates the following eight energy efficiency measures:

- Energy efficiency agreements
- Transport fuel taxes/road transport
- Energy audits
- Energy efficiency agreements/Energy Services Action Plan and Höylä III with regard to customers
- Heat pumps for detached and terraced houses
- Investments in heating plants
- Energy efficiency regulations for renovations and start-up assistance for renovation work
- Energy efficiency regulations for new development

It has been estimated that the measures to be implemented during the first years of the programming period (2014–2016) will create a cumulative energy saving of 54.87 TWh_{cum} and the measures to be implemented during the latter years (2017–2020) will generate a cumulative energy saving of 37.26 TWh_{cum}. The estimated total cumulative energy saving to be achieved across the entire period 2014–2020 is 92.14 TWh_{cum}. It is therefore expected that Finland's target pursuant to Article 7 (Section 2.2) will be achieved.

More detailed descriptions of the energy efficiency measures contained in Finland's National Energy Efficiency Programme are included in the annexes (Annex 1: Annual Report on the EED 2017, Annex 3).

[18] NEEAP-4 (Annex 1): Annual Report on the EED 2017

[19] The saving effect attributable to early actions implemented between 2009 and 2013 was reported in the Annual Report on the EED 2015.

3.4 Energy audits and energy management systems – Article 8

Finland has been promoting systematic, high-quality energy audits since 1992. Following the entry into force of the Finnish Energy Efficiency Act at the beginning of 2015, energy audits were divided into voluntary, supported energy audits, and the mandatory energy audits of large companies that are carried out every four years.

In its current format, the system of voluntary energy audits meets the requirements laid down in paragraph 1 of Article 8 of the Energy Efficiency Directive concerning the availability to all final customers of high-quality energy audits, which are cost-effective and carried out by qualified experts. Responsibility for the practical coordination of voluntary energy audits lies with Motiva, which is in charge of promoting, developing and monitoring the progress of energy audits, training energy auditors and quality control. The Finnish Ministry of Economic Affairs and Employment confirms the general guidelines for energy audits each year.

In 2017, energy subsidies can be granted towards audits carried out in accordance with four different templates for the service sector, three for the industrial sector, two for the energy sector, one for local government relating to the use of renewable energy, one for energy plans for farms and one for transport chains, which can also be adapted to the auditing of delivery companies. For residential properties, an energy audit template for apartment blocks has been introduced but no energy subsidies are being granted for such audits in 2017.

In addition to the supported energy audits, Motiva has published several more-detailed instructions to assist in the auditing of specific systems and properties, such as compressed air systems, refrigeration systems, ski resorts, and steam and condensate transfer systems.

The energy audit obligation applicable to large companies, pursuant to paragraph 4 of Article 8, is laid down in the Finnish Energy Efficiency Act, which entered into force on 1 January 2015. The Act obliges large companies to carry out an energy audit every four years; the first audit had to be carried out by 5 December 2015. An energy audit of large companies identifies the current energy consumption of all sites of a company or group and examines any potential for energy saving. The national minimum requirements of energy audits of large companies are laid down in the Finnish Energy Efficiency Act, and the government decree and the Decree of the Ministry of Economic Affairs and Employment issued under the Act[20].

According to the Finnish Energy Efficiency Act, large companies that have adopted an ISO 50 001 certified energy management system, or both an ISO 14 001 certified environmental system and a national Energy Efficiency System EES+ certified by a body accredited for the certification of ISO 14 001, are exempt from mandatory energy audits of large companies[21]. If a company covered by the energy efficiency agreement scheme adopts an Energy Efficiency System EES+ included in the energy audit obligation, the company is regarded as fulfilling the obligation of mandatory energy audits applicable to large companies. In such a case, the EES+ need not be certified.

Responsibility for official duties relating to mandatory energy audits of large companies is arranged so that the Finnish Energy Authority is responsible for the implementation of the Finnish Energy Efficiency Act, including the certification of persons responsible for energy audits of large companies, and quality assurance and oversight in all sectors.

The current status and upcoming changes to energy audits in Finland are described in more detail in the annexes (Annex 3 Description of energy efficiency measures – excluding impact assessment, HO-14-

[20] http://www.energiavirasto.fi/suurten-yritysten-pakolliset-katselmukset

[21] https://www.motiva.fi/ratkaisut/energiakatselmustoiminta/pakollinen_suuren_yrityksen_energiakatselmus/energiatehokkuusjarjestelma_etj

TEM/YM/MMM/LVM). The energy saving effects of energy audits are discussed by sector in Section 3.6 of the report.

3.5 Metering and billing – Articles 9–11

3.5.1 Metering – Article 9

The Finnish Act on energy efficiency services of companies operating in the energy market (*Laki energiamarkkinoilla toimivien yritysten energiatehokkuuspalveluista* 1211/2009) and the government decree on electricity supply statements and metering (*Valtioneuvoston asetus sähköntoimitusten selvityksestä ja mittauksesta* 66/2009) issued under the Finnish Electricity Market Act (*Sähkömarkkinalaki* 588/2013) covered most of the requirements laid down in paragraph 1 of Article 9 concerning the provision of meters to final customers for electricity, natural gas, district heating and district cooling and the requirements laid down in paragraph 2 of Article 9 concerning the implementation of intelligent metering systems.

The necessary amendments required by Article 9 were made in a government proposal in the autumn of 2014. The requirements relating to district heating and district cooling were incorporated into the Finnish Energy Efficiency Act (1429/2014). At the same time, the Finnish Electricity Market Act (588/2013) and the Finnish Natural Gas Market Act (508/2000) were amended. The new Energy Efficiency Act and the amendments to the existing statutes entered into force at the beginning of 2015.

At the beginning of 2016, 98.9% of all electricity usage points had an hourly electricity meter that can be read remotely. Remote reading is in use for 90% of district heating customers. In Finland, there is very little retail-level supply of natural gas to consumers, and the current regulations do not require hourly meters that can be read remotely.

The Finnish Energy Efficiency Act was supplemented in the autumn of 2016, since Finnish legislation lacked some of the definitions used in the Energy Efficiency Directive.

According to a decree issued under the Finnish Land Use and Building Act (132/1999) and concerning plumbing and sewerage systems in properties (*Ympäristöministeriön asetus kiinteistöjen vesi- ja viemärilaitteistoista*), new properties with multiple units must, in addition to a main water meter, also be equipped with unit-specific meters for measuring the volume of cold and hot water supplied to each unit. It must be easy to monitor water consumption and it must be possible to use meter readings as the basis for billing. The use of unit-specific water consumption data as the basis for billing is regulated by the Articles of Association of housing associations.

Unit-specific heating metering

During the negotiations concerning the Energy Efficiency Directive, the Commission confirmed that a report commissioned by a Member State is sufficient evidence that methods of heat consumption measurement are not cost-efficient as referred to in paragraph 3 of Article 9. A report commissioned by the Finnish Ministry of Economic Affairs and Employment from VTT Technical Research Centre of Finland was published in October 2013, concerning the technical and economic requirements of unit-specific metering and cost allocators. The report is based on information, compiled from sources abroad, on the direct costs of cost allocators. The report did not strive to factor in all possible indirect costs. In addition, the report does not take account of heat conveyance between units, which would inevitably cause problems in the fair allocation of costs if billing based on unit-specific metering or cost allocators were introduced.

According to the report, cost allocators would only pay for themselves if, by using them, consumers were able to save more than 21% of their energy in apartment blocks and more than 14% in terraced houses. Covering the costs of unit-specific heating volume metering would require an energy saving of 45% in apartment blocks and 30% in terraced houses.

These thresholds have been calculated without factoring in any discount rates in profitability calculations. If discount rates are factored in, the required energy savings would be even greater. Another question concerns how substantial the financial benefit would have to be to steer consumer choices. The aforementioned thresholds would only be sufficient to cover the costs incurred. Since financial viability must be considered at the level of individual buildings, this level of savings would have to be achieved in each residential unit.

Of the types of residential properties examined, cost allocators paid for themselves at an energy saving rate of 10% only in relatively large terraced properties built before 1980. These kinds of properties account for five percent of all terraced houses (1% of all terraced houses and apartment blocks). This means that in 99% of existing buildings with multiple residential units, energy metering and indirect determination of heating consumption would generate costs beyond what could be covered by energy savings resulting from changes in consumer behaviour. It would be more cost-effective to invest in adjusting and balancing the heating systems of buildings, which is more likely to bring savings than equipment with indirect effects.

On the basis of experience, the Commission has estimated that heat cost allocators would result in an average energy saving of 20%. In the absence of anything better, this saving is theoretically based on a reduction of room temperatures by 1.1 degrees and a decrease of window ventilation by 0.25 times/hour. However, there is little need for window ventilation in Finland, as forced general ventilation is very common. A study commissioned by the Finnish Energy Authority and carried out in the winter of 2016 showed that 3.3% of all windows were open in apartment blocks. A total of 434 buildings in three cities were photographed for the study. They had 20,757 windows, of which 685 were open, and most of these were small ventilation windows that were ajar. Outside temperatures during the photographing were average temperatures typical of the heating season. The number of open windows decreases rapidly as the temperature drops. This study on window ventilation was carried out after the Commission had called into question the sparing use of window ventilation in Finland on the grounds that it could not be substantiated. In more recent building stock and non-residential buildings, in particular, there tends to be no openable windows, which are unnecessary due to forced general ventilation.

The 2013 report by VTT Technical Research Centre of Finland showed that unit-specific heating consumption metering is extremely difficult to implement, in technical terms, in existing buildings, and that cost allocation is not cost-effective even in the case of radiator-specific equipment. Based on the current technology, neither solution seems financially viable in new buildings either, given that the energy regulations applicable to new buildings are already efficient and will tighten in the future.

3.5.2 Billing – Articles 10 and 11

With regard to district heating and district cooling the requirements, concerning district heating, laid down in Articles 10 and 11 and Annex VII of the Energy Efficiency Directive were implemented by the Finnish Energy Efficiency Act (1429/2014). With regard to electricity and natural gas, those requirements that were not covered by the Finnish Electricity Market Act (588/2013) and the Finnish Natural Gas Market Act (508/2000) were implemented by their amendments. The new Energy Efficiency Act and the amendments to the existing statutes entered into force at the beginning of 2015.

3.6 Other measures related to energy end-use efficiency in different sectors

This section sets out the energy efficiency measures relating to the implementation and monitoring of Finland's quantitative energy saving target and required by the Energy Services Directive (ESD), divided between six sectors (buildings, public sector, private services, industry, transport and agriculture) and the energy saving effects of the same calculated according to the methods laid down in the ESD for the years 2010, 2016 and 2020. More detailed descriptions of Finland's energy efficiency measures are included in the annexes (Annex 2 Description of energy saving measures pursuant to the ESD).

The energy efficiency measures notified for the implementation of Article 7 of the Energy Efficiency Directive (EED) and the related saving calculations and cumulative energy saving effects are presented in the EED Annual Report (Annex 1 – Annual Report on the EED 2017).

3.6.1 Buildings

With regard to buildings, the key energy efficiency measures relate to heat pumps in terraced and detached houses, the Höylä III energy efficiency agreement and energy performance regulations applicable to new development.

The annual energy saving effect of 6 665 GWh calculated for the year 2010 equates to a 5% energy saving across the total energy consumption attributable to buildings. The measures presented in the following table are expected to raise the annual energy saving to 11% of the sector's total energy consumption by the year 2016 and to 15% by 2020.

Table 2. Buildings (RA) – summary of impacts on energy consumption

CODE	MEASURE*	ENERGY SAVING		
		2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
RA-01-YM	Energy efficiency regulations for new development in 2003, 2008, 2010 and 2012	1,817	4,195	6,006
RA-02-YM	Energy efficiency regulations for renovations	0	622	1,514
RA-03-YM	Energy subsidies for residential buildings	284	1,172	1,170
RA-04-TEM	Heat pumps for detached, semi-detached and terraced houses	2,326	5,456	7,574
RA-05-YM	Mandatory installations of unit-specific water meters	0	74	128
RA-07-TEM/YM	Höylä III energy efficiency agreement – oil-heated detached houses	2,192	2,392	2,530
RA-08-YM	Energy efficiency agreement for the property sector – residential lettings associations	45	244	326
TOTAL ENERGY SAVING– ESD		**6,665**	**14,156**	**19,248**

* Descriptions of the measures and the principles for calculating energy savings are included in Annex 2 (Annex 2 Description of energy saving measures pursuant to the ESD).

3.6.2 Public sector

Two energy efficiency measures are monitored separately in the local government sector: the energy efficiency agreement for local governments and supported local government energy audits.

The annual energy saving effect of 290 GWh calculated for the year 2010 equates to approximately 2.4% of total energy consumption attributable to the local government sector. It has been estimated that, with the help of these measures, the annual energy saving effect will rise to approximately 3.8% of total energy consumption attributable to the sector by the year 2016 and to 3.8% by 2020.

Measures with an impact on energy consumption in the local government sector are also included in the measures discussed in Section 3.6.1 "Buildings" and in the horizontal measures discussed in Section 4; the energy saving effects of these measures have not been evaluated in most cases.

With regard to central government, energy saving effects have been evaluated across four measures implemented by Senate Properties[22], the most important of which relates to maintenance and user information.

The energy saving effect of 118 GWh calculated for the year 2010 equates to 4.6% of the total energy consumption attributable to central government. It has been estimated that the annual energy saving effect will rise to approximately 10% of the total energy consumption attributable to the sector by the year 2016 and to around 15% by 2020.

Measures that have an impact on central government energy consumption are also included in the horizontal measures discussed in Section 4.

[22] https://www.senaatti.fi/en/

Table 3. Public sector (KU, VA) – summary of impacts on energy consumption

Code**	Measure*	Energy saving		
		2010 GWh/a	estimate 2016 GWh/a	estimate 2020 GWh/a
KU-01-TEM	Energy efficiency agreement for the local government sector	221	366	366
KU-02-TEM	Energy audits – local government sector	69	89	88
VA-01-VM	Increasing the efficiency of space utilisation in central government	7	73	115
VA-02-VM	Renovation of the state's building stock	3	32	68
VA-03-VM	Increasing energy efficiency in new development in the state sector	1	10	22
VA-04-VM	Maintenance and user information for the state's building stock	98	125	153
Energy saving, local governments (KU)– ESD		290	455	455
Energy saving, central government (VA) – ESD		109	240	358
Total energy saving– ESD		**399**	**695**	**813**

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

** KU = Local governments, VA = Central government

3.6.3 Services – private

Energy efficiency measures monitored separately in the service sector include supported energy audits, the Commercial Properties Action Plan associated with the energy efficiency agreement for the property sector, and the Services Action Plans associated with the energy efficiency agreement for businesses.

The annual energy saving effect of 114 GWh calculated for the year 2010 equates to 0.5% of total energy end-use in the private services sector. It has been estimated that the energy saving effect of these measures would be slightly under 2.5% of the total energy consumption attributable to the sector in the years 2016 and 2020.

Energy efficiency measures that have an impact on energy consumption in the private services sector are also included in

the measures, related to buildings, discussed in Section 3.6.1 and in the horizontal measures discussed in Section 4.

Table 4. Private services (PA) – summary of impacts on energy consumption

Code	Measure*	Energy saving		
		2010 GWh/a	estimate 2016 GWh/a	estimate 2020 GWh/a
PA-01-TEM	Energy audits – private services	76	78	71
PA-02-TEM	Energy efficiency agreement for businesses – service sector	36	191	200
PA-03-TEM	Energy efficiency agreement for the property sector – commercial properties	3	214	242
Total energy saving– ESD		**114**	**483**	**513**

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

3.6.4 Industry

Key energy efficiency measures monitored separately in the industrial sector include all industry action plans associated with the energy efficiency agreement for businesses and supported energy audits in the sector.

The energy saving effects of these measures have been monitored separately at industrial sites governed by the Energy Services Directive and those participating in emissions trading. Of the energy saving of 10.1 TWh calculated for the year 2010, a total of 0.96 TWh (10%) is attributable to industry governed by the Energy Services Directive and 9.16 TWh (90%) to the energy consumption of industrial sites participating in emissions trading. Relative to the total energy consumption attributable to Finnish industry, which amounted to 140 TWh in 2010, the energy saving effect of all of the implemented measures came to more than 7 % of the sector's total final energy consumption. The saving effect of measures implemented by sites governed by the ESD amounted to almost 1% of the total final energy consumption of the industrial sector.

Table 5. Industry (TE) – summary of impacts on energy consumption

CODE	MEASURE*	ENERGY SAVING		
		2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
TE–01–TEM	Industrial energy audits, ESD	438	393	335
	Industrial energy audits, non-ESD	1,837	1,010	438
TE–02–TEM	Energy efficiency agreement for businesses – medium-sized industrial organisations, ESD	269	446	591
	Energy efficiency agreement for businesses – medium-sized industrial organisations, non-ESD	48	151	179
TE–03–TEM	Energy efficiency agreement for businesses – energy-intensive industry, ESD	250	354	263
	Energy efficiency agreement for businesses – energy-intensive industry, non-ESD	7,272	9,970	11,428
TOTAL ENERGY SAVING– ESD		**957**	**1,193**	**1,188**
TOTAL ENERGY SAVING – NON-ESD		9,157	11,131	12,046
TOTAL ENERGY SAVING– ALL		10,115	12,324	13,234

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

Compared to the previous NEEAP reports, the division between savings attributable to the ESD sector and the non-ESD sector has been further revised by examining the distribution between sites participating and those not participating in emissions trading. In terms of savings attributable to the industrial sector, this gives an even greater role to savings in final energy consumption by the non-ESD sector.

3.6.5 Transport

Energy efficiency measures in the transport sector, for which the energy saving effects have been evaluated, include improving the energy efficiency of cars, changes in the mass and dimensions of heavy goods vehicles, and promoting public transport, walking and cycling.

The annual energy saving effect of 1,478 GWh, calculated for the measures presented in the following table for the year 2010, equates to 2.5% of the total final energy consumption attributable to road transport. It is estimated that the measures presented in the following table will raise the annual energy saving rate to more than 7% of the sector's total energy consumption by the year 2016 and to 14% by 2020.

The energy efficiency of transport is being improved by other measures in addition to these. These include improving the energy efficiency of vans, the responsibility model for road transport enterprises, promoting fuel economy among car users and professional drivers, energy labelling of tyres, various websites developed for supporting the energy-efficient procurement of vehicle and transport services, and energy taxation relating to transport. The ESD-related energy saving effects of these measures have not been evaluated. Some of these measures are described in Annex 3.

Table 6. Transport (LI) – summary of impacts on energy consumption

CODE	MEASURE*	ENERGY SAVING		
		2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
LI–01–LVM	Improving the energy efficiency of cars	1,008	2,336	4,475
LI–03–LVM	Promoting public transport	38	230	570
LI–04–LVM	Promoting walking and cycling	38	190	460
LI–05–LVM	Changes in the mass and dimensions of heavy goods vehicles	0	400	550
TOTAL ENERGY SAVING– ESD		**1,084**	**3,156**	**6,055**

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

3.6.6 Agriculture

This section discusses five energy efficiency measures, whose energy saving effects have been estimated, in the agricultural sector. The annual energy saving of 1 222 GWh calculated for the measures presented in the following table for 2010 equates to 9% of the total final energy consumption of farms and horticultural facilities attributable to the sector.

It has been estimated that the annual energy saving effect will rise to more than 15% of the sector's total energy consumption by the year 2016 and to approximately 17% by 2020.

Table 7. Agriculture (MA) – summary of impacts on energy consumption

CODE	MEASURE*	ENERGY SAVING		
		2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
MA-01-MMM	Investments in heating plants	1,201	1,950	2,198
MA-02-MMM	Fresh grain silos	4	16	23
MA-03-MMM	Energy efficiency of cowsheds and pig farms	2	7	13

MA-04-MMM	Re-parcelling projects	15	90	133
MA-05-MMM	Energy consultancy for farms	0	11	24
TOTAL ENERGY SAVING– ESD		**1,222**	**2,074**	**2,391**

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

3.7 Summary of impacts on energy consumption

The table below gives a summary of the annual energy saving effects of the energy efficiency measures in the six sectors discussed in Section 3.6 above, calculated in accordance with the Energy Services Directive (ESD) for the years 2010, 2016 and 2020. Annual energy saving effects have been calculated for 28 measures in Section 3.6 above, 26 of which relate purely to energy consumption in the ESD sector. The effects of industrial measures are split between the ESD sector and the non-ESD sector (= sites participating in emissions trading).

For the first time, the saving effects calculated in Section 3.6 in this NEEAP report include the saving effects of the Höylä energy efficiency agreement and the Energy Services Action Plan associated with the energy efficiency agreement for businesses with regard to advice and information targeted at customers (Annex 2: RA-07TEM/YM and EP-02-TEM). In the transport sector, some measures have been eliminated and some have been transferred to Annex 3. In addition, compared to the NEEAP-3, some of the content and/or numbering has been updated with regard to the measures presented in Annexes 2 and 3.

The greatest energy savings can be achieved in the building sector, where the key individual measures relate to building regulations, measures relating to oil-heated detached houses, and heat pumps in detached and terraced houses. The second greatest savings within the scope of the ESD quantified in Section 3.6 come from the transport and agricultural sectors. The energy savings attributable to the industrial sector are also considerable, but mainly relate to energy consumption in the non-ESD sector.

Table 8. Summary of the impacts of energy efficiency measures discussed in Section 3.6

SECTOR	ENERGY SAVING		
	2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
ESD:			
Buildings	6,665	14,156	19,248
Public sector	399	695	813
Services – private	114	483	513
Industry	957	1,193	1,188
Transportation	1,084	3,156	6,055
Agriculture	1,222	2,074	2,391
NON-ESD:			
Industry	9,157	11,131	12,046
TOTAL ENERGY SAVING– ESD	**10,441**	**21,756**	**30,208**
TOTAL ENERGY SAVING – NON-ESD	9,157	11,131	12,046
TOTAL ENERGY SAVING– ALL	19,598	32,887	42,254

4 HORIZONTAL MEASURES – IMPLEMENTATION OF THE ENERGY EFFICIENCY DIRECTIVE

4.1 Information and training – Articles 12 and 17

4.1.1 Information

Finland has a long history of investing in the dissemination of information, advice and training relating to energy efficiency. One of the most important organisations in this respect is Motiva, which covers all sectors from consumers to industry. Various ministries contribute approximately EUR 2 million a year to Motiva's communications.

The energy companies and a network of regional consultancy organisations coordinated by Motiva are the key providers of energy advice targeted at consumers. Advice is also available for businesses. In addition, the Finnish Ministry of the Environment hosts an online portal called Korjaustieto.fi, which contains information on property renovations for consumers and property owners, and coordinates a renovation consultancy network. More detailed information about the dissemination of information and advice concerning energy efficiency in Finland is included in the annexes (Annex 3 Description of energy efficiency measures – excluding impact assessment/Communications and advice: HO-07–HO-11 and EP-02).

Energy efficiency advice for the transport sector is provided in connection with national mobility management work, which is coordinated by Motiva under commission by the Finnish Transport Agency. The Finnish Transport Agency also grants funding to regions and local government for the purposes of mobility management. The measures are described in more detail in the annexes (Annex 2 Description of energy saving measures pursuant to the ESD/Transport: LI-03 and LI-04 as well as Annex 3 Description of energy efficiency measures – excluding impact assessment / Horizontal measures: HO-08).

In addition to the renovation consultancy provided by the Finnish Ministry of the Environment, the Ministry has commissioned Motiva to disseminate information on the energy performance of buildings and energy certificates. In addition, advice is provided nationwide on themes such as property management and maintenance, material efficiency, damp and mould problems, and accessibility.

Responsibility for advising consumers on ecodesign and energy labelling requirements lies with Motiva. Communications are financed by the Finnish Ministry of Economic Affairs and Employment and the Finnish Ministry of the Environment.

Motiva and lighting companies have set up a joint website containing information on lighting products for households[23]. The website has information on choosing the right kinds of light bulbs and locations to which light bulbs can be taken for recycling. An online training course[24] on light bulbs has also been developed for retailers.

Motiva's website motiva.fi/bioenergia showcases ways of promoting renewable sources of energy and energy efficiency, and presents the related services in rural areas. The website also incorporates content taken from the bioenergiatieto.fi website, which was hosted by the Finnish Ministry of Agriculture and Forestry until the end of 2013. In addition, advice by qualified consultants on the energy efficiency of farms is available as part of the Neuvo2020 activities of the rural development programme.

4.1.2 Training

In Finland, sustainable development and energy efficiency are featured at all levels of education, from comprehensive school to university. The way in which energy efficiency is factored into training is discussed in more detail in the annexes (Annex 3 Description of energy efficiency measures – excluding impact assessment/Training: HO-02–HO-06).

[23] http://www.lampputieto.fi
[24] http://www.lamppukoulu.fi

4.2 Availability of qualification, accreditation and certification schemes – Article 16

In terms of the technical competence of operators, objectivity and reliability, Finland's qualification and certification schemes are of a high standard.

Motiva has been providing energy auditor training on commission from the Finnish Ministry of Economic Affairs and Employment since 1993. By the end of 2016, a total of almost 2 100 energy auditors had been trained and certified to carry out audits in the service sector, industrial sector and energy sector. Around 50 new energy auditors have obtained the qualification in each of the last few years. In practice, this energy auditor training serves as a basic course in energy efficiency for experts. All individuals participating in the courses need to have passed basic training in their respective fields (e.g. electrical engineering or heating, plumbing and air-conditioning engineering).

In addition to the energy auditor training carried out by Motiva, the training of persons responsible for mandatory energy audits within large companies was started by the Finnish Energy Authority at the beginning of 2015. By the beginning of 2017, a total of 427 such persons had been trained. Qualitatively and quantitatively speaking, Finland has enough qualified energy auditors and persons responsible for the mandatory energy audits of large companies.

The Finnish Ministry of the Environment has estimated that individuals authorised by the Housing Finance and Development Centre of Finland to issue energy certificates are also qualified to carry out energy audits in residential properties. Finland currently (29 March 2017) has 734 energy certifiers with basic-level qualifications and 267 energy certifiers with advanced qualifications. Energy auditors trained and certified by Motiva are also qualified to carry out energy audits in residential properties.

Accreditations for drawing up energy plans for farms are issued by the Finnish Agency for Rural Affairs.

As a market for ESCO services, Finland is small. Due to the limited number of ESCOs (5–8 companies), there has been no need to set up a separate qualification or certification scheme for service providers, and no such need is foreseen in the near future. In practice, providers of ESCO services are already covered by the current energy auditor training and other vocational further education schemes.

In accordance with Article 14.3 and Annex IV of the European Renewable Energy Directive (2009/28/EC), Finland has set up a voluntary certification and training scheme for installers of solar heating, solar energy, bioheat, heat pump and pellet systems. The advanced and in-training courses provided in accordance with the certification scheme give installers and other service providers an opportunity to demonstrate their competence and gain certification. The scheme forms part of vocational further education from the perspective of the Finnish education system. Motiva maintains a list of certified installers of solar heating, solar energy, bioheat (e.g. pellet and wood chips) and heat pump systems[25].

4.3 Energy services – Article 18

The promotion of energy services is an important part of Motiva's energy programme, which has a total budget of around EUR 2.7 million in 2017. Promotion typically takes the form of disseminating information about energy efficiency and organising development projects with various operators.

Operators classified and registered as providers of energy services in Finland mainly comprise businesses that perform supported energy audits[26], persons responsible for energy audits of large companies[27], individuals who issue energy certificates[28] and ESCOs[29]. Motiva maintains lists of auditing

[25] https://www.motiva.fi/ratkaisut/uusiutuva_energia/palvelut/sertifioidut_asentajat

[26] https://www.motiva.fi/ratkaisut/energiakatselmustoiminta/tem_n_tukemat_energiakatselmukset/patevoityneet_energiakatselmoijat

[27] http://www.energiavirasto.fi/vastuuhenkilorekisteri

[28] https://www.energiatodistusrekisteri.fi/public_html?command=browse&lang=fi

companies that have satisfactorily performed energy audits and of ESCOs, while the Finnish Energy Authority maintains a list of persons responsible for energy audits of large companies. Lists of individuals who issue energy certificates are maintained by the Housing Finance and Development Centre of Finland. Motiva has been commissioned by the Finnish Ministry of the Environment to organise networking and training events for individuals who issue energy certificates, and by the Finnish Ministry of Economic Affairs and Employment to hold retraining events for energy auditors. Motiva is developing a new ESCO project register, into which companies can enter information on implemented ESCO projects.

Considering the various services and electronic systems relating to the management of energy consumption and energy supply, Finnish service providers can be considered both versatile and knowledgeable. Numerous service providers on the market have their own products, and efficient channels and resources for marketing them. The future prospects are encouraging.

The development of energy services in Finland has mainly been promoted by means of programmes coordinated by the Finnish Funding Agency for Innovation (Tekes). During the NEEAP-3 reporting phase, the key programmes, which included the development of energy service business activities, were Green Growth[30] – Road to sustainable economy (2011–2015, EUR 80 million) and Built Environment[31] (2009–2014, EUR 75 million). During the NEEAP-4 reporting period, the programmes in progress are Witty City[32] (2013–2017, EUR 100 million) and Smart Energy[33] (2017–2021, EUR 200 million), which incorporate energy services relating to housing and consumers.

4.4 Other measures promoting energy efficiency – Article 19

There are no legislative barriers in Finland to the private or public sector acquiring energy-efficient technology, or that prevent landlords and tenants from agreeing to energy efficiency measures and splitting any energy savings thus achieved. A good example of enabling benefit sharing between landlords and tenants was the development and promotion of the so-called Green Lease concept in 2011.

To set an example in the public sector, Senate Properties[34] developed the first Green Lease contracts for state-owned properties. These contract templates were in use until 2015. Since the beginning of 2016, the State has used a single contract template in which Senate Properties and the tenant mutually agree on the energy-efficient use of the property and reporting.

In the private sector, Green Lease templates[35] were developed during the course of the Energy Efficient Contractual Practices project of the Finnish Association of Building Owners and Construction Clients (RAKLI). One of the obligations laid down in the energy efficiency agreement for the property sector (2010–2016) was promoting energy-efficient tenancy and service agreement practices. Use of these contract templates is monitored as part of the annual reporting of the energy efficiency agreement for the property sector (2010–2016). In 2015, these contract templates were used by six companies that had signed the energy efficiency agreement for the property sector.

Another obligation laid down in the energy efficiency agreement for the property sector involved promoting the incorporation of energy efficiency targets into property management agreements. For

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[29] https://www.motiva.fi/ratkaisut/energiakatselmustoiminta/energiatehokkuus-_ja_esco-palvelut/escoyritykset_suomessa

[30] https://www.tekes.fi/en/programmes-and-services/recently-ended-programmes/green-growth/

[31] https://www.tekes.fi/en/programmes-and-services/recently-ended-programmes/built-environment/

[32] https://www.tekes.fi/en/programmes-and-services/tekes-programmes/witty-city/

[33] https://www.tekes.fi/en/programmes-and-services/tekes-programmes/smart-energy/

[34] https://www.senaatti.fi/en/

[35] http://www.rakli.fi/energia-tehokkuus/energiatehokkuus/ekotehokkaat-sopimuskaytannot.html

Senate Properties, this operating model, which includes an energy saving target, has been a key energy efficiency measure with regard to the implementation of Article 5 of the EED.

No barriers exist that would limit access to ESCO services. Local governments that had signed the energy efficiency agreements for the local government sector (2008–2016) committed themselves to acquiring sufficient expertise for evaluating and subscribing to ESCO services whenever a viable energy efficiency investment would otherwise have been abandoned due to lack of funding.

The key elements of the above-mentioned obligations to promote energy efficiency are also included in the new energy efficiency agreements for the property sector and local governments for 2017–2025. Local governments that had signed the energy efficiency agreements for local governments (2008–2016) committed themselves to acquiring sufficient expertise in evaluating and subscribing to ESCO services whenever a viable energy efficiency investment would otherwise have been abandoned due to lack of funding.

4.5 Funds and financing – Article 20

Finland has no plans to establish a national energy efficiency fund. Because the Parliament of Finland has no control over state funds that are not part of the state budget, Section 87 of the Constitution of Finland includes a restriction on founding extra-budgetary funds. An extra-budgetary fund may be created if this is an essential requirement for the performance of a permanent duty of the State. However, a decision by Parliament to adopt a legislative proposal for the creation of an extra-budgetary fund must be supported by at least two thirds of the votes cast. No new funds are set up in practice.

Lack of funding is not an issue in the implementation of energy efficiency projects in Finland if the funding applicant is creditworthy. Various loan and leasing financing products are available on the market. The newest financing product is green financing, launched in 2016 by Kuntarahoitus (Municipality Finance), for local government projects that promote the transition to low-carbon and climate resilient growth. When interest rates are low, the main benefit provided by green financing is an improved image. Kuntarahoitus also has long experience of the financing of ESCO projects in the local government sector.

Finnish Government policy states that 25% of Finland's ERDF financing will be allocated to measures that promote the transition to a low-carbon society, while the minimum target set by the EU is 20%. Promoting energy efficiency in various sectors plays a key role in funded projects promoting the transition to a low-carbon society.

The Rural Development Programme for Mainland Finland 2014–2020 (the Rural Development Programme) also provides funding in support of projects and business and primary-sector investments that promote energy efficiency. Motiva contributes to the implementation of ERDF funding and the Rural Development Programme by producing supporting material for project applicants and application examiners, and organising events to promote cooperation between operators commissioned by funding providers.

Information on funding options is also disseminated as part of projects and events relating to Motiva's energy programme (Section 4.3, Annex 3, HO–07–TEM), where possible.

4.6 Other horizontal energy efficiency measures

This section describes a few of the key horizontal measures for promoting energy efficiency.

4.6.1 Financial steering

Tax administration (HO-01-VM)

Energy efficiency in Finland is promoted by means of energy tax, car tax, vehicle tax and tax credits for households, in addition to other energy efficiency measures. The effects of taxes have not been evaluated separately as ESD savings in the NEEAP-4, as the saving effects would overlap with the effects of other measures discussed in this report. The energy saving effect of the tax credit available to households also overlaps with the effects of energy subsidies.

A description of measure HO-01-VM is included in the annexes (Annex 3 Description of energy efficiency measures – excluding impact assessment/Taxes).

Energy subsidies granted by the Finnish Ministry of Economic Affairs and Employment (budget item No 32/60/40)

The Finnish Ministry of Economic Affairs and Employment grants energy subsidies to businesses and non-governmental organisations towards investments aimed at promoting energy conservation and the use and production of renewable forms of energy, as well as towards energy audits. The annual energy subsidy budget is divided between subsidies targeted at energy audits and subsidies targeted at energy saving investments.

These subsidies are granted by the Energy Department of the Ministry of Economic Affairs and Employment, as well as Tekes.

Subsidies for conventional energy saving investments are only available to businesses that have signed an energy efficiency agreement and normally cover 20% of the investment costs. Subsidies towards investments in new technology are available to all businesses and non-governmental organisations, and the subsidies normally cover 20-35 % of the investment costs.

Energy subsidies granted for energy saving investments between 1998 and 2008 have amounted to between EUR 2 million and EUR 4 million each year. The energy efficiency agreement scheme launched in 2008 has had a considerable impact on the number of energy efficiency projects. Between 2009 and 2015, an annual average of almost EUR 12 million in energy subsidies – ranging from EUR 5 million to EUR 23 million a year – was granted towards energy-efficiency investments.

Subsidies towards energy audits have been available since 1992. Between 2008 and 2015, the annual amount of energy subsidies was EUR 1.6 million on average and such subsidies covered between 40% and 60% of the costs in question, depending on the type of energy audit and applicant. During the above-mentioned years, the annual amount of subsidies granted ranged from EUR 0.9 million to EUR 2.7 million. There is significant variation between years.

An important change in subsidies towards energy audits occurred when energy audits of large companies became mandatory in accordance with the Energy Efficiency Directive and support for such audits was terminated on 5 June 2014. The record-breaking amount of EUR 3.4 million in subsidies was granted during the first part of 2014. In 2015, subsidies granted towards energy audits amounted to only EUR 0.5 million and are expected to remain at a lower level than previously.

The energy saving effects of energy subsidies have not been evaluated separately, as they mainly overlap with the effects of energy saving investments reported in the context of energy audits and energy efficiency agreement schemes, the energy saving effects of which are discussed in Section 3.3.

4.6.2 Ecodesign and Energy Labelling Directives

National measures under the Ecodesign Directive and the Energy Labelling Directive focus on preparation work relating to the Regulations, market surveillance and the dissemination of information. The Finnish Ministry of Economic Affairs and Employment is responsible for preparation work relating to the framework Directives, and the Finnish Safety and Chemicals Agency is responsible for market surveillance. Responsibility for preparation work relating to the product group-specific Regulations has been divided between the Finnish Ministry of the Environment and the Finnish Energy Authority. The Ministry of the Environment is responsible for the Regulations relating to construction products, while the Finnish Energy Authority is responsible for the other Regulations and most horizontal issues.

In 2009, a communication campaign relating to the Energy Labelling Regulations was launched in order to disseminate information to manufacturers and importers, particularly SMEs. Responsibility for the initiative was transferred to the Finnish Energy Authority in 2015. The main communication channel of

the project is a website on ecodesign[36], which contains in-depth, up-to-date information on the requirements applicable to each product group. The website was updated in 2015. A newsletter associated with the website has been published since 2010 In order to disseminate information, Finland has also invested in stakeholder meetings, which have been organised in cooperation with organisations such as the Federation of Finnish Technology Industries. In addition, a general ecodesign forum, open to all, has been organised annually. The initiative has an annual budget of approximately EUR 70,000

Important product groups for Finland include most construction products, compressors, electric motors, as well as lighting appliances and equipment. Due to the growing role of harmonised standards, resources have also been allocated to preparation work relating to the horizontal standards that are most significant to Finland.

The energy saving effects of energy efficiency requirements applicable to specific types of appliances are discussed in the annexes (Annex 2 Description of energy saving measures pursuant to the ESD/Others: HO-13-TEM).

4.6.3 Civil engineering (HO-12-YM)

Several projects are in progress within the administrative sector of the Finnish Ministry of the Environment, which are aimed at improving the energy efficiency of local communities. This measure includes subsidies, evaluations of the effectiveness of steering mechanisms, collaboration between the state and local governments, and regional analyses.

A description of the measure is included in the annexes (Annex 3 Description of energy efficiency measures – excluding impact assessment/Civil engineering and planning: HO-12-YM).

4.7 Summary of impacts on energy consumption

Finland has introduced numerous horizontal measures promoting energy conservation and energy efficiency, the energy saving effects of which cannot be calculated in an applicable form. Such measures tend to be so-called “soft measures” and involve education, the dissemination of information and advice, and research and development programmes and projects. In respect of the ESD savings reported in the NEAAP-4, it was not considered expedient to produce separate impact assessments of all means of financial steering, such as taxes and subsidies.

The saving effects of these measures largely overlap with the effects of measures for which energy saving effects have been reported in Section 3.7 of the NEAAP-4. The only horizontal measure whose energy saving effects have been calculated is the Ecodesign Directive and the energy efficiency requirements issued on specific equipment groups thereunder.

The table below shows the annual estimated energy saving effects of the implementation of the Ecodesign Directive, calculated in accordance with the Energy Services Directive for the years 2010, 2016 and 2020. The savings have been calculated ensuring that they do not overlap with the saving effects of other measures reported in the NEEAP-4.

Table 9. Horizontal measures (HO) – summary of impacts on energy consumption

CODE	MEASURE*	ENERGY SAVING		
		2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
HO-13-TEM	Ecodesign Directive and equipment group-specific energy efficiency requirements	0	1,278	4,259
TOTAL ENERGY SAVING– ESD		**0**	**1,278**	**4,259**

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

[36] http://www.ekosuunnittelu.info

5 EFFICIENCY OF ENERGY PRODUCTION AND SUPPLY – IMPLEMENTATION OF THE ENERGY EFFICIENCY DIRECTIVE

5.1 Promotion of efficient heating and cooling – Article 14

5.1.1 Comprehensive assessment of cogeneration and district heating and cooling

Finland has made good use of the potential of CHP and district heating. The comprehensive assessment required under Article 14 has been carried out.

A significant proportion of the heated building stock in towns and cities, and other densely populated municipalities, is connected to district heating networks. Heating energy consumption and district heating statistics show that 90% of apartment blocks, 30% of industrial buildings and more than 60% of other buildings are heated by district heating. For detached houses, the corresponding figure is approximately 10%. The market share of district heating is 45% (35.9 TWh, 2010) in total. District heating consumption is expected to total 40 TWh in 2025. Annual heat losses in district heating networks in Finland are approximately 8–9%, calculated as the difference between produced and sold heat. This calculation also includes a margin for measurement errors. The average amount of heat delivered to customers is 2.5 MWh/m of district heating pipe.

According to the current schedule, the new Äänekoski pulp mill will commence production in the second half of 2017. District heat produced by the mill can be used in Äänekoski's district heating network. In 2010, the total consumption of district heating in Äänekoski was approximately 140 GWh, and around 90% of district heating was purchased from industry. In addition, a project was completed in Mäntsälä in 2015, involving the use of surplus heat produced by a data centre for district heating. The process heat recovery equipment at the Kittilä gold mine was completed in 2016. Surplus process heat can now be used for heating mineshafts through a district heating pipework.

Provisions on an installation-specific, cost-benefit analysis to be carried out in accordance with paragraph 5 of Article 14 are given in the Finnish Energy Efficiency Act, which entered into force on 1 January 2015. Exemptions from the obligation to carry out an installation-specific cost benefit analysis are provided for on the basis of a government decree that entered into force in October 2015. The Commission was notified of Finland's provisional thresholds for these exemptions, pursuant to paragraph 6 of Article 14, on 17 December 2013. By the end of 2016, one notification of a completed cost-benefit analysis had been submitted to the Finnish Energy Authority, as required by the Act.

5.1.2 Other measures relating to efficient heating and cooling

In Finland, energy efficiency agreement schemes have covered both energy generation and the production, transmission and distribution of district heating, as well as the Energy Services Action Plan which covers measures relating to electricity and district heating customers since 1997.

Moreover, various development projects aimed at improving energy efficiency are carried out each year, in connection with the energy efficiency agreement schemes for energy production and the industrial sector.

Energy efficiency agreement – Energy Production Action Plan

The measures laid down in the Energy Production Action Plan associated with the energy efficiency agreement for businesses focus on improving the efficiency of primary energy consumption and the overall efficiency of energy generation. In the contracting period 2008–2016, the businesses that signed the agreement committed themselves to saving 1,000 GWh of primary energy and increasing the efficiency of energy generation by 1,000 GWh by 2016.

The businesses that implemented the Action Plan during the contracting period 2008–2016 represented more than 90% of Finland's energy generation and more than 70% of its heating generation. The energy saving effect shown in the table below has not been included in progress monitoring with regard to the target laid down in the ESD, as the savings relate to activities other than energy end-use.

Table 10. Energy production (ET) – summary of impacts on energy consumption (non-ESD)

CODE	MEASURE*	ENERGY SAVING 2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
ET–01–TEM	Energy efficiency agreement for businesses – energy production, non-ESD			
	Primary energy saving**	273	1,712	2,516
	Increasing efficiency in electricity production	222	795	1,152
TOTAL ENERGY SAVING– ESD		**0**	**0**	**0**
TOTAL CONVERTED INTO SAVINGS** – NON-ESD		331	1,480	2,158

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

** Primary energy savings have been converted into final energy using the default coefficient 2.5.

Energy efficiency agreement – Energy Services Action Plan

In the period 2009–2016, the energy efficiency agreement for businesses obligated companies that engage in electricity transmission and distribution and district heating sales under the Energy Services Action Plan to set themselves the target of cutting their own energy consumption by at least five percent by 2016.

Businesses implementing the Action Plan represent the majority of electricity and district heating distribution and sales activities, as well as all district cooling, in Finland. They account for approximately 90% of Finland's total electricity distribution, just over 90% of electricity sales and 86% of district heating sales, as well as around 100% of district cooling.

The table below shows only the saving effect of measures directed towards the businesses' own energy consumption. Energy savings have not been calculated across the ESD sector, even though some of the savings are being achieved there, due to uncertainty factors relating to how the savings are divided between the ESD and non-ESD sector.

Table 11. Energy services (EP)/own operations – summary of impacts on energy consumption (non-ESD)

CODE	MEASURE*	ENERGY SAVING 2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
EP–01–TEM	Energy efficiency agreement for businesses – energy services/own operations, non-ESD**	106	379	552
EP–02–TEM	Energy efficiency agreement for businesses – energy services/customers, ESD	1,061	1,003	995
TOTAL ENERGY SAVING– ESD		**1,061**	**1,003**	**995**
TOTAL ENERGY SAVING – NON-ESD		132	466	679
TOTAL ENERGY SAVING– ALL		1,193	1,469	1,674

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

** The effects of the measures have not been split between the ESD sector and the non-ESD sector.

In addition to companies' obligation, under the Energy Services Action Plan, to engage in electricity transmission and distribution, and district heating sales, in order to increase their own energy efficiency, the energy efficiency agreement for businesses obliged them to engage in energy efficiency measures together with any customers subscribing for energy services that significantly promote the achievement of the 9% target, set in the ESD, for the energy consumption of such customers between 2008 and 2016. The energy saving effects of energy services offered to customers annually have also been calculated in the NEEAP-4.

5.2 Energy transformation, transmission, distribution and demand response – Article 15

5.2.1 Energy efficiency criteria in network tariffs and regulation

The provisions of the Finnish Electricity Market Act (588/2013) were supplemented during the spring of 2014 to stipulate that tariffs cannot include incentives that could jeopardise the overall efficiency of electricity generation, transmission, distribution and supply, or incentives that could compromise the application of demand response. Provisions on incentives used in the terms and conditions and pricing (tariffs) of system services are laid down in sections 24 a and 24 b of the Electricity Market Act.

The current provisions on the terms and conditions and pricing (tariffs) of electricity system services do not include restrictions on the structure of tariffs. Legislation governing the terms and conditions and pricing of system services does not therefore prevent consumer participation in system efficiency, including demand response. Moreover, according to section 18 of the Electricity Market Act, which lays down the general principles governing the provision of system services, system operators have an obligation to provide their system services for all electricity market participants in an equitable and non-discriminatory manner.

According to section 53 a of the Electricity Market Act, distribution system operators shall have general and easily applicable procedures for connecting the high-efficiency cogeneration and small-scale electricity production referred to in the Energy Efficiency Directive to the distribution system.

5.2.2 Facilitating and promoting demand response

Of the demand response measures listed in paragraph 3 of Annex XI of the Energy Efficiency Directive, Finland has already implemented at least a) time-of-use tariffs and c) real-time pricing. In addition, tariffs in which pricing is based on expected peak hours on working days during the winter are used in Finland (b). The current legislation on the terms and conditions and pricing of system services does not prevent demand response, or the development of tariffs that support dynamic pricing.

In the autumn of 2016, the Finnish Ministry of Economic Affairs and Employment established a working group to promote electricity demand response and enable the easy participation of consumers in the electricity markets. The working group includes representatives of authorities, electricity market operators, grid companies, technology suppliers and interest groups. One of the aims of the working group is to clarify the roles of operators and thereby promote market-based demand response.

Several studies on power-based transmission pricing are being carried out in Finland. Here, operators decide on their pricing structure independently. Retail consumers can already participate in wholesale marketplaces, by offering demand response through aggregators. Customers can obtain a system that controls their electricity consumption as they wish, on the basis of market prices, for example. Smart meters can also be used to control the electricity loads of customers in certain cases. Finland is currently considering which controlling option would offer the most effective way of making flexible electricity consumption available for the markets. Future smart meter solutions and their role in demand-side management are being considered.

An evaluation is being performed of how an independent operator outside the balancing chain could participate in electricity markets. Finland is the first country in Europe in which this is already possible in certain marketplaces where low amounts of energy are traded.

In addition, the Finnish Energy Authority is carrying out a study on electricity storage and its promotion.

5.2.3 Energy efficiency criteria in network design and regulation

An assessment of the energy efficiency potential of Finland's national gas and electricity infrastructure was completed on 28 June 2015 and submitted to the Commission on 30 June 2015. With regard to electricity transmission and distribution, the assessment report includes a comparison (Targotz 2008), according to which transmission and distribution losses in Finland were 3.7%, while average losses in the EU were approximately 7.2% – the level achieved by Finland in the 1970s.

In 2015, transmission and distribution losses were 3.1% in Finland, representing an improvement of 0.1% on 2014. The energy efficiency potential of Finland's national gas infrastructure lies in the optimal running of compressors and promoting the utilisation of local heat demand or production at compressor and pressure regulating stations.

5.2.4 Summary of impacts on energy consumption

The table below gives a summary of the annual energy saving effects of the saving measures discussed in Section 5.1 above, for the years 2010, 2016 and 2020.

Table 12. Energy sector – summary of impacts on energy consumption (non-ESD)

CODE	MEASURE*	ENERGY SAVING		
		2010 GWh/a	ESTIMATE 2016 GWh/a	ESTIMATE 2020 GWh/a
ET–01–TEM	Energy efficiency agreement for businesses – energy production, non-ESD			
	Primary energy saving**	273	1,712	2,516
	Increasing efficiency in electricity production	222	795	1,152
EP–01–TEM	Energy efficiency agreement for businesses – energy services/own operations, non-ESD**	132	466	679
EP–02–TEM	Energy efficiency agreement for businesses – energy services/customers, ESD**	1,061	1,003	995
TOTAL ENERGY SAVING– ESD		**1,061**	**1,003**	**995**
TOTAL ENERGY SAVING ** **– NON-ESD**		463	1,946	2,837
TOTAL ENERGY SAVING – ALL		1,524	2,950	3,832

* Annex 2 includes descriptions of savings measures and an account of the principles used when calculating energy savings.

** Primary energy savings from energy generation have been converted into final energy using the default coefficient 2.5.

Annual Report on the EED 2017

28 April 2017

Report to the European Commission pursuant to Article 24(1) of the Energy Efficiency Directive (2012/27/EU)

ANNUAL REPORT 2017 – CONTENTS

1 INTRODUCTION

The EED Annual Report 2016 is Finland's fourth annual report pursuant to Directive 2012/17/EU of the European Parliament and of the Council on energy efficiency (Energy Efficiency Directive, EED). The report presents statistical information (indicators) for 2015 as referred to in Annex XIV to the EED in accordance with the reporting requirements stated in that Directive, the relevant energy efficiency actions taken in 2016 aimed at the achievement of overall national energy efficiency targets, the central government's energy savings strategy for 2016 pursuant to Article 5, and the energy savings achieved through the measures implemented in 2015 and adopted under Article 7(9).

By virtue of Article 7, the Finnish national cumulative energy savings target for the period 2014-2020 is 49 TWh_{cum}. The energy saving impact of the measures implemented in 2015 is a total of 6.7 TWh/a. The estimate for the cumulative energy saving impact, by the end of 2020, of the measures implemented in 2015-2020 is 92.14 TWh_{cum}.

The central government energy savings target for the period 2014-2020 is 8,225 MWh. Energy savings between 2014 and 2016 totalled 11,684 MWh up to the year 2016. Of this, the long-term energy saving impact up to the year 2020 is 7,699 MWh.

The key measures taken affecting energy efficiency in 2016 are the new national energy and climate strategy and the new energy efficiency agreements. In addition, amendments to the Finnish Energy Efficiency Act (*Energiatehokkuuslaki*, 1429/2014) were adopted in order to implement obligations set out for central governments in Article 6 of the Energy Efficiency Directive and to incorporate certain definitions of the Directive into the legislation.

As regards indicators, the Energy Efficiency Directive only calls for the presentation of the information for 2015. In sectors in which energy consumption remains stable or has risen from the previous year, an analysis of the changes is required. The indicators are given as figures for 2014 and 2015 and in the form of graphs for the period 2000–2015.

2 FINLAND'S INDICATIVE NATIONAL ENERGY EFFICIENCY TARGET FOR 2020

Finland's indicative national energy efficiency target for 2020 is a level of final energy consumption of 310 TWh (26.6 Mtoe). This corresponds to a level of primary energy consumption of 417 TWh (35.86 Mtoe). The estimated gross domestic product for 2020 used in the scenarios was EUR 159 billion (EUR 134.7 billion in 2010 at 2000 prices). National targets, which are based on the energy and climate strategy drawn up in 2008 and updated in 2013, were notified to the European Commission in the EED Annual Report for 2013. The targets set for 2020 were not revised in the new energy and climate strategy drawn up in 2016.

In 2015, the consumption of primary energy in Finland was 372 TWh (31.99 Mtoe), and final energy consumption was 281 TWh (24.18 Mtoe).

3 INDICATORS SET OUT IN THE ANNUAL REPORT AND STATISTICAL INFORMATION ON COMBINED HEAT AND POWER (CHP)

Indicators

Table 1 gives the indicators required for the EED Annual Report for the years 2014 and 2015. No far-reaching conclusions regarding changes to energy efficiency can be reached based on a comparison of two consecutive years. In Finland, the situation very much depends on the weather in any given year (need for heating) and the production volumes of energy-intensive industry.

Table 1. Statistical information on energy consumption 2014 and 2015[1]

	INDICATOR	2014	2015	UNIT
1	Primary energy consumption	1,406,765	1,339,776	TJ
2	Gross final energy consumption	1,025,892	1,012,414	TJ
3	Final energy consumption – industry	447,836	447,910	TJ
4	Final energy consumption – transport	199,199	200,595	TJ
5	Final energy consumption – households	212,282	205,084	TJ
6	Final energy consumption – services	120,107	113,645	TJ
7	Gross value added – industry[2]	39,312	38,752	M€
8	Gross value added – services[2]	98,099	99,114	M€
9	Disposable income of households	113,635	115,761	M€
10	Gross domestic product (GDP)[2]	186,553	187,054	M€
11	Electricity generation from thermal power generation	53,491	49,420	GWh
12	Electricity generation from combined heat and power	22,947	21,665	GWh
13	Heat generation from thermal power generation	51,388	49,323	GWh
14	Heat generation from combined heat and power plants	33,938	32,621	GWh
15	Fuel input for thermal power generation	623,224	578,105	TJ
16	Passenger kilometres (pkm)	78,700	79,700	million pass. km
17	Tonne kilometres (tkm)	32,197	32,400	million tonne/km
18	Total population	5,451,270	5,471,753	inhabitants
19	*Average disposable income per household*	*43,409*	*43,943*	*€/household*
20	*Total number of households*	*2,617,780*	*2,634,339*	*Number*
21	*Fuel input for combined heat and power plants*	*397,710*	*382,093*	*TJ*
22	*Energy transmission and distribution losses (all fuels)*	*8,195*	*7,638*	*GWh*
23	*Heat generation from district heating plants*	*38,095*	*38,102*	*TJ*

[1] Indicators presented in italics in the table are included in the reporting guidelines for the Commission's annual report (2013) at http://ec.europa.eu/energy/sites/ener/files/documents/20131106_swd_guidance_neeaps.pdf,, but are not required by Part 1(a) of Annex XIV to the Directive, which concerns reporting.

[2] Fixed prices as at 2010

	(separate production)			
24	*Fuel input for district heating plants (separate production)*	*40,831*	*39,720*	*TJ*

Contrary to previous years, the data presented in the Annual Report for 2017 is mainly Eurostat data, which is referred to in the voluntary Excel template for EED annual reports issued by the Commission. The data has been supplemented with Statistics Finland data, wherever no Eurostat data was available (indicators 16, 17, 19, 20 and 21). In addition, indicators 23 and 24 are reported based on Statistics Finland data, which only covers the separate production of district heat. They do not therefore correspond to the references made to Eurostat statistics in the voluntary Excel template, which also include district heat produced by heat pumps, industrial reaction heat and electric boilers, for example. The time series for indicators 11, 13, 14 and 15 changed significantly with the shift to using the Eurostat data referred to in the Excel template issued by the Commission, probably due to different interpretations made of the data content on the basis of the indicator's name.

Data on the indicators in the previous Table, which must be reported annually in accordance with Part 1 of Annex XIV to the Directive, is set out in this annex in the form of time series covering the period 2000–2015 (Annex 1: EED Annual Report – indicator illustrations). Such data is given annually in accordance with the Directive ('EED indicators') and in the form of three-year rolling averages.

Analysis of changes in energy consumption

As part of the annual report, the Energy Efficiency Directive requires the analysis and presentation of an evaluation of any changes in final energy consumption in various sectors/areas (industry, transport, households and services), in which it has remained stable or increased (EED, Annex XIV, Part 1).

Primary energy consumption in 2015 was down by 4.8% on the previous year and the final consumption of energy fell by 1.3%. Energy consumption in 2015 fell by 3.4% in households and by 5.4 % in the service sector. According to Eurostat, energy consumption remained at the 2014 level in industry, while according to corresponding data by Statistics Finland, it decreased by 3.1 %. Energy consumption in the transport sector increased by 0.7%.

In Finland, energy consumption is greatly affected by annual fluctuations in the need for heating. The difference between a cold and warm year alone can result in a change of more than 5% in final energy consumption for the country.

Industry

According to Eurostat, energy consumption in industry remained at the 2014 level, while according to the corresponding data from Statistics Finland used in previous years, it continued to decrease in all branches of industry other than the metal industry, in which it remained unchanged.

Fuel consumption varies annually due to several factors. The use of fuels is affected by the prices of fuels and emission allowances, availability, any changes in taxation, developments in each branch of industry, structural factors, etc.

In 2015, the volume of industrial production dropped on the previous year, and the gross value added was 1.4% lower than in 2014.

Transportation

In the transport sector, the 0.7% increase in energy consumption is explained by increased mileage. In freight transport, the number of tonne kilometres grew by 0.6%, and in passenger transport, the number of passenger kilometres increased by 1.3%.

Statistical information on combined heat and power (CHP)

The EED obliges Member States to submit statistics for the year (x-2)[3] by the end of April on national electricity and heat production from high and low efficiency cogeneration in relation to total heat and electricity production.

Statistics Finland, the Finnish national authority for statistics, has submitted statistical information for 2015 to Eurostat via the eDAMIS portal, with the exception of statistics relating to district cooling. The tables are also set out in Annex 2.

In 2015, sales of district cooling[4] were 181.6 GWh and customers' contract capacity was 243 MW. Of the cooling energy produced, 60.5% was produced by heat pumps, 24.7% by free cooling, 5.2% by compressors and 9.6% by absorption.

4 MAJOR MEASURES TAKEN IN THE PREVIOUS YEAR

The key measures taken in 2016 were the national energy and climate strategy 2016 and the new energy efficiency agreements 2017–2025.

The new national energy and climate strategy, preparations for which were launched at the end of 2015, was submitted to the Parliament of Finland as a Government report (VNS 7/2016 vp) on 24 November 2016. The strategy outlines the actions that will enable Finland to attain the targets specified in the Government Programme and adopted in the EU for 2030, and to make systematic progress towards achieving an 80−95 percent reduction in greenhouse gas emissions by 2050.

The energy efficiency agreements in effect until the end of 2016 play a major role in the achievement of the cumulative energy savings target for 2014-2020 referred to in Article 7 of the EED. In October 2016, new energy efficiency agreements, which are in effect for the period 1 January 2017–31 December 2025, were signed in four areas.

3 x = current year

4 http://energia.fi/ajankohtaista_ja_materiaalipankki/materiaalipankki/kaukojaahdytys_2015_graafeina.html#material-view http://energia.fi/ajankohtaista_ja_materiaalipankki/materiaalipankki/kaukojaahdytystilasto.html#materialview

5 CENTRAL GOVERNMENT BUILDINGS– ARTICLE 5

Finland opted for an alternative approach in the implementation of Article 5, in accordance with paragraph 6 of the Article. Finland submitted a report[5] to the Commission on 18 December 2013 setting out details of the central government building stock (884,000 m²), an annual energy saving reflecting the 3 % renovation rate for the period 2014-2020 (8,225 MWh), and eight major energy efficiency measures to achieve the saving.

Table 2. Energy savings target under Article 5 of the Energy Efficiency Directive and actual energy savings in the period 2014–2020

YEAR	SAVINGS TARGET MWh	ACTUAL LONG-TERM SAVING MWh	ACTUAL SHORT-TERM SAVING MWh	ACTUAL TOTAL SAVING MWh
2014	1,285	**878**	**7,948**	**8,826**
2015	2,531	**3,358**	**10,513**	**13,871**
2016	3,741	**6,331**	**5353**	**11,684**
2017	4,913	*7,699*	(2,788)	*10,487*
2018	6,051	*7,699*	-	*7,699*
2019	7,154	*7,699*	-	*7,699*
2020	8,225	*7,699*	-	*7,699*

The long-term saving effect of the measures implemented in 2016 (2,737 MWh) covers measure 3 (1,306 MWh) and measure 6 (1,431 MWh) described in the report[5] referred to in Article 5. Savings based on the latter measure (6 = improved space efficiency) have only been included for the defence forces. Energy savings from long-term measures are calculated in full for the years following the year in which they were realised. Half of the energy savings effect is taken into account in the year in which the savings were achieved.

The short-term saving effect of the measures implemented in 2016 covers measures 1, 4 and 8 of the report referred to in Article 5. Measures 2, 5 and 7 were not realised in 2016. With no new measures, the short-term energy saving impact for 2017 will be 2,788 MWh. The short-term saving is calculated in full for the year in which it is realised and for subsequent years.

The combined effect of the measures taken in the period 2014–2016 will be 11,684 MWh in 2016. With no new measures, the combined effect would be 10,487 MWh in 2017 and 7,699 MWh in the period 2018–2020. Of the total energy savings pursuant to Article 5 (8,225 MWh), 94% has been achieved through measures taken in the first three years.

[5] http://ec.europa.eu/energy/sites/ener/files/documents/2013_fi_eed_article5_fi.pdf

6 ENERGY SAVINGS– ARTICLE 7

Finland opted to take other policy measures in the Article's implementation under Article 7 of the EED. Finland's target for cumulative energy savings pursuant to Article 7 is 49 TWh_{cum}.

The monitoring of the achievement of the energy savings target referred to in Article 7 of the Energy Efficiency Directive may take account of energy savings resulting from the energy efficiency measures implemented in 2014–2020. Annex 3 to this Annual Report includes detailed descriptions of the eight energy efficiency measures notified for the implementation of Article 7 and the method of calculating the cumulative energy savings to be achieved from each measure[6].

In accordance with the Directive, the new annual savings effect of the previous year and an estimate of the cumulative energy saving impact pursuant to the Directive during the implementation period and the entire period 2014−2020 are presented. The new annual energy saving can be reported for the year (x–2), in which x is the current year.

Table 3 presents the energy saving impact of measures implemented in 2015 and an updated estimate of the cumulative savings impact pursuant to Article 7 in the periods 2014–2020, 2014–2016 and 2017–2020.

Table 3. Energy efficiency measures under the national energy efficiency programme and their cumulative energy saving impacts (TWh_{cum}) 2014–2020

ENERGY EFFICIENCY MEASURE	YEAR 2015[7] GWh	PERIOD 1[8] 2014-2016 TWh_{cum}	JAKSO 2[8] 2017-2020 TWh_{cum}	TOTAL[8] PROGRAMME 2014 - 2020 TWh_{cum}
KETO-1 ENERGY EFFICIENCY AGREEMENTS	1,438	22.19	10.09	32.28
KETO-2 TRANSPORT FUEL TAXATION/ROAD TRAFFIC	3,002	8.86	13.49	22.34
KETO-3 ENERGY AUDITS	39	0.83	0.48	1.31
KETO-4 ENERGY EFFICIENCY AGREEMENTS/ACTION PLAN FOR ENERGY SERVICES AND HÖYLÄ – CUSTOMERS	1,101	3.39	4.42	7.81
KETO-5 HEAT PUMPS FOR DETACHED, SEMI-DETACHED AND TERRACED HOUSES	534	8.06	2.55	10.60
KETO-6 HEATING PLANT INVESTMENT	52	1.33	0.63	1.97
KETO-7 ENERGY EFFICIENCY REGULATIONS FOR RENOVATIONS AND START-UP ASSISTANCE FOR RENOVATION WORK	207	3.67	1.99	5.66
KETO-8 ENERGY EFFICIENCY REGULATIONS FOR NEW CONSTRUCTION	370	6.54	3.62	10.16
TOTAL	**6,743**	**54.87**	**37.26**	**92.14**[9]

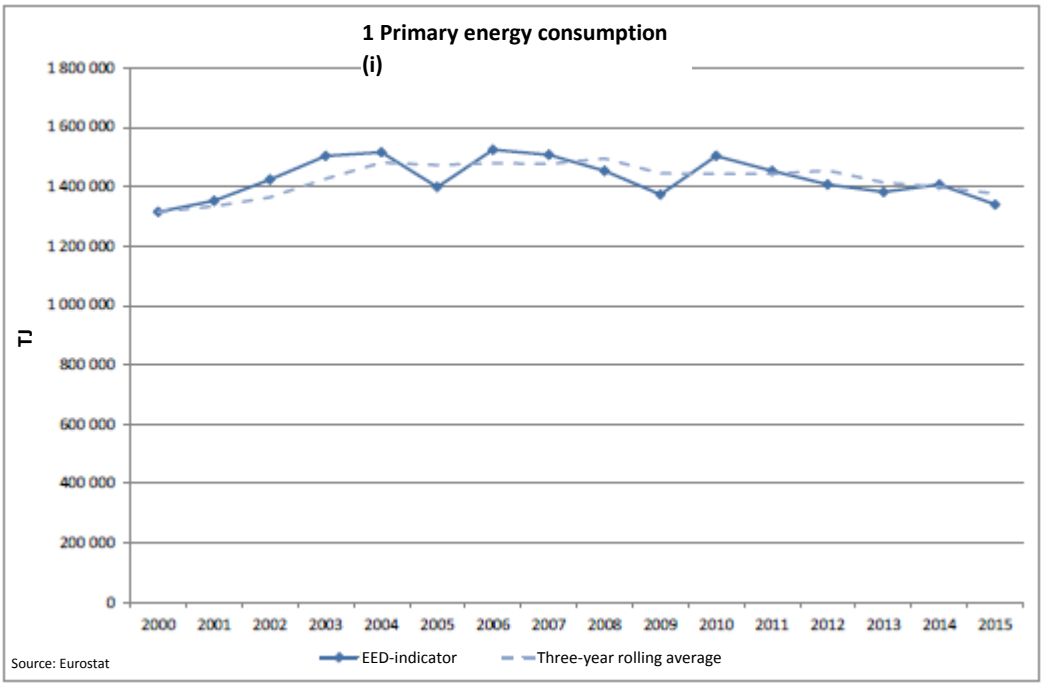
[6] The descriptions of the measures under Article 7 and the related calculation methods have previously been presented only in the notification of the implementation of Article 7 submitted on 5 December 2013 and – partly updated – within Finland's notification of the national implementation of the Energy Efficiency Directive submitted on 5 June 2014.

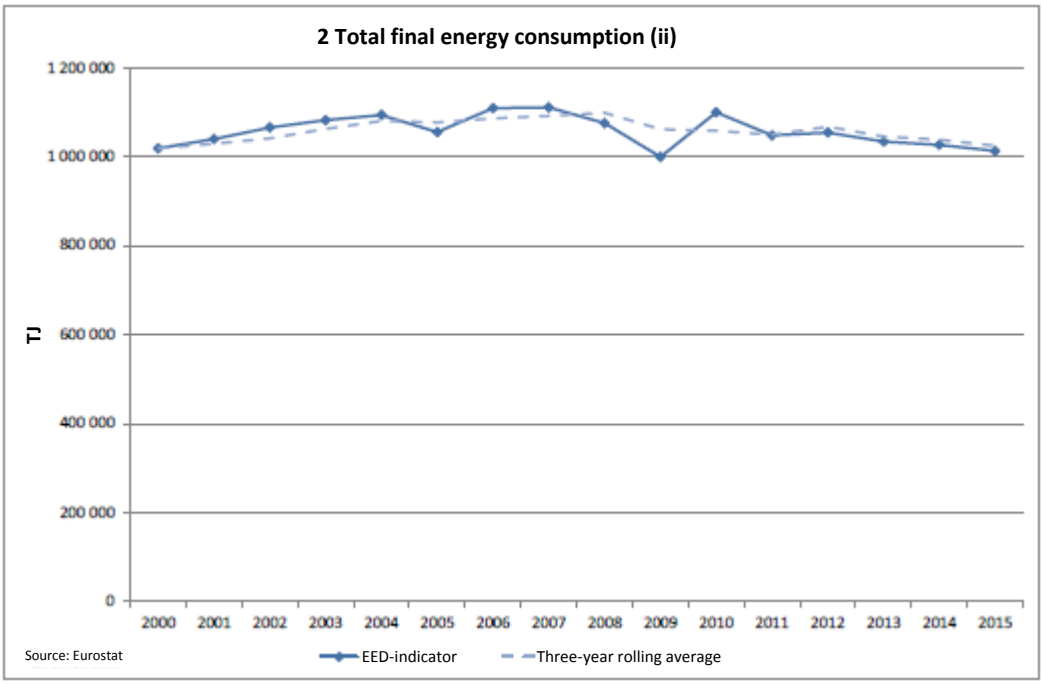
[7] New energy saving in 2015

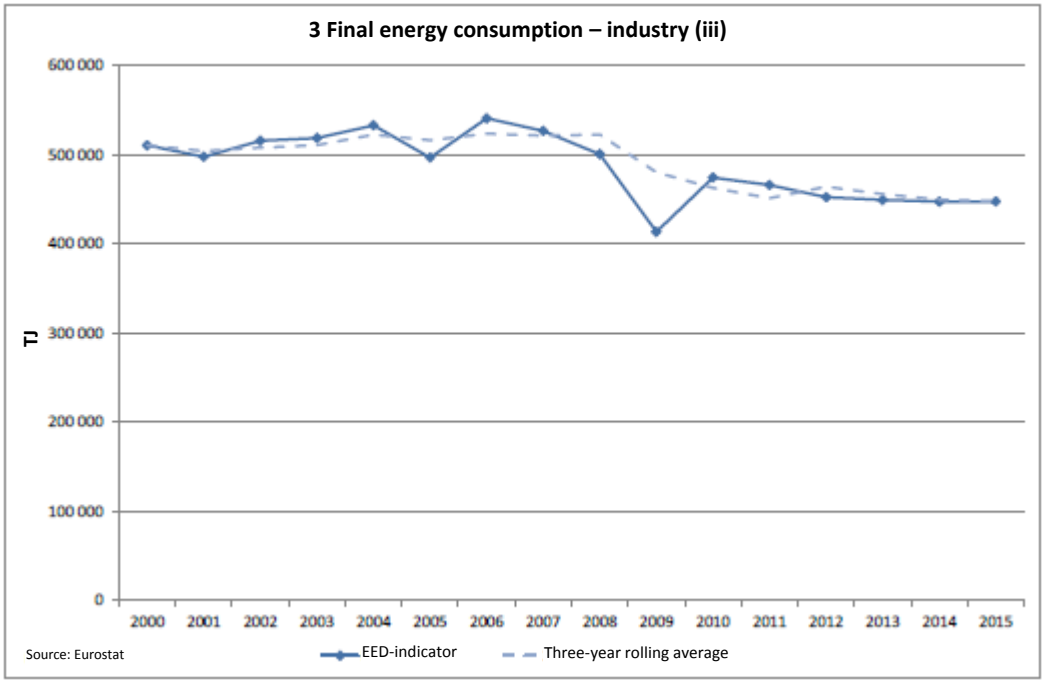
[8] Estimate of the cumulative savings impact in 2020 of measures implemented in the period concerned, pursuant to Article 7

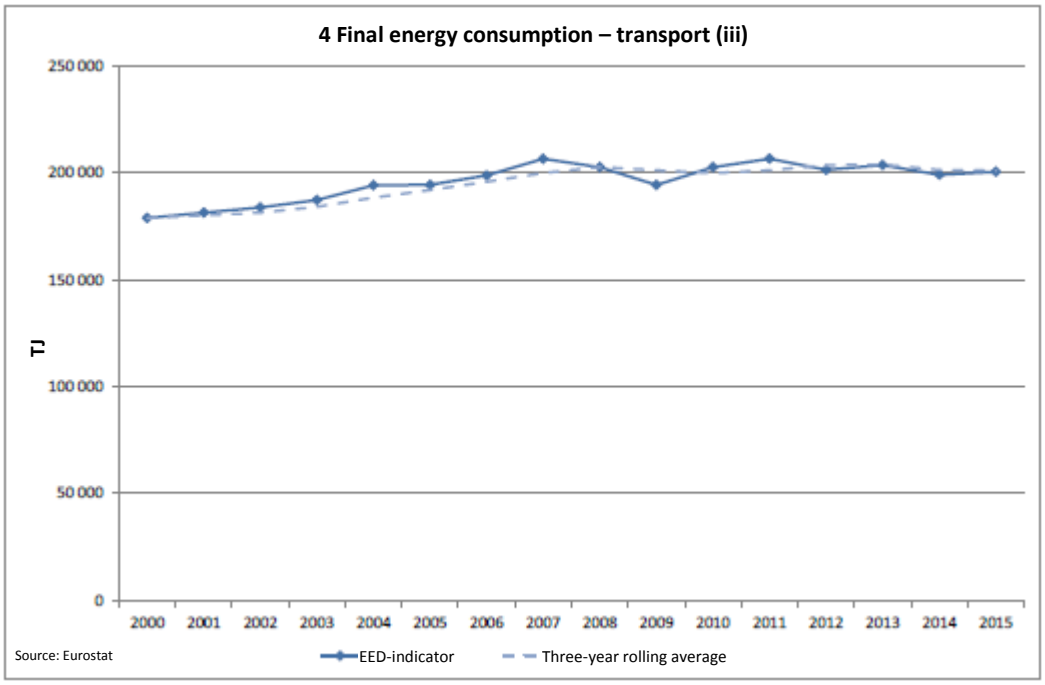
[9] The Finnish national target pursuant to Article 7 is 49 TWh_{cum}.

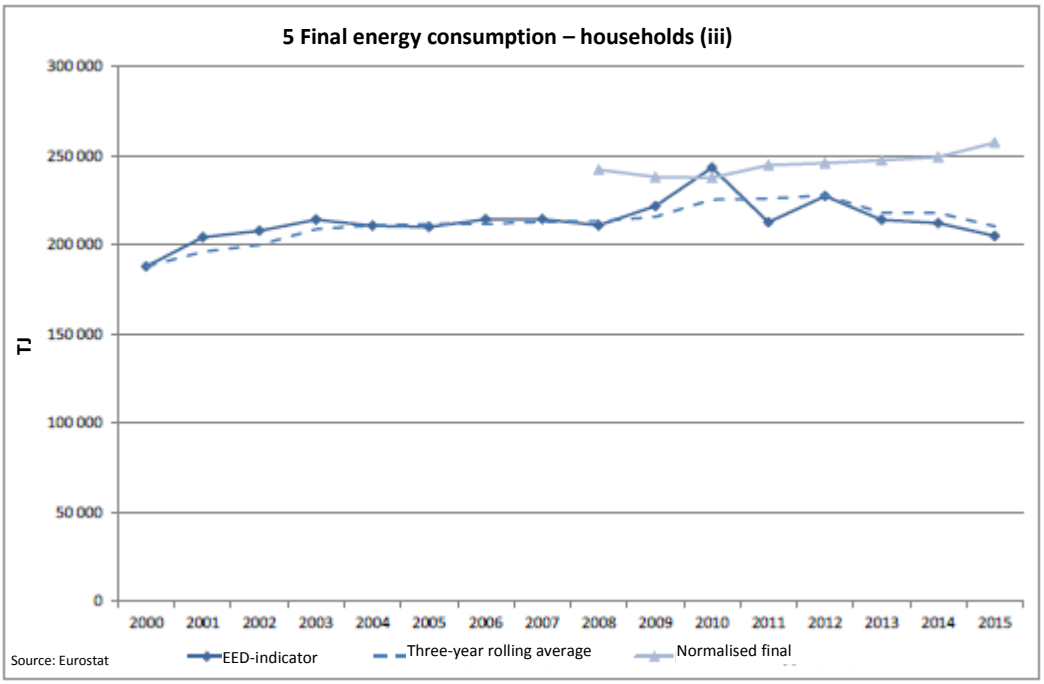
ANNEX 1 EED ANNUAL REPORT– INDICATOR ILLUSTRATIONS

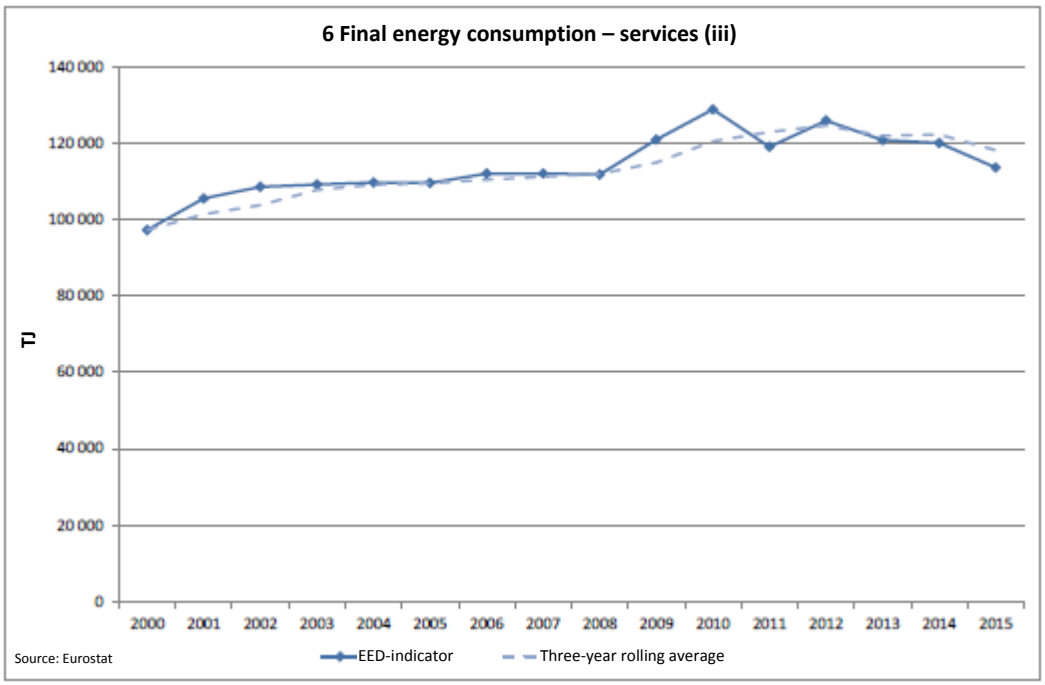


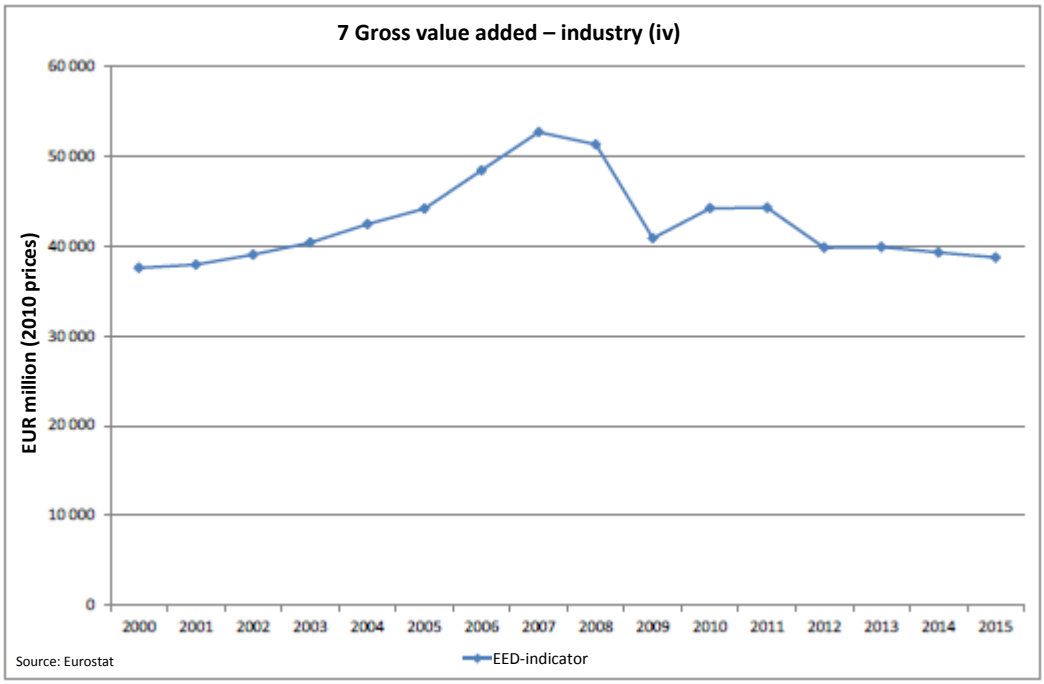


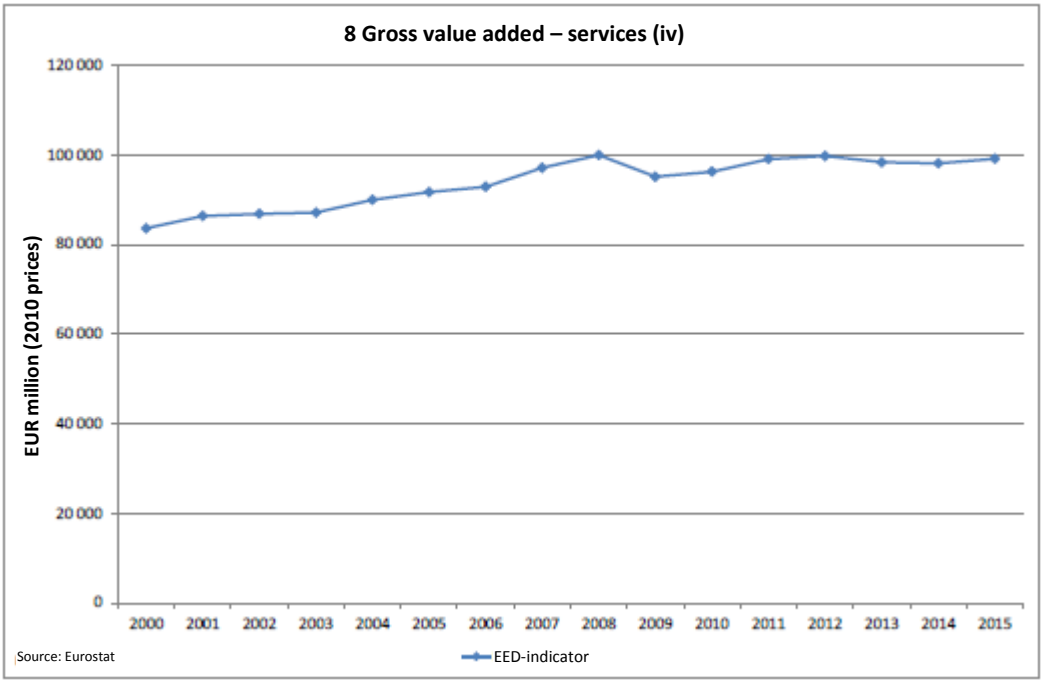

3 Final energy consumption – industry (iii)
600 000
500 000
400 000
300 000
200 000
100 000
0
TJ
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator
Three-year rolling average

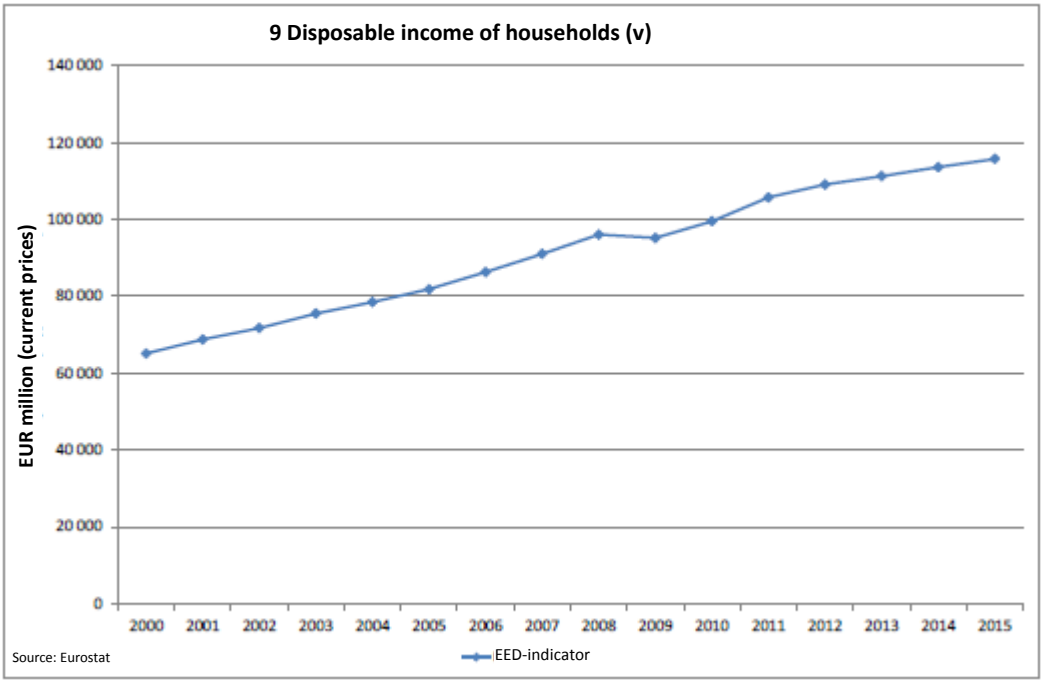

4 Final energy consumption – transport (iii)
250 000
200 000
150 000
100 000
50 000
0
TJ
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator
Three-year rolling average

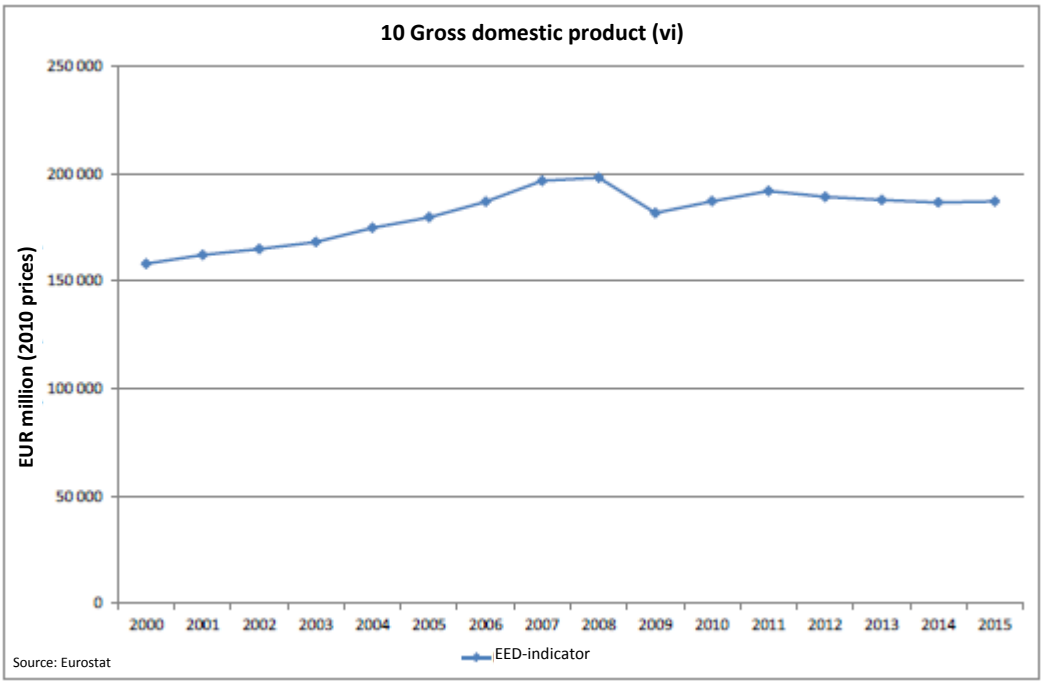

5 Final energy consumption – households (iii)
300 000
250 000
200 000
150 000
100 000
50 000
0
TJ
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator
Three-year rolling average
Normalised final

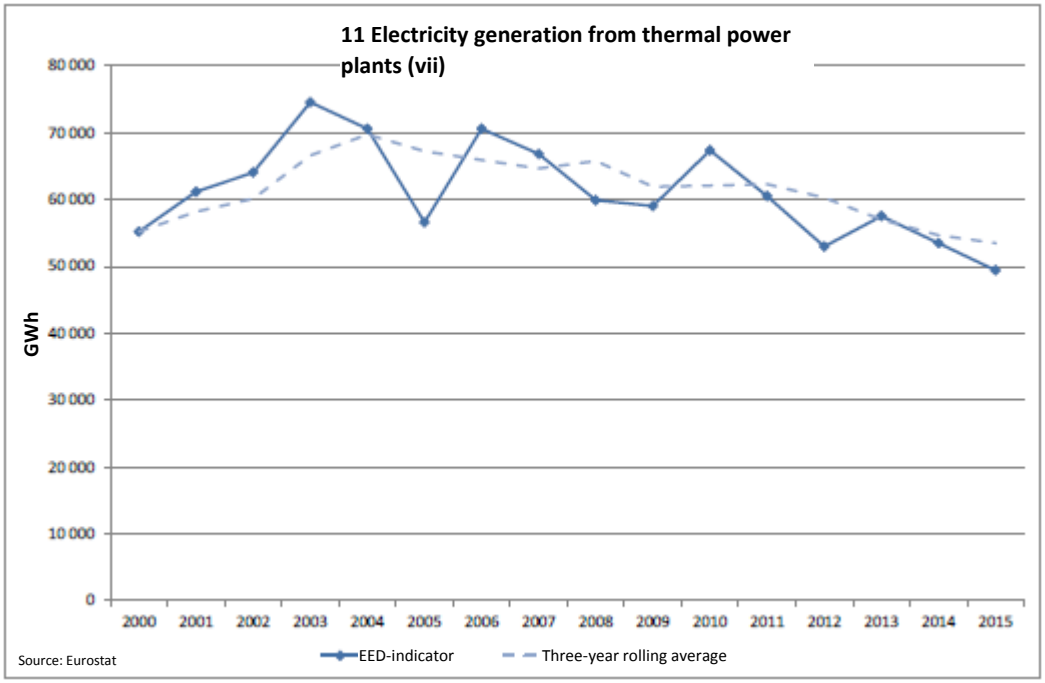

6 Final energy consumption – services (iii)
140 000
120 000
100 000
80 000
60 000
40 000
20 000
0
TJ
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator
Three-year rolling average

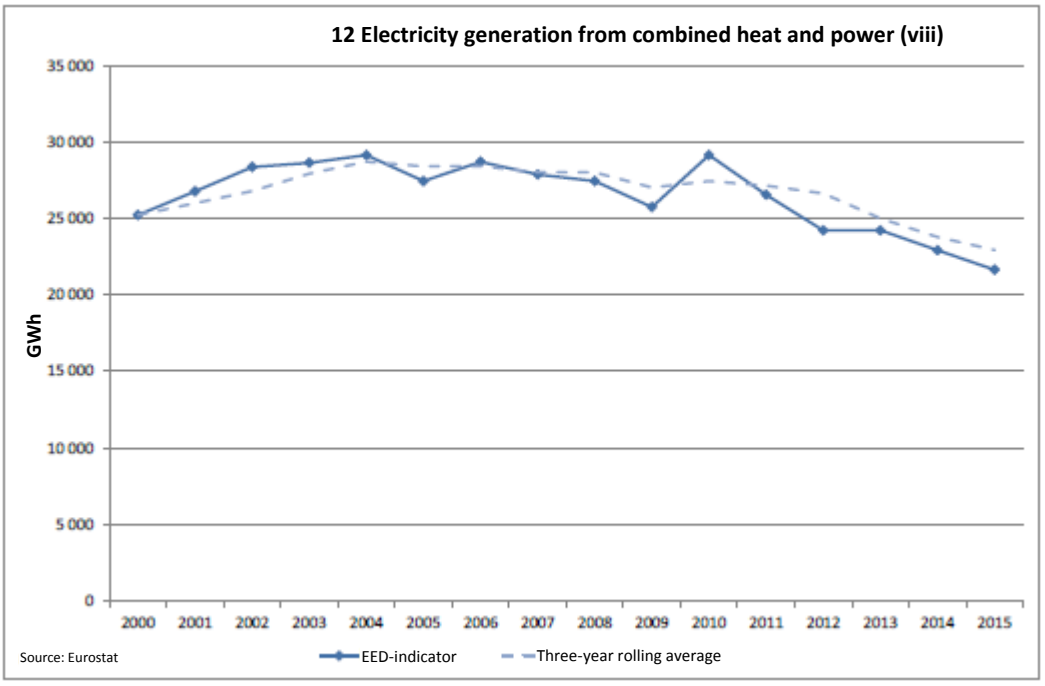

7 Gross value added – industry (iv)
60 000
50 000
40 000
30 000
20 000
10 000
0
EUR million (2010 prices)
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator

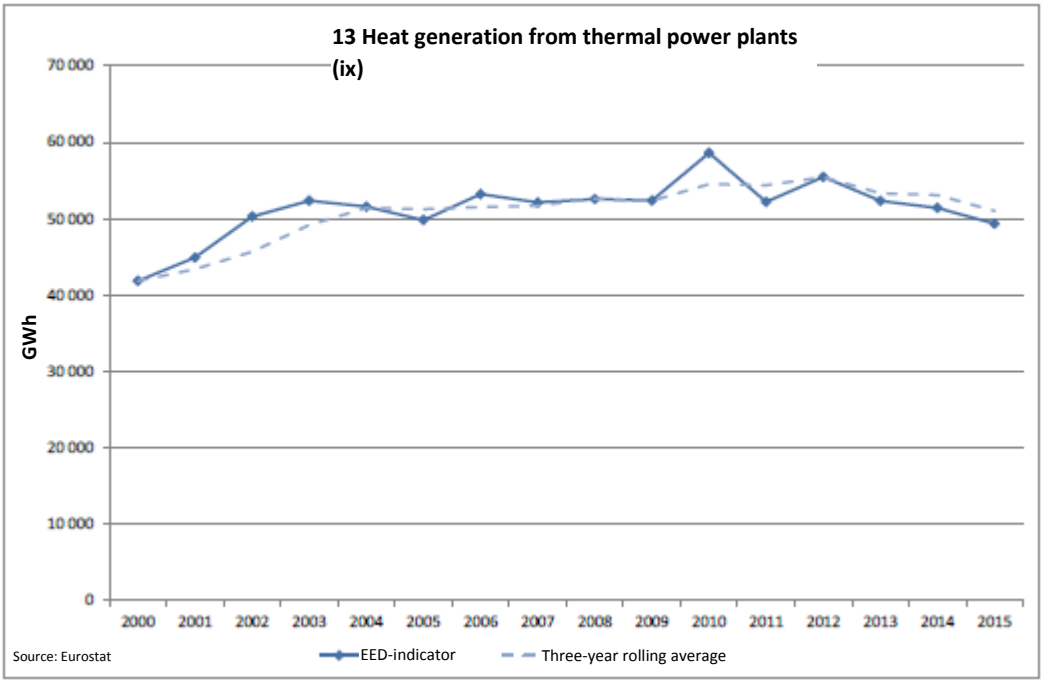

8 Gross value added – services (iv)
120 000
100 000
80 000
60 000
40 000
20 000
0
EUR million (2010 prices)
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator

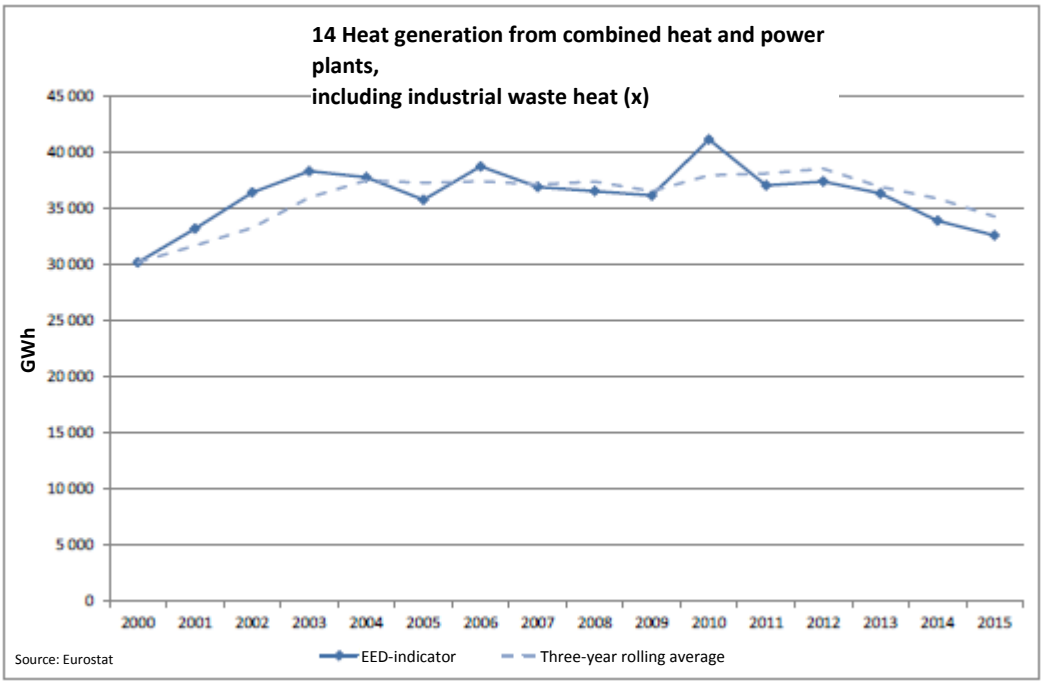

9 Disposable income of households (v)
EUR million (current prices)
140 000
120 000
100 000
80 000
60 000
40 000
20 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
EED-indicator
Source: Eurostat

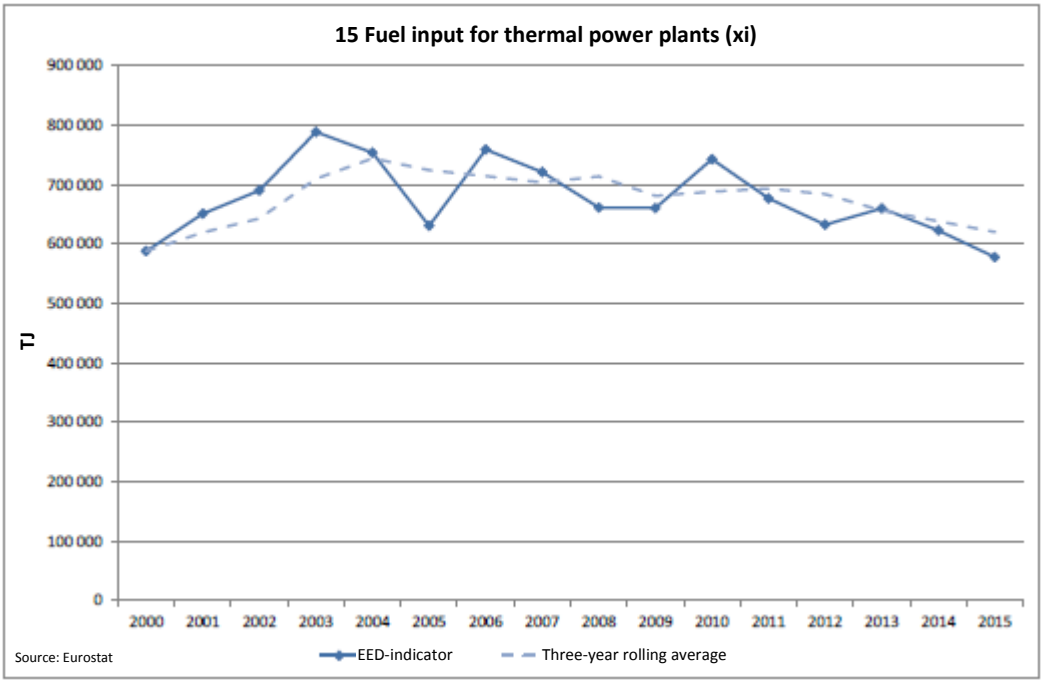

10 Gross domestic product (vi)
EUR million (2010 prices)
250 000
200 000
150 000
100 000
50 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
EED-indicator
Source: Eurostat

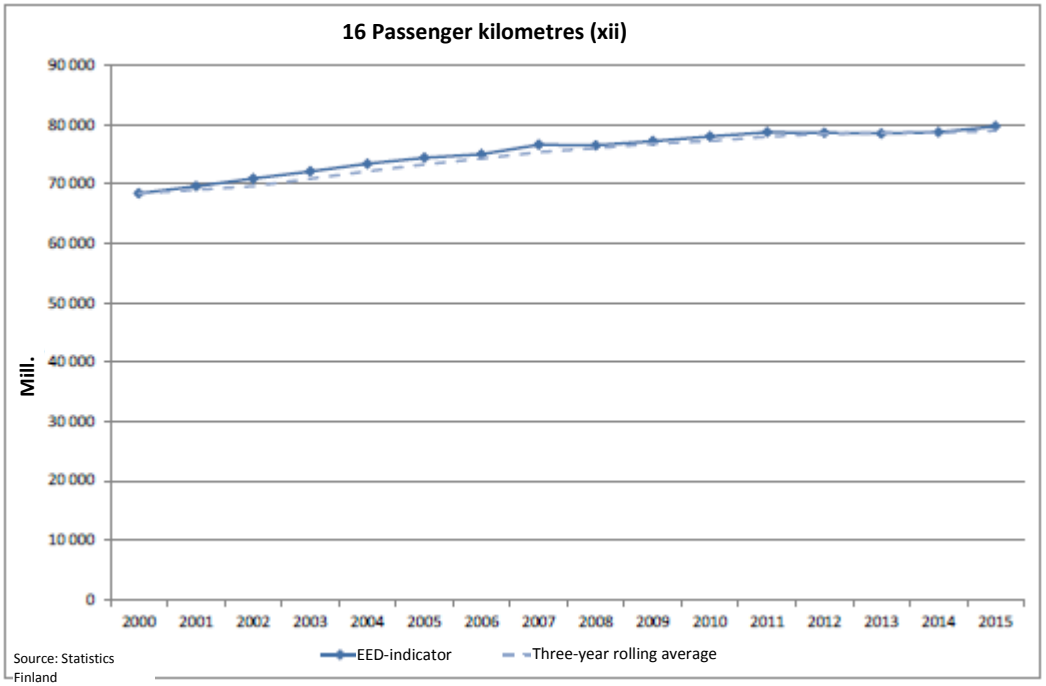

11 Electricity generation from thermal power plants (vii)
GWh
80 000
70 000
60 000
50 000
40 000
30 000
20 000
10 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator
Three-year rolling average

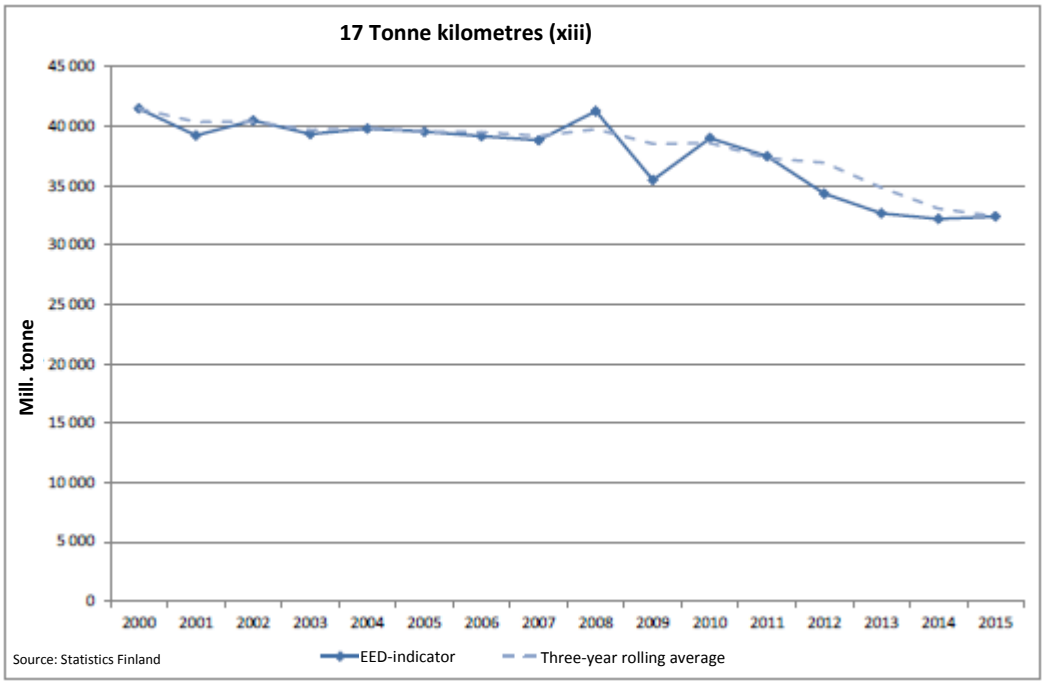

12 Electricity generation from combined heat and power (viii)
GWh
35 000
30 000
25 000
20 000
15 000
10 000
5 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator
Three-year rolling average

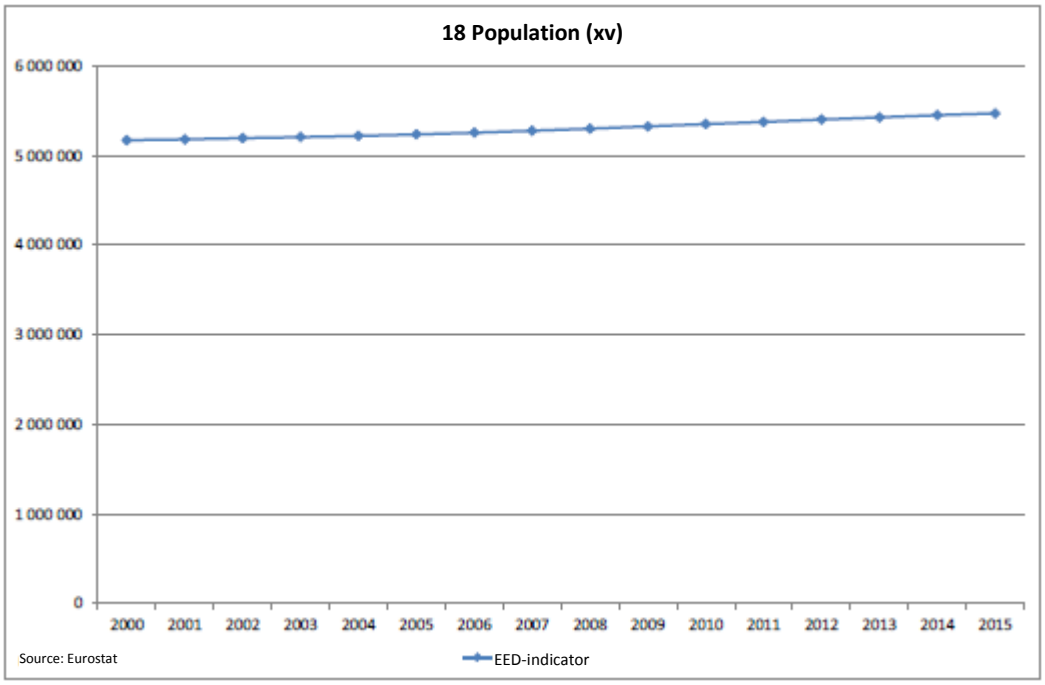

13 Heat generation from thermal power plants (ix)
GWh
70 000
60 000
50 000
40 000
30 000
20 000
10 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator
Three-year rolling average

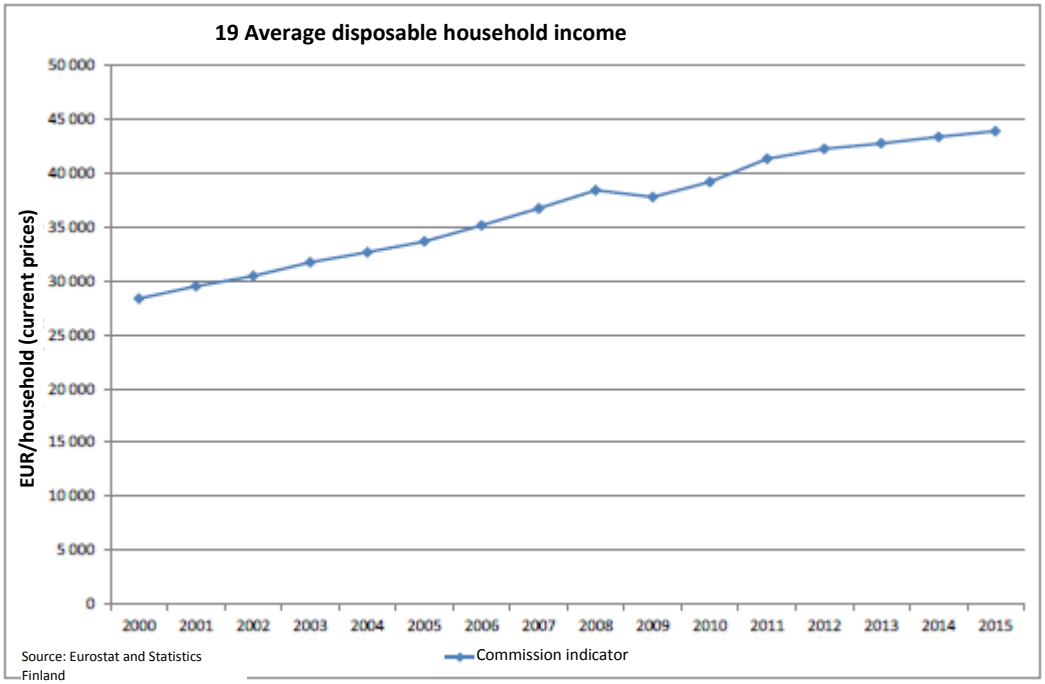

14 Heat generation from combined heat and power plants, including industrial waste heat (x)
GWh
45 000
40 000
35 000
30 000
25 000
20 000
15 000
10 000
5 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator
Three-year rolling average

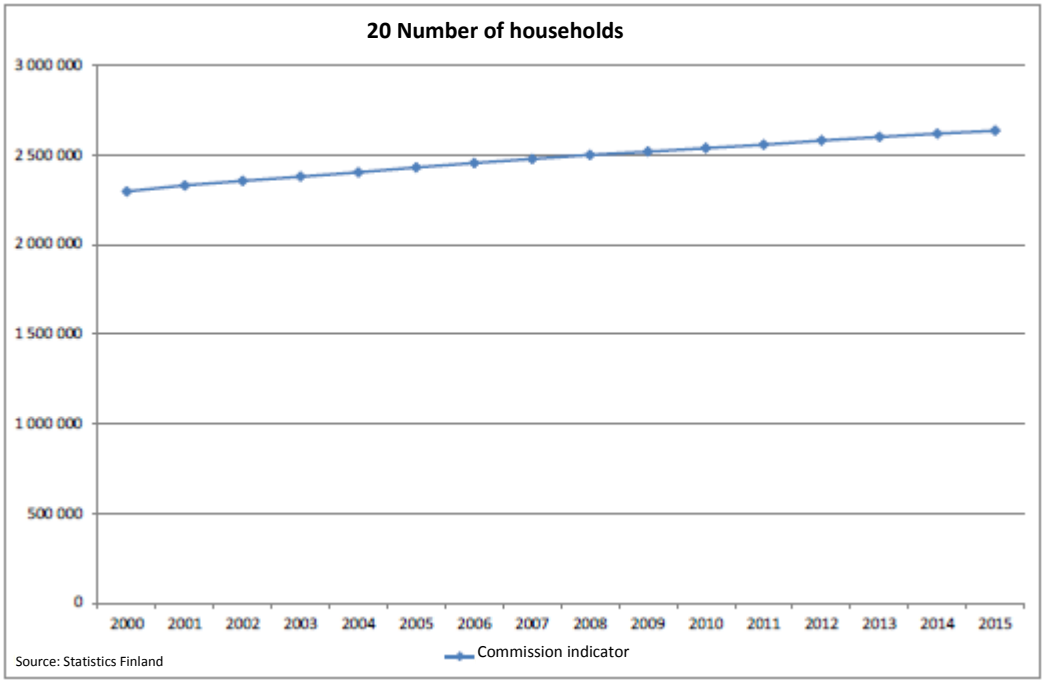

15 Fuel input for thermal power plants (xi)
TJ
900 000
800 000
700 000
600 000
500 000
400 000
300 000
200 000
100 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
EED-indicator
Three-year rolling average
Source: Eurostat

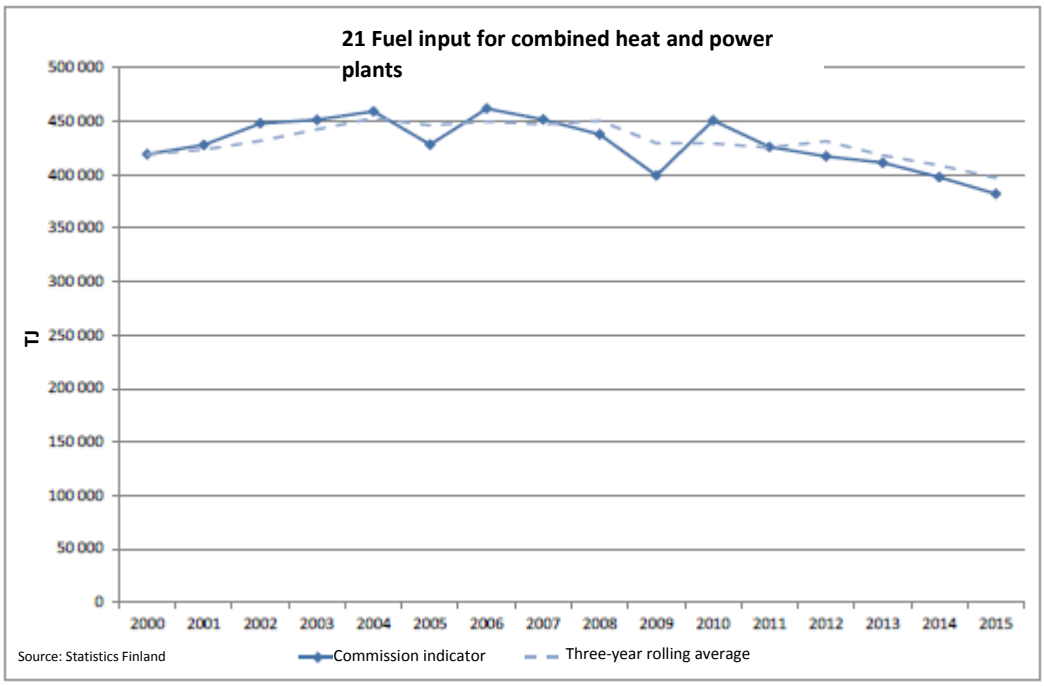

16 Passenger kilometres (xii)
Mill.
90 000
80 000
70 000
60 000
50 000
40 000
30 000
20 000
10 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
EED-indicator
Three-year rolling average
Source: Statistics Finland

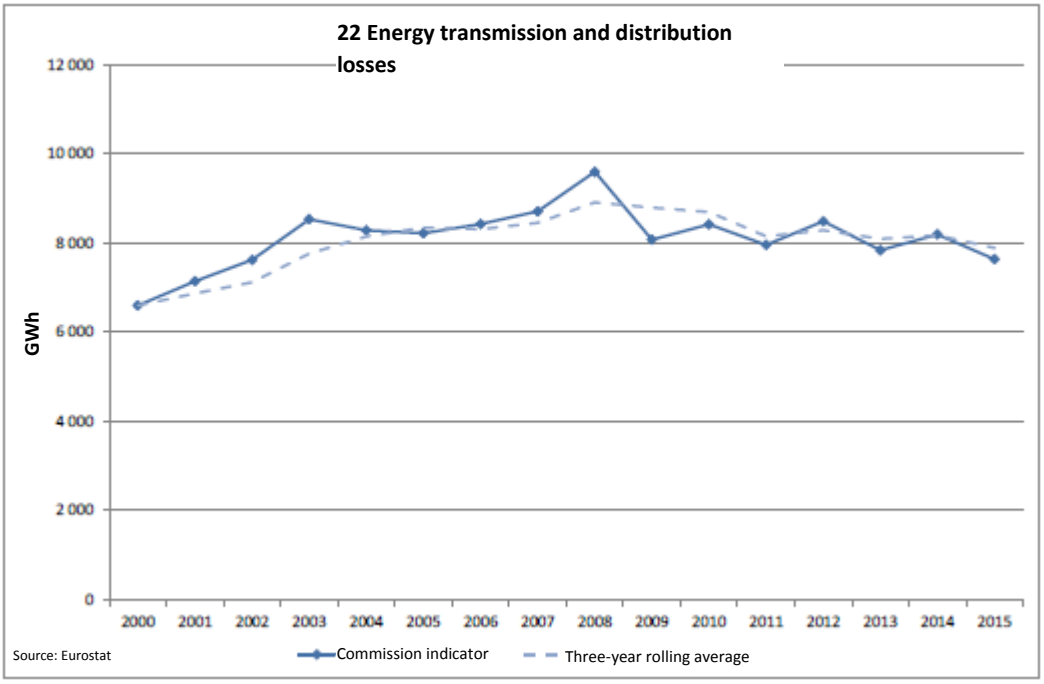

17 Tonne kilometres (xiii)
Mill. tonne
45 000
40 000
35 000
30 000
25 000
20 000
15 000
10 000
5 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Statistics Finland
EED-indicator
Three-year rolling average

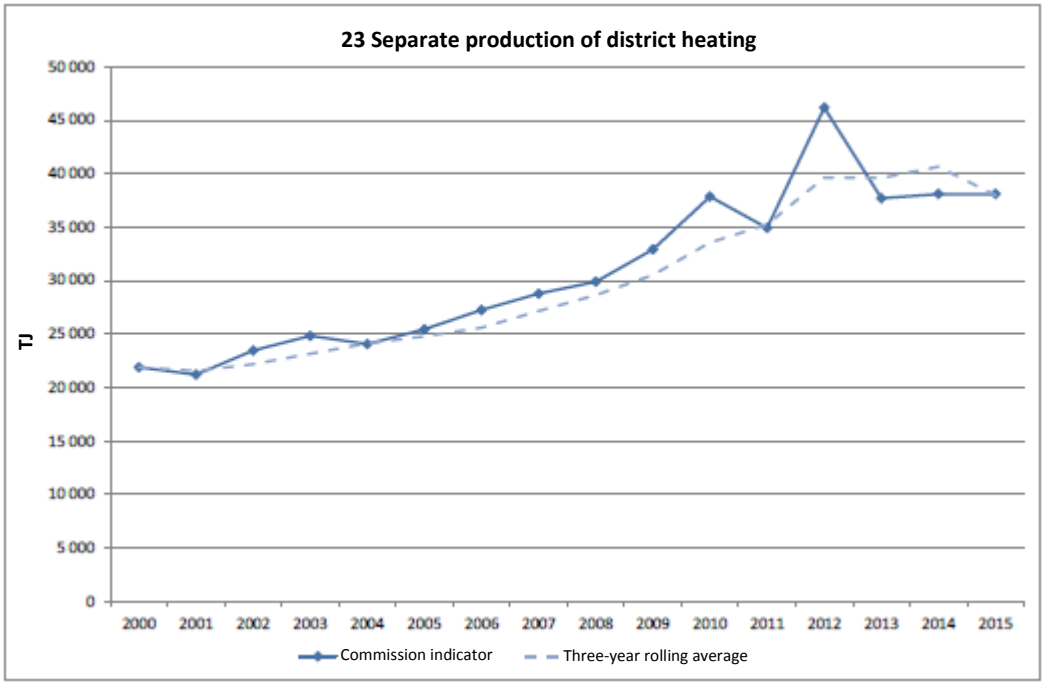

18 Population (xv)
6 000 000
5 000 000
4 000 000
3 000 000
2 000 000
1 000 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
EED-indicator

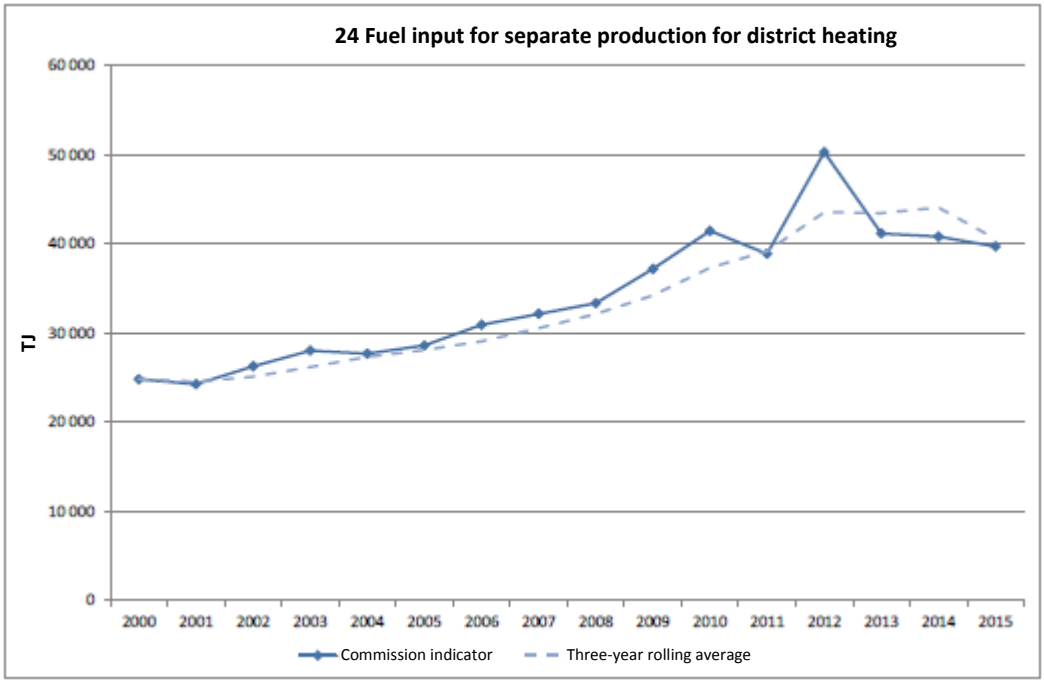

19 Average disposable household income
EUR/household (current prices)
50 000
45 000
40 000
35 000
30 000
25 000
20 000
15 000
10 000
5 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Commission indicator
Source: Eurostat and Statistics Finland


20 Number of households
3 000 000
2 500 000
2 000 000
1 500 000
1 000 000
500 000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Commission indicator
Source: Statistics Finland


21 Fuel input for combined heat and power plants
500 000
450 000
400 000
350 000
300 000
250 000
200 000
150 000
100 000
50 000
0
TJ
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Statistics Finland
Commission indicator
Three-year rolling average


22 Energy transmission and distribution losses
12 000
10 000
8 000
6 000
4 000
2 000
0
GWh
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Source: Eurostat
Commission indicator
Three-year rolling average


23 Separate production of district heating
50 000
45 000
40 000
35 000
30 000
25 000
20 000
15 000
10 000
5 000
0
TJ
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Commission indicator
Three-year rolling average


24 Fuel input for separate production for district heating
60 000
50 000
40 000
30 000
20 000
10 000
0
TJ
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
Commission indicator
Three-year rolling average

ANNEX 2 STATISTICAL INFORMATION ON COMBINED HEAT AND POWER (CHP)

CHP Supplementary Reporting for European Union Countries Under the EU DIRECTIVE 2004/8/EC
Table EU-1: Electricity and Heat production by CHP Units

Finland

2015

Completely CHP Units (Efficiency ≥ 75%)

Type of cycle		Maximum capacity			Production			Fuel for CHP	Number of Units
		Electricity		Heat	Electricity		Heat		
		CHP	Gross	Net	CHP	Gross	CHP		
		MW	MW	MW	GWh	GWh	TJ	TJ (NCV)	n
		A	B	C	D	F	G	H	I
Combined cycle (eff ≥ 80%)	1	1,536	1,719	1,710	4,916	4,938	19,894	41,696	13
Gas turbine with heat recovery	2	138	162	258	256	260	1,822	3,415	15
Internal Combustion engine	3	11	11	17	58	58	285	620	28
Steam: backpressure turbine	4	2,289	2,475	7,613	8,810	8,999	132,329	190,962	75
Steam: condensing turbine (eff ≥ 80%)	5	894	1,319	2,106	3,612	4,318	32,776	51,574	13
Others	6								
Subtotal (1+2+3+4+5+6)	7	**4,868**	**5,686**	**11,704**	**17,652**	**18,573**	**187,106**	**288,267**	**144**

Units with a non-CHP component (Efficiency < 75%)

Type of cycle		Maximum capacity			Production			Fuel for CHP	Number of Units
		Electricity		Heat	Electricity		Heat		
		CHP	Gross	Net	CHP	Gross	CHP		
		MW	MW	MW	GWh	GWh	TJ	TJ (NCV)	n
Combined cycle (eff < 80%)	8								
Gas turbine with heat recovery	9	32	33	41	19	89	88	216	8
Internal Combustion engine	10	31	31	46	7	7	25	75	4
Steam: backpressure turbine	11	545	566	2,556	2,941	3,360	47,730	79,605	15
Steam: condensing turbine (eff ≥ 80%)	12	372	876	835	1,120	3,410	7,483	13,935	6
Others	13								
Subtotal (8+9+10+11+12+13)	14	**980**	**1,506**	**3,478**	**4,087**	**6,866**	**55,326**	**93,831**	**33**
Total (7+14)	15	**5,848**	**7,192**	**15,182**	**21,739**	**25,439**	**242,432**	**382,098**	**177**
of which Autoproducers	16	1,610	1,781	6,915	8,227	8,930	138,156	207,677	77

CHP Supplementary Reporting for European Union Countries Under the EU DIRECTIVE 2004/8/EC

Table EU-2: OPERATIONAL CHP UNITS FUEL USED FOR CHP PRODUCTION

Finland

2015		Units	MAIN ACTIVITY PRODUCER PLANTS	AUTOPRODUCERS PLANTS	TOTAL
HARD COAL	1	10^3 t	1,609	81	**1,690**
	2	TJ (NCV)	39,588	2,054	**41,642**
SUB-BITUMINIOUS COAL	3	10^3 t			**0**
	4	TJ (NCV)			**0**
BROWN COAL	5	10^3 t			**0**
	6	TJ (NCV)			**0**
PEAT	7	10^3 t	3,225	928	**4,153**
	8	TJ (NCV)	32,456	9,324	**41,780**
COKE OVEN GAS	9	TJ (GCV)			**0**
	10	TJ (NCV)	129		**129**
BLAST FURNACE AND OXYGEN STEEL FURNACE GAS	11	TJ (GCV)			**0**
	12	TJ (NCV)	1,729		**1,729**
OTHER COAL PRODUCTS (SOLID)	13	10^3 t	1		**1**
	14	TJ (NCV)	28		**28**
RESIDUAL FUEL OIL	15	10^3 t	19	112	**131**
	16	TJ (NCV)	782	4,558	**5,340**
REFINERY GAS	17	10^3 t		18	**18**
	18	TJ (NCV)		880	**880**
OTHER LIQUID FOSSIL FUELS	19	10^3 t	3	19	**22**
	20	TJ (NCV)	134	768	**902**
NATURAL GAS AND GAS WORKS GAS	21	TJ (GCV)	35,972	17,818	**53,790**
	22	TJ (NCV)	32,378	16,052	**48,430**
SOLID BIOMASS	23	TJ (NCV)	55,023	161,552	**216,575**
INDUSTRIAL WASTE	24	TJ (NCV)	1,819	6,116	**7,935**
MUNICIPAL WASTE (RENEWABLE)	25	TJ (NCV)	6,105	2,982	**9,087**
MUNICIPAL WASTE (NON-RENEWABLE)	26	TJ (NCV)	4,044	2,404	**6,448**
BIOGAS	27	TJ (NCV)	195	958	**1,153**
OTHER RENEWABLES AND WASTES	28	10^3 t			**0**
	29	TJ (NCV)	11	29	**40**
NUCLEAR HEAT	30	TJ (NCV)			**0**
TOTAL	31	TJ (NCV)	**174,421**	**207,677**	**382,098**

NCV - Net Calorific Value

GCV - Gross Calorific Val

ANNEX 3 DESCRIPTIONS OF MEASURES NOTIFIED FOR THE IMPLEMENTATION OF ARTICLE 7 OF THE EED

TABLE OF CONTENTS

THE MEASURE	MEASURE CODE
Energy efficiency agreements	KETO-1-TEM

MEASURE PERIODS **PERIOD 1** 2014–2016, 3 a **PERIOD 2** 2017–2020, 4 a

POLICY MEASURE LINK

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

The energy efficiency agreement scheme falls into category c) "voluntary agreements" under paragraph 9, Article 7 of the EED.

The Finnish Ministry of Economic Affairs and Employment has annually commissioned assignments from Motiva related to the administration and implementation of the energy efficiency agreement scheme and the monitoring and impact assessment of the scheme since 1997 (see Motiva's role in the following section). In 2017, the commissions will total around EUR 0.8 million in value. In addition, energy advice services, funded by trade associations and provided by Motiva are offered for medium-sized companies that have joined the scheme.

CONTRACTORS, PARTICIPANTS AND IMPLEMENTING AUTHORITIES

Contractors:

- Motiva: Support for companies/organisations that have joined the scheme in the implementation of the agreement, the development of tools and services in support of implementation, and advisory services and the distribution of information e.g. via seminars, training websites and joint development projects. In certain operational areas, advisory services are company-specific. Checking of annual reporting data for each party joining the scheme and the requesting of further information. In addition, maintenance and development of the monitoring database for the energy efficiency agreement scheme, monitoring and impact assessment of the scheme and the preparation of summary reports.
- TEKES, the Finnish Funding Agency for Technology and Innovation: Processing of applications for investment aid related to the energy efficiency agreement scheme and the granting of aid.

Participants:

- Industrial companies, private service sector companies, municipalities and joint municipal authorities, owners of business properties and residential lettings associations that have joined the scheme: Commit to the objectives concerning the implementation of their individual agreement/action plan, set an indicative energy saving goal for themselves and provide an annual report on the measures implemented and the resulting impacts on energy consumption and other measures pursuant to the agreement.
- Confederation of Finnish Industries and its member associations, Finnish Forest Industries, Finnish Association of Building Owners and Construction Clients RAKLI: Commit to promoting the achievement of the coverage target in their sector and the implementation of their individual agreement or action plan. In addition, they commit to the implementation targets defined for trade associations. Some trade associations also provide funding for the energy advice provided by Motiva for SMEs that have joined the scheme, with the key goal of supporting companies in charting energy efficiency measures and implementing detected energy savings measures.

Implementing public authority:

- Ministry of Economic Affairs and Employment (TEM): Contracting party in the energy efficiency agreement scheme and the administrative responsible authority, except for the action plan for residential lettings associations in the property sector. Committed to the measures allocated by the agreement to the ministry in question. http://www.energiatehokkuussopimukset20172025.fi/
- Ministry of the Environment (YM): Contracting party in the energy efficiency agreement scheme and the responsible administrative authority in the action plan for residential lettings associations in the property sector. Committed to the measures allocated by the agreement to the ministry in question. http://www.energiatehokkuussopimukset2017-2025.fi/en/
- Energy Authority A new authority, operational since the beginning of 2014, to which the majority of administrative duties related to the agreement scheme were transferred from the Ministry of Economic Affairs and Employment.

DESCRIPTION OF THE MEASURE

Here, the following three agreement sectors are included in the energy efficiency agreement scheme:

The energy efficiency agreements for trade and industry and the property sector are framework agreements, signed by the Ministry of Economic Affairs and Employment, the Ministry of the Environment, the Confederation of Finnish Industries (EK) and some of its member associations, Finnish Forest Industries, and the Finnish Association of Building Owners and Construction Clients RAKLI.

The energy efficiency agreement scheme for trade and industry includes two action plans for energy-intensive industries (the forest industry and other energy-intensive industries), four sector-specific action plans for medium-sized industry (food, chemical, wood-processing and technology) and a generic industrial action plan for enterprises that do not fall under any of the sector-specific action plans. There are three sector-specific action plans for the service sector (trade, tourism and hospitality services, and the automotive industry) as well as a generic action plan for the service sector, which is designed for businesses that do not fall under any of the sector-specific action plans. The enterprises join the agreements by signing a separate Act of Accession.

The property sector energy efficiency agreement includes two action plans, one for business properties and the other for residential buildings owned by residential lettings associations#. The actors join the agreements by signing a separate Act of Accession.

In the local government sector, there is a separate energy efficiency agreement for municipalities and joint municipal authorities. Municipalities and joint municipal authorities sign the local government sector energy efficiency agreement, thereby joining the local government sector energy efficiency agreement scheme.

At the end of 2016, the energy consumption of industrial businesses that have signed an energy efficiency agreement represented over 85% of all industrial energy consumption. For medium-sized industrial organisations, the energy consumption of businesses implementing action plans varies from sector to sector and amounts to 50–70% of the total energy consumption covered by the action plan in question. A total of 77 municipalities and joint municipal authorities have signed the local government energy efficiency agreement, whereas 54 municipalities and joint municipal authorities have joined the energy programme. The participating local governments represent 77% of Finland's population. By the end of 2016, a total of 43 organisations that manage commercial properties had signed the agreement, representing more than 80% of the building stock governed by the action plan. At the end of 2016, 27 residential lettings associations had signed the agreement, with housing stock representing more than 80% of the total number of rental, right of occupancy and part-ownership dwellings falling under the agreement.

For more information about agreements from 2008 see http://www.energiatehokkuussopimukset.fi and, with respect to new energy efficiency agreements in 2017−2025, see http://www.energiatehokkuussopimukset2017-2025.fi/ .

Via a web-based monitoring system, businesses and organisations that have signed the energy efficiency agreement submit annual reports on their energy consumption, any energy saving measures implemented and progress with their other contractual obligations. The energy saving measures included in the reports can be measures identified during the course of energy audits or analyses, or measures otherwise identified by the businesses.

Company and organisation-specific annual reporting is not public. An annual summary, by operating area and on the agreement scheme as a whole, is prepared on the reported information. This summary data is published annually.

ASSESSMENT OF IMPACTS ON ENERGY CONSUMPTION

Premises and assumptions

The calculations include all implemented energy saving measures reported (I) in the annual reports of the participating organisations, with the exception of those identified during the course of energy audits. The saving effect of measures proposed and implemented in the energy audits of signatories is presented in connection with the audits, to avoid overlapping savings.

The savings (MWh/a) used in calculations up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. As of 2016, annual savings have been estimated on the basis of the average in 2008−2015.

The records cover nearly all of the businesses that have signed an energy efficiency agreement, since approximately 95–100% of these businesses have submitted annual reports each year.

The measures are divided into operational and technical measures. Because the lifetime of savings from technical measures exceeds 12 years, their effects will be in force in 2020 regardless of whether they were undertaken in the early years 2009−2013, or during the period of EED implementation 2014−2020.

One half of the savings effect of technical measures implemented each year is expected to materialise

during the first year. In the calculation of cumulative savings, the coefficient for measures implemented in 2014 is therefore 6.5 and for 2020 it is 0.5. A lifetime of five years has been used in the calculation of operational measures because one of the key principles of the energy efficiency agreement scheme involves monitoring consumption efficiently and reacting promptly to faults (continuous improvement and linking of energy issues to management systems).

On the basis of monitoring data, measures in which ecodesign requirements must be taken into account in the calculation of saving effects, have been separated from reported electricity savings. Of the savings concerning lighting, only part concerns actual bulbs, while part concerns lighting solutions and inductors etc. Of the saving effects of measures related to lighting, 40% are included in the cumulative calculation of saving effects in accordance with Article 7. Savings related to engines are treated correspondingly, with 20% of the savings being taken into account during calculation. In addition, at this stage 25% of the remaining electricity savings are deducted for industry, and 50% in the service sector.

Baseline data

Baseline data for calculations is obtained through the annual reports of signatories to the energy efficiency agreement scheme from data compiled in the agreement scheme monitoring system.

Each of the participating businesses includes at least the following information in its annual report:

- General information (e.g. contact details, line of business etc.)
- Detailed energy consumption data
- Energy saving measures other than those identified during the course of energy audits and the following information concerning the same:
  implementation year, size of investment, payback period, etc.
  estimated energy saving (electricity, heating, fuels) in MWh/a
- The implementation status of energy-saving measures proposed in the energy audits and analyses
  I = implemented, D = decided, P = possible, A = abandoned
  - other data gained through the energy audit (e.g. saving effect)
- information relating to energy efficiency systems concerning energy consumption monitoring, energy efficiency plans and environmental systems, etc.
- other information relating to the use of renewable forms of energy, how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, the energy efficiency of transport and logistics, etc.

The accuracy of the saving calculations for reported individual saving measures corresponds to the level of accuracy achieved by means of normal field testing and such calculations are usually performed by a third party consultant (e.g. energy auditor) on behalf of the signatory. Specific instructions on the evaluation of the saving effects of reported energy saving measures are available on the website of the energy efficiency agreement scheme. Briefings on savings calculation were arranged for signatories and their service providers as the annual reporting began.

Some of the baseline data for calculations is based on design values or estimates, as measuring is not always possible. Normalised thermal energy consumption figures are used in the calculation of the saving effects of individual measures concerning thermal energy dependent on the outdoor temperature. The savings achieved by savings measures are not usually verified by measuring afterwards, as this is often impossible in practice and/or results in significant extra costs.

Method of calculation

For the purposes of calculating the saving effects of individual energy efficiency measures reported in the energy efficiency agreements, the generally used method is method c) “scaled savings”, presented in paragraph 1, Annex V of the Energy Efficiency Directive (see also “Baseline data” above). Some of the reported saving effects may also be “metered” (Annex V, paragraph 1 method b). See also “Baseline data” above.

The overall saving effect of the energy efficiency agreement scheme described herein is calculated using the special national BU calculation method, modified from the method previously used in NEEAP calculations, while taking account of the framework conditions related to EED calculation. Separate account is taken of the lifetime of savings in calculations related to operational and technical measures. In addition, account is taken of the need, prompted by ecodesign requirements, to calculate only the saving achieved for measures involving technology superior to the minimum levels.

The annual energy saving (ES) is based on the energy saving effects (electricity + heating + fuels) of measures reported by the participating organisations as 'implemented' (I).

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = ES(heating + fuels) + ES(electricity)

The cumulative energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year, on the basis of the aforementioned principles, multiplied by the cumulative coefficient for each year.

As stated above, the coefficient for operational measures in the calculation of cumulative savings is 5 (5 for the years 2014 and 2015, 4.5 for 2016 and 0.5 for 2020). For technical measures, the coefficient for the calculation of cumulative savings is 6.5 in 2014 and 0.5 in 2020. The savings from early measures were reported in the annual report for 2015. In that calculation, the coefficient for the calculation of cumulative savings from technical measures was 11.5 for 2009 and 7.5 for 2013. The operational measures implemented in 2009–2013 were not included in the calculation of the saving effects of early measures, because the savings they generated are not effective in 2020.

The total cumulative energy saving effect shown in the table below has been calculated by combining the annual cumulative saving effects for the periods shown in the table. The "straightforward" calculation method was used.

Overlap

Account has been taken of the overlap with energy audits. With the exception of process industry energy analyses, this assessment does not factor in the effects of measures identified during energy audits, which have been covered only in the impact assessment associated with such audits.

Parties responsible for impact assessment

Energy Authority, Motiva

FOLLOW-UP OF RESULTS AND CORRECTIVE MEASURES

The results of energy efficiency agreements are monitored through the signatories' company/organisation-specific annual reporting. The data reported annually by companies and organisations is described above in #"Assessment of impacts on energy consumption − baseline data". Motiva checks the orders of magnitude of the data and its accuracy in other respects after all reports have been submitted, asking the participating businesses for additional information if necessary. Annual reporting data per signatory is not public.

Energy advisory services related to the agreement scheme are in progress in some sectors covered by the agreement scheme. In connection with contacts with companies, measures reported by the companies as having been implemented, and those related to the calculation of savings, are also discussed. In addition, a report was drawn up in 2011, based on a random sampling of the calculation and documentation of saving measures, reported as implemented by medium-sized industrial companies.

Annual summaries by operating area and on the energy saving agreement scheme as a whole are compiled on the basis of reported company/organisation specific data. These summaries are public, e.g. Toimialakohtaiset vuosiraportit ja Energiatehokkuussopimusten tuloksia 2008-2015.pdf .#

Each agreement has a management team, whose tasks include the assessment of the results of the agreement scheme and, if necessary, the planning and implementation of corrective measures.

CUMULATIVE ENERGY SAVINGS UNDER ARTICLE 7, GWh_{cum} (END-USE)	**2014–2016**	**2017–2020**	**2014–2020**
EED KETO-1-TEM Energy efficiency agreement scheme	**22,341**	**10,156**	**32,497**

MEASURE	MEASURE CODE
Transport fuel taxes/road transport	KETO-2-VM/LVM

MEASURE PERIODS **PERIOD 1** 2014−2016, 3 a **PERIOD 2** 2017−2020, 4 a

POLICY MEASURE LINK

Transport fuel taxation falls into category a) of paragraph 9, article 7

CONTRACTORS, PARTICIPANTS AND IMPLEMENTING PUBLIC AUTHORITIES

Contractors:

- Not relevant

Participants:

- Not relevant

Implementing public authority:

- Ministry of Finance (VM): issues proposals for tax legislation in Finland
- Customs: was responsible for the collection of fuel taxes in Finland until 2017
- Tax administration: responsible for the collection of fuel taxes in Finland

DESCRIPTION OF THE MEASURE

The Act on excise duty on liquid fuels (Laki nestemäisten polttoaineiden valmisteverosta 1472/1994) and the Act on the amendment of the Act on excise duty on liquid fuels (Laki nestemäisten polttoaineiden valmisteverosta annetun lain muuttamisesta 1170/2016)

ASSESSMENT OF ENERGY SAVING IMPACT

Premises and assumptions

The assessment covers the use of petrol and diesel in passenger cars. In this measure, savings are generated from transport fuel taxation (including excise duties, carbon dioxide based taxes, the strategic stockpile fee and VAT) which is higher in Finland than the EU minimum requirements for the tax bands and VAT on fuels.

Baseline data

The source of the transport fuel consumption data for 2009–2015 is VTT's LIPASTO database. For instance, in 2015 petrol consumption by passenger cars amounted to 1,760 million litres and that of diesel fuel to 956 million litres. The study only applies to petrol-driven and diesel-powered vehicles, motorcycles and mopeds. The consumption figures for 2015 were also used for 2016–2020.

Statistics Finland's energy statistics are the source of the tax-free price of transport fuels. An average price calculated on a quarterly basis is used for each year. For instance, in 2016, the tax-free price of 95-octane petrol was 45.30 cents/litre and that of diesel fuel was 45.90 cents/litre.

The minimum tax rate on petrol, set by the EU, has been 35.9 cents/litre since 2009. The minimum tax rate on diesel fuel was 30.2 cents/litre in 2009 and has been 33.0 cents/litre since then. The prevailing rate has been used for the coming years 2018–2020.

Taxes and levies on petrol have developed as follows in Finland:

- The excise duty on petrol was 62.02 cents/litre in 2009–2010. From 2011, the excise duty was divided into energy content tax at 50.36 cents/litre and carbon dioxide tax at 11.66 cents/litre. In 2012, the carbon dioxide tax rose to 14 cents/litre, which was the rate for 2013.
- The strategic stockpile fee was 0.673 cents/litre in 2009–2013.
- In 2014, the tax rate, including energy content tax, carbon dioxide tax and the strategic stockpile fee totalled 67.29 cents/litre. In 2015–2016, the tax rate totalled 68.13 cents/litre. In 2017, the tax rate is 70.25 cents/litre. The same tax rate was applied for the years 2018–2020.

The taxes and levies on diesel fuel have developed as follows in Finland:

- The excise duty on diesel fuel was 36.05 cents/litre in 2009–2011. From 2012, the excise duty was divided into energy content tax at 30.7 cents/litre and carbon dioxide tax at 15.9 cents/litre. This rate also applied in 2013.
- The strategic stockpile fee was 0.353 cents/litre in 2009–2013.
- In 2014, the tax rate, including energy content tax, carbon dioxide tax and the strategic stockpile fee totalled 49.66 cents/litre. In 2015–2016, the tax rate totalled 50.61 cents/litre. In 2017, the tax rate is 53.02 cents/litre. The same tax rate was applied for the years 2018–2020.

The minimum value-added tax rate in the EU has been 15%. On 25 May 2016, the European Council decided to maintain the same rate for two more years. In Finland, VAT was 22% in 2009. In 2010, VAT was raised to 23%

midway through the year (1 July 2010). The rate applied for 2010 is therefore 22.5%. In 2011–2012, VAT was 23%. In 2013–2017, VAT was 24% and the same rate was applied for the period 2018–2020.

The applied price elasticity for demand was as estimated in Sweden (Regeringskansliet, Finansdepartement, 19.3.2013. Bensin- och dieselkonsumption i Sverige – ekonometriska skattningar av priselasticiteter. By Runar Brännlund, CERE, Umeå Universitet.). The resulting short-term elasticity for petrol was -0.49 and -0.17 for diesel fuel. However, these fuels have cross linkage: when petrol prices rise and consumption falls, diesel consumption rises and vice versa. The impact of a 10% increase in petrol prices on demand for diesel is 1.2% (price elasticity 0.12) and the impact of a 10% increase in diesel prices on demand for petrol is 11% (price elasticity 0.11). A simultaneous change in price reduces the impact of cross linkage, but no account was taken of this in the calculation. The short-term price elasticity applied in the calculations mainly takes account of changes in behaviour. Price changes also have long-term impacts, but these were not studied.

A lifetime of one year was assumed for the measures.

Method of calculation

Finland has its own BU calculation system. The method corresponds to method c in paragraph 1 of Annex V of the EED and the principles in paragraph 3 of Annex V on the calculation of taxation impacts.

The calculations examined fuel prices at taxation rates in Finland and the minimum taxation rate of the EU for every year during the period 2009–2020. The taxation rate in Finland led to the price of petrol being 41% higher in 2009 than it would have been at EU tax rates. Diesel prices would have been 15% higher. In 2016, the difference was 51% for petrol and 32% for diesel. When these annual differences in price are multiplied by price elasticity, the result shows how many percent higher consumption would be if EU tax rates were applied. When this figure is multiplied by the actual consumption, the figure shows the saving resulting from higher taxes. In addition, account is taken of the aforementioned cross linkage between petrol and diesel consumption in passenger car traffic.

The total cumulative energy saving effect shown in the table below has been calculated by combining the annual saving effects for the periods shown in the table. The "straightforward" method has been used in the calculation.

The impacts of taxes and other levies on transport fuels were also calculated using the VATTAGE model of the VATT Institute for Economic Research. The saving effect calculated using the VATTAGE model totals 22 TWh_{cum} for the period 2014–2020. Documentation for the model is available online at VATTAGE documentation

Overlap

No overlapping impacts.

Parties responsible for impact assessment

Finnish Ministry of Economic Affairs and Employment, Motiva, VATT

FOLLOW-UP OF RESULTS AND CORRECTIVE MEASURES

The development of energy efficiency in transport is monitored as part of the implementation of the National Energy and Climate Strategy. The Ministry of Finance has the authority to issue proposals on changes to transport fuel taxation, if necessary.

CUMULATIVE ENERGY SAVINGS UNDER ARTICLE 7, GWh_{cum} (END-USE)	2014–2016	2017–2020	2014–2020
EED KETO-2-VM/LVM Transport fuel taxes/passenger cars	**8,856**	**13,486**	**22,342**

MEASURE Energy audits	**MEASURE CODE** KETO-3-TEM

MEASURE PERIODS **PERIOD 1** 2014−2016, 3 a **PERIOD 2** 2017−2020, 4 a

POLICY MEASURE LINK

Supported energy audits have long been an important part of Finland's energy policy. Energy audits were one of the obligations laid down in the industrial sector energy saving agreement (1997–2007), as they were in the implementation of the energy efficiency agreements 2008–2016 and in the new agreement period 2017–2025.

The energy audit programme was launched in 1992, and subsidies towards energy audits of real properties and industrial energy audits and analyses have been available since then. A total of EUR 38 million in subsidies was granted between 1992 and 2015. The amount of subsidies varied from EUR 1 million to EUR 8.2 million between 2009 and 2015. The subsidies cover 40% of eligible labour costs for all organisations and 50% of the costs of small and medium-sized organisations that have signed an energy efficiency agreement, and for municipalities. Large enterprises have not been eligible for energy audit subsidies since the introduction of the Energy Efficiency Directive on 5 June 2014.

In addition, the Finnish Ministry of Economic Affairs and Employment has annually commissioned assignments from Motiva related to the energy efficiency agreement scheme and the monitoring and impact assessment of the scheme since 1994 (see Motiva's role in the following section). In 2017, these commissions will total around EUR 0.35 million in value.

The energy efficiency measures implemented as proposed in the energy audits are acceptable energy efficiency measures other than those in categories (a)–(f) and cited as examples in paragraph 9, Article 7.

CONTRACTORS, PARTICIPANTS AND IMPLEMENTING PUBLIC AUTHORITIES

Contractors:

- TEKES, the Finnish Funding Agency for Technology and Innovation: Processing of decisions on energy auditing subsidies and granting of subsidies
- Motiva: Serves as the practical operator in the implementation of the energy audit programme. Tasks include the development of energy audits (incl. energy audit models), training of energy auditors, arrangement of topical seminars, quality assurance of the audits, participation in marketing and advice for audit subsidy applicants. The work also includes the maintenance, development and impact assessment of the energy audit monitoring system.

Participants:

- Businesses and non-governmental organisations commissioning energy audits: Order an energy audit/analysis from qualified energy auditors who have completed the energy audit training. Utilise energy audit results in enhancing the energy efficiency of their operations.
- Energy auditors: Attend energy auditor training provided by Motiva and, once they have completed the related exam, become qualified to perform energy audits subsidised by the Ministry of Economic Affairs and Employment.
  Market energy audits and perform them for businesses and non-governmental organisations.

Implementing public authority:

- Ministry of Economic Affairs and Employment/Energy Authority: Authority responsible for the energy audit programme.

DESCRIPTION OF THE MEASURE

The energy audit programme has been implemented in Finland since 1994. Various energy audit models for different user groups and various purposes have been developed within the programme. An energy audit always includes an evaluation of current energy and water consumption, an examination of potential energy saving measures, an estimate of their saving effects and reporting. Energy audits are carried out by consultants trained and certified by Motiva.

Three different energy audit templates are available in the industrial sector: industrial energy audit, industrial energy analysis and a two-stage energy analysis for the process industry. Industrial organisations can also use the energy audit templates developed for the service sector to audit office buildings, for example.

Four energy audit templates are in use in the local government sector: the energy inspection for properties, energy audit for properties, follow-up audit for properties and commissioning inspection for properties. In addition, renewable energy audits were introduced for the local government sector in 2005, which involve examining the opportunities of local government to increase the use of renewable forms of energy.

ASSESSMENT OF ENERGY SAVING IMPACT

Premises and assumptions

When calculating actual savings in energy audits, information is used as provided by businesses and non-governmental organisations which have signed up to energy efficiency agreements, on the energy audit measures implemented each year from among those proposed in energy audits and their calculated saving effects. Such information is gained from the annual reports of the energy efficiency agreement scheme. When assessing the annual savings in energy audits of businesses and non-governmental organisations that have not signed up to the energy efficiency agreements, use is made of the savings potential (TSP) of measures identified during the course of energy audits and reported to the energy audit database and the percentage of implemented measures (IP) reported by all energy efficiency agreement signatories in their annual reports.

Saving potential data derived from the energy audits of companies other than those that have signed up to the energy efficiency agreements for 2009–2015 is based on reported audits. The average materialisation percentage of the saving potential identified during audits has been calculated on the basis of information submitted by organisations, in their annual reports, concerning the implementation of energy efficiency agreements in 2015. In recent years, energy audits related to the energy efficiency agreement scheme have accounted for over 80% of all industrial energy audits: over 95% in the local government sector, over 80% in industry and around 50% in the private service sector. These savings relate to both medium-sized industrial organisations and energy-intensive industry, but do not include savings due to measures proposed during second stage energy analyses of the process industry, which are reported in annual reports on energy efficiency agreements. Likewise, the results of the renewable energy audit of the local government sector are not included.

It is estimated that, in 2016, the average saving potential of audits will equal the level of 2012−2014, while that of 2017−2020 will equal the average level implemented during the energy efficiency agreement period in 2008−2014. No figures are available for 2015 with regard to the average saving potential, as many of the audits carried out that year have not yet been reported.

Saving potential and implementation figures have been calculated separately for operational measures and technical measures. The lifetime of savings derived from technical measures is over 12 years, which means that their impact will still be in effect in 2020.

It is estimated that half of the savings effect of technical measures implemented each year materialises during the first year. In the calculation of cumulative savings, the coefficient for measures implemented in 2014 is therefore 6.5 and for 2020 it will be 0.5. The calculated lifetime of operational measures is 5 years.

With respect to the monitoring data, measures in which account must be taken of ecodesign requirements when calculating saving effects have been separated from reported savings in electricity, while measures related to lighting and engines have so far been separated from electricity savings. Of savings related to lighting, only part are attributable to the actual bulbs used. Of the saving impact of measures related to lighting, 40% are included in the cumulative calculation of the saving effect pursuant to Article 7. Savings associated with engines are treated correspondingly, taking 20% of the savings into account in the calculations. In addition, at this stage 25% of the remaining savings in electricity have been deducted for industry and 50% for the service sector.

Baseline data

The baseline data for calculations has been derived from the energy audit and energy efficiency agreement monitoring system, in which data from the subject of each energy audit is compiled at three stages.

- The following information is submitted on the application and funding decision:
  - the size of the property, the year in which it was built, the type of property, participation in saving agreements, audit subsidies granted
- The following information is submitted concerning the energy audit report:
  - energy and water consumption data from the year preceding the audit
  - for each proposed measure:
    - brief description/name of the measure, categorisation used for separating operational and technical measures
    - heating, electricity and/or water saving in units of energy (kWh/a) and costs (EUR/a)
    - investment estimate and direct payback period (EUR, a)
    - status of proposed measures (implemented = I, decided = D, possible = P, abandoned = A)
- The following information concerning annual reports is submitted on the implementation of energy efficiency agreements:
  - information on the implementation of measures proposed in connection with energy audits and their status (I, D, P, A)
  - participation in the emissions trading scheme

Information derived from energy audit reports includes figures calculated and/or measured by trained and certified energy auditors on site, and calculations produced on the basis of the same. The accuracy of savings calculations corresponds to the accuracy achieved by means of normal field testing. Normalised thermal energy consumption

figures are used in the calculation of the saving effects of individual measures concerning thermal energy dependent on the outdoor temperature. Because measurement is not always possible, some baseline data is based on design values or estimates. In most cases, savings achieved by saving measures are not verified by retrospective measurements, as measurement is often difficult in practice and results in considerable extra costs.

The status of each of the measures proposed in connection with energy audits must be entered during annual reporting, i.e. on whether the measure has been implemented (I), whether a decision has been made to implement the measure (D), whether the possibility of implementing the measure is being contemplated (P) or whether a decision has been taken to abandon the measure (A). The percentage of saving measures identified during the course of industrial energy audits that are implemented (IP) is assessed in this calculation, which only applies to implemented savings i.e. the implementation percentage (I) calculated on the basis of measures proposed in energy audits annually reported as having been implemented by the signatories of energy efficiency agreements.

IP [%] = I

The implementation percentage is calculated separately for heating and electricity saving measures, and for operational measures and technical measures. It is calculated for energy-intensive industry, medium-sized industrial organisations, the private service sector and the local government sector. Based on information from the 2012 annual reports, on agreements and measures already implemented (no terminated measures or parts of measures being considered are included), according to the impact assessments of energy audits the percentages of saving potential implemented (IP) are:

- 68% for operational measures relating to heating and fuels (H + F) for medium-sized energy consumers, 65% for measures relating to electrical energy (E) and, correspondingly, 41% (H + F) and 35% (E) for energy-intensive energy users, 58% (H+F) and 52% (E) for the local government sector, and 73% (H+F) and 58% (E) for the private service sector
- 31% for technical measures relating to heating and fuels (H + F) for medium-sized energy consumers and 39% for measures relating to electrical energy (E) and, correspondingly, 41% (H + F) and 21% (E) for energy-intensive energy users, 58% (H+F) and 26% (E) for the local government sector, and 17% (H+F) and 37% (E) for the private service sector,

Method of calculation

For the purposes of calculating the saving effects of individual energy efficiency measures proposed in energy audits, the method used is method c) “scaled savings”, as presented in paragraph 1, Annex V of the Energy Efficiency Directive. See also “Baseline data” above.

The overall saving effect of the energy efficiency agreement scheme described herein is calculated using the special national BU calculation method, modified from the method previously used in NEEAP calculations and taking account of the framework conditions for EED calculation. Separate account is taken of the lifetime of savings when calculating for operational measures and technical measures. Account is also taken of the need – due to ecodesign requirements – to calculate the savings solely for measures that are technology superior to the minimum levels. Classification
of energy audit measures is used when calculating savings involving these target groups.

The annual new energy saving effect (ES) is calculated on the basis of the total saving potential (TSP) of the saving measures proposed, during the course of the energy audits reported each year, with regard to heating and electricity and the percentage of the proposed saving measures already implemented (IP). The premises and assumptions applied to the calculations are discussed above.

The new annual energy saving (ES) is calculated by adding the actual saving effects of energy audits to those of measures proposed in other energy audits and reported as having been implemented in annual reporting on energy efficiency agreements (ETS-ES), using the percentage of measures implemented (IP) and previously identified as sound plus the total saving potential (TSP) of the energy audits in question by operating area (energy-intensive industry, medium-sized industrial organisations, private service sector, the local government sector) as follows:

ES [GWh/a] = ETS-ES by operating area + IP(heating)*TSP(heating)operating area + IP(electricity)*TSP(electricity)$_{\text{operating area}}$ The total cumulative energy saving effect shown in the table below has been calculated by combining the annual cumulative saving effects (ES).

As stated above, in the calculation of cumulative savings the coefficient for operational measures is 5 (4.5 for 2016 and 0.5 for 2020). With respect to technical measures, the coefficient for the calculation of cumulative savings is 6.5 in 2014 and 0.5 in 2020. Savings from early measures were reported in the annual report for 2015. In that calculation, the coefficient for the calculation of cumulative savings from technical measures was 11.5 for 2009 and 7.5 for 2013. The operational measures implemented in 2009–2013 were not included in the calculation of the saving effects of early measures, because the savings they generated will not be in effect in 2020.

The total cumulative energy saving effect shown in the table below has been calculated by combining the annual cumulative saving effects for the periods shown in the table. The “straightforward” method was used in the

calculation.

Overlap

Energy auditors propose the order in which the identified saving measures should be implemented and factor in any overlaps between individual measures.

Account has been taken of the overlap between energy audits and the energy efficiency agreement scheme in such a manner that all measures – including those proposed in the energy audits of businesses and non-governmental organisations that have signed up to the agreements and for which a saving effect has been determined – are included in the energy audit saving impact presented in this Annex and that no account is taken of this saving effect when calculating the saving effect of the energy efficiency agreement scheme.

Parties responsible for impact assessment

Energy Authority, Motiva

FOLLOW-UP OF RESULTS AND CORRECTIVE MEASURES

The volume (including the number and cubic capacity rm^3 of service sector buildings and the energy consumption of industrial enterprises included in the audits) and results (savings potentials) of energy audits subsidised by the Ministry of Economic Affairs and Employment are monitored annually.

A summary of this information has been created for use by the ministry; information for a variety of purposes (e.g. case cards and webpages etc) is based on the summary. Tilastotietoa energiakatselmuksista (Statistical data on energy audits) etc).

In addition, the implementation of measures proposed in energy audits is monitored through the annual reporting of energy efficiency agreements.

The responsible ministry (Ministry of Economic Affairs and Employment) and the Energy Authority monitor the results of energy audits and may undertake corrective measures, if necessary.

CUMULATIVE ENERGY SAVINGS UNDER ARTICLE 7, GWh_{cum} (END-USE)	2014–2016	2017–2020	2014–2020
EED KETO-3-TEM Energy audits	**831**	**484**	**1,314**

MEASURE	MEASURE CODE
Energy efficiency agreements/Energy Services Action Plan and Höylä III – Customers	KETO-4-TEM

MEASURE PERIODS **PERIOD 1** 2014−2016, 3 a **PERIOD 2** 2017−2020, 4 a

POLICY MEASURE LINK

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements (1997–2007) have been important elements in Finland's climate and energy policy since 2001.
The energy efficiency agreement scheme falls into category c) "voluntary agreements" under paragraph 9, Article 7 of the EED.

CONTRACTORS, PARTICIPANTS AND IMPLEMENTING PUBLIC AUTHORITIES

Contractors:

- Motiva: Support for the companies/organisations that have joined the scheme, in the implementation of the agreement, the development of tools and services in support of implementation, and the provision of advisory services and information e.g. via seminars, training websites and joint development projects. Advisory services are company-specific in certain operational areas. Auditing the annual reporting data of each party joining the scheme, requesting further information and engaging in the related development. In addition, maintenance and development of the monitoring database of the energy efficiency agreement scheme, monitoring and impact assessment of the scheme and the preparation of summary reports.

Participants:

- Companies that engage in electricity transmission and distribution, and district heating and cooling distribution and sales, having joined the Energy Services Action Plan of the energy efficiency agreement for businesses. In accordance with the Energy Services Action Plan, these companies have committed themselves to helping their customers raise the efficiency of energy consumption, and to markedly promoting the efficiency of the end use of energy and the achievement of the indicative 9% energy saving target laid down by the ESD with regard to the energy consumption of such customers, between 2008 and 2016 compared to the progress made without energy efficiency measures. In addition, via the agreement scheme monitoring system they annually report the energy efficiency advice and communications-related measures implemented for customers.
- Finnish Petroleum Federation, Oil Industry Service Centre, Association of Finnish Petrol Retailers and Transport Services, all major Finnish retailers of heating and transport fuels: Commit to enhancing the energy efficiency of oil heating systems in their respective areas. In addition, they commit to the implementation targets defined for trade associations.
- Confederation of Finnish Industries and Finnish Energy Industries: Commit to promoting the achievement of the coverage target in their sector and the implementation of their individual agreement or action plan. In addition, they commit to the implementation targets defined for trade associations.

Implementing public authority:

- Ministry of Economic Affairs and Employment (TEM): Contracting party in the energy efficiency agreement scheme and the administrative responsible authority. Committed to the measures allocated by the agreement to the ministry in question.
- Ministry of the Environment (YM): One of the two ministries that have signed the Höylä III agreement. Responsible for boiler inspections and the related advisory services.
- Energiavirasto (EV): Energy Authority A new authority, operational since the beginning of 2014, to which some administrative duties related to the agreement scheme were transferred from the Ministry of Economic Affairs and Employment.

More information about agreements valid from 2008 onwards is available at http://www.energiatehokkuussopimukset.fi and, for further details on new energy efficiency agreements for the period 2017−2025, see http://www.energiatehokkuussopimukset2017-2025.fi/ .

DESCRIPTION OF THE MEASURE

Energy efficiency agreement for businesses/Energy Services Action Plan – Customers

The Energy Services Action Plan is one of the action plans included in the Energy efficiency agreement for businesses
. For participating businesses, the Action Plan includes goals and obligations related to both their own energy consumption and that of their customers. This description of measures focuses on advisory and

communication services provided by businesses participating in the Energy Services Action Plan for their customers.

Businesses that have joined the Energy Services Action Plan represent almost 90% of Finland's electricity distribution businesses, just over 90% of all electricity sales and 86% of all district heating sales.

Businesses that have signed an energy efficiency agreement submit annual reports, via a web-based monitoring system, on measures aimed at improving the energy efficiency of their customers. The measures reported via the monitoring system relate to advice, communications, consumption data and billing. Quantitative information on the implementation of measures and their target groups is also reported. This indicates that, in each year monitored, almost all (95%–99%) signatories have implemented measures for end customers in the aforementioned measure categories.

Company and organisation-specific annual reporting is not public. An annual summary by operating area and on the agreement scheme as a whole is prepared on the reported information.

The most popular of the types of measures reported by businesses are discussed below. As stated above, the participating businesses represent most electricity and district heating/cooling sales in Finland, and the information therefore paints a very reliable picture of the market. In Finland, energy companies also have long traditions in implementing measures targeted at customers and such activities are continued on an annual basis. The number of measures to be implemented during the 2008–2016 contracting period and the number of people targeted will become very high.

Advice

The most popular consultancy measures in energy saving advisory services targeted at customers include:

- Telephone-based provision of energy saving advice
- Consumption meter hire
- Email-based or web-based provision of advice
- On-site provision of energy saving advice
- Events for customers and stakeholders

Communication

The most popular communication measures in energy saving communications include:

- Articles about energy efficiency in customer magazines
- Information about energy efficiency on websites
- Leaflets about energy efficiency for customers
- Participating in the Energy Saving Week
- Provision of material on energy saving for schools

Consumption data

The most popular measures relating to consumption data are:

- Access to personal consumption data online
- Remote metering
- Provision of energy consumption reports for customers
- Installation of kilowatt-hour meter and customer's online monitoring of own consumption

Invoicing

Most companies invoice their customers either monthly or at least 4–6 times a year on the basis of actual consumption.

Höylä – energy efficiency agreements – Customers

The 2017–2025 agreement follows on from the Höylä I (1997–2001) and II (2002–2007) energy saving programmes and the Höylä III energy efficiency agreement (2008–2016).

Höylä energy efficiency agreements are more extensive than the previous Höylä programmes. This description applies to oil-heated residential properties.

The objective of the Höylä II agreement is to achieve a saving of at least nine percent in the consumption of heating oil between 2005 and 2016. The agreement promotes the maintenance of oil-based heating systems, boiler replacements and other energy-efficient repairs in buildings. The Höylä IV energy efficiency agreement 2017−2025 continues the aforementioned activities.

In addition, the Höylä energy efficiency agreements promote regular inspections of heating boilers in buildings and the training and certification of inspectors pursuant to Article 8 of the Energy Efficiency Directive.

With regard to the implementation of the agreement, the participants provide comprehensive training, advice and communications for the group targeted by the measure.

Via a web-based monitoring system, the Oil Industry Service Centre submits annual reports on measures aimed at improving the energy efficiency of its customers. The monitored measures mainly involve communications at trade fairs and events, and advice on enhancing energy efficiency in
a customer magazine targeted at all oil-heated properties. Quantitative information on the implementation of

measures and their target groups is also reported.

In addition, the Höylä III agreement promotes regular inspections of heating boilers and the training and certification of inspectors, pursuant to Article 8 of the Energy Efficiency Directive.
Target-specific advice is provided during boiler inspections.

ASSESSMENT OF ENERGY SAVING IMPACT

Premises and assumptions

Based on the 2011–2012 report, which measures and assesses the impacts of so-called soft energy efficiency measures taken by Energy Services Action Plan customers, the saving effect of these measures totals 1–3% of the target group's energy consumption.
http://energia.fi/files/1225/Pehmeiden_energiatehokkuustoimien_vaikutusten_mittaus_ja_arviointi.pdf

On the basis of the report, the estimated saving effect is 2.5% of households' energy consumption (electricity, district heating and light fuel) and only 1% of energy consumption (electricity and district heating) of other target groups. Hence, the savings estimates used are fairly moderate in relation to the results of the report.

The target group for the calculation includes household consumption of electricity and district heating, as well as an additional 10% of the corresponding energy consumption of industry (small industrial organisations), one third of the corresponding energy consumption of services, and one half of that of agriculture and forestry. Residential properties heated with light fuel form an additional target group. District cooling is not included in the assessment.

Baseline data

The baseline data used is data by Statistics Finland on the electricity and district heating energy consumption of the measure's target group in 2009–2015, and estimates of consumption figures for the subsequent years based on such data and district heating consumption forecasts. When determining the energy consumption subject to the saving effect, account is taken of the share of energy sold and distributed – by businesses that have signed the agreement – of the total sales and distribution of electricity and district heating in Finland.

The calculation assumptions also take account of the coverage, reported by signatories, of measures related to advice and communications (close to 100%).

In addition, for oil-heated buildings, the baseline data used includes Statistics Finland's energy consumption data for residential properties in 2009–2015, and consumption for the following years estimated on the basis of such data. With regard to light fuel, it is assumed that communications comprehensively reach the target group in question.

Method of calculation

The basis for calculating the saving effect of so-called soft energy efficiency measures (see "Description of the measure" above) targeted at customers is the method presented in Annex V, paragraph 1 of the Energy Efficiency Directive, d) "Surveyed savings" (see also "Baseline data" above). Using this and other information described above, the saving effect can be calculated using the method c) "scaled savings", presented in paragraph 1 of Annex V.

The total saving effect described herein is calculated using Finland's own BUI calculation method and takes only the saving effect of so-called soft measures, i.e. Measures related to people's behaviour, into account. Annual energy savings (ES) are calculated using the following formula:

Energy Services Action Plan – Customers

ES[GWh/a] = 0.025*households' energy consumption (electricity+district heating) + 0.01*other energy consumption in the target group (electricity+district heating).

Höylä III – Customers

ES[GWh/a] = 0.025*consumption of light fuel oil in residential properties

In calculating cumulative savings, the lifetime used for new annual energy saving is 1 year.

The measures were also effective in the early period 2009−2013, but no account was taken of their effects (5,934 GWh_{cum}) in the cumulative saving effect of Article 7, because the saving effect of measures implemented in 2009−2013 will not be valid in 2020 (lifetime of saving 1 year). The early measures were reported in the EED annual report for 2015.

The total cumulative energy saving effect shown in the table below has been calculated by combining the annual saving effects for the periods shown in the table. The "straightforward" method was used in the calculation.

Overlap

Account has been taken of the overlap with other agreement scheme activities. This estimate does not include customers in medium-sized industrial organisations and energy-intensive industries, or energy consumption in service sectors related to other energy efficiency scheme activities (see measure KETO-1_TEM).

Parties responsible for impact assessment

Finnish Ministry of Economic Affairs and Employment, Motiva

FOLLOW-UP OF RESULTS AND CORRECTIVE MEASURES

The results of energy efficiency agreements are monitored through annual reporting. Motiva checks the orders of magnitude of the data and its accuracy in other respects after all reports have been submitted, and requests additional information if necessary.

Each agreement has a management team, whose tasks include assessing the results of the agreement scheme and, if necessary, the planning of corrective measures.

CUMULATIVE ENERGY SAVINGS UNDER ARTICLE 7, GWh_{cum} (END-USE)			**2014–2016**	**2017–2020**	**2014–2020**
EED	KETO-4-TEM-A	Energy Efficiency Agreement Scheme/ Energy Services Action Plan – Customers	2,996	3,979	6,976
EED	KETO-4-TEM-B	Energy Efficiency Agreement Scheme/Höylä III – Customers	397	440	837
EED	**KETO-4-TEM**	Energy Efficiency Agreement Scheme/Energy Services Action Plan and Höylä II – Customers	**3,393**	**4,419**	**7,813**

THE MEASURE	MEASURE CODE
Heat pumps for detached and terraced houses (rev. 28 February 2017)	KETO-5-TEM

MEASURE PERIODS **PERIOD 1** 2014–2016, 3 a **PERIOD 2** 2017–2020, 4 a

POLICY MEASURE LINK

Since 2001, householders have been able to obtain tax credit for the cost of work involved in installing a heating pump in their homes. Depending on the type of heat pump, the tax credit is worth between EUR 200 and EUR 3,500. The acquisition and introduction of heat pumps is actively promoted through information and communication measures financed by ministries, and via development projects. The popularity of heat pumps is the result of long-term efforts made since the early 2000s.

Heat pumps for detached and terraced houses fall into categories (b), (d) and (f) of Article7, paragraph 9.

CONTRACTORS, PARTICIPANTS AND IMPLEMENTING AUTHORITIES

Contractors:

- Motiva Oy: In 2010, the Ministry of Economic Affairs and Employment appointed Motiva Ltd as the national coordinator and developer of energy advice. Motiva Ltd's communications and the communication projects it coordinates promote the introduction of heat pumps, as part of energy advice for consumers.

Participants:

- Not relevant.

Implementing public authority:

- Tax Administration: The tax credit for households is requested on a separate form attached to the tax return. Taxpayers must store all documents and receipts for 6 years and the tax authorities may request to see them if necessary.

DESCRIPTION OF THE MEASURE

Heat pumps are installed in existing detached and terraced houses to cut energy consumption, and in new buildings to provide an energy-efficient primary and additional heating system. Fewer than 1,000 heat pumps were sold in 1999. Sales began to grow in 2000, when the Finnish Heat Pump Association and Motiva began promoting the use of heat pumps. By the end of 2016, almost 800,000 heat pumps had been installed in detached and terraced houses. In Finland, heat pumps constitute a key measure in achieving both the energy 2020 efficiency objective and the renewable energy objective. Heat pumps are reported as an energy efficiency measure in the national energy efficiency action plans (2007, 2011 and 2014).

ASSESSMENT OF IMPACTS ON ENERGY CONSUMPTION

Premises and assumptions

The annual sales figures for heat pumps, collected by the Finnish Heat Pump Association from importers and manufacturers and on the basis of which Statistics Finland compiles data on the energy produced by heat pumps for official statistics, are used as the basis for calculating the saving effect. Sales figures are compiled by heat pump type and power category. The average power of installed heat pumps, by heat pump type, is used in the calculation of savings effects. The following service life figures by heat pump category are taken into account in saving effects.

- Geothermal heat pump (GSHP) 20 years,
- Air-source heat pump (ASHP) 10 years,
- Air-water heat pump (AWHP) 15 years
- Exhaust air heat pump (EAHP) 15 years.

With respect to early measures (2009–2013), the actual sales figures used in the calculations are higher than those estimated in the NEEAP-2 report. A fairly small proportion of heat pumps will be acquired as replacements towards the end of the period 2017–2020. In 2016, the share of replacements was marginal.

Baseline data

The following numbers of installed heat pumps for the years 2010, 2016 and 2020 were used as baseline data in calculating the saving effect of heat pumps in detached and terraced houses. For the years up to 2016, the information is realised information. The figures for the period 2017–2020 are estimates of future development, which were updated in spring 2017.

Year	GSHP	ASHP	AWHP	EAHP	Total

2010	47,390 projects	319,500 projects	6,326 projects	18,033 projects	391,249 projects
2016	128,542 projects	611,248 projects	17,468 projects	32,287 projects	789,545 projects
2020	171,500 projects	771,200 projects	29,000 projects	40,300 projects	1,012,000 projects

It is estimated that the average power output of heat pumps will grow between 2014 and 2020, as follows:

Type/year	2010	2016	2020
GSHP	11.9 kW	13.4 kW	14.5 kW
ASHP	4.8 kW	5.4 kW	5.9 kW
AWHP	11.6 kW	13.0 kW	13.9 kW
EAHP	3.4 kW	3.8 kW	4.1 kW

Method of calculation

For the purposes of calculating the energy savings generated by heat pumps, the method used is method c) "scaled savings", presented in paragraph 1, Annex V of the Energy Efficiency Directive. The Commission Decision (2013/114/EU) establishing the guidelines for Member States on calculating renewable energy from heat pumps from different heat pump technologies, pursuant to Article 5 of the Directive 2009/28/EC of the European Parliament and of the Council, includes the calculation formula for heat pumps and the related coefficients. The energy savings and renewable energy obtained from other heat pump technologies are just as great. In practice, the energy saving from an exhaust air heat pump is considerably higher than the amount of renewable energy gained.

Four different types of heat pumps used in detached and terraced houses were examined when estimating the saving effect. For each year during the period 2014–2020, the number of heat pumps is provided either as statistical data, or as an estimate of future development. Using these figures, the #Eres# for the year in question is calculated, on the basis of which the cumulative energy saving achieved by the end of 2020 (GWh_{cum}) is calculated in accordance with the energy efficiency directive. When calculating new energy saving from 2016 onwards, a decrease of 50% has been taken into account as the probable EU-level energy efficiency minimum requirement effect. This reduction accounts for all other possible factors that may influence energy saving calculations. The cumulative saving effects (GWh_{cum}), calculated by heat pump type, are as follows:

Type/Periods	2009-2013	2014-2016	2017-2020
GSHP	9,097	3,272	1,141
ASHP	7,367	4,319	1,200
AWHP	338	430	192
EAHP	63	35	13
Total	16,866	8,056	2,546

It is estimated that half of the savings effect of measures implemented each year materialise during the first year. In the calculation of cumulative savings, the coefficient for measures implemented in 2014 is therefore 6.5, and for 2020 it is 0.5. Early measures are those taken in 2009–2013, whose the saving effect is still effective in 2020. When calculating savings, the coefficient for measures implemented in 2009 is 11.5, and for 2013 it is 7.5.

The total cumulative energy saving effect shown in the table below has been calculated by combining the annual cumulative saving effects for the periods shown in the table. The "straightforward" method was used in the calculation.

Overlap

In this estimate, there is a 500 GWh_{cum} overlap with the saving effect from the building regulations of new buildings. The overlap is taken into account as a deduction in the calculation of the saving effect of measure KETO-8-YM. **Parties responsible for impact assessment**

Energy Authority and the Finnish Heat Pump Association

FOLLOW-UP OF RESULTS AND CORRECTIVE MEASURES

The Finnish Heat Pump Association compiles information on heat pump sales figures for Statistics Finland on an annual basis. If the annual sales figures of heat pumps are insufficient to achieve the 2020 RES goal and the EED goal for the period 2014–2020, the responsible ministries can undertake corrective measures, which may take the form of promotional measures and/or regulations.

CUMULATIVE ENERGY SAVINGS UNDER ARTICLE 7, GWh_{cum} (END-USE)	**2014–2016**	**2017–2020**	**2014–2020**
EED KETO-5-TEM Heat pumps for detached, semi-detached and terraced houses	**8,056**	**2,546**	**10,602**

MEASURE	MEASURE CODE
Investments in heating plants	KETO-6-MMM

MEASURE PERIODS **PERIOD 1** 2014−2016, 3 a **PERIOD 2** 2017−2020, 4 a

POLICY MEASURE LINK

The Finnish Ministry of Agriculture and Forestry promotes the use of wood, and materials and energy derived from renewable natural resources, in construction. Many farms are self-sufficient with regard to wood chip production and switching to this form of energy is usually a profitable investment. Other biofuels produced by agricultural activity are also used. Since 1996, the ministry has allocated funds to support heating plant investments on farms. Most subsidised investments relate to switching from fossil fuels to biofuels produced on site, which is in line with the policies of the Energy Services Directive regarding energy saving measures, because less delivered energy is needed.

Subsidies are either given in the form of interest subsidies (up to 50–80% depending on the project) or grants (up to 15–40% of eligible costs). The grant was increased from 35% to 40% in 2016.

Investment subsidy falls into category (b) of paragraph 9, Article 7.

CONTRACTORS, PARTICIPANTS AND IMPLEMENTING PUBLIC AUTHORITIES

Contractors:

- ELY Centres: Processing of subsidy applications and decisions on subsidies and the processing of payment applications.

Participants:

- Not relevant.

Implementing public authority:

- Agency for Rural Affairs MAVI: Responsible for the implementation and monitoring of the subsidy.
- ELY Centres: Supervision and decisions on subsidies

DESCRIPTION OF THE MEASURE

Subsidies are either given in the form of interest subsidies (up to 50–80% depending on the project) or grants (up to 15-40 % of eligible costs). The grant was increased from 35% to 40% in 2016.

ASSESSMENT OF IMPACTS ON ENERGY CONSUMPTION

Premises and assumptions

ELY-centres store information on subsidy applications in the HYRRÄ information system (called RAHTU until 2015). Applications specify the scope of the project (power output to be replaced), estimated costs, details of the applicant and the date of the application. Funding decisions and related information are recorded in the same database.

Subsidies are available towards building, upgrading and extending heating plants on farms. **Baseline data**

The following data have been taken from funding applications:

- Approximately 330 applications were submitted each year between 1996 and 1999, and the total power output to be replaced was approximately 5.5 MW per year. Between 200 and 300 applications were submitted each year between 2001 and 2005, and the associated total power output was around 28 MW.
- Power output data was not systematically collected between the years 2006 and 2012. For this reason, the Finnish Ministry of Agriculture and Forestry has used typical power demand and the type and scope of investment projects to estimate the average power output of heating plants from 2009 onwards. The estimate is based on projects implemented between 1996 and 2005. The total power of subsidised projects was 85 MW in 2009, 31 MW in 2010, 66 MW in 2011 and 74 MW in 2012.
- The total power of subsidised projects was 84.4 MW in 2013, 53.4 MW in 2014, 25.8 MW in 2015 and 38.6 MW in 2016.

Method of calculation

The calculated savings estimated by experts is based on the number of completed heating plant projects, the average output and an estimate of annual running time and efficiency.

The following assumptions were applied in the impact assessment:

- the heating plants using biofuel that are presented in the applications replace not only heating plant power produced with oil, but also older log or wood chip boilers, which are assumed to account for 15% of the projects
- It is expected that around 85% of the heating plant modernisation projects will be completed.

- Some of the applicants cannot obtain fuel from their own farm, but must buy it from elsewhere (pellets, wood chips etc.); the assumption is that 80% will use their own fuel until 2013, which will reduce to 70% after that

  Due to the combined effects of the aforementioned correction coefficients, only 57.8 % of the total power proposed in the applications will be realised by 2013 and 50.6% from 2014 onwards.
- The annual running time of a biofuel-based boiler at full power is between 4,500 and 5,000 hours, as biomass-based boilers are rarely dimensioned according to their nominal maximum power and farms are likely to use an oil-fired boiler alongside their biomass boiler in cold winter weather (and many have an oil-fired boiler as a backup system).
- The impact assessment assumes that 30% of projects for which funding applications are submitted each year are implemented during the same year and the remainder in the following year

Impact assessment

The assessment is for heating plant investments that involve replacing an old fossil fuel (oil) boiler with a boiler that runs on renewable forms of energy (such as wood chips or energy crops) produced on site.

The annual energy saving (ES) is based on the saving in delivered energy (oil). The average useful life of boilers is 25 years, which means that all of these investments have an impact throughout the programming period.

New annual energy savings (ES) are calculated using the following formula:

ES [GWh/a] = installed boiler capacity per year [MW] * running time at full power [h] * a,

where

a = 0.58 = corrective coefficient (0.51 from 2014 on, taking account of the fact that

- some of the old boilers were running on renewable forms of energy before the upgrade
- some applicants do not produce their fuels on site but buy them in, and
- some subsidised projects do not go ahead for one reason or another.

It is estimated that half of the savings effect of measures implemented each year materialises during the first year. In the calculation of cumulative savings, the coefficient for measures implemented in 2014 is therefore 6.5, and for 2020 it is 0.5. Early measures are those taken in 2009–2013 and the saving effect is still valid in 2020. When calculating savings, the coefficient for measures implemented in 2009 is 11.5, and for 2013 it is 7.5.

The total cumulative energy saving effect shown in the table below has been calculated by combining the annual cumulative saving effects for the periods shown in the table.

Overlap

None.

Parties responsible for impact assessment

Ministry of Agriculture and Forestry (MMM), Motiva Ltd, Insinööritoimisto Granlund Oy

FOLLOW-UP OF RESULTS AND CORRECTIVE MEASURES

The Ministry of Agriculture and Forestry and the Agency for Rural Affairs monitor the implemented projects and amounts of subsidy on an annual basis.

CUMULATIVE ENERGY SAVINGS UNDER ARTICLE 7, GWh_{cum} (END-USE)	**2014–2016**	**2017–2020**	**2014–2020**
EED **KETO-6-MMM** Investments in heating plants	**1,333**	**632**	**1,965**

MEASURE	MEASURE CODE
Energy efficiency regulations for renovations and start-up assistance for renovation work	KETO-7-YM

MEASURE PERIODS	PERIOD 1	2014−2016, 3 a	PERIOD 2	2017−2020, 4 a

POLICY MEASURE LINK

The Decree on using repairs and alterations to improve the energy efficiency of buildings was issued on the basis of the Finnish Land Use and Building Act. This plays a key role in improving the energy efficiency and indoor air quality of properties during repairs subject to a permit, as well as in the implementation of Finland's climate and energy strategy.

The energy performance of new buildings has been regulated by Government Decrees since 1975. According to the Finland's current Land Use and Building Act (2000), and the preceding Building Act, regulations were applied to repairing and renovating properties in so far as the nature and scope of the project and any changes to the intended use of a building or part of a building so required.

Renovation start-up subsidies in the state supplementary budget for 2013–2014 promoted systematic property management by means such as requiring statutory use and maintenance guidelines for buildings during renovation measures subject to planning permission, and promoting the consideration of energy efficiency and indoor air conditions. The Government has supported renovation projects as efficient sources of employment, by subsidising the renovation of the building stock.

This measure belongs to categories (b) and (d) of paragraph 9, Article 7.

CONTRACTORS, PARTICIPANTS AND IMPLEMENTING PUBLIC AUTHORITIES

Contractors:

- Local government building supervision authorities: Check the regulatory compliance of plans when reviewing permit applications, and the implementation's conformity with the permit during inspections and handover.
- ARA Housing Finance and Development Centre of Finland Carried out means testing and decided on the granting of subsidies on the basis of applications for renovation subsidies.

Participants:

- Municipalities: Play a key role directly or indirectly, i.e. as owners of non-profit rental property companies, in ensuring that renovations are also begun in housing companies owned by local government.
- Other property owners: Play a key role as owners of buildings in initiating renovations.

Implementing public authority:

- Ministry of the Environment (YM): Drafting and issuing of regulations based on the Land Use and Building Act. In 2013-2014, prepared a proposal for a renovation subsidy for the supplementary budget. According to the Government's supplementary budget proposal, start-up subsidies for renovations could be granted from the funds of the Housing Fund of Finland.

DESCRIPTION OF THE MEASURE

The energy consumption of buildings is regulated by the National Building Code of Finland, in accordance with the Finnish Land Use and Building Act. The regulations lay down minimum requirements.

The energy performance of new buildings has been regulated by Government Decree since 1975. Since Finland's building stock is relatively young, its energy performance is already at a high level. In accordance with the Finnish Land Use and Building Act, regulations on repairs and renovations have been applied in so far as the nature and scope of the project and any changes to the intended use of a building or part of a building have so required.

Specific energy performance requirements for renovations entered into force in June 2013. They apply to renovations that require planning permission, such as changes to the intended use of a building, and must be observed whenever technically, functionally and economically feasible.

The renovation regulations target construction firms, engineers, independent builders and developers, including housing associations.

To boost renovation construction projects, a decision on renovation start-up subsidies was made for 2013–2014. Start-up subsidies are no longer granted. Renovations included modification, renovation, extension and other corresponding measures in apartments or buildings. Subsidies were granted for various measures, including piping renovation, replacing windows and external doors, ventilation systems, heating systems and foundations, and renovations of lifts, ceilings, roofs and balconies. The appropriation totalled EUR 115 million: 15 million for 2013 and up to 100 million for 2014. Start-up subsidies amounted to 10% of eligible costs.

The start-up subsidies for renovations targeted housing associations, right-of-occupancy companies and non-profit rental property companies, i.e. the organisation that owned a housing property.

ASSESSMENT OF IMPACTS ON ENERGY CONSUMPTION

Premises and assumptions

The premise is that all parts of the buildings are built in accordance with whatever regulations are in force at the time. The assumption is that buildings are renovated to a standard of approximately 1.5 times the original at the end of the useful life of building components. The saving effect attributable to the specific heating energy consumption of buildings has been calculated using heating degree days, while taking account of the volume and location of renovation projects. Energy savings achieved by exceeding the standard laid down in regulations are not attributed to building regulations. Thanks to the high standard of building supervision in Finland, there are no renovated buildings that do not meet the requirements laid down in the regulations.

The annual saving effect is expected to remain constant. It is believed that the ageing of structures in renovated buildings does not considerably weaken energy efficiency. In Finland, most properties are managed and maintained by professionals. Other assumptions are also based on the same data as that used for new buildings.

The saving effect attributable to regulations extends across the remaining life of a building. Building stock built after the year 2003 is designed to have a useful life of at least 50 years and ventilation systems with integrated heat exchangers to have a useful life of between 20 and 25 years, which is typical for these kinds of systems in Finland.

The saving effect attributable to the specific heating energy consumption of buildings has been calculated using heating degree days, while taking account of the volume and location of building stock.

The start-up grant has increased and advanced renovations, while the new regulations ensure that energy efficiency targets are achieved.

Baseline data

The volume of building stock by type and age of building is based on the construction statistics of Statistics Finland. The future quantitative development of renovation has been estimated on the basis of statistics and supplementary, in-depth analyses.

The activating effect of the start-up subsidy for renovation has been estimated on the basis of statistics and supplementary, in-depth analyses.

Method of calculation

The method applied to the energy savings effects of energy efficiency regulations for renovations and the start-up assistance intended to advance renovation work is the method c) “scaled savings”, presented in paragraph 1, Annex V of the Energy Efficiency Directive.

The savings effect described herein is calculated using Finland’s own national BU calculation system, whose basic principle was used in previous NEEAP calculations. The system was developed by Tampere University of Technology (TUT), with funding from the Finnish Ministry of the Environment. The model allows the specific energy consumption of each building component to be determined, while taking account of the type and age of the building and any changes in the heating method. Total energy consumption is calculated on the basis of specific consumption data and the volume of new development and renovation activity, as well as the loss of old buildings. Population and changes in population density have been factored into the projected changes in the size of the building stock. The volume of renovation has been estimated while taking account of the type and age of buildings and the popularity of different solutions at different times.

A decree on improving the energy performance of buildings during renovations and alterations was issued on 27 February 2013. The decree entered into force in full on 1 September 2013. The calculations assume a reduction in the energy consumption of existing buildings by six percent across the building stock by 2020.

Statistical data from 2015 was used for the purposes of the evaluation.

The total cumulative energy saving effect shown in the table below has been calculated by combining the annual cumulative saving effects for the periods shown in the table. The “straightforward” method was used for the calculation.

In the calculation of cumulative savings, the coefficient for measures implemented in 2014 is 6.5, and for 2020 it is 0.5.

Overlap

None.

Parties responsible for impact assessment

Finnish Ministry of the Environment, Tampere University of Technology/Department of Civil Engineering

FOLLOW-UP OF RESULTS AND CORRECTIVE MEASURES

Building stock energy consumption trends are monitored e.g. through Statistics Finland’s annual statistical releases (construction, energy) as part of a broader entity and through analyses and reports prepared by the industry of its operations. The responsible ministry (Ministry of the Environment) may impose amending measures, promotional measures and/or regulations, within the scope of its authority.

The granting authority monitors use and allocation and defines the preconditions for granting aid, whenever

similar subsidy measures are decided.#

CUMULATIVE ENERGY SAVINGS UNDER ARTICLE 7, GWh_{cum} (END-USE)			2014–2016	2017–2020	2014–2020
EED	KETO-7-YM -A	Energy efficiency regulations for renovations	3,411	1,987	5,397
EED	KETO-7-YM - B	Start-up assistance for renovation work	259	0	259
EED	**KETO-7-YM**	Energy efficiency regulations for renovations and start-up assistance for renovation work	**3,670**	**1,987**	**5,656**

MEASURE	MEASURE CODE
Energy efficiency regulations for new development	KETO-8-YM

MEASURE PERIODS	PERIOD 1	2014–2016, 3 a	PERIOD 2	2017–2020, 4 a

POLICY MEASURE LINK

Energy efficiency regulations for new development have played a key role in realising the national objective of improving the energy performance and indoor air quality of buildings since 1975, and in the implementation of national climate and energy strategies since 2001.

The measure falls into category (d) of paragraph 9, Article 7.

CONTRACTORS, PARTICIPANTS AND IMPLEMENTING PUBLIC AUTHORITIES

Contractors:

- Local government building supervision authorities check the regulatory compliance of plans when reviewing applications, and that implementation is in compliance with the permit during inspections and handover.

Participants:

- Not relevant

Implementing public authority:

- The Finnish Ministry of the Environment issues decrees on the basis of the Finnish Land Use and Building Act.

DESCRIPTION OF THE MEASURE

The energy consumption of new buildings is regulated by the National Building Code of Finland in accordance with the Finnish Land Use and Building Act. The energy performance of buildings has been regulated by Government Decrees since 1975. Regulations concerning energy efficiency were revised in 1978, 1985, 2003, 2008, 2010 and 2012. The 2008 reform was structural and therefore had little impact on energy efficiency. The 2012 reform introduced stricter requirements and a new overall structure based on a more comprehensive approach to energy, which now also covers energy generation.

The regulations for new development target construction firms, engineers, independent builders and developers.

ASSESSMENT OF IMPACTS ON ENERGY CONSUMPTION

Premises and assumptions

The basic premise is that all buildings are built in accordance with whatever regulations are in force at the time.

Energy savings achieved by exceeding the standard laid down by regulations are not attributed to building regulations. Thanks to the high standard of building supervision in Finland, no new buildings fail to meet the requirements laid down in the regulations.

The annual saving effect is expected to remain constant. It is believed that the ageing of structures will not considerably weaken energy efficiency, because structures such as windows and ventilation heat exchangers are upgraded as necessary. In Finland, most properties are managed and maintained by professionals.

The saving effect attributable to new, stricter thermal insulation requirements extends across the entire lifecycle of a building. Building stock built after the year 2003 is designed to have a useful life of at least 50 years and ventilation systems with integrated heat exchangers a useful life of between 20 and 25 years, which is typical for these kinds of systems in Finland. Products that represent at least as high a level of energy efficiency are almost always chosen when replacing and repairing systems and structures.

The saving effect attributable to the specific heating energy consumption of buildings has been calculated using heating degree days, while taking account of the volume and location of building stock. Buildings used for agricultural production have been excluded from the evaluation based on the assumption that most are unheated.

Baseline data

The volume of building stock by type and age of building is based on the construction statistics of Statistics Finland. The average level of new development over a ten-year period has been used as the volume of new development in future projections.

Method of calculation

For the purposes of calculating the energy savings effect generated by energy performance regulations for new development, the method used is method c) “scaled savings”, presented in paragraph 1, Annex V of the Energy Efficiency Directive.

The savings effect described here is calculated using Finland’s own national BU calculation system, whose basic principle was used in previous NEEAP calculations. The system was developed by Tampere University of

Technology (TUT), with funding from the Finnish Ministry of the Environment. The model allows the specific energy consumption of each building component to be determined and account to be taken of the type and age of the building and any changes in the heating method. Total energy consumption is calculated on the basis of specific consumption data and the volume of new development and renovation activity, as well as the loss of old buildings. A programmed version of the model was prepared to enhance usability and diversity.

The impact of the regulations that entered into force in July 2012 will only show in new development in 2013. The assumption used in the calculations is that, as a result of the new regulations, the heating energy consumption of residential and service sector buildings will fall, with respect to various heating methods, as follows: 20% for those using fossil fuels as the primary heating method and 35% for electric heating. The regulations only apply to new development and the key change is the introduction of a more comprehensive approach.

This means that future analyses will cover all energy consumption attributable to a building. In addition to heating, calculations will factor in all use of electricity and hot water, which were not previously included when assessing the regulatory compliance of new buildings.

The structure of the 2012 regulations on new development has been changed so as to base calculations on primary energy and the savings attributable to each building. The structural reform of the regulations will affect consumers' choices of heating systems, which have a considerable impact on energy consumption.

In the calculation of cumulative savings, the coefficient for measures implemented in 2014 is 6.5, and for 2020 it is 0.5. Early measures are those taken in 2009–2013 and the saving effect will still be effective in 2020. In the calculation of savings, the coefficient for measures implemented in 2009 is 11.5, and for 2013 it is 7.5.

The total cumulative energy saving effect shown in the table below has been calculated by combining the annual cumulative saving effects for the periods shown in the table. The "straightforward" method has been used in the calculation.

Overlap

Account has been taken of the overlap relating to heat pumps in detached houses (-0.5 TWh_{cum}).

Parties responsible for impact assessment

Finnish Ministry of the Environment, Finnish Environment Institute (SYKE), Tampere University of Technology, Faculty of Business and Built Environment, Department of Civil Engineering

FOLLOW-UP OF RESULTS AND CORRECTIVE MEASURES

Building stock energy consumption trends are monitored e.g. as part of a broader entity through Statistics Finland's annual statistical releases (construction, energy), and through analyses and reports prepared by the industry of its own operations. The responsible ministry (Ministry of the Environment) may impose amending measures, promotional measures and/or regulations, within the scope of its authority.

CUMULATIVE ENERGY SAVINGS UNDER ARTICLE 7, GWh_{cum} (END-USE)			2014–2016	2017–2020	2014–2020
EED	KETO-8-YM	Energy efficiency regulations for new development	**6,542**	**3,622**	**10,164**

ANNEX 2 DESCRIPTION OF MEASURES PURSUANT TO THE ENERGY SERVICES DIRECTIVE (ESD)

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TABLE OF CONTENTS

Agriculture (MA)

Horizontal measures (HO)

Energy sector (EP and ET)

MEASURE		MEASURE CODE
Energy efficiency regulations for new development in 2003, 2008, 2010 and 2012		RA–01–YM

IMPLEMENTATION PERIOD	Start	(2003) 1/2008	End
Continuing			

MEASURE TARGET	Construction firms, kit house designers and component manufacturers, engineers, independent builders and developers

MEASURE CONCERNS	Heating	2003–	Electricity	2012–	Fuel	2003–	Water

FINANCING AND BUDGET

PARTIES RESPONSIBLE FOR IMPLEMENTATION

The Finnish Ministry of the Environment issues decrees on the basis of the Finnish Land Use and Building Act. Local government building supervision authorities check the regulatory compliance of plans when reviewing applications, and the appropriateness of implementation during inspections and handover.

DESCRIPTION OF THE MEASURE

The energy consumption of new buildings is regulated by the National Building Code of Finland in accordance with the Finnish Land Use and Building Act. The energy performance of buildings has been regulated by Government Decree since 1975. Regulations concerning energy efficiency were revised in 1978, 1985, 2003, 2008, 2010 and 2012. The 2008 reform was structural and therefore had little impact on energy efficiency. The 2012 reform introduced stricter requirements and a new overall structure based on a more comprehensive approach to energy, which now also covers energy generation.

Due to the extent of the changes, the saving effects of the 2012 reform are examined separately.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations. The system was developed by Tampere University of Technology (TUT), with funding from the Finnish Ministry of the Environment. The model allows the specific energy consumption of each building component to be determined and account to be taken of the type and age of the building and any changes in the heating method. Total energy consumption is calculated on the basis of specific consumption data and the level of new development. A programmed version of the model has been prepared to enhance usability and diversity.

Premises and assumptions

The basic premise is that all buildings are built in accordance with whatever regulations are in force at the time.

Energy savings achieved by exceeding the standard laid down in regulations are not attributed to building regulations. Thanks to the high standard of building supervision in Finland, no new buildings exist that fail to meet the requirements laid down in the regulations.

The annual saving effect is expected to remain constant. It is not believed that the ageing of structures will considerably weaken energy efficiency, since structures such as windows and ventilation heat exchangers are upgraded as necessary. In Finland, most properties are managed and maintained by professionals.

The saving effect attributable to new, stricter thermal insulation requirements extends across the entire lifecycle of a building. Building stock built after the year 2003 is expected to have a useful life of at least 50 years and ventilation systems with integrated heat exchangers a useful life of between 20 and 25 years, which is typical of these kinds of systems in Finland. Products that represent at least as high a level of energy efficiency are almost always chosen when replacing and repairing systems and structures.

The saving effect attributable to the specific heating energy consumption of buildings has been calculated using heating degree days, while taking account of the volume and location of building stock. Buildings used for agricultural production have been excluded from the evaluation based on the assumption that most of them are unheated.

Baseline data

The volume of building stock by type and age of building is based on the construction statistics of Statistics Finland. The average level of new development over a ten-year period has been used as the volume of new development in future projections.

Overlap

Account has been taken of the overlap relating to heat pumps in detached houses.

Impact assessment

The energy saving estimates for 2010 are based on ex-post statistical data on the quantitative development of the volume of buildings, and the energy saving estimates for 2016 and 2020 are based on ex-ante forecasts.
The impact of the regulations that entered into force in July 2012 will only show in new development in 2013. In the calculations it is assumed that, as a result of the new regulations, the heating energy consumption of residential and service sector buildings will fall, with respect to various heating methods, as follows: 20% for those using fossil fuels as the primary heating method and 35% for electric heating. The regulations apply only to new development and the key change consists in the introduction of a more comprehensive approach.

This means that future analyses will cover all energy consumption attributable to a building. In addition to heating, calculations will factor in all use of electricity and hot water, which was not previously included when assessing the regulatory compliance of new buildings.

The structure of the 2012 regulations on new development has been changed, so as to base the calculations on primary energy and the savings attributable to each building. This structural reform of the regulations will affect consumers' choices of heating systems, which have a considerable impact on energy consumption.

Parties responsible for impact assessment

Finnish Ministry of the Environment, Finnish Environment Institute (SYKE), Tampere University of Technology, Faculty of Business and Built Environment, Department of Civil Engineering

ENERGY SAVING GWh/a			2010	2016	2020
ESD		Energy efficiency regulations for new development in 2003, 2007 and 2010	1,817	4,011	5,607
ESD		Energy efficiency regulations for new development in 2012		184	400
ESD total	RA–01–YM	Energy efficiency regulations for new development in 2003, 2007, 2010 and 2012	**1,817**	**4,195**	**6,006**

MEASURE		MEASURE CODE
Energy efficiency regulations for renovations		RA–02–YM

IMPLEMENTATION PERIOD	Start	2013	End	Continuing

MEASURE TARGET	Construction firms, component manufacturers, engineers, independent builders and developers, including housing companies

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water

FINANCING AND BUDGET

PARTIES RESPONSIBLE FOR IMPLEMENTATION

The Finnish Ministry of the Environment issues decrees on the basis of the Finnish Land Use and Building Act. Local government building supervision authorities check the regulatory compliance of plans when reviewing applications, and ensure that implementation complies with permits during inspections and handover.

DESCRIPTION OF THE MEASURE

The energy consumption of buildings is regulated by the National Building Code of Finland, in accordance with the Finnish Land Use and Building Act. The regulations lay down minimum requirements.

The energy performance of new buildings has been regulated by Government Decrees since 1975. Since Finland's building stock is relatively young, its energy performance is already at a high level. According to the Finnish Land Use and Building Act, regulations concerning new development must be factored in when renovating properties, in so far as the nature and scope of the project and any changes to the intended use of a building or part of a building so require.

Separate requirements for improving energy efficiency in connection with renovations and alterations (Decree No 4/13 of the Finnish Ministry of the Environment on improving the energy performance of buildings in connection with renovations and alterations) were issued on 27 February 2013 and entered into force in stages in June and September 2013. They apply to renovations that require planning permission, such as changes to the intended use of a building or part of a building, and for which planning permission has been sought after the entry into force of the requirements and must be observed whenever technically, functionally and economically feasible.

ASSESSMENT OF ENERGY SAVING IMPACT

Calculation method

Finland has its own national Bottom Up calculation system, which was also used in the NEEAP-1 and NEEAP-2. The system was developed by Tampere University of Technology (TUT), with funding from the Finnish Ministry of the Environment. The model allows the specific energy consumption of each building component to be determined, and account to be taken of the type and age of the building and any changes in its heating method. Total energy consumption is calculated on the basis of specific consumption data and the volume of renovation activity, as well as the loss of old buildings. The population and changes in population density have been factored into projected changes in the size of the building stock. The volume of renovation has been estimated while taking account of the type and age of buildings and the popularity of different solutions at different times.

Premises and assumptions

The basic premise is that all buildings are built in accordance with whatever regulations are in force at the time. The assumption is that buildings are renovated to a standard of approximately 1.5 times the original at the end of their useful life. The saving effect attributable to the specific heating energy consumption of buildings has been calculated using heating degree days, while accounting for the volume and location of renovation projects. Energy savings achieved by exceeding the standard laid down in regulations are not attributed to building regulations. Thanks to the high standard of building supervision in Finland, no renovated buildings fail to meet the regulatory requirements.

The annual saving effect is expected to remain constant. It is not believed that the ageing of structures in renovated buildings will considerably weaken energy efficiency. In Finland, most properties are managed and maintained by professionals. Other assumptions are based on the same data as that used for new buildings.

The saving effect attributable to regulations extends across the remaining lifecycle of a building. Building stock built after the year 2003 is designed to have a useful life of at least 50 years and ventilation systems with integrated heat exchangers a useful life of between 20 and 25 years, which is typical of these kinds of systems in Finland.

The saving effect attributable to the specific heating energy consumption of buildings has been calculated using heating degree days, while taking account of the volume and location of building stock.

Baseline data

The volume of building stock by type and age of building is based on the construction statistics of Statistics Finland. The future quantitative development of renovation has been estimated on the basis of statistics and

supplementary, in-depth analyses.

Overlap

Account has been taken of the overlap relating to heat pumps in detached houses.

Impact assessment

A decree on improving the energy performance of buildings during renovations and alterations was issued on 27 February 2013. The decree entered into force in full on 1 September 2013 and applies to all building permissions sought after that date. In the calculations, it has been assumed that the energy consumption of existing buildings will fall by six percent across the building stock by 2020.

Statistical data from 2015 was used for the purposes of the evaluation.

Parties responsible for impact assessment

Finnish Ministry of the Environment, Finnish Environment Institute (SYKE), Tampere University of Technology, Faculty of Business and Built Environment, Department of Civil Engineering

ENERGY SAVING GWh/a			2010	2016	2020
ESD	RA–02–YM	Energy efficiency regulations for renovations	**0**	**622**	**1,514**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy subsidies for residential buildings	2	RA–03–YM

IMPLEMENTATION PERIOD	Start	2003	End	2014

MEASURE TARGET	Owners of residential properties, i.e. housing associations, right-of-occupancy companies and non-profit rental property companies, as well as some private householders

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	

FINANCING AND BUDGET

Before 2006, energy subsidies for residential buildings were granted by the Housing Fund of Finland.
A total of EUR 64 million in such subsidies was granted between 2003 and 2006.

Between 2006 and 2011, the subsidies were paid out of the appropriations of the Finnish Ministry of the Environment. A total of EUR 29 million in conjunctural energy subsidies was granted in 2010. The subsidies covered 15% of renovation costs. Non-conjunctural subsidies amounted to a total of EUR 32 million between 2006 and 2010.

A total of EUR 30 million in subsidies was granted, in accordance with the state budget in 2011, towards the adoption of heating systems based on renewable forms of energy in residential properties. Other energy subsidies for residential properties amounted to EUR 14 million, of which EUR 2 million consisted of means-tested energy subsidies for detached houses.

In 2012, energy subsidies for residential properties amounted to EUR 10 million, of which means-tested subsidies accounted for EUR 1 million.

The ceiling for energy subsidies towards changing the method of heating in residential units has been set at 20% of costs, which mainly covers the costs of systems and materials. Beneficiaries implementing the action plan for residential lettings associations, under the energy efficiency agreement for the property sector, are eligible for a higher level of subsidy. The ceiling for means-tested energy subsidies for detached houses is 25 % of costs, excluding labour.

The plan is to use EUR 13 million of the appropriations included in the 2013 state budget towards energy subsidies, of which EUR 2 million has been earmarked for means-tested energy subsidies for detached houses. Due to the weaker economic situation, no energy subsidies have been granted since 2014. In 2014, EUR 2 million of state budget appropriations has been earmarked for means-tested energy subsidies for detached houses.

In the 2013–2014 supplementary budget and state budget, a total of EUR 115 million has been earmarked for start-up assistance for renovation work (EUR 15 million in 2013 and EUR 100 million in 2014). Start-up subsidies amounted to 10% of eligible costs. Such subsidies can also be granted towards measures aimed at improving energy efficiency. Start-up subsidies were granted by the Housing Fund of Finland. Start-up subsidies are no longer granted.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

The Finnish Ministry of the Environment draws up proposals for the state budget. The Housing Finance and Development Centre of Finland (ARA) carries out means testing and decides on the granting of subsidies on the basis of applications.

DESCRIPTION OF THE MEASURE

Each year, subsidies have been granted towards different kinds of energy renovations in residential properties.

With regard to early actions, the optimisation of radiator systems in apartment blocks has been promoted since the 1990s. Thanks to its success (which has been proven by monitoring) in bringing about energy savings (5-15 %), the measure was included in the scope of energy subsidies in the 2000s.

In practice, between 2003 and 2006 energy subsidies for residential properties were only granted for projects in apartment blocks and terraced houses.

Between 2006 and 2008, subsidies were granted towards the costs of installing more environmentally friendly heating systems in detached houses.

In 2010, conjunctural energy subsidies were mainly granted towards energy renovations in apartment blocks and terraced houses as of the beginning of April. Subsidies were available both for renovations aimed at cutting energy consumption and changes to heating systems, such as the adoption of renewable forms of energy.

Since 2009, means-tested energy subsidies for detached houses have been granted to low-income private householders, for measures aimed at improving the energy efficiency of homes and lowering emissions attributable to energy consumption, as well as for the adoption of renewable forms of energy.

In 2011 and 2012, energy subsidies were used to promote the adoption of heating systems based on renewable forms of energy. Subsidies were granted to owners of full-time residential properties, most of whom were private

householders. Subsidies were available for projects where oil-based or electrical heating systems which had been used as the primary source of heating in a property were replaced by heating systems mainly based on renewable forms of energy. Subsidies were also granted towards the adoption of additional heating systems based on solar heating and solar electricity.

In particular, other types of energy subsidies were granted towards energy audits of residential properties, external renovations and improvements in the energy performance of buildings, the introduction of heat exchangers to ventilation systems in existing buildings, and projects aimed at connecting residential properties to district or regional heating networks. In practice, such subsidies were only granted for renovations in apartment blocks and terraced houses.

The aforementioned kinds of energy subsidies were also available in 2013, with the exception of subsidies for the adoption of heating systems based on renewable forms of energy. In 2014, energy subsidies were only available on the basis of means testing, for energy renovations in detached houses.

Measures for which start-up assistance for renovation work was granted included the replacement of windows and external doors, ventilation systems, heating systems and ceilings and roofs.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system. The system is based on actual savings attributable to individual measures, on the basis of sample-based surveys. The energy saving effects of start-up assistance for renovation work have also been assessed using the method described in the measure RA-02-YM (Energy efficiency regulations for renovations).

Premises and assumptions

The energy savings attributable to each measure due to subsidies have been calculated on the basis of a sample-based survey. The sample of apartment blocks and terraced houses for which energy subsidies were granted included 700 properties in 2007 and 200 properties in 2009. The sample of detached houses for which energy subsidies were granted included 2,200 properties in 2007, which represented 70% of all properties for which subsidies were granted. The survey was conducted by the Housing Finance and Development Centre of Finland (ARA) and its primary aim was to collect information on changes to heating systems, the forms of renewable energy adopted and the forms of energy previously used. The energy savings achieved were expanded across the entire country on the basis of subsidy statistics compiled by the Housing Finance and Development Centre of Finland.

The percentage by which start-up assistance available for renovation work in 2013 and 2014 would increase the number of and expedite renovations was based on both statistical data and supplementary in-depth analyses. The regulations that entered into force ensured that energy efficiency targets were achieved.

Baseline data

The Housing Finance and Development Centre of Finland is responsible for compiling statistics on all subsidies and funding granted. Such statistics are based on data submitted by local governments. Local governments collected the information by distributing follow-up questionnaires, which beneficiaries had to fill in one year after completing their energy saving measure. The Finnish Ministry of the Environment has also commissioned sample-based studies from Tampere University of Technology, based on data compiled by the Housing Finance and Development Centre of Finland.

Energy saving measures for which subsidies were available in different years varied, as explained under “Description”. The types and numbers of buildings for which subsidies were granted each year also varied. The Housing Finance and Development Centre of Finland has compiled the following information concerning subsidies:

- Number of buildings and residential units for which energy subsidies have been granted
- Types of energy saving measures carried out and their timing
- Annual heating, electricity and water consumption data before and after renovation
- Details of properties where energy audits have been carried out and information on the scope of the audits
- Total amount of subsidies granted for each energy saving measure

The consumption data is relatively comprehensive. Almost all apartment blocks in Finland are connected to a district heating network and equipped with energy consumption meters. Electricity consumption is also metered both across each property and per residential unit. Most apartment blocks are managed by professional property managers, who are responsible for monitoring and reporting on the property’s energy consumption. Energy companies also provide customer-specific energy consumption data. Such data does not take account of factors such as the number of residents and the use of household appliances and systems.

Overlap

Any existing overlap was taken into consideration and eliminated. (See RA–03–TEM).

Impact assessment

The energy saving effects reported for the year 2010 are based on ex-post statistical data on the quantitative development of the volume of buildings, whereas the energy saving estimates for 2016 and 2020 are based on ex-ante forecasts.

Parties responsible for impact assessment

Finnish Ministry of the Environment, Finnish Environment Institute (SYKE), Tampere University of Technology, Faculty of Business and Built Environment, Department of Civil Engineering

ENERGY SAVING GWh/a			2010	2016	2020
ESD		Energy subsidies and conjunctural subsidies for apartment blocks and terraced houses	238	502	502
ESD		Energy subsidies and conjunctural subsidies for detached houses	44	624	622
ESD		Start-up assistance for renovation work	0	46	46
ESD TOTAL	RA–03–YM	Energy subsidies for residential buildings	**284**	**1,172**	**1,170**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Heat pumps for detached and terraced houses	2	RA–04–TEM

IMPLEMENTATION PERIOD	Start	2000	End	Continuing

MEASURE TARGET Detached houses and terraced houses

MEASURE CONCERNS	Heat	Electricity	Fuel	Water
	Yes	Yes	Yes	

FINANCING AND BUDGET

Since 2001, householders have been able to obtain tax credit for installing a heating pump in their homes. Depending on the type of heat pump, the tax credit is worth between EUR 200 and EUR 3,500 in 2016.
Investment subsidies were granted towards heat pump installations between 2006 and 2011.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Ministry of Finance and the tax administration.

DESCRIPTION OF THE MEASURE

Heat pumps are installed in existing buildings to cut energy consumption and in new buildings to provide an energy-efficient primary heating system. Heat pump sales began to grow substantially in 2000, when the Finnish Heat Pump Association and Motiva began promoting them, and when tax credits were introduced with respect to heat pump installation costs in 2001.

Approximately 60,000 heat pumps were sold in Finland in 2012, compared to less than 1,000 in 1999. By the end of 2016, approximately 800,000 heat pumps had been installed in detached and terraced houses. Sales figures are expected to remain high throughout the 2017–2020 period. Heat pump installations in detached and terraced houses are an important means of reaching both the 38% renewable energy target by 2020 and the energy efficiency target.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

In the calculation of the energy saving effect, the annual energy saving for 2010 is the same as that presented in previous reports. The calculation is based on annual sales figures of heat pumps and savings by unit. The annual energy saving effects for the period 2011– 2020 were based on the Commission Decision establishing the guidelines for Member States on calculating renewable energy from heat pumps (2013/114/EU). Measured in units of energy, the amount of renewable energy generated by heat pumps and savings in delivered energy achieved with heat pumps are the same in practice.

Premises and assumptions

The following lifetimes have been used for calculating the saving effects of different heat pump technologies:

- GSHP 20 years
- ASHP 10 years
- AWHP 15 vuotta
- EAHP 15 years

The numbers of heat pumps for 2002–2016 are actual sales figures. As of the year 2017, the figures are estimates of future development. In practice, the 10-year standard lifetime of heat pumps has proven too short compared to their actual service life. The number of replacement investments in 2016 was very low and is not forecast to become considerable by 2020.

It is estimated that the average power output (kW) of heat pumps will grow between 2014 and 2020 as follows:

Type/year	2010	2016	2020
GSHP	11.9	13.4	14.5
ASHP	4.8	5.4	5.9
AWHP	11.6	13.0	13.9
EAHP	3.4	3.8	4.1

Baseline data

The saving effects reported for the year 2010 have been calculated on the basis of the following average levels of energy savings determined during the course of a project coordinated by VTT Technical Research Centre of Finland in 2011:

- GHSP 19.8 MWh/a
- AHSP 4.8 MWh/a
- AWHP 11.6 MWh/a
- EAHP 5.8 MWh/a

The method used for calculating energy savings for the years 2016 and 2020 is the same as that described in the annex to the notification submitted to the Commission on 5 December 2013 concerning the implementation of Article 7, except that the reported energy savings have been calculated on the basis of actual saving effects. The method laid down in Article 7 of the Energy Efficiency Directive only allows energy savings to be calculated in so far as the energy efficiency of heat pumps exceeds the minimum requirements laid down in the Ecodesign Directive.

The following numbers (qty) of heat pumps have been used as the basis for calculating the saving effect of heat pumps.

Year/type	GSHP	ASHP	AWHP	EAHP	Total
2010	47,390	319,500	6,326	18,033	391,249
2016	128,542	611,248	17,468	32,287	789,545
2020	171,500	771,200	29,000	40,300	1,012,000

Overlap

Savings generated by heat pumps are included in the effects of energy subsidies granted for detached houses between 2006 and 2012. The overlap, which amounts to approximately 100 GWh in 2010 and to 500 GWh in 2016 and 2020, has been factored into this impact assessment.

The effects of heat pumps also overlap with those attributable to the building regulations, issued in 2012, concerning new development. Some of the heat pumps reported in the sales figures are installed in new buildings, in which case their impact in lowering the amount of delivered energy can be factored in when determining the maximum amount of total energy needed. As this effect has not been itemised in the 2012 building regulations, 160 GWh has been deducted from the energy saving attributable to heat pumps in detached houses for the year 2016 and 320 GWh for the year 2020. The deduction has been factored in on the basis of the saving effect attributable to 2,000 heat pump installations each year as of 2013.

These deductions are probably excessive. However, it was not considered necessary to check them because the 9% saving target pursuant to the Energy Services Directive will end in 2016.

Impact assessment

The table below shows the energy saving effects (GWh) attributable to different types of heat pumps and the aforementioned deductions.

Type/year	2010	2016	2020
GSHP	856	2,466	3,537
ASHP	1,403	3,316	4,351
AWHP	68	219	379
EAHP	99	115	127
Total	**2,426**	**6,116**	**8,394**
Deductions	-100	-660	-820
Total	**2,326**	**5,456**	**7,574**

Parties responsible for impact assessment

The Energy Authority, the Finnish Heat Pump Association (SULPU) and VTT Technical Research Centre of Finland

ENERGY SAVING GWh/a			2010	2016	2020
ESD	RA–04–TEM	Heat pumps for detached and terraced houses	**2,326**	**5,456**	**7,574**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Mandatory installations of unit-specific water meters	1	RA–05–YM

IMPLEMENTATION PERIOD	Start	2011	End	Continuing

MEASURE TARGET	Heating, plumbing and ventilation engineers, contractors and installers, private builders, developers, including housing associations and other property owners

MEASURE CONCERNS	Heat	Yes	Electricity	Fuel	Water	Yes

FINANCING AND BUDGET

PARTIES RESPONSIBLE FOR IMPLEMENTATION

The Finnish Ministry of the Environment issues decrees on the basis of the Finnish Land Use and Building Act. Local government building supervision authorities check the regulatory compliance of plans when reviewing applications and ensure that implementation is in compliance with the permit during inspections and handover.

DESCRIPTION OF THE MEASURE

The energy consumption of new buildings is regulated by the National Building Code of Finland in accordance with the Finnish Land Use and Building Act. The national decree on plumbing and sewerage systems on properties has been revised to stipulate that, in addition to a main water meter, new properties with multiple units must be equipped with unit-specific meters for measuring the volume of cold and hot water supplied to each unit. In addition to residential units, meters must also be installed in office and commercial properties. It must be easy to monitor water consumption and possible to use meter readings as the basis for billing.

The decree was issued on the basis of the Finnish Land Use and Building Act and has been applied to all replumbing works carried out in connection with renovations and alterations, where planning permission is required, since 2011. An obligation to apply the decree was also incorporated into a decree issued by the Finnish Ministry of the Environment, on 27 February 2013, on improving the energy performance of buildings during renovations and alterations (Section 5, paragraph 6).

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.
The system was developed by Tampere University of Technology (TUT), with funding from the Finnish Ministry of the Environment. Using this model, energy consumption attributable to water is calculated on the basis of specific consumption data and the volume of new development and renovation activity, as well as the loss of old buildings.

Premises and assumptions

The basic premise is that all buildings are built in accordance with whatever regulations are in force at the time.
Unit-specific water meters have been installed in all new apartment blocks and terraced houses since the beginning of 2011. Unit-specific water meters were previously uncommon in apartment blocks. Half of all terraced houses had unit-specific water meters before the regulatory reform of 2011.
In detached houses, water metering is based on mains water meters installed by water companies.

Approximately two percent of all apartment blocks and terraced houses per year have been fitted with unit-specific water meters during voluntary renovation projects.

Water metering and consumption monitoring systems were already common in office and commercial properties before the regulatory reform of 2011.

Other assumptions used in the calculations are as follows:

- In new buildings, unit-specific water metering and consumption monitoring lower building-specific water consumption by approximately 10%. Greater savings (approximately 20%) can be achieved in renovations when meters are installed in residential units while modernising water supply systems. In addition to metering, new equipment, water-saving fixtures and other technical measures generate savings in renovation projects.
- The hot water supply accounts for 40% of total water consumption.
- The baseline assumption when calculating energy savings was that 30% of the energy consumption of hot water becomes heat load in premises and 70% of this heat load is utilised in heating (SRMK D5).

Baseline data

The 10% decrease in building-specific water consumption is based on the report by the Ministry of the Environment in 2009: 'The use of unit-specific water meters and their impacts on the energy consumption of buildings', prepared

during the drafting of the regulation. Working group memorandum. Helsinki.

The baseline data for the Bottom-up calculation concerning the volumes of repair activities and the numbers of water meters installed in renovations are based on the study by Heljo, J. & Vihola J. (2010): Energy saving potential in the residential properties of the City of Helsinki. Tampere, Tampere University of Technology.

Various experts and reports were also consulted to determine and check the level of savings associated with renovations.

Overlap

None

Impact assessment

The regulation entered into force as of the beginning of 2011. As discussed above, additional savings are expected from all new apartment blocks and half of all new terraced houses as of the year 2011. Additional savings are not expected from single-family houses and half of terraced houses, because a unit-specific water metering system was already in use in such buildings before the regulation's entry into force.

Statistics Finland's data on building stock constitutes the starting level for renovations. Energy saving calculations on renovations are based on actual water consumption figures for 2010.

Parties responsible for impact assessment

Finnish Ministry of the Environment, Finnish Environment Institute (SYKE), Tampere University of Technology, Faculty of Business and Built Environment, Department of Civil Engineering

ENERGY SAVING GWh/a			2010	2016	2020
ESD	RA–05–YM	Mandatory installations of unit-specific water meters	**0**	**74**	**128**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Höylä III energy efficiency agreement – oil-heated detached houses	4	RA–07–TEM/YM

IMPLEMENTATION PERIOD		
Start		1997/2008
End		Continuing

MEASURE TARGET	Oil-heated detached houses

MEASURE CONCERNS				
Heat	Yes	Electricity	No	Fuel Oil (light fuel oil)
Water	No			

FINANCING AND BUDGET

As of 2001, householders have benefited from a tax credit that also applies to upgrading oil-based heating systems. The maximum tax deduction in 2014 is 45% of labour costs, including value added tax, and EUR 2,400 per year per spouse. In addition, energy subsidies were granted towards supplementing oil-based heating systems with solar heating between 2006 and 2008.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, Finnish Ministry of the Environment, Energy Authority, Petroleum & Biofuels Association Finland (until December 2014, Finnish Petroleum Federation), Finnish Heating Energy Association, Oil Industry Service Centre, Association of Finnish Petrol Retailers and Transport Services, all major Finnish retailers of heating fuels, Motiva

DESCRIPTION OF THE MEASURE

The Höylä III and Höylä IV energy efficiency agreements follow on from the Höylä I (1997–2001) and II (2002–2007) energy saving programmes.

This description covers oil-heated detached houses and energy saving measures in such properties.

The objective of the Höylä III agreement is to achieve a saving of at least nine percent in the consumption of heating oil between 2005 and 2016. The agreement promotes the maintenance of oil-based heating systems (e.g. controls and burners), boiler replacements and other energy-efficient repairs. The agreement is also aimed at increasing the use of renewable forms of energy alongside oil-based heating and raising the percentage of bio-oil to 10% of all heating oil sold by 2016. The Höylä IV energy efficiency agreement 2017–2025 continues the aforementioned activities.

The Höylä III and IV agreements also promote regular inspections of heating boilers and the training and certification of inspectors pursuant to Article 8 of the Energy Efficiency Directive.

The quantitative target laid down in the Höylä agreements (1997–) involved the upgrading of 100,000 oil-based heating systems by the year 2010. This was exceeded in 2008 and more than 120,000 boilers had been replaced by the end of 2015. Upgrades to heating systems can generate a saving of 10–30% in property-specific heating fuel consumption.

Höylä – energy efficiency agreements – Customers

One of the integral obligations of the Höylä energy efficiency agreements concerns the provision of information and advice for customers acquiring heating fuels and those residing in oil-heated properties. With respect to the implementation of the agreement, the participants provide comprehensive training, advice and communications for the measure's target group.

The Oil Industry Service Centre submits annual reports, via a web-based monitoring system, on measures aimed at improving the energy efficiency of its customers. The monitored measures mainly target communications at trade fairs and events, and advice on enhancing energy efficiency in
a customer magazine targeted at all oil-heated properties. Quantitative information on the implementation of measures and their target groups is also reported.

In addition, the Höylä agreement promotes regular inspections of heating boilers and the training and certification of inspectors, pursuant to Article 8 of the Energy Efficiency Directive.
Target-specific advice is provided during boiler inspections.

ASSESSMENT OF ENERGY SAVING IMPACT

Höylä technical measures

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises

For the purposes of calculating saving effects, oil-heated detached houses were divided into five categories according to the decade in which they were built: 50s, 60s, 70s, 80s and 90s. Average specific energy consumption was determined for each age group, according to the construction methods used during the relevant decade (Senewa Oy/Pääjärvi, 2009). With the exception of solar heating systems, the saving effects of measures were calculated separately for each age group.

The Höylä agreement includes the following measures for improving the energy efficiency of oil-heated detached houses:

- Replacing oil-based boilers and/or oil burners and controls, pumps and pipework and insulating the pipes, tanks and valves of the heating distribution room. During such work, thermostatic radiator valves are usually installed in the heating distribution system.
- Incorporating a solar heating system in the oil-based heating system (to reduce demand for delivered energy)
- Adding heat insulation to the roof and/or walls
- Replacing the windows

The lifetime of savings attributable to boiler replacement and insulation measures carried out since 1997 extends until 2020. Boilers in Finland generally have a useful life of more than 30 years. The effect of new measures relating to insulating roofs and/or ceilings and replacing windows has only been calculated for the years 1997–2007, in order to avoid overlaps with other measures relating to individual building components. Measures to incorporate a solar heating system have been factored into the calculations as of the year 2003. The Commission's guidelines set the lifetime of these savings at 20 years, but a lifetime of 12 years was used in these calculations as for controls and burners. The impact assessment does not account for reductions in the saving effect, or other factors affecting the scale of the saving.

Baseline data and assumptions

The average heating energy consumptions of buildings of different ages are as follows (Senewa Oy, 2009):

- 50s (45.3 MWh/a), 60s (38.8 MWh/a), 70s (35.8 MWh/a),
  80s (29.1 MWh/a) and 90s (26.2 MWh/a)

The effect of replacing an oil-based boiler was verified by means of field testing during the course of the Tuula project coordinated by Suomen Lämmitystieto Oy in 2006. As a result, Senewa Oy revised the method for calculating saving effects in 2007.

The following baseline data was used to calculate the saving effects of the Höylä agreements:

- Overall effect of oil boiler, burner and other heating system component repairs on energy consumption:
  50s (28.0%), 60s (29.4%), 70s (29.7%), 80s (29.9%) and 90s (19.3%)
- Effect of adding roof insulation with a change in the U value corresponding to 200 mm of more insulation on average:
  50s (8.5%), 60s (5.3%), 70s (4.4%), 80s (4.7%) and 90s (3.5%)
- Effect of adding wall insulation with a change in the U value corresponding to 100 mm of more insulation on average:
  50s (8.5%), 60s (5.8%), 70s (4.%), 80s (3.1%) and 90s (3.5%)
- Effect of replacing windows: The U value used for new windows in buildings dating back to the 50s, 60s and 70s was 1.4 as per the 2003 building regulations, whereas the U value used for buildings dating back to the 80s and 90s was 1.1:
  50s (9.0%), 60s (12.8%), 70s (9.5%), 80s (11.7%) and 90s (11.2%)
- The saving effect of adding a solar heating system was assumed to be 2.5 MWh/a per property.

The saving effect attributable to solar heating (MWh/detached house) was calculated on the basis of the energy generated by solar heating and collector area data (Statistics Finland), as well as a solar heating expert's (Motiva) assessment of a typical collector area (7.5 m2/renovation project). The saving effect is the same for all age groups.

The numbers of oil boiler replacements in different years and future projections are based on the records of the Oil Industry Service Centre. The Oil Industry Service Centre also provided information on the numbers of control and burner replacements and typical savings. The saving effect attributable to control and burner replacements was calculated as a percentage based on information on numbers of replacements and typical consumption, and is the same for all age groups. The average saving effect used in the calculations for controls was seven percent of the properties' energy consumption, whereas the average saving effect used for burner replacements was six percent of the properties' energy consumption.

The following assumptions were used for the years 2016 and 2020 as of the year 2016:

- The scale of new energy savings to be achieved annually from boiler replacements decreases as younger and younger properties are renovated and the number of boiler replacements falls.
- The saving attributable to solar heating system renovations will grow by 10% from 2012 to 2020.

- New savings from adding roof and wall insulation and from replacing windows are not factored into these calculations for the period since 2008.

The annual saving effect per measure is calculated in accordance with the aforementioned data for each type of measure.

Overlap

There is no overlap with the effects of other measures, as the assessment covers only renovation projects and, with regard to window replacements, new buildings during the period for which window replacements have been factored into the assessment (1997–2007).

Impact assessment

The saving effects attributable to boiler replacements are calculated using the aforementioned five age groups of detached houses with oil-based heating systems. The impact assessment is based on calculating a typical saving for each boiler replacement (S_{50} , S_{60}, S_{70} , S_{80}, S_{90}) in oil-heated detached houses built during different decades (1950–1990).

In addition to typical savings from boiler replacements, annual numbers of renovations (L_{50} , L_{60}, L_{70} , L_{80}, L_{90}) for oil-heated detached houses are required for the calculation of energy savings.

The total saving effect of boiler replacements is based on calculating the energy saving effect for each measure per year

Boiler replacements = $S_{50}*L_{50}+ S_{60}*L_{60}+ S_{70}*L_{70}+ S_{80}*L_{80}+ S_{90}*L_{90}$ [GWh/a],

where S = typical saving for the decade in question, L= number of boiler replacements in the monitored year in buildings from various decades.

Other energy efficiency renovations include adding insulation to roofs and walls, replacing windows, incorporating solar heating and replacing controls and/or burners. The table below shows the combined saving effect of these other energy efficiency renovations.

The saving effects attributable to increased roof and wall insulation and window replacements are calculated on the basis of the same principles as those discussed above with respect to boiler replacements, and typical savings are based on the information presented above under Baseline data and assumptions. The typical saving (S) attributable to solar heating systems and the principles for calculating the same are also discussed under Baseline data and assumptions. Similarly, the energy saving effect of controls and burners is calculated on the basis of the information given under Baseline data and assumptions. With regard to measures relating to incorporating solar heating and adding controls and burners, the figures have not been divided between different decades.

Höylä – Communications and advice for customers

Premises and assumptions

Based on the 2011–2012 report, which measures and assesses the impacts of so-called soft energy efficiency measures targeted at the customers of energy sellers and distributors, the saving effect of these measures totals 1–3% of the target group's energy consumption.
http://energia.fi/files/1225/Pehmeiden_energiatehokkuustoimien_vaikutusten_mittaus_ja_arviointi.pdf

On the basis of the report, the estimated saving effect is calculated herein as 2.5% of households' energy consumption (light fuel) and only 1.5 % of the energy consumption of other target groups (small-scale industry, service sector, agriculture and forestry). The savings estimates used are therefore fairly moderate compared to the results of the report. Residential properties heated with light fuel are the target group of the calculation.

Baseline data

For oil-heated buildings, the baseline data used includes Statistics Finland's energy consumption data for residential properties in 2009–2015, and consumption for forthcoming years estimated accordingly. With regard to light fuel, it is assumed that communications broadly reach the target group in question.

Method of calculation

The basis for calculating so-called soft saving effects targeted at customers
is the method presented in Annex V, paragraph 1 of the Energy Efficiency Directive, d) "Surveyed savings" (see also "Baseline data" above). Based on this and the other information described above, the saving effect can be calculated using the method c) "scaled savings", presented in paragraph 1 of Annex V.

The total saving effect described herein is calculated using Finland's own BUI calculation method, while only taking account of the saving effect of so-called soft measures, i.e. measures related to people's behaviour.

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = 0.025*consumption of light fuel oil in residential properties

When calculating the savings, the lifetime used for new annual energy saving is 1 year.

Overlap Account has been taken of the overlap with other agreement scheme activities.
Parties responsible for impact assessment Energy Authority/Motiva, Oil Industry Service Centre (ÖPK)

ENERGY SAVING GWh/a			**2010**	**2016**	**2020**
ESD		Höylä, oil boiler replacements	1,255	1,430	1,517
ESD		Höylä, other energy efficiency renovations	729	840	906
ESD		Höylä, advice to customers	208	123	107
ESD TOT.	**RA–07–TEM/YM**	Höylä energy efficiency agreement – oil-heated detached houses	**2,192**	**2,392**	**2,530**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy efficiency agreement for the property sector – residential lettings associations	4	RA–08–YM

IMPLEMENTATION PERIOD	Start	2/2010	End
Continuing			

MEASURE TARGET	Rental properties owned by residential lettings associations

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	Yes

FINANCING AND BUDGET

The action plan for residential lettings associations under the energy efficiency agreement for the property sector was adopted at the beginning of 2010. Residential buildings are ineligible for energy subsidies from the Ministry of Economic Affairs and Employment.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of the Environment, Housing Finance and Development Centre of Finland, Finnish Association of Building Owners and Construction Clients, Motiva, participating businesses

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements scheme (1997–2007) have been key elements of Finland's climate and energy policy since 2001.

The energy efficiency agreement for the property sector was signed at the end of 2009. The agreement is a framework agreement signed by the Finnish Ministry of the Environment, the Finnish Ministry of Economic Affairs and Employment and the Finnish Association of Building Owners and Construction Clients. Two action plans are associated with the energy efficiency agreement for the property sector: one concerning residential lettings associations and one concerning commercial property associations. This description relates to the action plan for residential lettings associations, which was launched at the beginning of 2010. At the end of 2016, 27 residential lettings associations had signed the agreement.

Businesses joining the action plan for residential lettings associations can define an energy efficiency target per signatory based on a saving in energy consumption to be achieved from the time of signing the agreement.

The signatories have committed themselves to identifying ways of improving energy efficiency on their own properties and production facilities, through means such as energy audits, drawing up plans for increasing energy efficiency, implementing cost-effective saving measures, providing energy efficiency training for their personnel, disseminating information on energy efficiency and factoring energy efficiency into their plans and procurements. The signatories also have an obligation to take action, encourage their tenants to use energy more efficiently and factor energy efficiency into their property management procedures, competitive tendering and contracts. More information on agreements from 2008 is available at http://www.energiatehokkuussopimukset.fi; for details on new energy efficiency agreements in 2017−2025, see http://www.energiatehokkuussopimukset2017-2025.fi/ .

Businesses that have signed the energy efficiency agreement submit annual reports, via a web-based monitoring system, on their energy consumption, any energy saving measures implemented and progress with their other contractual obligations. The energy saving measures included in these reports can be measures identified during the course of energy audits, or otherwise discovered by the businesses.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations include all energy saving measures which have been implemented (I) according to the annual reports of the participating organisations.

Under the energy efficiency agreement for the property sector, the action plan for residential lettings associations was adopted at the beginning of 2010; monitoring data reported by signatories for 2010−2015 was used in the present calculation.

The savings (MWh/a) used in the calculations for the period up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. As of 2016, annual savings have been estimated on the basis of the average in 2008−2015.

With regard to the measures reported in annual reports, operational and technical measures are reported separately. The lifetime of individual technical measures has not been assessed separately. An average lifetime of

12 years has been used for the reported measures, which is conservative considering the lifetime of 15 years laid down for most technical measures in the Commission's guidelines. The lifetime of five years used for operational measures is based on effective monitoring of consumption and prompt reaction to faults (continuous improvement and linking of energy issues to management systems), which is one of the key principles of the energy efficiency agreement scheme.

The reported data covers almost 95 % of the participating organisations.

Baseline data

Baseline data for calculations is obtained from the annual reports of signatories to the energy efficiency agreement scheme, based on data compiled via the agreement scheme's monitoring system.

Each of the participating businesses includes at least the following information in its annual report:

- General information (contact details, line of business, participation in the emissions trading scheme, etc.)
- Detailed energy consumption data
- Energy measures implemented, including
  - estimated energy saving (electricity, heating, fuels) in MWh/a
  - implementation year, size of investment, payback period, etc.
  - type measures and any associated baseline data (qty, m2, etc.)
- information relating to energy efficiency systems concerning energy consumption monitoring, energy efficiency plans and environmental systems, etc.
- Other information relating to the use of renewable forms of energy, how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, etc.

The accuracy of the savings calculated for separately reported energy saving measures correlates with the level of accuracy that can be achieved by normal field testing; some baseline data is based on design values or estimates, since measurement is not always possible. The saving effects of type measures are calculated on the basis of the numbers and/or scope reported to the monitoring system. In most cases, the savings achieved by saving measures are not usually verified through retrospective measurements, since measurement is often difficult in practice and results in extra costs.

Motiva checks the orders of magnitude of the data as well as its accuracy in other respects after all reports have been submitted, and asks the participating businesses for additional information if necessary.

Overlap

No overlap occurred with other assessed measures.

Impact assessment

The assessment covers the impact of energy saving measures resulting from the energy efficiency agreement scheme for residential lettings associations. The annual energy saving (ES) is based on the saving effects (electricity + heating + fuels) of measures reported as having been implemented (I) by the participating organisations, and the corresponding saving effect estimated for forthcoming years.

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = ES(heating + fuels) + ES(electricity)

The total energy saving effect during the years shown in the table below was calculated by combining the saving effects (ES) calculated for each year, on the basis of the aforementioned principles.

Parties responsible for impact assessment

Ministry of the Environment/Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	RA–08–YM	Energy efficiency agreement for the property sector – residential lettings associations	**45**	**244**	**326**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Local government sector energy efficiency agreement	4	KU–01–TEM

IMPLEMENTATION PERIOD **Start** (1997) 1/2008 **End** Continuing

TOIMENPITEEN KOHDE Local governments, cities, towns and joint municipal authorities

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

Local governments implementing the energy efficiency agreement and energy programme for the local government sector received a total of EUR 3.6 million in subsidies towards energy audits between 2008 and 2015, and EUR 21.1 million in investment subsidies towards the implementation of energy saving measures.

The signatories are entitled to subsidies amounting to 50% of the eligible labour costs of energy audits. In some cases, the signatories can receive investment subsidies towards implementing conventional saving investments, for which the ceiling is usually 20%. Subsidies towards projects involving ESCOs cover up to 25% of project costs if the beneficiary has signed an energy efficiency agreement. Local governments that have signed an energy efficiency agreement are also eligible for subsidies towards local government audits relating to renewable forms of energy, which cover up to 60% of eligible labour costs.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, the Energy Authority, TEKES - the Finnish Funding Agency for Technology and Innovation, Motiva, the Association of Finnish Local and Regional Associations, participating local governments and joint municipal authorities

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements scheme (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

In the local government sector, a separate energy efficiency agreement for large and medium-sized local governments and an energy programme for small local governments were in effect in 2008–2016. The 2017–2025 energy efficiency agreement for local governments covers small and large municipalities. All local governments and joint municipal authorities can join these schemes. A total of 77 municipalities and joint municipal authorities have signed the local government energy efficiency agreement, and 54 municipalities and joint municipal authorities have joined the energy programme. The participating local governments represent 77% of Finland's population.

The local government energy efficiency agreement is mainly aimed at increasing energy efficiency, but also includes goals and measures aimed at promoting the use of renewable forms of energy. Signatories joining the energy efficiency agreement between 2017 and 2025 set an annual energy saving target (MWh/a) for the period 2020–2025. This target is calculated on the basis of energy consumption at the time of signing. In addition to the energy consumption of buildings, this includes other energy consumption attributable to each local government.

The signatories have also committed themselves to identifying ways of improving energy efficiency by means such as energy audits and analyses, drawing up plans for increasing energy efficiency, implementing cost-effective saving measures, providing energy efficiency training for their personnel, disseminating information on energy efficiency and factoring energy efficiency into their plans and procurements. They have also committed themselves to investigating ways of increasing the use of renewable forms of energy and to introducing renewable energy sources in their buildings and other energy-intensive functions. More information on agreements in 2008–2016 is available at http://www.energiatehokkuussopimukset.fi; for details on the new agreement period 2017–2025 see http://www.energiatehokkuussopimukset2017-2025.fi/.

Local governments and joint authorities that have signed the energy efficiency agreement submit annual reports, via a web-based monitoring system, on their energy consumption, any energy saving measures implemented and progress with other contractual obligations. The energy saving measures included in these reports can be measures identified during the course of energy audits, or analyses or measures otherwise discovered by local governments or joint municipal authorities.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations include all energy saving measures which, according to the annual reports of the participating organisations, have been implemented (I), with the exception of measures identified during the course of energy audits. With regard to local governments and joint authorities which also implemented the earlier energy saving

agreement (1997–2007), account has also been taken of measures reported during the previous contracting period and their saving effects. The savings (MWh/a) used in the calculations up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. As of 2016, annual savings have been estimated on the basis of the average for 2008−2015.

With regard to measures reported in annual reports unrelated to energy audits, operational and technical measures are reported separately. The lifetime of individual technical measures has not been assessed separately. An average lifetime of 12 years has been used for the reported measures, which is conservative considering the lifetime of 15 years laid down for most technical measures in the Commission's guidelines. The lifetime of five years used for operational is based on effective monitoring of consumption and prompt reaction to faults (continuous improvement and linking of energy issues to management systems), which is one of the key principles of the energy efficiency agreement scheme.

The assumption was that half of the saving effects of the proposed measures materialise during their year of implementation, whereas the other half extend to the year after the average lifetime of 12 years is reached.

Baseline data

Baseline data for calculations is obtained from the annual reports of signatories to the energy efficiency agreement scheme, based on data compiled by the agreement scheme monitoring system.

In its annual report, each participating organisation includes at least the following information for each of its offices:

- General information (contact details, line of business, participation in the emissions trading scheme, etc.)
- Detailed energy consumption data
  - the implementation status of energy-saving measures proposed in the energy audits and analyses
    I = implemented, D = decided, P = possible, A = abandoned
- Energy saving measures other than those identified during the course of energy audits, and the following information concerning the same:
  - estimated energy saving (electricity, heating, fuels) in MWh/a
  - implementation year, size of investment, payback period, etc.
- information relating to energy efficiency systems concerning energy consumption monitoring, energy efficiency plans and environmental systems, etc.
- other information relating to the use of renewable forms of energy, how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, the energy efficiency of transport and logistics, etc.

The accuracy of calculations of reported savings correlates with the level of accuracy that can be achieved in normal field testing; some of the baseline data is based on design values or estimates, since measurement is not always possible. In most cases, the savings achieved by saving measures are not verified by retrospective measurement, since measuring is often difficult in practice and results in extra costs.

Motiva checks the orders of magnitude of the data and its accuracy in other respects after all reports have been submitted, and asks the participating local governments and joint authorities for additional information if necessary.

Overlap

Account has been taken of the overlap with energy audits. The effects of measures identified during the course of energy audits are only accounted for when assessing the impacts of local government energy audits.

Impact assessment

The assessment covers the impacts of local government energy efficiency agreements with regard to measures other than those identified during energy audits.

The annual energy saving (ES) is based on the energy saving effects (electricity + heating + fuels) of measures reported by the participating organisations as 'implemented' (I). As discussed above, in the calculations the average lifetime used for technical measures is 12 years and that used for operational measures is five years.

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = ES(heating + fuels) + ES(electricity)

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year, on the basis of the aforementioned principles.

Parties responsible for impact assessment

Energy Authority/Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	KU–01–TEM	Energy efficiency agreement for local governments	**221**	**366**	**366**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy audits – local government sector	3	KU–02–TEM

IMPLEMENTATION PERIOD	Start	1992	End	Continuing

MEASURE TARGET	Local government building stock

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	Yes

FINANCING AND BUDGET

The energy audit programme was launched in 1992; subsidies towards audits performed in local government buildings have been available since then. A total of EUR 9.0 million in subsidies was granted to the local government sector between 1992 and 2015. The amount of subsidies varied between EUR 0.13 million and EUR 0.69 million between 2008 and 2015, and totalled EUR 3.8 million. The subsidies cover 40% of eligible labour costs for all local government organisations and 50% of the costs of local government organisations that have signed an energy efficiency agreement.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, the Energy Authority, TEKES - the Finnish Funding Agency for Technology and Innovation, Motiva

DESCRIPTION OF THE MEASURE

Energy audits have long been an important part of Finland's energy policy. Energy audits were one of the obligations laid down in the local government sector energy saving agreement (1997–2007). Furthermore, in the local government sector energy saving agreement (large municipalities) and energy programme (small municipalities) in 2008–2016 and the local government sector energy efficiency agreement scheme of 2017−2025, signatories are obliged to investigate measures to enhance energy efficiency, for example by way of an energy audit.

An energy audit involves an evaluation of current energy and water consumption, an examination of potential energy saving measures, an estimation of their saving effects, and reporting. Energy audits are carried out by consultants trained and certified by Motiva.

Four energy audit templates are used by the local government sector: the energy inspection for properties, energy audit for properties, follow-up audit for properties and commissioning inspection for properties. In addition, renewable energy audits were introduced for the local government sector in 2005, which involve examining local governments' opportunities to increase the use of renewable forms of energy.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations are based on the saving potential (TSP) of measures identified during the course of energy audits and reported in the energy audit database, as well as the percentage of implemented measures (IP) given by all energy efficiency agreement signatories in their annual reports.

Implementation data is also used to calculate the percentage of the saving potential identified during the course of all energy audits, regardless of whether or not such audits were performed pursuant to energy efficiency agreements.

The saving potential data associated with energy audits for the years 1995–2014 is based on audit reports. The average materialisation percentage of the saving potential identified during audits has been calculated on the basis of information submitted by organisations in their annual reports concerning the implementation of energy efficiency agreements in 2015. Energy audits carried out by energy efficiency agreement signatories have accounted for more than 95% of all local government energy audits in recent years.

It is estimated that, in 2016, the average saving potential of audits will equal the level of 2012−2014, while that of 2017−2020 will equal the average level implemented during the energy efficiency agreement period in 2008−2014. No figures are available with regard to average saving potential for the year 2015, as many of the audits carried out in that year have not yet been reported.

Saving potential and implementation figures have been calculated separately for operational measures and technical measures. The lifetime of individual technical measures has not been assessed separately; instead an average lifetime of 12 years has been used, which is conservative considering the lifetime laid down by the Commission for most technical measures in the private service sector. A lifetime of five years has been used for operational measures, since one of the obligations laid down in the energy efficiency agreement scheme involves

the efficient monitoring of consumption and prompt reaction to faults. Around one third of all measures identified during the course of energy audits are operational measures. The calculations assume that the saving effect of measures identified during the course of audits materialises during the subsequent year.

Baseline data

The baseline data is derived from the energy audit and energy efficiency agreement monitoring system. Information is entered into the database at three stages of energy audits.

The following information is submitted concerning the application and funding decision:

- the size of the property, the year in which it was built, the type of property, participation in saving agreements and audit subsidies granted

The following information is submitted concerning the energy audit report:

- energy and water consumption data from the year preceding the audit
- for each proposed measure:
  - brief description/name of the measure, categorisation for the purpose of separating operational and technical measures
  - heating, electricity and/or water saving in units of energy (kWh/a) and costs (EUR/a)
  - investment estimate and direct payback period (EUR, a)
  - status of proposed measures (implemented = I, decided = D, possible = P, abandoned = A)

The following information is submitted concerning annual reports on the implementation of energy saving agreements:

- information on the implementation of measures proposed in connection with energy audits and their status (I, D, P, A)

Information derived from energy audit reports includes figures calculated and/or measured by trained and certified energy auditors on site, and calculations produced on the basis of the same. The accuracy of the saving calculations corresponds to the accuracy achieved by means of normal field testing. In most cases, savings achieved by saving measures are not verified by retrospective measurements, as measurement is often difficult in practice and results in considerable extra costs.

The status of each measure proposed in connection with energy audits must be entered during annual reporting, i.e. whether the measure has been implemented (I), whether a decision has been made to implement the measure (D), whether the possibility of implementing the measure is being contemplated (P) or whether a decision has been taken to abandon the measure (A). When calculating the percentage of saving measures identified during local government energy audits that are implemented (IP), account is taken of the total saving effect of implemented and decided measures, and a third of the potential represented by possible measures.

IP [%] = I + D + 0.33* P

The implementation percentage is calculated separately for heating and electricity saving measures, and for operational measures and technical measures. Based on the annual reports submitted on the basis of energy efficiency agreements in 2015, the percentages of materialised saving potential (IP) attributable to local government energy audits were as follows:

- 79% for operational measures relating to heating energy and fuels (H + F) and 76% for measures relating to electricity (E), and
- 53% (H + F) and 55% (E) for technical measures.

Overlap

In the assessment, account was taken of overlaps with the effects of local government sector energy efficiency agreements and the local government energy programme.

Energy auditors propose the order in which the identified saving measures should be implemented and factor in any overlaps between individual measures.

Impact assessment

The assessment covers the effects of energy audits in the local government sector. The annual new energy saving effect (ES) is calculated on the basis of the total saving potential (TSP) of the saving measures proposed during the energy audits reported each year with regard to heating and electricity and the percentage of proposed saving measures that have been implemented (IP). The premises and assumptions used in the calculations are discussed above.

Any new annual energy saving (ES) materialising from the total saving potential (TSP) of any given year is calculated with respect to both operational and technical measures as follows:

ES [GWh/a] = IP(heating) x TSP(heating) + IP(electricity) x TSP(electricity)

The total energy saving effect during each of the years shown in the table below was calculated by combining the annual saving effects (ES) calculated on the basis of the aforementioned principles.

Parties responsible for impact assessment Energy Authority/Motiva					
ENERGY SAVING GWh/a			**2010**	**2016**	**2020**
ESD	**KU–02–TEM**	Energy audits – local government sector	**69**	**89**	**88**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Increasing the efficiency of space utilisation in central government	8	VA–01–VM

IMPLEMENTATION PERIOD	Start	11/2005	End	Continuing

MEASURE TARGET	Offices used by the central government

MEASURE CONCERNS	Heat	Electricity	Fuel	Water
	Yes	Yes	No	No

FINANCING AND BUDGET

Measures aimed at improving the efficiency of space utilisation are financed by landlords whenever such measures are incorporated into construction projects. In other cases, funding comes from either the landlord or the tenants.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Government, Senate Properties, organisations that use the properties and parties contributing to construction projects (parties involved in developing, planning and building working environments)

DESCRIPTION OF THE MEASURE

One of the goals set by the Government Premises Strategy adopted in 2005 is to increase the efficiency of space utilisation in central government premises by approximately 20-25%. The Government Resolution on Government Premises Strategy 2014 (Valtioneuvoston periaatepäätös valtion toimitilastrategiaksi 2014) specifies this goal by defining the efficiency target for space utilisation in office premises that have been acquired or renovated at 18 m2/person-workyear, and for new buildings at 15 m2/person-workyear, unless determined otherwise for financial or other significant reasons. To increase the efficiency of space utilisation in premises that are not in office use, ministries, government agencies and institutions prepare their own sector-specific targets for this metric.

The efficiency of space utilisation is being promoted in two ways, both of which require tangible action. Factors to consider when planning the use of space in new developments and properties undergoing renovation include improvements to the working environment, which range from measures to increase the efficiency of space utilisation to those that boost the organisation's productivity and general ability to reinvent itself. This process involves identifying efficient solutions that complement the operating cultures of organisations developed in this manner. Since the long cycle of construction projects means that not all efficiency targets can be achieved within the deadline, measures to improve the efficiency of space utilisation are also implemented during restructuring processes and whenever possible from the perspective of contractual obligations and practical considerations. In such circumstances, the measures are usually less comprehensive than those associated with conventional renovation projects, and target existing premises or involve upgrading premises that have become inefficient into ones that offer greater efficiency and flexibility.

The energy saving effect of such measures is based on the fact that the reduction in the energy consumption attributable to the premises is almost directly proportional to the increase in the efficiency of space utilisation.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, whose principles are described below.

Premises and assumptions

The current level of efficiency stands at approximately 30 m2/person, while the target is 15−18 m2/person-year of work. In connection with the aforementioned surveys, calculations and tests confirm that the specific energy consumption of premises increases by 5% if the efficiency of space utilisation is increased by 30%, and by approximately 7% if the efficiency of space utilisation is increased by 40–50%. Increasing the efficiency of space utilisation lowers energy consumption almost linearly and a considerable total saving would probably be gained from achieving the target set in the Government Premises Strategy.

The energy saving effect is based on the average energy consumption of properties decommissioned as a result of the measures, which amounts to around 200 kWh/m2 according to the consumption monitoring data gathered by Senate Properties. It is assumed that decommissioned properties will satisfy demand for premises elsewhere, or be demolished.

Baseline data

The annual volume of new development by Senate Properties currently stands at around 20,000 m2 (gross square metres).

The volume of premises in which efficiency was improved through renovations in 2010−2014 has been estimated based on the annual volume of renovation projects undertaken by Senate Properties, which amounts to 130,000 m2 per year on average. The percentage of efficiency improvements achieved by means other than

renovation projects was calculated on the basis of the volume of office premises subject to renovation, which was around 1.5 million m2 at the beginning of the period under review and 1.2 million m2 at the end of 2016.
Premises rented from other property owners for central government totalled 0.5 million m2 at the beginning of the period under review and around 1.0 million m^2 at the end of 2016.

The increased efficiency of space utilisation in 2015−2020 is based on Senate Properties' reports on progress in finding solutions, according to which the use of a total of 490,000 m^2 was made more efficient in 2015–2016, i.e. an improvement rate of 31% on average. It is estimated that the increased efficiency of space utilisation will remain at the aforementioned level in 2017, but the volume of premises available for conversion will clearly fall thereafter. In the future, the efficiency of space utilisation can be expected to rise in buildings in other use categories but, based on the current information, this cannot yet be factored into the calculations.

Information in support of the calculations was derived from project-specific and general reports concerning the effects of efficient space utilisation drawn up by Senate Properties (such as Senate Properties' roadmap for energy-efficient investments in 2011–2020, IPY 5 May 2011).

Overlap None

Impact assessment

Space utilisation will become more efficient due to projects and otherwise, and will be spread out evenly over the period, with the same reduction in space being achieved each year.

Annual energy savings (ES) are calculated using the following formula:

ES [GWh/a] = average specific energy consumption of decommissioned property stock [kWh/m2]*

volume of decommissioned space each year [m^2]

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

Parties responsible for impact assessment

Finnish Ministry of Finance, Senate Properties

ENERGY SAVING GWh/a			2010	2016	2020
ESD	VA–01–VM	Increased energy efficiency from more efficient use of space in central government	**7**	**73**	**115**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Renovation of the state's building stock	8	VA–02–VM

IMPLEMENTATION PERIOD	Start	9/2009	End	Continuing

MEASURE TARGET	State-owned properties

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	No	Water	Yes

FINANCING AND BUDGET

Renovation projects are financed by the landlord (property owner). A new lease agreement is usually drawn up in connection with the project, to agree on any impact that the energy saving measures may have on rent. This may be relevant, for example, if the tenant pays for all electricity consumption in the building, in which case some of the investment in energy efficiency in the property will benefit the tenant.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Senate Properties and other state-owned property units

DESCRIPTION OF THE MEASURE

Although measures to improve energy efficiency implemented during renovations affect final energy consumption more than those implemented in new buildings, in other respects it is difficult for renovations to achieve the level of specific energy consumption achieved in new development. Consumption targets are based on energy efficiency regulations for renovations adopted in 2013, the Government Resolution of 13 June 2013 on promoting sustainable environmental and energy solutions, and Senate Properties' roadmap for energy-efficient investments (construction) in 2011–2020.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

The energy saving for each building component has been calculated using Finland's own national BU calculation system, the principles of which are described below. A target level, which has been compared to the characteristics of the building stock due for renovation, has been set for all significant measures to improve energy efficiency (improvements to walls and roofs, improvements to heat recovery systems, electrical efficiency of lighting, etc.) for the coming years.

Premises and assumptions

Senate Properties' buildings are renovated at a rate of 130,000 m^2 per year, to ensure that renovations either have or can have a significant impact on energy efficiency. As other state properties are added to this figure, it is estimated that the total annual volume of renovations carried out over the next four years will be around 160,000 m^2.

Where relevant with respect to renovations and modifications, this calculation is based on the requirements laid down in the Ministry of the Environment Decree and building regulations for individual building components or, where these are unavailable, the forecast energy efficiency of the best available technologies (e.g. lighting). Since not all energy saving measures can be implemented in all renovation projects, the feasibility rate for the implementation of individual measures has been estimated as a percentage of building components and other characteristics. Some renovation measures can be implemented more comprehensively than others (e.g. upgrading to more energy-efficient lighting solutions), and there is limited scope for implementing some profitably (e.g. opportunities to add thermal insulation to external walls). The figures used to represent this are based on lessons learnt from previous projects implemented by Senate Properties. The assumptions used in the calculations have been documented in Senate Properties' roadmap for energy-efficient investments in 2011–2020, IPY 5 May 2011, and in document No 251852 of 24 January 2014.

Based on the analysis, the most effective measures for increasing efficiency include improving the efficiency and scope of heat recovery in ventilation systems, replacing windows, and improving the electrical efficiency of lighting and ventilation.

Furthermore, the average energy efficiency target for renovation projects takes account of the Government Resolution of 13 June 2013 on promoting sustainable environmental and energy solutions, which also lays down general targets for the energy efficiency of renovation projects.

Baseline data

The annual construction volume used in the calculations is based on Senate Properties' construction project database, which has been analysed for several years. The number of renovation projects totals around 130,000 m^2 per year.

The baseline for measuring the improvement to the properties of individual building components and technical

systems is based on the building regulations of the year in which the property was built or, in the absence of such regulations, on a standard solution typically used in buildings of the same type and age. The number of building components and building services solutions affected by energy saving measures has been calculated using a model developed by Senate Properties, where the total number of key components and systems is derived from the average number of such components and systems in an average virtual building.

Overlap

If properties that have undergone energy efficiency renovations are decommissioned due to measures aimed at increasing the efficiency of space utilisation or otherwise, the benefit gained by the renovation is lost. To prevent this from happening, properties are bundled into portfolios so that renovations can be targeted expediently. The possibility of renovated properties being decommissioned has not been factored into the saving effect calculations. An overlap with maintenance measures has been factored in as discussed in connection with measure VA-04-VM.

Impact assessment

For the purposes of the calculation, the impact on savings of individual energy saving measures is based on the principle described above, by multiplying the total number/extent of the measures by their energy properties.

The saving effect of each energy saving measure per annum ($ES_{Measure}$) is calculated using the following formula

$ES_{Measure}$ [GWh/a] = specific saving per measure [kWh/units per measure] * annual volume of renovations [units per measure]

and the total saving (ES) is calculated as the sum of the measures:

ES[GWh/a] = ESMeasure1 + ESMeasure2 + … + ESMeasureN

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

It has been assumed that the effect of individual measures will increase gradually across the programming period, thanks to tightening regulations and requirements on the one hand and technological development on the other. Regulations applicable to renovations take account of the Government Resolution of 13 June 2013 and, with regard to technological development, the forecast improvement in the energy efficiency of lighting technology in particular.

Parties responsible for impact assessment

Finnish Ministry of Finance/Senate Properties

ENERGY SAVING GWh/a			2010	2016	2020
ESD	VA–02–VM	Renovation of the state's building stock	**3**	**32**	**68**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Increasing energy efficiency in new development in the state sector	8	VA–03–VM

IMPLEMENTATION PERIOD	Start	9/2009	End	Continuing

MEASURE TARGET	State-owned properties

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	No	Water	Yes

FINANCING AND BUDGET

New development projects are financed by the landlord (property owner). A lease agreement is drawn up for each project to agree on any impact on rent that energy saving measures over and above the regulatory level may have. This may be relevant, for example, if the tenant pays for all electricity consumption in the building, in which case some of the investment in energy efficiency aimed at the property benefits the tenant.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Senate Properties and other state-owned property units

DESCRIPTION OF THE MEASURE

The percentage of state construction projects represented by new development has been decreasing steadily and currently accounts for around 20% of all projects. The energy efficiency of new buildings is better than that of renovation projects and tightening regulations will continue to reduce the specific energy consumption of new buildings across the programming period. The state currently only builds new buildings in special circumstances. The impact of new development on improving the energy efficiency of the state's building stock is based on the fact that new buildings replace buildings that are sold or demolished, the energy properties of which are average or poorer than average.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The annual volume of new development by Senate Properties currently stands at 20,000 m^2. Other state properties add a further five percent or so to this figure. The assumption is that the same volume of new buildings will be built each year over the next seven years.

The impact of new development on improving the energy efficiency of the state's building stock has been calculated assuming that the consumption level of new buildings due to building regulations is known. The energy consumption assessments are based on the assumption that projects in 2011–2012 have been implemented in line with energy efficiency class A as stipulated in the Energy Certificates Decree of 2007, projects implemented from 2013 at around 35% higher than the energy efficiency requirements applicable to new development, and those from 2017 as almost zero-energy buildings.

With regard to regulations, account has been taken of the provisions of the 2012 building regulations, the Government Resolution and the requirements laid down in the Energy Performance of Buildings Directive (2002/91/EC) for public buildings. The requirements laid down in both the Government Resolution of 13 June 2013 on promoting sustainable environmental and energy solutions and the Energy Performance of Buildings Directive are stricter than those of Finnish building regulations.

Baseline data

The annual construction volume used in the calculations is based on the database of Senate Properties' construction projects, which has been analysed over several years. The energy consumption of decommissioned buildings has been calculated on the basis of information derived from Senate Properties' energy monitoring system for average buildings, whose total specific energy consumption is around 200 kWh/m^2.

The trend in consumption levels has been based on energy consumption calculations performed for implemented and planned projects.

Based on these calculations, the heating energy consumption attributable to the types of new development discussed above amounts to 45%, 33% and 27% of the average current level. It has been assumed that the energy efficiency of lighting will improve at a steady pace until 2015, by which time consumption will have been halved compared to the current level. A further reduction of 20% is expected over the following five-year period. Solutions for improving the electrical efficiency of ventilation systems can be adopted straight away. An increase in conventional cooling will reduce the improvement in electrical efficiency by one third. Year-round cooling solutions

can be used to reduce the need for heating.

The baseline data and assumptions used in the calculations were discussed in more detail in Senate Properties' roadmap for energy-efficient investments in 2011–2020, IPY 5 May 2011, and in document No 251852 of 24 January 2014.

Overlap

With regard to heating consumption, achieving energy efficiency above the current average level for new construction is largely based on building regulations, which is why there is an overlap between these two measures. However, since planning permission is not sought for all of Senate Properties' construction projects, the measure only partially overlaps with the effects of building regulations. There is also a degree of overlap with regard to electricity consumption, mainly in terms of the electrical efficiency of ventilation systems. It is not yet possible to forecast the effects of all regulations during the 2011–2020 period. An overlap with maintenance measures has been factored in as discussed in connection with measure VA-04-VM.

Impact assessment

Based on the principles discussed above, the calculation gives the energy consumption of new building stock completed each year as the product of the specific energy consumption target level for each period (2011–2014, 2015–2018, 2019–) and the volume of construction. The difference between this figure and the consumption attributable to decommissioned building stock represents the energy saving achieved.

ES_{Period} [GWh/a] = (current average specific consumption [kWh/m^2] − specific consumption for each period [kWh/m^2]) * annual volume of construction [m^2]

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

ES [GWh/a] = ESPeriod1 + ESPeriod2 + ESPeriod3

Parties responsible for impact assessment

Finnish Ministry of Finance/Senate Properties

ENERGY SAVING GWh/a			2010	2016	2020
ESD	VA–03–VM	Increasing energy efficiency in new development in the state sector	**1**	**10**	**22**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Maintenance and user information for the state's building stock	6, 8	VA–04–VM

IMPLEMENTATION PERIOD	Start	1/2006	End	Continuing

MEASURE TARGET	State-owned properties, tenants

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	No	Water	Yes

FINANCING AND BUDGET

Maintenance is primarily financed by landlords, or tenants in the case of capital leases. User information and more extensive energy-related cooperation are agreed separately between the landlord and tenant.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Senate Properties and other state-owned property units

DESCRIPTION OF THE MEASURE

Experience shows that maintenance and the provision of user information play significant roles in lowering energy consumption attributable to the building stock and in improving and maintaining energy efficiency. The specific energy consumption of the housing stock cannot be controlled, let alone lowered, without systematic action, innovation and continuous monitoring. The following are examples of measures that have already been implemented or are due to be implemented during the programming period:

- the use and further development of reward/penalty models for property management
- quality audits of property management in connection with the above
- maintenance and energy renovations
- increasing the scope of consumption metering
- electricity consumption reviews
- electricity user projects
- remote monitoring of automation
- energy efficiency plans for users
- lease agreement models that promote energy efficiency
- Green Office or similar services for improving the energy efficiency of tenants' appliances and operations
- raising tenants' energy awareness with the help of information systems, visualisations, etc.
- comprehensive energy monitoring, reporting and analysis of hourly data for control measures

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, the principles of which are described below.

Premises and assumptions

Although new measures are still being introduced, it has been estimated that approximately half of the 2% annual drop in energy consumption achieved with the help of earlier measures will return to the original level. Consumption is therefore expected to drop by approximately one percent year on year, making the overall trend a logarithmic one. Care has also been taken to ensure that this target serves to achieve the goals set in the energy efficiency agreement for commercial properties, to which Senate Properties is a signatory, when other measures (VA–02–VM and VA–03–VM) are also taken into account (excluding measures aimed at improving the efficiency of space utilisation). Systematic measures yielded an annual average energy saving in the specific energy consumption of Senate Properties' office-type premises of 2% per year in the period 2006–2010 and 1% per year in the period 2011-2016.

An average saving of one percent is assumed for properties other than those included in Senate Properties' reports, as capital lessors develop their operations according to their own energy efficiency plans.

Baseline data

Energy consumption data was derived from Senate Properties' energy monitoring system, and the saving in consumption achieved was reported in Senate Properties' corporate social responsibility report, which is verified by a third party. Senate Properties' energy monitoring system includes consumption data for all buildings managed by Senate Properties. The trend for other properties is assumed to be similar.

The impacts of maintenance and user information have been estimated on the basis of the trend in actual energy consumption. The impact of energy renovations is calculated separately for each project.

Overlap

The energy saving measures described herein overlap, in particular, with the savings to be achieved through energy-efficient renovations. This has been taken into consideration in the assessment of savings since 2010, in such a manner that the impact of renovations has been deducted from the estimated total savings as a 50% share of all savings.

Impact assessment

Absolute consumption savings have been calculated on the basis of the percentage saving described above, based on the current overall energy consumption and by estimating the logarithmic continuum for the saving effects of future years, which includes the impact of future energy-efficient construction.

Savings for future years have been calculated on the basis of the previous year's consumption as described above, taking account of the savings achieved. This assessment also factors in the loss of buildings as a result of measures taken to increase the efficiency of space utilisation as well as lower consumption, and the improvement in the energy properties of buildings, which also plays a role in the long-term slowdown of the decrease in specific energy consumption.

Savings for the year 2010 have been calculated according to actual figures and compared to the level of consumption in 2006. Savings for the years 2016 and 2020 have been calculated in the manner described above relative to energy consumption data from 2016.

Parties responsible for impact assessment

Finnish Ministry of Finance/Senate Properties

ENERGY SAVING GWh/a			2010	2016	2020
ESD	VA–04–VM	Maintenance and user information for the state's building stock	**98**	**125**	**153**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy audits – private services	3	PA–01–TEM

IMPLEMENTATION PERIOD	Start	1992	End	Continuing

MEASURE TARGET	Private service sector building stock

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	Yes

FINANCING AND BUDGET

The energy audit programme was launched in 1992; subsidies towards audits in private service sector buildings have been available since then. A total of EUR 5.4 million in subsidies was granted to the private services sector between 1992 and 2015. The amount of subsidies varied between EUR 0.1 million and EUR 0.5 million between 2008 and 2015, and totalled EUR 1.8 million. The subsidies cover 40% of the eligible labour costs of all organisations and 50% of the costs of small and medium-sized private service sector organisations that have signed an energy efficiency agreement. Since the Energy Efficiency Directive began to be implemented on 5 June 2014, large enterprises have no longer been eligible for energy audit subsidies.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, the Energy Authority, TEKES - the Finnish Funding Agency for Technology and Innovation, Motiva

DESCRIPTION OF THE MEASURE

Energy audits have long been an important part of Finland's energy policy. Energy audits were one of the obligations laid down in the property sector energy saving agreement (1997–2007). Signatories to the property sector energy efficiency agreements 2008–2016 and energy efficiency scheme 2017−2025 are also obliged to investigate measures to enhance energy efficiency, by means such as energy audits.

An energy audit includes an evaluation of current energy and water consumption, an examination of potential energy saving measures, an estimation of their saving effects, and reporting. Energy audits are carried out by consultants trained and certified by Motiva.

Four energy audit templates are used in the private service sector: the energy inspection for properties, energy audit for properties, follow-up audit for properties and commissioning inspection for properties.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations are based on the saving potential (TSP) of measures identified during the course of energy audits and reported in the energy audit database, as well as the percentage of implemented measures (IP) given by all energy efficiency agreement signatories in their annual reports.

The implementation data is also used to calculate the percentage of the saving potential identified during the course of all energy audits, regardless of whether or not they were carried out pursuant to energy efficiency agreements.

The saving potential data associated with energy audits for the years 1995–2014 is based on audit reports. The average materialisation percentage of the saving potential identified during the course of audits has been calculated on the basis of information, submitted by organisations in their annual reports, on the implementation of energy efficiency agreements in 2015. Energy audits carried out by energy efficiency scheme signatories have accounted for 24−66% of all energy audits per year in the private service sector and the average figure for the period 2008–2015 was less than 50%.

It is estimated that, in 2016, the average saving potential of audits will equal the level of 2012−2014, while that of 2017−2020 will equal the average level implemented during the energy efficiency agreement period in 2008−2014. No figures are available for the year 2015 with regard to average saving potential, as many of the audits carried out that year have not yet been reported.

Saving potential and implementation figures have been calculated separately for operational measures and technical measures. The lifetime of individual technical measures has not been assessed separately; an average lifetime of 12 years has been used instead, which is conservative given the lifetime set by the Commission for most technical measures in the private service sector. A lifetime of five years has been used for operational measures, because one of the obligations laid down in the energy efficiency agreement scheme involves monitoring consumption efficiently and promptly reacting to faults. Approximately one third of all measures identified during the course of energy audits are operational measures. The calculations assume that the saving effect of measures

identified during the course of audits materialises in the year after the energy audit.

Baseline data

The baseline data is derived from the energy audit and energy efficiency agreement monitoring system. Information is entered into the database at three stages of energy audits.

The following information is submitted on the application and funding decision:

- the size of the property, year in which it was built, type of property, participation in saving agreements and audit subsidies granted

The following information is submitted on the energy audit report:

- energy and water consumption data from the year preceding the audit
- for each proposed measure:
  - brief description/name of the measure, categorisation for separating operational and technical measures
  - heating, electricity and/or water saving in units of energy (kWh/a) and costs (EUR/a)
  - investment estimate and direct payback period (EUR, a)
  - status of proposed measures (implemented = I, decided = D, possible = P, abandoned = A)

The following information is submitted concerning annual reports on the implementation of energy saving agreements:

- information on the implementation of measures proposed in connection with energy audits and their status (I, D, P, A)

Information taken from energy audit reports includes figures calculated and/or measured by trained and certified energy auditors on site, and calculations produced on the basis of the same. The accuracy of the saving calculations corresponds to the accuracy achieved by means of normal field testing. In most cases, savings achieved by saving measures are not verified by retrospective measurements, as measurement is often difficult in practice and results in considerable extra costs.

The status of each measure proposed in connection with energy audits must be entered during annual reporting, i.e. whether the measure has been implemented (I), whether a decision has been made to implement the measure (D), whether the possibility of implementing the measure is being contemplated (P) or whether a decision has been taken to abandon the measure (A). When calculating the percentage of saving measures identified during local government energy audits that are implemented (IP), account is taken of the total saving effect of implemented and decided measures, and a third of the potential represented by possible measures.

IP [%] = I + D + 0.33* P

The implementation percentage is calculated separately for heating and electricity saving measures and for operational measures and technical measures. Based on annual reports submitted on the basis of energy efficiency agreements in 2015, the percentages of materialised saving potential (IP) attributable to local government energy audits were as follows:

- 85% for operational measures relating to heating energy and fuels (H + F) and 76% for measures relating to electricity (E), and
- 43 % (H + F) and 51 % (E) for technical measures.

Overlap

Energy auditors propose the order in which the identified saving measures should be implemented and factor in any overlaps between individual measures.

An overlap with the effects of service sector agreements has been factored into the impact assessments concerning the energy efficiency agreements for businesses and the property sector.

Impact assessment

The assessment covers the effects of energy audits in the private service sector. The annual new energy saving effect (ES) is calculated on the basis of the total saving potential (TSP) of the saving measures proposed, in the energy audits reported each year, with regard to heating and electricity, as well as the percentage of proposed saving measures that have been implemented (IP). The premises and assumptions used in the calculations are discussed above.

Any new annual energy saving (ES) materialising from the total saving potential (TSP) of any given year is calculated for both operational and technical measures, as follows:

ES [GWh/a] = IP(heating) x TSP(heating) + IP(electricity) x TSP(electricity)

The total energy saving effect during each of the years shown in the table below has been calculated by combining the annual saving effects (ES) calculated on the basis of the aforementioned principles.

Parties responsible for impact assessment Energy Authority/Motiva					
ENERGY SAVING GWh/a			**2010**	**2016**	**2020**
ESD	**PA–01–TEM**	Energy audits – private services	**76**	**78**	**71**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy efficiency agreement for businesses – service sector	4	PA–02–TEM

IMPLEMENTATION PERIOD **Start** (1997) 1/2008 **End** Continuing

MEASURE TARGET Private service providers and their premises

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

Businesses implementing the energy efficiency agreement and action plans for the private service sector received a total of EUR 0.58 million in subsidies towards energy audits between 2008 and 2015, and EUR 6.4 million in investment subsidies towards the implementation of energy saving measures.

Small and medium-sized signatories are entitled to subsidies amounting to 50% of the eligible labour costs of energy audits. Since the implementation of the Energy Efficiency Directive began on 5 June 2014, large enterprises have been ineligible for energy audit subsidies. In some cases, the signatories can also receive investment subsidies towards implementing conventional saving investments, in which the ceiling is usually 20%. Subsidies towards projects involving ESCOs cover up to 25% of project costs if the beneficiary has signed an energy efficiency agreement.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

The Finnish Ministry of Economic Affairs and Employment, the Energy Authority, the Confederation of Finnish Industries and its member organisations, the Finnish Forest Industries Federation, Motiva, participating businesses, TEKES - the Finnish Funding Agency for Technology and Innovation

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements scheme (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

The energy efficiency agreement for businesses sets out three sector-specific action plans for the service sector (trade, tourism and hospitality services, and the automotive industry) as well as a generic action plan for the service sector, which is designed for businesses that do not fall under any of the sector-specific action plans.

A total of 125 businesses and their more than 3,000 offices had joined the Energy Services Action Plan associated with the energy efficiency agreement for businesses by the end of 2016.

Signatories joining the energy efficiency agreement between 2017 and 2025 will set an annual energy saving target (MWh/a) for the period 2020–2025. The target is calculated on the basis of energy use at the time of signing.

The signatories have also committed themselves to identifying ways to improve energy efficiency in their own properties and production facilities by means such as energy audits or analyses, drawing up plans for increasing energy efficiency and implementing cost-effective saving measures, as well as providing energy efficiency training for their personnel, disseminating information on energy efficiency and factoring energy efficiency into their plans and procurements. For more information on the agreements for the period 2008–2016, see http://www.energiatehokkuussopimukset.fi/en and for further details on the new agreement period 2017–2025 go to http://www.energiatehokkuussopimukset2017-2025.fi/.

Businesses that have signed the energy efficiency agreement submit annual reports, via a web-based monitoring system, on their energy consumption, any energy saving measures implemented and progress with their other contractual obligations. The energy saving measures included in the reports can be measures identified during the course of energy audits or analyses, or otherwise identified by the businesses.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations include all energy saving measures which, according to the annual reports of the participating organisations, have been implemented (I), with the exception of measures identified during the course of energy audits. With regard to businesses in sectors other than trade that also implemented the earlier energy saving agreement for the property sector (1999–2007), account has also been taken of measures reported during the previous contracting period and their saving effects. The savings (MWh/a) used in the calculations up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. As of 2016, annual savings have been estimated on the basis of the average in 2008–2015. The records cover nearly all of the businesses that have signed the energy efficiency agreement, as almost all of these businesses have submitted annual reports each year.

With regard to measures reported in annual reports unrelated to energy audits, operational and technical measures are reported separately.

The lifetime of individual technical measures has not been assessed separately. An average lifetime of 12 years has been used for the reported measures, which is conservative given the lifetime of 15 years laid down for most technical measures in the Commission's guidelines. A lifetime of five years has been used for operational measures, since one of the obligations laid down in the energy efficiency agreement involves monitoring consumption efficiently and reacting promptly to faults.

The assumption was that half of the saving effects of the proposed measures materialise during their year of implementation and the other half extend into the year after the average lifetime of 12 years is reached.

Baseline data

The baseline data is based on the annual reports submitted via the monitoring system by the participating organisations, and data relating to the previous contracting period.

In its annual report, each participating organisation includes at least the following information for each of its offices:

- General information (contact details, line of business, participation in the emissions trading scheme, etc.)
- Detailed energy consumption data
- the implementation status of energy-saving measures proposed in the energy audits and analyses
  I = implemented, D = decided, P = possible, A = abandoned
- Energy saving measures other than those identified during the course of energy audits and the following information concerning the same:
  - estimated energy saving (electricity, heating, fuels) in MWh/a
  - implementation year, size of investment, payback period, etc.
- information relating to energy efficiency systems concerning energy consumption monitoring, energy efficiency plans and environmental systems, etc.
- other information relating to the use of renewable forms of energy, how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, the energy efficiency of transport and logistics, etc.

The accuracy of the saving calculations corresponds to the accuracy achieved by means of normal field testing. Some of the baseline data are based on design values or estimates, as measuring is not always possible. In most cases, the savings achieved by saving measures are not verified by retrospective measurement, since measuring is often difficult in practice and results in extra costs.

Motiva checks the orders of magnitude of the data as well as their accuracy in other respects after all reports have been submitted and asks the participating businesses for additional information if necessary.

Overlap

Overlap with private service sector energy audits has been taken into account. This assessment does not factor in the effects of measures identified in connection with energy audits, which have been covered in the impact assessment associated with energy audits in the private service sector.

Impact assessment

The assessment covers the impacts of service sector energy efficiency agreements with regard to measures other than those identified during the course of energy audits.

The annual energy saving (ES) is based on the energy saving effects (electricity + heating + fuels) of measures reported by the participating organisations as 'implemented' (I). As discussed above, the average lifetime used for technical measures in the calculations is 12 years and that used for operational measures is five years.

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = ES(heating + fuels) + ES(electricity)

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

Parties responsible for impact assessment

Energy Authority/Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	PA–02–TEM	Energy efficiency agreement for businesses – service sector	**36**	**191**	**200**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy efficiency agreement for the property sector – commercial properties	4	PA–03–TEM

IMPLEMENTATION PERIOD **Start** 2/2010 **End** Continuing

MEASURE TARGET Commercial properties

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

The action plan for commercial properties under the energy efficiency agreement for the property sector was adopted at the beginning of 2011. Businesses implementing the energy efficiency agreement for the property sector and the associated Commercial Property Action Plan received a total of EUR 0.30 million in subsidies towards energy audits in 2011 and 2015 and EUR 6.9 million in investment subsidies towards the implementation of energy saving measures.

Small and medium-sized signatories are entitled to subsidies amounting to 50% of the eligible labour costs of energy audits. Since the implementation of the Energy Efficiency Directive began on 5 June 2014, large enterprises have been ineligible for energy audit subsidies. In some cases, the signatories can also receive investment subsidies towards implementing conventional saving investments, in which the ceiling is usually 20%. Subsidies towards projects involving ESCOs cover up to 25% of project costs if the beneficiary has signed an energy efficiency agreement.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, Energy Authority, the Finnish Association of Building Owners and Construction Clients, Motiva, participating businesses, TEKES - the Finnish Funding Agency for Technology and Innovation

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements scheme (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

The energy efficiency agreement for the property sector was signed at the end of 2009. The agreement is a framework agreement signed by the Finnish Ministry of the Environment, the Finnish Ministry of Economic Affairs and Employment and the Finnish Association of Building Owners and Construction Clients. The energy efficiency agreement for the property sector has two action plans associated with it, one concerning residential lettings associations and one concerning commercial property associations. This description concerns the Commercial Property Action Plan, which was launched in February 2011. The action plan is designed for businesses and non-governmental organisations that have de facto control over their business premises. By the end of 2016, a total of 43 organisations that manage commercial properties had signed the agreement, representing more than 80% of the building stock governed by the action plan.

Signatories joining the Action Plan for commercial property associations set an annual energy saving target (MWh/a) for the period 2020–2025. The target is calculated from energy use at the time of signing.

The signatories have committed themselves to identifying ways to improve energy efficiency in their own properties and production facilities with the help of means such as energy audits, drawing up plans for increasing energy efficiency and implementing cost-effective saving measures as well as providing energy efficiency training to their personnel, disseminating information about energy efficiency and factoring energy efficiency into their plans and procurement. The signatories also have an obligation to take measures and encourage their tenants to use energy more efficiently and to factor energy efficiency into their property management procedures, competitive tendering and contracts. For more information about the agreements for the period 2008–2016, go to http://www.energiatehokkuussopimukset.fi and the new agreement period 2017–2025http://www.energiatehokkuussopimukset2017-2025.fi/.

Businesses that have signed the energy efficiency agreement submit annual reports, via a web-based monitoring system, on their energy consumption, any energy saving measures implemented and progress with their other contractual obligations. The energy saving measures included in the reports can be measures identified during the course of energy audits or otherwise identified by the businesses.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The action plan was launched at the beginning of 2011. The calculations include all energy saving measures which, according to the annual reports of the participating organisations, have been implemented (I), with the exception of measures identified during the course of energy audits. With regard to businesses that also implemented the earlier energy saving agreement (1999–2007), account has also been taken of measures reported during the previous contracting period and their saving effects. The savings (GWh/a) used in the calculations up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. As of the year 2016, annual savings have been estimated on the basis of the average realisation from the previous years. The records cover nearly all of the businesses that have signed the energy efficiency agreement, as almost all of these businesses have submitted annual reports each year.

With regard to measures reported in annual reports unrelated to energy audits, operational and technical measures are reported separately. The lifetime of individual technical measures has not been assessed separately. An average lifetime of 12 years has been used for the reported measures, which is conservative considering the lifetime of 15 years laid down for most technical measures in the Commission's guidelines. A lifetime of five years has been used for operational measures because one of the obligations laid down in the energy efficiency agreement involves monitoring consumption efficiently and reacting promptly to faults.

The assumption was that half of the saving effects of the proposed measures materialise during their year of implementation and the other half extend to the year after the average lifetime of 12 years is reached.

Baseline data

The baseline data is based on the annual reports submitted via the monitoring system by the participating organisations, and data relating to the previous contracting period.

Each of the participating organisations includes at least the following information for each of its offices in its annual report:

- General information (contact details, line of business, participation in the emissions trading scheme, etc.)
- Detailed energy consumption data
- the implementation status of energy-saving measures proposed in the energy audits and analyses
  I = implemented, D = decided, P = possible, A = abandoned
- Energy saving measures other than those identified during the course of energy audits and the following information concerning the same:
  - estimated energy saving (electricity, heating, fuels) in MWh/a
  - implementation year, size of investment, payback period, etc.
- information relating to energy efficiency systems concerning energy consumption monitoring, energy efficiency plans and environmental systems, etc.
- other information relating to the use of renewable forms of energy, how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, the energy efficiency of transport and logistics, etc.

The accuracy of the saving calculations corresponds to the accuracy achieved by means of normal field testing. Some of the baseline data are based on design values or estimates, as measuring is not always possible. In most cases, the savings achieved by saving measures are not verified by retrospective measurement, since measuring is often difficult in practice and results in extra costs.

Motiva checks the orders of magnitude of the data as well as their accuracy in other respects after all reports have been submitted and asks the participating businesses for additional information if necessary.

Overlap

Account has been taken of the overlap with energy audits. This assessment does not factor in the effects of measures identified in connection with energy audits, which have been covered in the impact assessment associated with energy audits in the private service sector.

Impact assessment

The assessment covers the impacts of the Commercial Property Action Plan associated with the energy efficiency agreement for the property sector, with regard to measures other than those identified during the course of energy audits.

The annual energy saving (ES) is based on the energy saving effects (electricity + heating + fuels) of measures reported by the participating organisations as 'implemented' (I). As discussed above, the average lifetime used for technical measures in the calculations is 12 years and that used for operational measures is five years.

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = ES(heating + fuels) + ES(electricity)

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

Parties responsible for impact assessment

Energy Authority/Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	PA–03–TEM	Energy efficiency agreement for the property sector – commercial properties	**3**	**214**	**242**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy audits – industry	3	TE–01–TEM

IMPLEMENTATION PERIOD **Start** 1992 **End** Continuing

MEASURE TARGET Energy consumption attributable to industrial properties and processes

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

The energy audit programme was launched in 1992, and subsidies towards industrial energy audits and analyses have been available since then. A total of EUR 20.7 million was granted in subsidies towards industrial energy audits between 1992 and 2015, of which approximately two thirds were for the projects of medium-sized industrial organisations. The amount of subsidies varied between EUR 0.1 million and EUR 2.1 million between 2008 and 2015, and totalled EUR 8.0 million. The subsidies cover 40% of eligible labour costs for all organisations and 50% of the costs of small and medium-sized organisations that have signed an energy efficiency agreement.
Since the implementation of the Energy Efficiency Directive began on 5 June 2014, large enterprises have been ineligible for energy audit subsidies.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, the Energy Authority, TEKES - the Finnish Funding Agency for Technology and Innovation, Motiva

DESCRIPTION OF THE MEASURE

Energy audits have long been an important part of Finland's energy policy. Energy audits were one of the obligations laid down in the property sector energy saving agreement (1997–2007). Also signatories to the property sector energy efficiency agreements 2008–2016 and energy efficiency scheme 2017–2025 are obliged to investigate measures to enhance energy efficiency, by way of an energy audit for example.

An energy audit includes an evaluation of current energy and water consumption, an examination of potential energy saving measures, an estimation of their saving effects, and reporting. Energy audits are carried out by consultants trained and certified by Motiva.

Three different energy audit templates are available in the industrial sector: industrial energy audit, industrial energy analysis and a two-stage energy analysis for the process industry. Industrial organisations can also use the energy audit templates developed for the service sector, for example, to audit office buildings.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations are based on the saving potential (TSP) of measures identified during the course of energy audits and reported in the energy audit database, as well as the percentage of implemented measures (IP) given by all energy efficiency agreement signatories in their annual reports.

Implementation data is also used to calculate the percentage of the saving potential identified during the course of all energy audits, regardless of whether or not these were carried out pursuant to energy efficiency agreements.

The saving potential data associated with energy audits for the years 1995–2014 is based on energy audit reports. The average materialisation percentage of the saving potential identified during the course of audits has been calculated on the basis of information, submitted by organisations in their annual reports, concerning the implementation of energy efficiency agreements in 2015. The share of energy audits carried out by energy efficiency scheme signatories of all industrial energy audits has varied in recent years, averaging 70% in medium-sized industrial companies and approximately 95% in energy-intensive industrial organisations. The savings relate to both medium-sized industrial organisations and energy-intensive industry. Savings have been calculated separately for premises that fall within the scope of the ESD and for those that fall within the scope of the emissions trading scheme, the savings of which cannot be taken into consideration in the context of the ESD target.

It is estimated that, in 2016, the average saving potential of audits will equal the level of 2012−2014, while that of 2017−2020 will equal the average level implemented during the energy efficiency agreement period in 2008−2014. No figures are available for the year 2015 with regard to average saving potential, as many of the audits carried out in that year have not yet been reported.

Saving potential and implementation figures have been calculated separately for operational measures and technical measures. The lifetime of individual technical measures has not been assessed separately; instead an

average lifetime of 12 years has been used, which is conservative given the lifetime set by the Commission for most technical measures in the private service sector. A lifetime of five years has been used for operational measures, because one of the obligations laid down in the energy efficiency agreement scheme involves monitoring consumption efficiently and reacting promptly to faults. Approximately one third of all measures identified during the course of energy audits are operational measures. The calculations assume that the saving effect of measures identified in audits materialises during the year after the energy audit.

Baseline data

The baseline data is derived from the energy audit and energy efficiency agreement monitoring system. Information is entered into the database at three stages of energy audits.

The following information is submitted concerning the application and funding decision:

- the size of the property, the year in which it was built, the type of property, participation in saving agreements and audit subsidies granted

The following information is submitted concerning the energy audit report:

- energy and water consumption data from the year preceding the audit
- for each proposed measure:
  - a brief description of the measure and categorisation for separating operational and technical measures
  - the heating, electricity and/or water saving in units of energy (kWh/a) and costs (EUR/a)
  - an investment estimate and direct payback period (EUR, a)
  - the status of proposed measures (implemented = I, decided = D, possible = P, abandoned = A)

The following information is submitted concerning annual reports on the implementation of energy saving agreements:

- information on the implementation of measures proposed in connection with energy audits and their status (I, D, P, A)
- participation in the emissions trading scheme

Information taken from energy audit reports includes figures calculated and/or measured by trained and certified energy auditors on site, and calculations produced on the basis of the same. The accuracy of the saving calculations corresponds to the accuracy achieved by means of normal field testing. Some of the baseline data is based on design values or estimates, as measuring is not always possible. In most cases, savings achieved by saving measures are not verified by retrospective measurements, as measurement is often difficult in practice and results in considerable extra costs.

The status of each measure proposed in connection with energy audits must be entered during annual reporting, i.e. whether the measure has been implemented (I), whether a decision has been made to implement the measure (D), whether the possibility of implementing the measure is being contemplated (P) or whether a decision has been taken to abandon the measure (A). When calculating the percentage of saving measures identified during the course of industrial energy audits that are implemented (IP), account is taken of the overall saving effect of implemented and decided measures and five percent of the potential of possible measures.

IP [%] = I + D + +0.05* P

The implementation percentage is calculated separately for heating and electricity saving measures, and for operational measures and technical measures. Furthermore, calculations associated with industrial energy audits make a distinction between medium-sized energy users (total energy use < 100 GWh/a) and energy-intensive energy users (total energy use > 100 GWh/a). Based on the annual reports submitted on the basis of energy efficiency agreements in 2012, the percentages of materialised saving potential (IP) attributable to industrial energy audits were as follows:

- operational measures: 68% for measures relating to heating and fuels (H + F) and 53% for measures relating to electrical energy (E) with regard to medium-sized energy users, and 43% (H + F) and 37% (E) with regard to energy-intensive energy users
- technical measures: 38% (H + F) and 48% (E) for medium-sized energy users and 44% (H + F) and 36% (E) for energy-intensive energy users

Overlap

Energy auditors propose the order in which the identified saving measures should be implemented and factor in any overlaps between individual measures.

An overlap with the effects of industrial sector agreements has been factored into impact assessments of the energy efficiency agreement for businesses.

Impact assessment

The assessment covers the effects of energy audits in the industrial sector. The assessment distinguishes between premises that fall within the scope of the ESD and those that fall within the scope of the emissions trading scheme (non-ESD).

The annual new energy saving effect (ES) is calculated on the basis of the total saving potential (TSP) of the saving measures proposed during the course of the energy audits reported each year with regard to heating and electricity, and the percentage of proposed saving measures that have been implemented (IP). The premises and assumptions used in the calculations are discussed above.

Any new annual energy saving (ES) materialising from the total saving potential (TSP) of any given year is calculated for both operational and technical measures as follows:

ES [GWh/a] = IP(heating) x TSP(heating) + IP(electricity) x TSP(electricity)

The total energy saving effect during each of the years shown in the table below has been calculated by combining the annual saving effects (ES) calculated on the basis of the aforementioned principles.

In addition to the ESD sector, the table shows the saving effect of industrial energy audits in industrial premises that fall within the scope of the emissions trading scheme (non-ESD). Savings from measures identified during the course of process industry energy analyses are mainly covered by annual reports on the implementation of the industrial action plans associated with the energy efficiency agreement for businesses, and are therefore not included in this assessment.

Parties responsible for impact assessment

Energy Authority/Motiva

ENERGY SAVING GWh/a			**2010**	**2016**	**2020**
ESD	**TE–01–TEM**	Energy audits – industry	**438**	**393**	**335**
NON-ESD	**TE–01–TEM**	Energy audits – industry	1,837	1,010	438

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy efficiency agreement for businesses – medium-sized industrial organisations	4	TE–02–TEM

IMPLEMENTATION PERIOD **Start** (1997) 1/2008 **End** Continuing

MEASURE TARGET Industrial enterprise locations with a total annual energy consumption (electricity + heat + fuel) below 100 GWh/a

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

Businesses implementing the action plan for medium-sized industrial organisations associated with the energy efficiency agreement for businesses received a total of EUR 3.6 million in subsidies towards energy audits between 2008 and 2015, and EUR 16.2 million in investment subsidies towards the implementation of energy saving measures.

Small and medium-sized signatories are entitled to subsidies amounting to 50% of the eligible labour costs of energy audits. Since the implementation of the Energy Efficiency Directive began on 5 June 2014, large enterprises have been ineligible for energy audit subsidies. In some cases, the signatories can also receive investment subsidies towards implementing conventional saving investments, in which the ceiling is usually 20%. Subsidies towards projects involving ESCOs cover up to 25% of project costs if the beneficiary has signed an energy efficiency agreement.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

The Finnish Ministry of Economic Affairs and Employment, the Energy Authority, the Confederation of Finnish Industries and its member organisations, the Finnish Forest Industries Federation, Motiva, participating businesses, TEKES, the Finnish Funding Agency for Technology and Innovation.

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements scheme (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

The energy efficiency agreement for businesses sets out five sector-specific action plans for medium-sized industrial organisations (food processing, chemicals, plastics, wood and technology) as well as a generic action plan for the service sector, which is designed for businesses that do not fall under any of the sector-specific action plans.

A total of approximately 290 businesses and their almost 650 offices have joined the medium-sized industrial sector action plans associated with the energy efficiency agreement for businesses. The energy consumption of industrial businesses that have signed an energy efficiency agreement represents over 85% of all industrial energy consumption. The energy consumption of businesses implementing action plans for medium-sized industrial organisations varies from sector to sector and amounts to 50–70% of the total energy consumption attributable to each sector under the ESD.

Signatories joining the energy efficiency agreement between 2017 and 2025 will set an annual energy saving target (MWh/a) for the period 2020–2025. The target is calculated on the basis of energy use at the time of signing.

The signatories have also committed themselves to identifying ways to improve energy efficiency in their own properties and production facilities by means such as energy audits or analyses, drawing up plans for increasing energy efficiency and implementing cost-effective saving measures, as well as providing energy efficiency training for their personnel, disseminating information on energy efficiency and factoring energy efficiency into their plans and procurements. For more information about the agreements for the period 2008–2016, see http://www.energiatehokkuussopimukset.fi/en and for further details on the new agreement period 2017–2025 go to http://www.energiatehokkuussopimukset2017-2025.fi/.

Businesses that have signed the energy efficiency agreement submit annual reports, via a web-based monitoring system, on their energy consumption, any energy saving measures implemented and progress with their other contractual obligations. The energy saving measures included in the reports can be measures identified during the course of energy audits or analyses, or otherwise identified by the businesses.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations include all energy saving measures which have been implemented (I) according to the annual reports

of the participating organisations, with the exception of measures identified during the course of energy audits. With regard to businesses that also implemented the earlier energy saving agreement (1997–2007), account has also been taken of measures reported during the previous contracting period and their saving effects. The savings (GWh/a) used in the calculations up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. Since 2016, annual savings have been estimated on the basis of the average in 2008−2015. The records cover nearly all businesses that have signed the energy efficiency agreement, as almost all of them have submitted annual reports each year.

With regard to measures reported in annual reports unrelated to energy audits, operational and technical measures are reported separately. The lifetime of individual technical measures has not been assessed separately, as in the context of energy audits; instead, an average lifetime of 12 years has been used for reported implemented measures, which is conservative given the 15-year lifetime set by the Commission for most technical measures in the industrial sector. A lifetime of five years has been used for operational measures, because one of the obligations laid down in the energy efficiency agreement involves monitoring consumption efficiently and reacting promptly to faults.

The assumption was that half of the saving effects of proposed measures materialise during their year of implementation and the other half extend into the year after the average lifetime of 12 years is reached.

Baseline data

The baseline data is based on the annual reports submitted via the monitoring system by participating organisations, and data relating to the previous contracting period.

In its annual report, each participating organisation includes at least the following information for each of its offices:

- General information (contact details, line of business, participation in the emissions trading scheme, etc.)
- Detailed energy consumption data
- the implementation status of energy-saving measures proposed in the energy audits and analyses
  I = implemented, D = decided, P = possible, A = abandoned
- Energy saving measures other than those identified during the course of energy audits and the following information concerning the same:
  - estimated energy saving (electricity, heating, fuels) in MWh/a
  - implementation year, size of investment, payback period, etc.
- information relating to energy efficiency systems concerning energy consumption monitoring, energy efficiency plans and environmental systems, etc.
- other information relating to the use of renewable forms of energy, how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, the energy efficiency of transport and logistics, etc.

The accuracy of the calculations of reported savings correlates with the level of accuracy that can be achieved by normal field testing; some of the baseline data is based on design values or estimates, as measuring is not always possible. In most cases, the savings achieved by saving measures are not verified by retrospective measurement, since measuring is often difficult in practice and results in extra costs.

Motiva checks the orders of magnitude of the data as well as its accuracy in other respects after all reports have been submitted, and asks the participating businesses for additional information if necessary.

Overlap

Account has been taken of an overlap with industrial energy audits. With the exception of process industry energy analyses, this assessment does not factor in the effects of measures identified in connection with energy audits, which have been covered in the impact assessment associated with industrial energy audits.

Impact assessment

The assessment covers the impacts of the energy efficiency agreement for medium-sized industrial organisations with regard to measures other than those identified during the course of energy audits. The assessment distinguishes between premises that fall within the scope of the ESD and those that fall within the scope of the emissions trading scheme (non-ESD).

The annual energy saving (ES) is based on the energy saving effects (electricity + heating + fuels) of measures reported by the participating organisations as 'implemented' (I). As discussed above, the average lifetime used in the calculations is 12 years.

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = ES(heating + fuels) + ES(electricity)

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

Parties responsible for impact assessment

Energy Authority/Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	TE–02–TEM	Energy efficiency agreement for businesses – medium-sized industrial organisations	**269**	**446**	**591**
NON-ESD	TE–02–TEM	Energy efficiency agreement for businesses – medium-sized industrial organisations	48	151	179

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy efficiency agreement for businesses – energy-intensive industry	4	TE–03–TEM

IMPLEMENTATION PERIOD **Start** (1997) 1/2008 **End** Continuing

MEASURE TARGET Industrial enterprise locations with a total annual energy consumption (electricity + heat + fuel) a total of over 100 GWh/a

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

Businesses implementing the action plan for energy-intensive industry associated with the energy efficiency agreement for businesses received a total of EUR 3.5 million in subsidies towards energy audits between 2008 and 2014, and EUR 21.5 million in investment subsidies towards the implementation of energy saving measures between 2008 and 2015.

Small and medium-sized signatories are entitled to subsidies amounting to 50% of the eligible labour costs of energy audits, and others to 40%. Since the implementation of the Energy Efficiency Directive began on 5 June 2014, large enterprises have been ineligible for energy audit subsidies. In some cases, the signatories can also receive investment subsidies towards implementing conventional saving investments, in which the ceiling is usually 20%. Subsidies towards projects involving ESCOs cover up to 25% of project costs if the beneficiary has signed an energy efficiency agreement.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

The Finnish Ministry of Economic Affairs and Employment, the Energy Authority, the Confederation of Finnish Industries and its member organisations, the Finnish Forest Industries Federation, Motiva, participating businesses, TEKES, the Finnish Funding Agency for Technology and Innovation.

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements scheme (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

A total of 41 businesses and their almost 131 offices have joined the energy-intensive industrial sector action plans associated with the energy efficiency agreement for businesses. In practice, the energy consumption of businesses implementing the action plan for energy-intensive industry represents almost all energy consumption by Finland's energy-intensive industry. In addition to the action plan for energy-intensive industry, the energy efficiency agreement for businesses sets out five sector-specific action plans for medium-sized industrial organisations (food processing, chemicals, plastics, wood and technology) as well as a generic action plan for the service sector, which is designed for businesses that do not fall under any of the sector-specific action plans.

Signatories joining the energy efficiency agreement between 2017 and 2025 will set an annual energy saving target (MWh/a) for the period 2020–2025. The target is calculated from energy use at the time of signing. Businesses implementing the action plan for energy-intensive industry have also committed themselves to incorporating the continuous improvement of energy efficiency into their environmental and/or management systems. This is done by integrating energy considerations into the aforementioned systems in the way described in the Energy Efficiency System set out in the action plan, and by committing to implementing the system throughout the contracting period. For more information on agreements for the period 2008−2016, see http://www.energiatehokkuussopimukset.fi/en and for further details on the new agreement period 2017−2025 go to http://www.energiatehokkuussopimukset2017-2025.fi/.

Businesses that have signed the energy efficiency agreement submit annual reports, via a web-based monitoring system, on their energy consumption, any energy saving measures implemented and progress with their other contractual obligations. The energy saving measures included in the reports can be measures identified during the course of energy audits or analyses, or otherwise identified by the businesses.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations include all energy saving measures which have been implemented (I) according to the annual reports of the participating organisations, with the exception of measures identified during the course of energy audits. Savings (GWh/a) used in the calculations up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. As of 2016, annual savings have been estimated on the basis of the average in 2008−2015. The records cover nearly all businesses that have signed the energy efficiency agreement, since

practically all of them have submitted annual reports each year.

With regard to measures reported in annual reports unrelated to energy audits, operational and technical measures are reported separately. The lifetime of individual technical measures has not been assessed separately, as in the context of energy audits; instead, an average lifetime of 12 years has been used for reported implemented measures, which is conservative given the 15-year lifetime set by the Commission for most technical measures in the industrial sector. A lifetime of five years has been used for operational measures, because one of the obligations laid down in the energy efficiency agreement involves monitoring consumption efficiently and reacting promptly to faults.

The assumption was that half of the saving effects of the proposed measures materialise during their year of implementation and the other half extend into the year after the average lifetime of 12 years is reached.

Baseline data

The baseline data is based on the annual reports submitted via the monitoring system by the participating organisations, and data relating to the previous contracting period.

In its annual report, each participating organisation includes at least the following information for each of its offices:

- General information (contact details, line of business, participation in the emissions trading scheme, etc.)
- Detailed energy consumption data
- The implementation status of energy-saving measures proposed in the energy audits and analyses: I = implemented, D = decided, P = possible, A = abandoned
- Energy saving measures other than those identified during the course of energy audits and the following information concerning the same:
  - estimated energy saving (electricity, heating, fuels) in MWh/a
  - implementation year, size of investment, payback period, etc.
- information relating to energy efficiency systems concerning
- energy consumption monitoring, energy efficiency plans and environmental systems, etc.
- other information relating to the use of renewable forms of energy, how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, the energy efficiency of transport and logistics, etc.

The accuracy of calculations of reported savings correlates with the level of accuracy that can be achieved by normal field testing; some baseline data is based on design values or estimates, as measuring is not always possible. In most cases, the savings achieved by saving measures are not verified by retrospective measurement, since measuring is often difficult in practice and results in extra costs.

Motiva checks the orders of magnitude of the data as well as its accuracy in other respects after all reports have been submitted, and asks the participating businesses for additional information if necessary.

Overlap

Account has been taken of an overlap with industrial energy audits. With the exception of process industry energy analyses, this assessment does not factor in the effects of measures identified in connection with energy audits, which have been covered in the impact assessment associated with industrial energy audits.

Impact assessment

The assessment covers the impacts of the energy efficiency agreement for energy-intensive industry with regard to measures other than those identified during the course of energy audits. The assessment distinguishes between premises that fall within the scope of the ESD and those that fall within the scope of the emissions trading scheme (non-ESD).

The annual energy saving (ES) is based on the energy saving effects (electricity + heating + fuels) of measures reported by the participating organisations as 'implemented' (I). As discussed above, the average lifetime used in the calculations is 12 years.

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = ES(heating + fuels) + ES(electricity)

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles. **Parties responsible for impact assessment**

Energy Authority/Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	TE–03–TEM	Energy efficiency agreement for businesses – energy-intensive industry	**250**	**354**	**263**
NON-ESD	TE–03–TEM	Energy efficiency agreement for businesses – energy-intensive industry	7,272	9,970	11,428

MEASURE		MEASURE CODE
Improving the energy efficiency of cars		LI–01–LVM

IMPLEMENTATION PERIOD	Start	6/2009	End	Continuing

MEASURE TARGET	Car buyers

MEASURE CONCERNS	Heat	No	Electricity	No	Fuel	Yes	Water	No

FINANCING AND BUDGET

Market-based

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Contributing to the drafting of EU regulations: Finnish Ministry of Transport and Communications; Taxation: Finnish Ministry of Finance; Development of information management: LVM

DESCRIPTION OF THE MEASURE

Measures for improving the energy efficiency of cars include the following:

1) EU legislation
2) taxation and
3) information management development.

EU legislation

Regulation (EC) No 443/2009 of the European Parliament and of the Council setting emission performance standards for new passenger cars (a binding CO2 ceiling for cars) entered into force in June 2009. The Directive was revised in the spring of 2014 to set new ceilings for the year 2020. The objective is to lower the new car stock's average carbon dioxide emissions to the level of 95 g/km by 2020. The target for 2015 was 120-130 g of CO2/km. This target was reached, with the CO2 emissions of newly registered passenger cars in 2015 being 123.6 g/km on average.

Taxation

Finland's car tax legislation was revised in 2007 and 2011. The 2007 reform involved basing the amount of car tax on the specific emissions of each vehicle (CO_2/km). The reform entered into force on 1 January 2008. The 2011 reform introduced changes to tax bands, whereby the lowest car tax band was lowered from 12.2% to five percent and the highest tax band was raised from 48.8% to 50%. The 2015 tax bands were changed, the lowest car tax band being 3.8% in 2017. The lowest tax band applies to vehicles with carbon dioxide emissions amounting to 0 g/km. The highest tax band applies to vehicles with carbon dioxide emissions amounting to 360 g/km or more. The 2015 reform entered into force on 1 January 2016.

The vehicle tax system was also revised in 2007, in order to base the amount of tax payable on the specific emissions of each vehicle. The basic rate was initially set at between EUR 19 and EUR 606 a year, depending on the amount of specific carbon dioxide emissions attributable to each vehicle. The lowest tax band applies to vehicles with carbon dioxide emissions amounting to 0 g/km. The highest tax band applies to vehicles with carbon dioxide emissions amounting to 400 g/km or more. The Vehicle Tax Act was also revised towards the end of 2011. The lowest basic rate band was raised from EUR 19 to EUR 43 per year, while the highest rate band remained unchanged (EUR 606 per year). The vehicle tax was raised again in 2015. The tax increase was implemented by increasing the amount of tax based on CO_2 emissions. This means that the lowest tax rose from EUR 43 to EUR 69.71 and the highest tax to EUR 617.94. At the beginning of 2017, the vehicle tax was raised to make all taxable vehicles subject to an increase of EUR 36.50, regardless of the emissions level. This put the lowest amount of tax at EUR 106.21 and the highest at EUR 654.46.

In addition to the basic rate of the applied vehicle tax, a driving power tax based on the vehicle's total weight is levied on passenger cars, vans and lorries other than those using motor gasoline as fuel or driving power.

Information guidance

In connection with the tax reform, Finland introduced an energy labelling system for cars, which is similar to the A–G energy efficiency classification used for domestic appliances. The energy marking is given for both new passenger cars and vehicles, whose first date of use was later than 2000, in the Car Comparison Service of the Finnish Transport Safety Agency's (Trafi) Car Comparison Service (http://autovertaamo.trafi.fi/). The use of the energy labelling scheme for cars has been promoted by training car sales people and disseminating information to customers.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, the premises and principles of which are described below.

Premises and assumptions

The potential to reduce CO2 emissions is based on calculations by VTT Technical Research Centre of Finland, where the BAU scenario (= no measures) is assumed to be a continuation of the trend prevailing in 2006–2007 with regard to the distribution of car sales (petrol and diesel) and average carbon dioxide emissions. The average carbon dioxide emissions of sold cars have fallen as a consequence of these measures.

To evaluate the effectiveness of the measures taken for the year 2016, the situation at the end of 2016 has been used as the baseline, assuming that the average carbon dioxide emissions of cars taken into use between 2008 and 2016 is the average given in sales statistics, and that the cars average normal annual mileage. It is likely that the large increase in diesel car sales (which accounted for 28% of all car sales in 2007 and 50% in 2008) has created a group of diesel car users who drive less than the previous typical annual mileage for diesel cars, otherwise the total mileage would have increased. The calculations assume that approximately 30% of cars are continuing to put in the previous "normal" diesel mileage and that the average CO2 emissions from these cars correspond with the statistics. The remainder of diesel cars are assumed to be averaging an annual mileage typical of petrol-powered cars, but their average CO2 emissions have been derived from the statistics for diesel cars. All cars registered as petrol-driven are assumed to be putting in the typical annual mileage and producing the average carbon dioxide emissions recorded in the statistics. However, only 50% of the emissions attributable to cars sold in 2016 are included, as it has been assumed that new cars are taken into use at a steady rate throughout the year.

The reduction in emissions in 2016 is therefore based on the difference between these emissions figures, or approximately 616,000 tonnes of CO2, which equates to a drop of approximately 14 percent in combined carbon dioxide emissions attributable to new cars sold in 2008–2016. Similarly, the difference in emission figures for 2020 has been estimated at around 1,180,000 tonnes of CO_2.

Carbon dioxide amounts have been converted into energy at a ratio of: 1 tonne of CO2 = 0.00379 GWh. The drop in energy consumption in 2012 therefore amounts to 1,008 GWh, which equates to a drop of around 10% in the energy consumption attributable to cars each year. The corresponding figures for 2016 are 2,336 GWh, with a reduction of about 14%. The reduction for 2020 is estimated at 4,245 GWh, or 18.5%.

Baseline data

Passenger cars' average carbon dioxide emissions, source: Finnish Transport Safety Agency Trafi. Annual mileage, source: LIPASTO/LIISA 2015 (VTT)

Overlap

The assessment takes account of the combined impact of the EU's binding ceiling values for CO_2 from passenger cars and the Finnish tax system, as it was not possible to distinguish between the impact of the individual measures.

Impact assessment

The saving estimate for the year 2012 is therefore around 10% of the annual energy consumption of cars. The savings estimated for the years 2016 and 2020 amount to approximately 14% and 19% respectively. These figures are based on conservative forecasts of new car sales, which are insufficient for upgrading the car stock in the long term.

Parties responsible for impact assessment

Finnish Ministry of Transport and Communications/VTT Technical Research Centre of Finland

ENERGY SAVING GWh/a			2012	2016	2020
ESD	LI–01–LVM	Improving the energy efficiency of cars	**1,008**	**2,336**	**4,475**

MEASURE		MEASURE CODE
Promoting public transport		LI–03–LVM

IMPLEMENTATION PERIOD	Start	Continuing	End	Continuing

MEASURE TARGET	People who make choices between forms of transport

MEASURE CONCERNS	Heat	No	Electricity	No	Fuel	Yes	Water	No

FINANCING AND BUDGET

Public transport subsidies in large urban areas (Helsinki Regional Transport Authority, Oulu, Tampere, Turku) totalled around EUR 12.2 million in 2013, about 12.8 million in 2014, and about 9.8 million in 2015–2017. State funding is no more than 50% of total costs, with the remaining amount paid by municipalities. The municipalities' share of the costs vary, but they are generally much higher than that of the state. Annual state subsidies for mobility control total some EUR 900,000.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Transport and Communications, Finnish Ministry of the Environment, municipalities

DESCRIPTION OF THE MEASURE

The energy efficiency of transport could be improved considerably by increasing the number of public transport passengers and by replacing private car use with an efficient, functional public transport system. Key measures for the promotion of public transport include the following:

1) coordinating land use and transport, particularly in growing cities and towns

2) gearing road investments towards projects that promote public transport

3) development of traffic market legislation (especially the new Act on traffic services, Laki liikenteen palveluista)

4) financial support for public transport and

5) mobility management both nationally and in major cities.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, the premises and principles of which are described below.

Premises and assumptions

The potential to reduce CO2 emissions is based on calculations by VTT Technical Research Centre of Finland and the 2009–2020 Climate Policy Programme of the Finnish Ministry of Transport and Communications. Carbon dioxide volumes have been converted into energy using the CO2-to-energy correlation for fossil transport fuels indicated by the LIISA system, which was developed by VTT Technical Research Centre of Finland for calculating Finland's road transport emissions. The percentage of biofuels is irrelevant in this context, as around the same amount of energy is needed to propel a car regardless of the origin of the fuel.

The conversion coefficient is: 1 tonne of CO_2 = 0.00379 GWh.

The impact of promoting public transport has been calculated by determining how many car users could potentially switch to using public transport. The target is to increase the annual number of journeys by 100 million by 2020 (approximately 500 million journeys/year in 2008). The potential for switching to public transport has been estimated separately for major cities, other towns, and long-distance transport. Consideration has also been given to the adjustment of fleet sizes in rural areas. The calculated target for increasing the number of public transport journeys was also examined from another perspective, based on different groups of people and the likelihood of them increasing their use of public transport. The calculation established that the targeted increase in the use of public transport is achievable if approximately half of the active population and the elderly increase their use of public transport by one or two journeys per week in major cities, and if there is some increase in other areas.

Baseline data

Major cities

With regard to major cities, the calculations are based on the report "Additional Studies on the Efficiency of Public Transport in Major Urban Areas" of January 2009 and the level of subsidies at the time, EUR 80 million. The funding is split between different cities according to population. Each area has a separate budget for tickets and for improving the standard of service, either on main routes or new routes. Some of the funding has been earmarked for giving buses priority at traffic lights and for the provision of up-to-date information, as well as for improving safety in the Greater Helsinki area in particular.

Contrary to the report on subsidies for public transport in major towns and cities, where the time frame was five

years (elasticity of 0.2–0.5), the calculations set out here estimated the impact of public transport improvements and falling prices over the long term (elasticity of 0.5–1.0). Greater elasticity over a longer period of time, i.e. the effectiveness of the measure, is the result of passenger awareness of better services increasing over time, growing faith in the service and its quality, and other travel-related choices gradually adapting to the new situation (e.g. selection of ticket types and choices relating to car use or purchases).

The elasticity calculations have divided journeys into three categories: commuting, shopping and errands, and leisure. The main forms of transport were also divided into three categories: walking and cycling, public transport and passenger car. Journey yield figures and mean journey distances for these groups, given separately for city centres and suburbs, have been taken from local governments' own studies or from the results given by the National Travel Survey 2004–2005 for each commuting area type. Changes in mileage were calculated on the basis of the average number of passengers per journey group.

The increase in ticket revenue has been estimated very roughly, as the calculations do not factor in any division into ticket types or switching from one ticket type to another.

Other towns

The estimate for the increase in journeys by public transport in other towns has been directly derived from the estimates included in the recently published action plan for improving everyday mobility through better public transport in 2009–2015.

Interurban transportation

For long-distance transport, the assessment was based on the aforementioned public transport development programme, estimates by VR Group, as well as an impact assessment of the Journey.fi online travel service and an associated survey.

Overlap

The impacts of the measure overlap to some degree with the impacts of measures to promote walking and cycling: both measures contribute to the drop in private car use and it is not always possible to distinguish between them.

Impact assessment

See Baseline data. Since follow-up data is unavailable, the figures are estimates.

Parties responsible for impact assessment

Finnish Ministry of Transport and Communications/VTT Technical Research Centre of Finland

ENERGY SAVING GWh/a			2010	2016	2020
ESD	LI–03–LVM	Promoting public transport	**38**	**230**	**570**

MEASURE		MEASURE CODE
Promoting walking and cycling		LI–04–LVM

IMPLEMENTATION PERIOD	Start	Continuing	End	Continuing

MEASURE TARGET	People who make choices between forms of transport

MEASURE CONCERNS	Heat	No	Electricity	No	Fuel	Yes	Water	No

FINANCING AND BUDGET

State funding of pedestrian and cycling conditions has been scarce in recent years. Municipalities are increasingly also funding pedestrian and cycling routes along roads. Municipalities' own road networks have comprehensive pedestrian and cycling routes, and such routes in new areas have usually been built at the same time as other civil engineering projects

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Transport and Communications, Finnish Ministry of the Environment, municipalities

DESCRIPTION OF THE MEASURE

The energy efficiency of transport could be improved considerably by replacing short car journeys with walking and cycling. Key measures for promoting walking and cycling include the following:

1) revising planning practices and coordinating land use and transport, especially in growing cities and towns

2) improving the infrastructure for pedestrians and cyclists

3) increasing the maintenance of pedestrian and cycling routes, and
4) mobility management both nationally and in major cities.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, the premises and principles of which are described below.

Premises and assumptions

The potential to reduce CO2 emissions is based on calculations by VTT Technical Research Centre of Finland and the 2009–2020 Climate Policy Programme of the Finnish Ministry of Transport and Communications. Carbon dioxide volumes have been converted into energy using the CO2-to-energy correlation for fossil transport fuels, presented by the LIISA system developed by VTT Technical Research Centre of Finland for calculating Finland's road transport emissions. The percentage of biofuels is irrelevant in this context, as around the same amount of energy is needed to propel a car regardless of the origin of the fuel.

The conversion coefficient is: 1 tonne of CO_2 = 0.00379 GWh.

Baseline data

The estimated increase in the number of journeys made by walking and cycling is based on the shift from private car use to walking or cycling. The target is to increase the annual number of journeys by 300 million by 2020 (approximately 1.6 billion journeys/year in 2008). According to the 2010–2011 passenger transport survey, almost one quarter (23%) of all journeys of less than one kilometre and more than half (53%) of all journeys between one and three kilometres are made by private car. Although some short car journeys may be linked to a longer journey, most of them are independent journeys started with a cold engine. The calculations assume a 30% shift from short car journeys to walking and cycling.

Overlap

The impacts of the measure overlap to some degree with the impacts of measures to promote the use of public transport: both measures contribute to the drop in private car use and it is not always possible to distinguish between them.

Impact assessment

The measure's impact on CO2 emissions (converted into energy using the aforementioned coefficient) has been calculated on the basis of different car journey lengths (< 3 km and 3–5 km), the percentage of switching (30% for < 3 km and 10% for 3–5 km) and average car emissions (g/km) presented by the LIISA system of VTT Technical Research Centre of Finland. The calculations factor in the additional emissions attributable to starting up cold engines and the impact of technological development on average emissions attributable to the entire vehicle stock. Since follow-up data is unavailable, the figures are estimates.

Parties responsible for impact assessment

Finnish Ministry of Transport and Communications/VTT Technical Research Centre of Finland					
ENERGY SAVING GWh/a			**2010**	**2016**	**2020**
ESD	**LI–04–LVM**	Promoting walking and cycling	**38**	**190**	**460**

MEASURE		MEASURE CODE
Changes in the mass and dimensions of heavy goods vehicles		LI–05–LVM

IMPLEMENTATION PERIOD	Start	2013	End	Continuing

MEASURE TARGET	Heavy goods vehicles

MEASURE CONCERNS	Heat	No	Electricity	No	Fuel	Yes	Water	No

FINANCING AND BUDGET

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Transport and Communications, Finnish Transport Agency, Finnish Transport Safety Agency

DESCRIPTION OF THE MEASURE

The ceiling for the maximum weight of articulated lorries was raised in Finland in 2013. Since then, further increases have been effected by making minor amendments to the Decree on the Use of Vehicles on the Road (1257/1992). The maximum total weight allowed for lorries operating on Finnish roads is 76 tonnes (previously 60 tonnes). This applies to vehicles with at least nine axles. The maximum weight of vehicles with eight axles is 68 tonnes. The maximum weights of four- and five-axle vehicles were increased from 32 to 38 tonnes and 35 to 42 tonnes, respectively. The maximum height was raised from 4.2 metres to 4.4 metres. The maximum weight of a three-axle vehicle was increased on 1 March 2017, under certain conditions, from 26 to 28 tonnes, while the maximum weight of an articulated lorry with six axles was increased from 48 to 52 tonnes.

The goal is to increase the cost-effectiveness of transport and improve energy efficiency. Energy efficiency can be optimised by larger vehicles travelling with full loads.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, the premises and principles of which are described below.

Premises and assumptions

It is estimated that the new ceilings for dimensions and weights will lower annual CO_2 emissions by as much as 180,000 tonnes, which would equate to almost 1.5% of all carbon dioxide emissions attributable to transport. However, this requires that the new dimensions and weight limits do not cause a shift from rail to road transport and that vehicles operate with full loads. The change has not been found to cause any major shift of transports from rail to road. The impact of the measure has been examined from three perspectives:

1) Permanent drop in consumption as a result of higher maximum weight limits.
2) Drop in consumption during the transition period (seven years), and
3) Drop in consumption as a result of the increased height limit (0.2 m).

The change with regard to all these variables will materialise at a different rate depending on how quickly advantage can be taken of the new regulations across the fleet.

Baseline data

The calculations are based on a report by Statistics Finland on lorry mileage by axle type and category of goods in domestic transport in 2011. The data cover 45 categories of goods and 17 different classes of vehicles/axles. The new dimensions and weight limits affect different categories of goods and different vehicle classes in different ways.

Statistics Finland material was also studied with respect to lorry mileage in Finland per gross weight category. The years that were studied were 2012, 2013 and 2015. According to the statistics, vehicles with a gross weight in excess of 60 tonnes accounted for 0.1% of tonne-kilometres in 2012, 5.2% in 2013 and 47.9% in 2015. However, the percentages of tonne-kilometres by vehicles with a gross weight of 53 tonnes has remained more or less the same (about 71–72% during the entire period under review, with the total tonne-kilometres fluctuating by no more than ±3%).

http://www.stat.fi/til/kttav/2015/kttav_2015_2016-05-18_tau_003_fi.html

Overlap

There is no overlap between the permanent impacts of the new weight limits and impacts during the transition period. The impact of the new height limit, on the other hand, overlaps to some degree with the permanent impacts, in so far as advantage can be taken of both the new weight limits and the new height limit across the modernised fleet. The extent of the overlap has not been calculated, but it is not believed to be very large.

Impact assessment

The aforementioned goods-specific transport matrix incorporates a coefficient for the impact on each category of goods and each type of vehicle/axle, based on expert opinion. The mileage attributable to each was multiplied by

this coefficient in order to calculate the impact. The change in the volume of cargo (%) in each type of vehicle/axle, and therefore the drop in tonne-kilometres, was calculated separately. The total CO_2 emissions attributable to lorry transport were multiplied by the ratio of mileage saved v. total tonne-kilometres, in order to arrive at the drop in CO_2 emissions. The figure was then converted into energy by multiplying it by the average energy-to-emissions ratio of 0.004032 GWh/tCO_2.

Vehicles corresponding to the new regulations were assumed to have been adopted fully by 2020 and their number to grow linearly between 2014 and 2020. The energy volume attributable to the permanent change was calculated in this way. A seven-year transition period, from 2014 to 2020, was used assuming that the impact would peak after two years and begin to decrease during the fourth year, reaching zero in 2020. The impact of the new height limit was assumed to materialise as the fleet is upgraded, and the change from 2014 to 2020 was assumed to be linear.

Parties responsible for impact assessment

Finnish Ministry of Transport and Communications/Finnish Transport Safety Agency/VTT Technical Research Centre of Finland

ENERGY SAVING GWh/a			2010	2016	2020
ESD	LI–05–LVM	Changes in the mass and dimensions of heavy goods vehicles	**0**	**400**	**550**

MEASURE		MEASURE CODE
Investments in heating plants		MA–01–MMM

IMPLEMENTATION PERIOD	Start	1996	End	Continuing

MEASURE TARGET	Farms

MEASURE CONCERNS	Heat	No	Electricity	No	Fuel	Yes	Water	No

FINANCING AND BUDGET

The Ministry has been granting investment subsidies towards building heating plants since 1996. The majority of subsidised investments relate to switching from fossil fuels to biofuels produced on site. Subsidies are available for building, upgrading and extending heating plants on farms.

Subsidies are either given in the form of interest subsidies (up to 50–80%, depending on the project) or grants (up to 15-40% of eligible costs). The grant was increased from 35% to 40% in 2016.

Applications are processed by the rural development departments of Centres for Economic Development, Transport and the Environment. Subsidies are paid in up to five instalments as the project progresses, against cost receipts.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Agriculture and Forestry, Finnish Agency for Rural Affairs (payment and follow-up), rural development departments of Centres for Economic Development, Transport and the Environment (funding decisions and oversight)

DESCRIPTION OF THE MEASURE

The Finnish Ministry of Agriculture and Forestry promotes the use of wood and materials and energy derived from renewable natural resources in construction. Many farms are self-sufficient in wood chip production and switching to this form of energy is usually a profitable investment. Other biofuels produced by agricultural activity are also used.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations. The saving is based on replacing existing fossil fuel boilers (oil) with renewable forms of energy produced on farms (wood chips or energy crops) pursuant to the ESD, thereby reducing the need for delivered energy.

Premises and assumptions

ELY-centres store information on subsidy applications in the HYRRÄ information system (called RAHTU until 2015). Applications specify the scope of the project (power output to be replaced), estimated costs and any subsidies already granted, details of the applicant and the date of the application. Funding decisions and the related information are recorded in the same database.

Eligible heating plant projects include new piggery, poultry-rearing establishment and greenhouse and grain drying projects and the associated new heating plants or extensions to existing heating plants, as well as other heating plants used to replace existing ones.

The calculation is based on the number of completed heating plant projects, the average output and an estimate of annual running time and efficiency.

The following assumptions were used in the impact assessment:

- because the heating plants using biofuel that are presented in the applications replace not only heating plant power produced with oil but also older log or wood chip boilers, which are assumed to account for 15% of the projects, the savings are calculated on the basis of replacing oil-fired boilers with biofuels
- It is expected that around 85% of heating plant modernisation projects will be completed.
- some applicants cannot get fuel from their own farm but must buy it from elsewhere (pellets, wood chips etc.), the assumption is that 80% will use their own fuel until 2013, falling to 70% after that
- Due to the combined effects of the aforementioned correction coefficients, only 58% of the total power proposed in the applications will be realised by 2013 and 51% in subsequent years.
- The annual running time of a biofuel-based boiler at full power is between 4,500 and 5,000 hours, as biomass-based boilers are rarely dimensioned according to their nominal maximum power and farms are likely to use an oil-fired boiler alongside their biomass boiler in cold winter weather (and many have an oil-fired boiler as a backup system).
- The impact assessment assumes that 30% of projects for which funding is applied each year are implemented during the same year and the remaining 70% not until the following year.
- Biomass boilers have a useful life of 25 years, which is why savings have been calculated as of the year

1996.

Baseline data

The following data has been derived from funding applications:

- Approximately 330 applications were submitted each year between 1996 and 1999, and the total power output to be replaced was around 5.5 MW per year.
- Between 200 and 300 applications were submitted each year between 2001 and 2005, and the associated total power output was approximately 28 MW.
- Power output data was not collected systematically between the years 2006 and 2012. For this reason, the Finnish Ministry of Agriculture and Forestry has estimated the average power output of heating plants as of the year 2006 on the basis of typical power demand and the type and scope of investment projects. The estimate is based on projects implemented between 1996 and 2005. The total estimated power associated with projects was 27 MW in 2006, 166 MW in 2007, 62 MW in 2008, 85 MW in 2009, 31 MW in 2010, 66 MW in 2011 and 74 MW in 2012.
- The total power of subsidised projects was 84.4 MW in 2013, 53.4 MW in 2014, 25.8 MW in 2015 and 38.6 MW in 2016.

Overlap

None.

Impact assessment

The assessment is for heating plant investments that involve replacing an old fossil fuel (oil) boiler with a boiler that runs on renewable forms of energy (such as wood chips or energy crops) produced on site.

The annual energy saving (ES) calculated pursuant to the ESD is based on the saving in delivered energy (oil). As has been stated above, the average useful life of boilers is 25 years, which means that all of these investments have an impact throughout the programming period.

Annual energy savings (ES) are calculated using the following formula:

ES [GWh/a] = installed boiler capacity per year [MW] x running time at full power [h] x a,

where

a = 0.58 = corrective coefficient (0.51 in 2014) to take account of the fact that some of the

- old boilers were running on renewable forms of energy before the upgrade
- some applicants do not produce their fuels on site and instead buy them in, and
- some subsidised projects do not go ahead for one reason or another.

The total energy saving effect during the years shown in the table below was calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

Parties responsible for impact assessment

Finnish Ministry of Economic Affairs and Employment/Motiva (NEEAP-2-method, Olof Granlund Engineering)

ENERGY SAVING GWh/a			2010	2016	2020
ESD	MA–01–MMM	Investments in heating plants	**1,201**	**1,950**	**2,198**

MEASURE		MEASURE CODE
Fresh grain silos		MA–02–MMM

IMPLEMENTATION PERIOD	Start	2008	End	Continuing

MEASURE TARGET	Farms

MEASURE CONCERNS	Heat	No	Electricity	Yes	Fuel	Yes	Water	No

FINANCING AND BUDGET

The Finnish Ministry of Agriculture and Forestry grants subsidies towards fresh grain silos. Subsidies are either given in the form of interest subsidies (up to 70% depending on the project) or grants (up to 10-40% of eligible costs). Applications are processed by the rural development departments of Centres for Economic Development, Transport and the Environment. Subsidies are calculated on the basis of the Ministry of Agriculture and Forestry's unit costs and paid in up to five instalments as the project progresses, against cost receipts. Subsidies are only available towards specific types of projects.

The amount of subsidies granted towards fresh grain silo towers and clamp silos depends on the level of subsidies available for the line of livestock production involved.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Agriculture and Forestry, Finnish Agency for Rural Affairs (payment and follow-up), rural development departments of Centres for Economic Development, Transport and the Environment (funding decisions and oversight)

DESCRIPTION OF THE MEASURE

The Finnish Ministry of Agriculture and Forestry promotes construction relating to agriculture, other rural business and rural living, as well as developing the rural built environment. The goal is to create economical and functional buildings and a good rural environment. Means of achieving this goal include construction steering, cooperation between public authorities and research and development. The Finnish Ministry of Agriculture and Forestry promotes the use of wood and materials and energy derived from renewable natural resources in construction, by means such as investment subsidies.

The measure's saving effect is based on eliminating the need to dry animal feed before storage. In livestock production, the storage of fresh feed grain in air-tight silos, or in open silos once it has been treated with a preservative, significantly reduces the use of grain dryers and the associated energy consumption.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which is based on the number of fresh grain silo projects that have been completed.

Premises and assumptions

ELY-centres store information about subsidy applications in an information system (called RAHTU until 2015, and now known as HYRRÄ).

Applications specify the scope of the project (silo capacity).

The assumption is that subsidies are used to build silos for grains that are not dried. The use of fresh grain silos reduces the need to use grain dryers and therefore lowers energy consumption. Most grain dryers are oil-powered. Between 90% and 95% of hot air dryers are oil-powered. The use of cold air dryers is no longer very widespread but they do still exist, particularly on small farms. Cold air dryers that are equipped with a heating system are usually heated with electricity or oil, and, in some cases, a wood-heated heat exchange system.

The following assumptions were used in the impact assessment:

- The silos are used to store feed that would otherwise be dried.
- Approximately 95% of the total capacity for which subsidies are sought is actually built.
- Some of the dryers do not run on oil but on renewable forms of energy (pellets, wood chips); the calculation is based on oil-powered dryers accounting for 95% of the total energy consumption.
- The impact assessment assumes that 60% of projects for which funding is applied each year are implemented during the same year and the remaining in the following year
- It is assumed that the silo capacity disclosed in the applications will grow annually by 10 % as of the year 2016.

Baseline data

Fresh grain is stored in gas-tight tower silos, or in clamp silos if preservatives are used. Statistics on gas-tight silo capacity have been obtained directly from information systems. Grain storage accounts for approximately 5-10% of

all clamp storage. Fresh grain storage is increasing and already accounts for 20-30% on large cattle farms. A small percentage of feed grain is stored in cold air dryers and in dryer silos that have fans equipped with electric motors.

Subsidies were granted towards approximately 40 dryer silos at the end of the 2000s. Their average storage capacity was around 1,500 m^3. There are no statistics on the numbers of cold air dryers and dryer silos, but it is estimated that their use for grain storage is almost as widespread as that of clamp silos.

The storage capacity figures recorded in the databases are estimates of actual use. The total storage capacity of silos tends to be 10-20% greater than the figures in the databases.

The storage capacity of various types of fresh grain silos has been obtained from subsidy applications, for subsequent use in energy saving calculations:

- 2008: 51,700 m^3, 2009: 67,800 m^3, 2010: 54,400 m^3, 2011: 73,300 m^3, 2012: 73,200 m^3, 2013: 84 100 m^3:
  2014: 97,000 m^3, 2015: 23,600 m^3, 2016: 49 900 m^3
- Subsidised construction capacity is expected to increase by 10% a year after 2016.

Drying reduces the moisture content of grain from 23% to approximately 14% on average. The energy required for drying amounts to approximately 170 kWh/1 000 kg (source: Guide to grain drying with domestic fuels, Finnish Forest Centre). The average specific weight of grain is assumed to be 190 kg/m^3. Drying one cubic metre of grain consumes approximately 32.3 kWh/m^3 of oil.

Overlap

None

Impact assessment

The estimate relates to fresh grain silos that allow farms to save the energy that would normally be needed to dry feed grain.

The energy savings generated by fresh grain silos have been calculated as of 2008 with the average silo lifetime being more than 20–25 years; the saving effect therefore extends across the entire programming period.

Annual energy savings (ES) are calculated using the following formula:

ES [GWh/a] = energy required to dry grain [kWh/m^3] x annual increase in fresh grain silo capacity [m^3] x a, where a =
0.9 = corrective coefficient to factor in the following:

- Some dryers are not oil-powered, but use fuels such as wood chips procured on site.
- For one reason or another, not all projects towards which funding has been granted go ahead.

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

Parties responsible for impact assessment

Finnish Ministry of Economic Affairs and Employment/Motiva (NEEAP-2-method, Olof Granlund Engineering)

ENERGY SAVING GWh/a			2010	2016	2020
ESD	MA–02–MMM	Fresh grain silos	**4**	**16**	**23**

MEASURE		MEASURE CODE
Energy efficiency of cowsheds and pig farms		MA–03–MMM

IMPLEMENTATION PERIOD	Start	2008	End	Continuing

MEASURE TARGET	Farms

MEASURE CONCERNS	Heat	No	Electricity	Yes	Fuel	Yes	Water	No

FINANCING AND BUDGET

Investment subsidies are available towards building unheated livestock sheds (cowsheds). Subsidies are either given in the form of interest subsidies (up to 50–80% depending on the project) or grants (up to 15–40% of eligible costs). Applications are processed by the rural development and environment departments of Centres for Economic Development, Transport and the Environment. Subsidies are calculated on the basis of the Ministry of Agriculture and Forestry's unit costs and paid in up to five instalments, as the project progresses and against cost receipts.

Investment subsidies are also available towards building heat recovery systems for liquid manure gutters on pig farms. Subsidies are given in the form of grants that cover up to 50% of eligible costs.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Agriculture and Forestry, Finnish Agency for Rural Affairs (payment and follow-up), rural development departments of Centres for Economic Development, Transport and the Environment

DESCRIPTION OF THE MEASURE

The Finnish Ministry of Agriculture and Forestry promotes construction relating to agriculture, other rural business and rural living, as well as developing the rural built environment. The goal is to create economical and functional livestock production buildings that provide a high level of animal welfare and a good rural environment. Means of reaching this goal include construction steering, cooperation between public authorities and research and development.

The Finnish Ministry of Agriculture and Forestry promotes the use of wood and materials and energy derived from renewable natural resources in construction, by means such as investment subsidies. The Ministry of Agriculture and Forestry encourages the use of renewable forms of energy and energy efficiency, and grants subsidies towards the construction of unheated livestock sheds where these do not compromise animal welfare.

Cows generate a considerable amount of heat. No heating is required in cowsheds. Other areas such as milk processing areas and staff facilities do require heating, but this can be arranged using heat generated when cooling milk, heating plants built for other purposes or electric radiators. Calving pens may require additional heating. Electricity consumption attributable to ventilation on farms with adult animals can be lowered by means of curtain solutions and natural ventilation, and the amount of electricity needed for lighting can be reduced by means of curtain solutions and skylights.

The thermal energy contained in liquid manure gutters on pig farms can be recovered and used to heat pig production facilities or staff facilities. The net saving amounts to approximately one third of the thermal energy contained in manure in Finnish conditions. Lowering the temperature of manure also helps to prevent the evaporation of gaseous nitrogen compounds, which reduces the need for ventilation, as well as mitigating harmful climatic effects.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which is based on the number of unheated and semi-heated cowshed projects that have been completed.

Premises and assumptions

ELY-centres store information about subsidy applications in the HYRRÄ information system (called RAHTU until 2015).

Unheated cowsheds

Applications specify the scope of the project (square metres), the intended use of the facilities (dairy or suckler cows) and their type (cold or cool).

The assumption is that cold or cool cowsheds will be built to replace heated facilities (both existing and new). Traditional cow sheds are usually at least semi-heated with the help of a building-specific heating plant, or a heating plant that serves the entire farm.

The thermal energy consumption of a traditional cow shed was calculated with the help of the RIUSKA system. The calculations were based on a cow shed with 60–65 cows and an area of 1,000 m^2. The specific consumption given by the calculation, 21 kWh/m^2, was used as the typical consumption attributable to a semi-heated cowshed. The following assumptions were used in the impact assessment:

- The cow sheds towards which subsidies are sought replace at least semi-heated facilities or corresponding new buildings.
- Approximately 95% of the cowsheds towards which subsidies are sought are actually built.
- A total of 85% of the area specified in each application will be unheated (areas such as milk processing facilities will be heated).
- Some existing heated cowsheds are not heated by oil, but instead by renewable forms of energy (pellets, wood chips); the calculation is based on oil-heated cowsheds accounting for 70% of total energy consumption.
- The impact assessment assumes that 50% of projects for which funding is applied each year are implemented during the same year and the remainder in the following year
- the cowshed floor area presented in the applications is expected to grow annually by 10% from 2017.

Heat recovery from liquid manure gutters on pig farms

Applications do not specify the scope of the project. The scope can nevertheless be deduced from the amount of subsidies granted.

The impact assessment assumes that 50% of projects for which funding is applied each year are implemented during the same year and the remainder in the following year

Baseline data

Unheated cowsheds

The characteristics of a typical heated cowshed and the required level of ventilation were determined on the basis of the reports associated with a study conducted by the University of Helsinki on the effect of livestock sheds on animal welfare (KARVA, 2009–2010). The need for ventilation was calculated using a tool developed during the course of the study.

The tool is based on a table for calculating design values for ventilation systems in dairy cowsheds, which can be found on the website associated with the KARVA project of the University of Helsinki Department of Agricultural Sciences.

Energy consumption was calculated using weather data for Southern Finland (Part D3 of the National Building Code of Finland, 2012/weather for the reference year). This makes the savings calculations more reliable, as not all the cowsheds are located in Southern Finland in practice.

The following data have been taken from funding applications:

Total area of cowsheds built in 2008: 51,099 m^2, 2009: 92,704 m^2, 2010: 72,690 m^2, 2011: 75,172 m^2, 2012: 65,117 m^2, 2013: 94,602 m^2, 2014: 36,597 m^2, 2015: 27,367 m^2, and 2016: 86,916 m^2.

Heat recovery from liquid manure gutters on pig farms

The Baltic Manure project examined heat recovery from liquid manure (Juha Grönroos, Katri Rankinen, José E Cano-Bernal, Lauri Larvus and Laura Alakukku. Knowledge report: Life Cycle Inventory & Assessment Report: Cooling of Manure, Applied to Fattening Pig Slurry, Finland. Baltic Forum for Innovative Technologies for Sustainable Manure Management. December 2013.). The calculation is based on the Finnish example in the report, in which 105 kWh of heat was obtained per tonne of manure, of which it is possible to extract 2/3 in Finland, that is, 70 kWh. This equates to 35 kWh/tonne of manure in electricity consumption, which translates into a net saving of 35 kWh/tonne of manure.

The volume of manure production used in the report was 0.47 tonnes per animal per year.

The scope of projects varies, but pig farms with 1,500 animals are believed to be the average.

The number of projects each year is based on funding applications:

- 11 in 2010, 3 in 2011, 4 in 2012, 10 in 2013, 2 and 2014 and none in 2015.
- During the year, the number of applications has risen again, but follow-up information was not yet available on this. We shall assume that there were 6 projects in 2016, which is about 20% of the 28 pig farms subsidised. This is an average of projects fulfilled in 2010–2014.
- Manure production covered by the applications is expected to grow by 10% a year from 2016.

Overlap

None

Impact assessment

Unheated cowsheds

The assessment covers cold or cool cowsheds that replace heated cowsheds and help farms to save the heating energy normally needed in heated cowsheds.

Energy savings have been calculated as of 2008, with the average cowshed lifetime being more than 25 years; the saving effect therefore extends across the entire programming period.

Annual energy savings (ES) are calculated using the following formula:

ES [GWh/a] = average energy consumption of cowsheds [kWh/m^2] x annual increase in the area of cold cowsheds [m^2] x a, where a = 0.67 = corrective coefficient to factor in the following:

- Not all cowsheds are heated by oil, but instead by fuels such as logs or wood chips procured on site.
- For one reason or another, not all projects towards which funding has been granted go ahead.

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

Heat recovery from liquid manure gutters on pig farms

The assumption is that all the projects are implemented.

Energy savings have been calculated as of 2010, with the average head recovery system lifetime being 15 years; the saving effect therefore extends across the entire programming period.

Annual energy savings (ES) are calculated using the following formula:

ES [GWh/a] = average saving effect [kWh/tonne of manure] x manure production [tonnes/animal, a] number of projects [qty/a] x average scope of projects [number of animals]

Parties responsible for impact assessment

Finnish Ministry of Economic Affairs and Employment/Motiva (NEEAP-2-method, Olof Granlund Engineering)

ENERGY SAVING GWh/a			**2010**	**2016**	**2020**
ESD		Unheated cowsheds	2.1	6.6	11.7
ESD		Heat recovery from liquid manure gutters on pig farms	0.1	0.8	1.5
ESD TOT.	**MA–03–MMM**	Total (rounded)	**2**	**7**	**13**

MEASURE		MEASURE CODE
Re-parcelling projects		MA–04–MMM

IMPLEMENTATION PERIOD	Start	End	Continuing

MEASURE TARGET	Farmers

MEASURE CONCERNS	Heat	No	Electricity	No	Fuel	Yes	Water	No

FINANCING AND BUDGET

The Finnish State grants subsidies towards both the administrative costs of reparcelling and any modification works required as a result of reparcelling, such as arterial and subsoil drainage as well as the construction of access roads. In recent years, the total costs of reparcelling projects have amounted to approximately EUR 10 million per year, with government subsidies covering approximately half of this.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Agriculture and Forestry, National Land Survey of Finland

DESCRIPTION OF THE MEASURE

Reparcelling includes field reparcelling, forest reparcelling, regional allocations of private roads and the formation of shared forests. Reparcelling is also referred to as land consolidation. This assessment only covers field reparcelling. The average size of farms has increased but the extra land is often located far away from the economic centre of the farm and is small in size. Reparcelling is a way of restructuring farms and developing rural land use.

Reparcelling is a collaborative effort between land owners, the National Land Survey of Finland and other land use experts. Reparcelling sometimes requires modifications to roads and drainage systems. Reparcelling was carried out across a total of 184,380 hectares between 1995 and 2015.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system.

Premises and assumptions

The assessment is based on the following baseline data:

- Average tractor use (km/h)
- Typical reduction in tractor use (km) as a result of reparcelling
- Typical area (ha) per reparcelling project
- Annual reparcelling volume (ha)

Reparcelling generates savings in fuel consumption not just thanks to shorter transit journeys but also in field work due to a more expedient parcel structure; however, this assessment only covers the impact of reduced transit times.

Baseline data

The average fuel consumption for tractors used in the calculations was 31 l/h. At a speed of 40 km/h, this equates to an average fuel consumption rate of 0.76 l/km on transit journeys.

No information is available on the average reduction in transit time per reparcelling project. Instead, the assessment is based on the impact of a single typical reparcelling project. The area of reparcelled land associated with the projects varies between 300 and 3,000 hectares. The area in the case study was 730 hectares. Agricultural transport decreased by approximately 30%, or 145,000 km per year. This equates to a drop in fuel consumption of approximately 111,000 litres, or 1,113 MWh, per year. The saving per hectare was 1.52 MWh.

The total saving generated by reparcelling can be calculated by generalising this figure across all reparcelling projects carried out during one year and taking into account the cumulative saving achieved across the programming period. In the calculations, account was taken of the fact that reparcelling projects were carried out on 10,130 ha in 2010, 9,743 ha in 2011, 8,315 ha in 2012, 7,782 ha in 2013, 9,007 ha in 2014 and 7,978 ha in 2015. The figure is estimated to be around 7,000 ha per year until 2020.

Overlap

The promotion of reparcelling is also one of the objectives laid down in the Farm Energy Guidance (measure MA–05–MMM), but there is little overlap in practice, as the farms implementing the programme have not reported having participated in reparcelling projects. Compared to the total number of farms, those that received guidance or took part in reparcelling projects was low.

Impact assessment

See Baseline data

Parties responsible for impact assessment

Ministry of Agriculture and Forestry/Motiva

ENERGY SAVING GWh/a			**2010**	**2016**	**2020**
ESD	**MA–04–MMM**	Reparcelling projects	**15**	**90**	**133**

MEASURE		MEASURE CODE
Farm energy guidance		MA–05–MMM

IMPLEMENTATION PERIOD	Start	1/2010	End	12/2020

MEASURE TARGET	Farmers

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	Yes

FINANCING AND BUDGET

Energy guidance was provided in 2010–2015 under the Farm Energy Programme, receiving its funding from sub-item 30.01.40 in the Budget (Subsidies for bioenergy production). Since 2016, energy guidance has been wholly funded through the rural development programme for continental Finland (Rural Development Programme). This funding was already begun in 2015, when guidance was provided through both funding channels. The Rural Development Programme does not have a separate budget; it is part of the Neuvo2020 system.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Agriculture and Forestry, Finnish Agency for Rural Affairs, Centres for Economic Development, Transport and the Environment, national associations of agricultural and horticultural producers, Farm Energy Programme operator Motiva (2010–2015), farm energy planners and energy advisers

DESCRIPTION OF THE MEASURE

Farm Energy Programme in a national voluntary energy efficiency agreement between the Ministry of Agriculture and Forestry and the producer organisations. It was possible for individual farms to join the programme in 2010–2014, but the nature of the programme changed at the end of 2014, and farms no longer took part directly. The programme aims to improve energy efficiency in the use of heating and electricity on farms and to reduce the use of fossil fuels by promoting domestic renewable energy and biofuels, while also taking forest management objectives into consideration. Farms that joined the programme carried out systematic energy management by following either a monitoring plan designed by themselves or by a trained energy engineer, whose costs were eligible for 40% support. 496 farms joined the programme by the end of 2014. A total of about 330 energy plans were made with the support of the programme by the end of 2015. Any energy plan initiated by the end of 2014 could still be carried out in 2015.

Energy guidance (energy plans and other guidance) has been available under the Rural Development Programme since early 2015, but was little used until 2016. According to follow-up data, guidance services have become more popular compared to the Farm Energy Programme, with the number of energy plans doubling compared to 2014. The reason for this may be that guidance is fully subsidised up to a certain amount per farm.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system.

Premises and assumptions

The assessment is based on the following baseline data:

- Estimate of the impact of energy saving measures implemented by farms in the Farm Energy Programme between 2010 and 2013
- Percentage and lifetime of operational measures
- Estimate of the impact energy saving measures resulting from the Rural Development Programme in 2017–2020
- The impact of measures to promote the use of renewable forms of energy has been excluded from the calculations, as it would overlap in part with the impact of measure MA–01–MMM.

Baseline data

The savings achieved between 2010 and 2014 were calculated on the basis of programme monitoring data, which in turn are based on progress surveys carried out among participating farmers in the autumn of each year. The surveys generate information about measures that have been implemented, and the savings attributable to these measures were calculated on the basis of typical savings. These figures were used directly as the savings achieved between 2010 and 2014.

No surveys were made in 2015–2016, but the savings are estimated to be at the same level as in 2014, based on the number of energy plans. Between 2017 and 2020, the annual savings are expected to be double those of 2014, because the number of energy plans under the Rural Development Programme between 2015 and 2016 (primarily in 2016) was more than double that of 2014, when 25 such plans were submitted. In addition, energy efficiency

guidance other than guidance on energy efficiency plan preparation was provided on 104 occasions. However, no major savings have yet been allocated for 2016, due to delays in implementation.

Polttoaineiden käyttöön liittyvistä toimenpiteistä 70 % on arvioitu olevan käyttöteknisiä ja sähkön ja lämmön käyttöön liittyvistä 30 %. The lifetime used for these measures was two years. With regard to non-operational measures, the assumption was that their lifetime would extend to at least the year 2020.

The estimated savings attributable to the programme are conservative, as measures were also implemented on farms that did not complete the survey, albeit probably to a lesser extent. A great deal of information on the potential to conserve energy was also disseminated in connection with the Farm Energy Programme, which is also having an impact even if it did not result in any major increase in farms joining the programme. The number of energy plans to be made under the Rural Development Programme is expected to reach at least the 2016 level owing to the higher subsidy, but it is possible that operations will also expand as more people become aware of the subsidy.

Overlap

The effects of the measure do not overlap with those of other measures such as subsidies towards heating plants on farms since, although the Farm Energy Guidance also promotes the use of renewable forms of energy, such measures have not been included in this assessment. The objectives of the Farm Energy Programme also included the promotion of reparcelling, but there is little overlap in practice, as farms implementing the programme did not report having participated in reparcelling projects. Compared to the total number of farms, the number that received guidance or took part in reparcelling projects was low.

Impact assessment

See Baseline data

Parties responsible for impact assessment

Ministry of Agriculture and Forestry/Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	MA–05–MMM	Energy consultancy for farms	**0**	**11**	**24**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Ecodesign Directive and energy efficiency requirement per device category	1	HO–13–TEM

IMPLEMENTATION PERIOD **Start** 2009 **End** Continuing

MEASURE TARGET Consumers (private individuals, businesses and non-governmental organisations) as well as manufacturers of products relating to energy

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** No

FINANCING AND BUDGET

Most of the measures are market-based but the Finnish Ministry of Employment and the Energy Authority have provided funding towards awareness-raising projects.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, Energy Authority, Finnish Safety and Chemicals Agency

DESCRIPTION OF THE MEASURE

Directive 2005/32/EC (EcoDesign Requirements for Energy Using Products) was transposed into Finnish legislation by the Act Imposing Requirements on Ecological Design and Energy Labelling (1005/2008, "the Ecodesign Act") which entered into force on 1 January 2009. The act was subsequently amended to factor in changes to the scope of the Directive, namely new ecodesign requirements for energy-related products (2009/125/EU, EcoDesign Requirements for Energy Related Products). The amended act (1009/2010) entered into force on 1 December 2010. The act provides a framework for ecological requirements relating to the design and development of products that use energy.

The Directive combines previous regulations on energy efficiency and energy labelling, and its implementing provisions on specific product groups lay down increasingly strict energy consumption limits for a wide range of products. At the moment, implementing measures have mainly been prepared for electrical appliances, but provisions will also be issued for other appliance and product groups.

No separate implementing provisions are expected for office equipment, as the EU participates in the Energy Star system developed in the United States for office equipment (computers, computer screens and imaging equipment). The US and the EU have had an agreement concerning the Energy Star scheme for promoting the energy efficiency of office equipment since 2001. The agreement was implemented across the EU by Regulation (EC) No 106/2008 of the European Parliament and of the Council on a Community energy-efficiency labelling programme for office equipment.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has previously been used to assess the impact of national measures.

Premises and assumptions

Each product group was evaluated separately. The product groups covered and the premises and baseline data used are described under Baseline data. Most of the information on the popularity and consumption of different household appliances was taken from the Household Electrical Consumption surveys carried out in 2006 (Adato 2008) and 2011 (Adato 2013).

Baseline data

Dishwashers

Current situation: The energy consumption attributable to dishwashers amounted to 261 GWh/a in 2006 and to 367 GWh/a in 2011 (Adato 2008 and 2013). A total of 54% of Finnish households had a dishwasher in 2006, and their average electricity consumption amounted to approximately 199 kWh/a. In 2011, approximately 65% of households had a dishwasher and their average electricity consumption amounted to 221 kWh/a. The consumption data from 2011 is based on the assumption that all dishwashers were connected to a cold water supply.

Baseline: A useful life of 12 years was used for dishwashers. The electricity consumption of new dishwashers amounted to approximately 25% less than those that were more than 10 years old in 2011. The average electricity consumption of new dishwashers has dropped by more than 2.5% per year on average. This trend was assumed to slow down a little and the figure used for the drop in the average electricity consumption of new dishwashers in the calculation was 2% per year. This means that the average electricity consumption of dishwashers will be 189 kWh/a in 2020. A total of 60% of dishwashers were assumed to have a timer and a display. Without measures, the

electricity consumption attributable to dishwashers would be approximately 433.5 GWh in 2020. The electricity consumption attributed to stand-by modes was 16.4 GWh/a.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2011, 2013 and 2016.

Savings: The saving to be achieved with the EuP scenario compared to the baseline amounts to 12.5 GWh/a in 2020. The Directive has only a small saving effect compared to the baseline and mostly reinforces the current trend.

Washing machines

Current situation: The electricity consumption attributable to washing machines was 277 GWh/a in 2006. A total of 88% of Finnish households had a washing machine, and their average electricity consumption amounted to approximately 130 kWh/a (Adato 2008). The consumption attributable to an average washing machine was estimated at 118 kWh/a and that attributable to all washing machines at approximately 275 GWh/a in 2011 (Adato 2013).

Baseline: The average electricity consumption of new washing machines was assumed to remain constant as of 2011, as the increase in energy efficiency is the result of running washing machines on fuller loads. Many householders do not fill their washing machines fully, which is why no improvement in energy efficiency materialises in practice. The average electricity consumption of washing machines was therefore estimated to amount to 105 kWh/a in 2020. Approximately 60% of washing machines were assumed to have a timer and a display, and the electricity consumption attributed to these stand-by functions was 11.8 kWh/a. Without measures, the electricity consumption attributable to washing machines would be approximately 295 GWh/a in 2020 and that attributable to stand-by modes would be 18.6 GWh/a.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2011 and 2013.

Savings: The saving to be achieved with the EuP scenario compared to the baseline amounts to almost 10 GWh/a in 2020. The Directive only has a small saving effect compared to the baseline and mainly reinforces the current trend.

Tumble dryers

Current situation: According to Statistics Finland, 14% of Finnish households had a tumble dryer in 2006 and 17% in 2012. These figures were used to estimate that 16% of households had a tumble dryer in 2010. The consumption attributable to an average tumble dryer was estimated at 283 kWh/a and that attributable to all tumble dryers at approximately 115 GWh/a. Almost 40% of tumble dryers have an on/off switch and five percent have a timer. Residual moisture levels in laundry have a considerable impact on the electricity consumption of tumble dryers. New washing machines have better spinning cycles than old ones.

Baseline: The popularity of tumble dryers based on heat pump technology is expected to grow slowly and they should account for between three and five percent of all tumble dryers in 2020. The electricity consumption of these kinds of tumble dryers is approximately 40% lower than that of traditional air dryers. The calculations assume that two thirds of tumble dryers have an on/off switch and that a third have a display and a clock/timer in 2020, which will lead to energy consumption even when the tumble dryer is switched off. The electricity consumption of new tumble dryers was assumed to be around five percent lower (267 kWh/a) than in 2010. Without measures, the electricity consumption of tumble dryers would be 150 GWh/a in 2020. The electricity consumption attributed to stand-by modes was approximately 1.0 GWh/a.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2013 and 2015.

Savings: According to the EuP scenario, the electricity consumption of tumble dryers would be approximately 137 GWh/a in 2020 and that of stand-by modes would be 0.9 GWh/a. The saving to be achieved compared to the baseline amounts to almost 13 GWh/a in 2020.

Vacuum cleaners

Current situation: According to a test by a periodical focusing on consumer issues, the electricity consumption of vacuum cleaners amounts to approximately 3.14 Wh/m^2. Considering the average area of homes, the electricity consumption of an average vacuum cleaner was 78 kWh/a and that of all vacuum cleaners (2.5 million) approximately 194 GWh/a in 2010.

Baseline: According to the EuP background study, the average useful life of vacuum cleaners is eight years, which means that all existing vacuum cleaners will have been replaced by 2020. It is estimated that the electricity consumption of vacuum cleaners had increased by 1.5% per year over the last 20 years. This trend was expected to continue, and the electricity consumption of an average vacuum cleaner was estimated at 84 kWh/a in 2020 and that of all vacuum cleaners at 233 GWh/a.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2014 and 2017.

Savings: The electricity consumption of an average vacuum cleaner will be 55 kWh/a and that of all vacuum

cleaners approximately 153 GWh/a in 2020. The saving to be achieved compared to the baseline amounts to approximately 81 GWh/a in 2020.

Simple digital set-top boxes

Scope: The regulation covers digital set-top boxes without additional features, as well as devices with an internal recording hard drive.

Current situation: The assumption is that the digital set-top boxes in use in Finland in 2006 were mainly basic models. A total of 82% of Finnish households had a digital set-top box in 2006, and the combined electricity consumption attributable to the devices was 156 GWh/a (Adato 2008). The popularity of digital set-top boxes has since declined, as new televisions come with a built-in digital tuner. It was estimated that 30% of Finnish households had a digital set-top box in 2011, half of which were assumed to have a recording function. All digital set-top boxes that were in use in 2006 have since been replaced and the overall popularity of the devices has fallen considerably. The electricity consumption of all devices in 2011 was estimated at 30.6 GWh/a (Adato 2013).

Baseline: Digital set-top boxes are expected to gradually disappear from the market altogether. Their sales have dropped from more than 900,000 devices per year (2008) to just 144,000 (2012). The electricity consumption attributable to the stand-by mode on digital set-top boxes that will be in use in 2020 (283 000 devices) was assumed to amount to 5 W (40.8 kWh/a), and their electricity consumption while switched on to 12 W (16.3 kWh/a). On a national scale, the electricity consumption of digital set-top boxes would be 14.2 GWh/a in 2020, of which 9.6 GWh/a would be attributable to stand-by modes. Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2010 and 2012. The electricity consumption attributable to the stand-by mode on digital set-top boxes was assumed to amount to 0.75 W and their electricity consumption while switched on to 11.5 W. This equates to 15.6 kWh/a in electricity consumption, with 5.1 kWh/a attributable to stand-by modes. Electricity consumption in 2020 will be 5.9 GWh/a with stand-by modes accounting for 1.4 GWh/a.

Savings: The saving to be achieved with the EuP scenario compared to the baseline amounts to approximately 8.3 GWh/a in 2020.

Television sets

Savings: The energy efficiency of televisions has improved so rapidly that the Ecodesign Directive will have no effect by 2020.

Household refrigeration equipment

Current situation: The total electricity consumption attributable to refrigeration equipment amounted to 1,461 GWh/a in 2006 and 1,410 GWh/a in 2011. The numbers and average consumption attributable to the equipment are given in the table below.

	2006				**2011**			
	Frequency	Number[1]	Average consumption, kWh/a	Consumption by device category, GWh/a	Frequency	Number[2]	Average consumption, kWh/a	Consumption by device category, GWh/a
Refrigerators, refrigerator-cellars	60%	1,620,200	227	368	57 %	1,456,920	205	298.7
Refrigerator-freezer	54%	1,458,200	404	589	58%	1,482,480	365	541.1
Freezers	66%	1,783,240	373	665	66 %	1,686,960	338	570.2
Other refrigerating appliances	1%	27,000	206	5				
Total				1,628				1,410

[1] Per number of all homes

[2] Per number of permanently occupied homes

Baseline: The average electricity consumption of new refrigerators was assumed to drop by 1.5% per year and that of other types of new refrigeration equipment by 2% per year. The electricity consumption attributable to refrigeration equipment in 2020 would therefore be 1,159 GWh/a.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2010, 2012 and 2014.

Savings: The saving to be achieved under the EuP scenario compared to the baseline amounts to approximately 75 GWh/a in 2020.

Household lighting

Current situation: Energy consumption attributable to households' indoor lighting amounted to 2,427 GWh/a in 2006 and to 1,230 GWh/a in 2011 (Adato 2008 and 2013). The electricity consumption attributable to lighting in an average home in 2011 was approximately 481 kWh/a. The number of incandescent light bulbs has fallen since 2006, and most light bulbs are now compact fluorescent lamps.

Baseline: It is assumed that the number of light bulbs per household will remain unchanged. If the current trend continues, no more incandescent light bulbs will be in use in 2020. Without measures, the electricity consumption attributable to lighting would be 983 GWh/a in 2020. This equates to an average consumption of 348 kWh/a per home.

Effect of ecodesign: Incandescent light bulbs disappeared from the market by September 2012 as a result of new energy efficiency regulations concerning household light bulbs, which is why no incandescent light bulbs will be in use in 2020. According to the EuP scenario, electricity consumption attributable to lighting will be 802 GWh/a in 2020, or 283 kWh/a per home.

Savings: The saving to be achieved under the EuP scenario compared to the baseline amounts to 182 GWh/a in 2020.

Spotlights

Savings: Lighting technology has developed faster than ecodesign requirements, due to which the Ecodesign Directive will have no effect on savings by 2020.

Computers and servers

Current situation: In the Commission's EU27 background study, the annual electricity consumption attributable to computers and monitors was estimated at 55 TWh in 2010.

Baseline: The Commission's EU27 background study found that, without measures, the annual electricity consumption attributable to computers and monitors would grow by 53% by 2020.

Effect of ecodesign: The background study indicated that the electricity consumption could be lowered cost-effectively to a level of approximately 12.5–16.3 TWh/a below the baseline across the EU by 2020. The calculations are based on these estimates. Finland's contribution was calculated on the basis of the popularity of computers. It was estimated that Finnish households account for two percent of all household computers across the EU27 area. The same percentage was used to assess the energy consumption of servers.

Savings: It has been estimated that the Energy Star scheme and the Ecodesign Directive will lower the electricity consumption of computers in Finland by 200 GWh/a by the year 2020. With regard to servers and data centres, Finland has recently grown increasingly attractive as a location for businesses' data centres, which makes it more difficult to forecast future development. However, maintaining Finland's energy consumption at the 2010 level of 1.4 TWh/a until 2020 is likely to be challenging.

External Power Supply Units

Scope: In general, external power sources of less than 250 W that feed consumer electronics are governed by the implementing measure for external power supplies. Development of the technical properties of external power sources is opening up many new opportunities to conserve energy. Efficiency is extremely low when using external power sources for low loads, such as when a device or battery is almost fully charged (the wastage is attributable to the device or battery growing warmer). Technology is developing at a rapid pace, with wireless chargers being one example of this.

Saving estimate: In the absence of reliable estimates of the numbers of devices and the volume of energy consumption, external power sources in Finland have been evaluated with the help of the EU27 assessment, assuming that Finland represents two percent of the total consumption estimated by the Commission (17 TWh in 2010 and 31 TWh in 2020) and of the savings to be achieved by means of the Ecodesign Directive (9 TWh/a in 2020) across Europe, based on the number of households and the scope of the service sector. Finland's baseline for the electricity consumption of external power sources has been estimated at 620 GWh in 2020 and the level to be achieved with the help of the Ecodesign Directive at 240 GWh. This equates to a saving of 380 GWh/a in 2020.

Stand-by and off modes

Current situation: Estimates of the numbers of devices and energy consumption are based on information collected by Statistics Finland or, in the absence of statistics, on the numbers of household appliances reported in the EuP background study across the EU. With regard to appliances for which an estimate of the effects of the Ecodesign Directive has been presented, the same numbers of appliances and the same level of consumption have been used as those stated in the product group specific estimates. For example, the estimated numbers of ovens, tumble dryers, dishwashers and washing machines are based on the assumption that only some of the appliances have functions that consume electricity when the appliances are on stand-by or switched off. The electricity consumption attributable to stand-by and off modes amounted to approximately 375.5 GWh/a in 2011, which equates to 4.7% of the total electricity consumption of households.

Baseline: The scenario calculations assume that, in principle, the popularity of appliances that have stand-by modes will remain at the 2011 level. It was assumed that electricity consumption, attributable to appliances for which no estimates of future electricity consumption during stand-by and off modes were available, would drop by around one third compared to 2011. It was estimated that, without measures, the electricity consumption attributable to stand-by and off modes would amount to approximately 293 GWh/a in 2020.

Effect of ecodesign: This estimate is based on the energy efficiency regulations applicable to the years 2010 and 2013. According to the EuP scenario, electricity consumption attributable to stand-by and off modes in household appliances would be approximately 128 GWh/a in 2020.

Savings: The total saving to be achieved with the help of the Directive by 2020 was estimated at 165 GWh/a. Considering overlap with the effects of stand-by modes that are already included in the product group specific estimates (washing machines, dishwashers, digital set-top boxes and computers), the net saving amounts to 103 GWh/a in 2020.

Sleep modes

Scope: The scope of ecodesign requirements concerning sleep modes is due to be extended to cover all network devices. The assessment covers desktop computers, printers, wireless telephones, smart-TVs, broadband systems and game consoles.

Baseline: The baseline is based on the electricity consumption figures given in the EuP background study. According to the background study, the amount of time that televisions and games consoles are in sleep mode will increase considerably by 2020. Without measures, the electricity consumption attributable to sleep modes would be more than 510 GWh/a in 2020.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2015, 2017 and 2019.

Savings: The total saving to be achieved with the help of the Directive by 2020 was estimated at 344 GWh/a. The majority of the saving (approximately 300 GWh/a) was attributed to games consoles, whose current electricity consumption during sleep mode was estimated to be as high as 100 W.

Water heaters and back boilers

Scope: The Regulation applies to water heaters with rated heat output not exceeding 400 kW and back boilers with a volume not exceeding 2,000 litres.

Savings: All electric and fuel-driven water heaters on the market already fulfil

the requirements that will enter into force 2 and 4 years after the Directive came into effect (15 September 2015) The Directive will therefore have

no effect on energy savings in Finland by 2020.

Room heaters and combination heaters

Scope: The Regulation applies to room heaters and combination heaters with a heat output not exceeding 400 kW.

Savings: The requirements laid down in the Ecodesign Directive concerning room heaters and combination heaters are more lax than those included in earlier national regulations, and the Directive will therefore not generate any savings in Finland. The standards have also fallen behind technological development.

Water circulator pumps

Scope: The assessment covers water circulator pumps without shaft seals, which are commonly used in heating and cooling systems. Other types of pumps governed by the Ecodesign Directive are also commonly used as water circulator pumps in buildings.

Current situation: The assessment factors concerning different types of pumps and their statistical and assumed sales, as well as the considerable decline in construction activity. It was assumed that water circulation systems had been installed in 53% of detached and semi-detached houses, 71% of terraced houses and 95% of apartment blocks.

Baseline: According to information obtained from importers, the annual running times used in the energy consumption calculations for water circulator pumps without shaft seals were 5,000 h in detached houses and 6,000 h in terraced houses and apartment blocks. The average pump lifetime used in the calculations was 15 years. It was assumed that, without measures, the input power of pumps would not improve at all after the year 2012 and

the figures used in the calculations were 56 W for detached houses, 62 W for terraced houses and 88 W for apartment blocks.

Effect of ecodesign: The input power of pumps will improve gradually in accordance with energy efficiency requirements (see table) in 2012 and 2015. The Directive will be reviewed in 2017, which means that new requirements are expected to enter into force on 1 January 2018 and 1 January 2020.

Pump type	**Input power (W) 1 January 2013-**	**Input power (W) 1 January 2015-**	**Input power (W) 1 January 2018- (estimate)**	**Input power (W) 1 January 2020- (estimate)**
EEI	< 0.27	< 0.23	< 0.20	< 0.15
Detached and semi-detached homes	31	26	23	17
Terraced or linked houses	35	30	26	19
Blocks of flats	49	42	36	27

Savings: The saving to be achieved according to the EuP scenario is approximately 97 GWh compared to the baseline, with new development accounting for 22 GWh and renovations for 75 GWh.

Water pumps

Scope: The water pumps product group includes both free-standing and integrated centrifugal clean water pumps, although the requirements apply only to the pumps' hydraulic output. In order to fall under the definition used in the Directive, the hydraulic element of a pump needs to belong to the structural classes of ESOB, ESCC, ESCCi, MS-V or MSS and the operating pressure must be less than 16 bar, the specific spinning speed 6–80 rpm, the specific output more than 6 m³/h, the shaft power less than 150 kW and the lift height less than 90 m at 1,450 rpm and less than 140 m at 2,900 rpm.

Current situation: Water pumps forming parts of electric motor systems are essential to various pumping processes. The energy efficiency of these pump systems can be improved cost-effectively by between 20% and 30%. Although the main savings can be achieved using motors, one of the factors contributing to such improvements is the use of energy-efficient pumps. As no published information is available on the electrical consumption of water pumps in Finland, an estimate was used of two percent of all pumps across the EU27 area in 2005 (109 TWh).

Baseline: Without energy efficiency measures, electricity consumption is expected to grow to 136 TWh across Europe by 2020, of which Finland will account for two percent.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2013 and 2015. The assumption is that 10% of the most inefficient water pumps will be replaced between 2010 and 2013 (saving 120 GWh/a), 20% between 2013 and 2015 (saving 230 GWh/a) and 40% between 2015 and 2020 (saving 340 GWh/a).

Savings: The saving to be achieved with the help of ecodesign requirements was estimated at approximately 680 GWh/a in 2020.

Fans

Current situation: Fans are often built into other products, such as ventilation systems in buildings and various kinds of gas processing systems. The number of fans per type of fan (axial, centrifugal, others) was calculated on the basis of domestic production and export and import statistics.

Baseline: According to importers and manufacturers, sales of fans affected by the regulations are expected to remain stable. Based on information obtained from importers and manufacturers, the annual running time used in the energy consumption and saving calculations for all fans was 5,000 h, although fans in ventilation systems generally run 24 h/d. The average fan lifetime used in the calculations was 15 years. The reference values used in the energy saving calculations were input powers for four different classes in 2013: 150 W for small fans 1 (125–1,000 W), 1 100 W for small fans 2 (1-3 kW), 7.5 kW for medium-sized fans (315 kW) and 30 kW for large fans (more than 15 kW).

Effect of ecodesign: Ecodesign requirements enter into force in two stages. The first set of requirements entered into force on 1 January 2013 and only applied to ventilation fans. The second set of requirements is due to enter into force on 1 January 2015, at which time all fans will be covered.

Savings: The effect estimated for the year 2020 was 1,215 GWh/a, of which more than 90% will be attributable to new installations. Considerable additional saving potential lies in replacing fans in connection with renovation projects. The calculation involves considerable uncertainty factors due to the categories used in the statistics, but fans can be considered to have major energy saving potential in any case.

Electric motors

Scope: The assessment covers low-voltage electric motors of 0.75-375 kW pursuant to the Ecodesign Directive

(according to the efficiency rating laid down in IEC standard 60034-30).

Current situation: Numerically speaking, small motors of less than 0.75 kW are the commonest type, accounting for about 90% of all motors, so the Directive is relevant to 10% of electric motors. Large motors are usually medium-voltage motors, made individually to order. These motors represent less than one percent of all motors, but account for approximately one quarter of all electrical consumption attributable to motors.

Assessment method: Four different scenarios were formulated in connection with the background studies for the Directive (baseline and three ecodesign scenarios), concerning the development of motors between 1998 and 2020. The scenarios focus on AC (alternating current) motors, as such motors account for more than 95% of all motors sold, and also on three-phase induction motors, which account for approximately 87% of all AC motors sold. The scenarios were formulated for motors with a power rating of less than 200 kW.

Baseline (BAU): The number of motors across the EU in 1998 and motor sales between 1998 and 2020 are consistent with electricity consumption forecasts for the industrial and service sectors. The efficiency of motors developed in accordance with the efficiency ratings (Eff1-Eff3) used by European electric motor and power electronics manufacturers and the EU between 1998 and 2005.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2011, 2015 and 2017. With regard to electric motors, the effects were evaluated by applying the three scenarios formulated in connection with the background studies for the Ecodesign Directive to Finland:

1. The same as the BAU scenario until the end of 2010, after which motors (0.75-200 kW) will meet or exceed the requirements of the IE2 efficiency class. A total of 15% of the motors sold, including special motors, will not meet the IE2 class. Class IE3 motors will account for two percent of sales. Savings will amount to 368 GWh/a in 2020.
2. The same as the BAU scenario until the end of 2010 and the same as scenario 1 until the end of 2014, after which motors over 7.5 kW must meet the requirements of the IE3 efficiency class. A total of 15% of the motors sold, including special motors, will not meet the IE3 class. Savings will amount to 452 GWh/a in 2020.
3. The same as the BAU scenario until the end of 2010 and the same as scenario 1 until the end of 2014, after which all motors must meet the requirements of the IE3 efficiency class. A total of 15% of the motors sold, including special motors, will not meet the IE3 class. Savings will amount to 529 GWh/a in 2020.

Savings: The saving effect is based on the middle scenario, i.e. 452 GWh/a in 2020.

Lighting in the service sector

Scope: Road and street lighting and other regional lighting; office lighting

Current situation: It is difficult, if not impossible, to estimate the exact number of light bulbs. According to rough estimates, there were approximately 1.4 million mercury-vapour lamps, 664,000 mercury lamps, 557,000 high-pressure sodium lamps, 23,000 multi-metal lamps and 32,000 other lamps in use in street lighting as well as in local governments and government offices in 2010. Technological development is hampered by the long lifetime of the lighting solutions currently used in the service sector, which is more than 20 years.

Baseline: According to the Commission's background study, without measures, final energy consumption across the service sector in Finland would be 2.34 TWh/a in 2020.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2013, 2014 and 2016. Thanks to the increasing popularity and efficiency of multi-metal lamps and fluorescent lamps, it will be possible to cut the energy consumption of the service sector by between five and seven percent, regardless of the increase in the total number of light bulbs. In Finland, across the three scenarios, this equates to final consumption of 2.23–2.28 TWh/a across the service sector in 2020.

Savings: The saving effect attributable to the regulation has been estimated to be 110 GWh/a in 2020. Given the increasing popularity of LED lighting, it would be possible to cut total energy consumption by as much as around 15%, rather than just 5-7%.

Air-conditioning equipment and fans

Scope: The product group consists of mains-driven room air conditioners with a nominal output of less than 12 kW, and indoor fans of less than 125 W. The former either cool or warm indoor air by means of a vapour-compression cycle driven by an electric compressor.

Current situation: The background study conducted in connection with drawing up the Directive shows that insufficient information is available on the efficiency of indoor fans. Finland's relatively cold climate naturally means that the volume, energy consumption and saving potential of air-conditioning (cooling) are very low compared to warmer, Southern European countries with large populations. Finland accounts for approximately 0.3% of all air-conditioning across the EU25 area. The use of air-conditioning equipment as air-source heat pumps is rapidly becoming more widespread in Finland.

Baseline: Annual sales figures (2010) were taken directly from statistics or calculated on the basis of cross-referencing, sampling and interviews. When estimating the popularity of air-conditioning equipment in 2020, the

assumption was made that annual sales of equipment other than air-source heat pumps correspond to the loss of old equipment, keeping the total number of equipment constant. A total of 335,000 air-source heat pumps had been installed in detached houses and 56,000 in terraced houses and apartment blocks by the end of 2010. These figures are expected to double by 2020. Energy consumption was calculated on the basis of a cooling time of 8h/60 days and an estimate of average electricity consumption. The running time used in the calculations for air-source heat pumps was 300 days at half power.

Effect of ecodesign: The estimate is based on the energy efficiency regulations applicable to the years 2013 and 2014. An average increase of the EER/COP value by 0.5 (e.g. 3.0 -> 3.5) would lower the energy consumption attributable to air-conditioning equipment by 15%. This relatively ambitious figure was used to estimate energy saving potential.

Savings: The estimated saving to be achieved from air-conditioning equipment amounts to 300 GWh/a in 2020. No saving estimates could be calculated for fans in the absence of baseline data.

Overlap

The impact assessment concerning road and street lighting overlaps to some degree with the effects of the local government energy efficiency agreement and action plan. This overlap has been eliminated by deducting the savings attributed to modernising road and street lighting (KU–01–TEM) from the total impacts of the measure in question.

Impact assessment

In the case of most product groups, the calculation consisted of the following steps (exceptions are mentioned in connection with the product group specific assessments):

- The popularity of each type of product was evaluated at the beginning of the programming period.
- The energy consumption attributable to the products was evaluated at the beginning of the programming period.
- A baseline was established to represent how the popularity of the product group and the energy consumption attributable to the same would develop by 2020 without the requirements laid down in the Directive.
- The potential to improve energy efficiency with the help of the Directive and compared to the baseline was evaluated on the basis of regulations, draft regulations or background studies.

The potential savings were assessed using the year 2010, 2011 or 2012 as the reference year. Considering useful lives and suppliers' stocks, the savings achieved by 2010 were still very modest, despite a few regulations entering into force in 2009. The year 2020 was used as the target year in most cases. Savings for the year 2016 were not calculated separately. The effects will not materialise linearly, as the regulations will enter into force gradually and many product groups have long useful lives, taking a long time to be replaced. On the other hand, some electronic products have very short useful lives. Savings for the year 2016 were estimated at roughly 30% of the 2020 figure.

Parties responsible for impact assessment

Energy Authority/Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	HO–13–TEM	Ecodesign Directive and equipment group-specific energy efficiency requirements	**0**	**1,278**	**4,259**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy efficiency agreement for businesses – energy services/own operations	4	EP–01–TEM

IMPLEMENTATION PERIOD **Start** (1997) 1/2008 **End** Continuing

MEASURE TARGET Businesses that engage in the supply and distribution of electricity, district heating and district cooling as well as the generation of district heating

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** No

FINANCING AND BUDGET

Businesses implementing the Energy Services Action Plan associated with the energy efficiency agreement for businesses received a total of EUR 0.08 million in subsidies towards energy audits between 2008 and 2015 and EUR 1.3 million in investment subsidies towards the implementation of energy saving measures.

In most cases, the signatories are entitled to subsidies amounting to 40% of the eligible labour costs of energy audits. Since the implementation of the Energy Efficiency Directive began on 5 June 2014, large enterprises have been ineligible for energy audit subsidies. In some cases, the signatories can also receive investment subsidies towards implementing conventional saving investments, for which the ceiling is usually 20%. Subsidies can also be granted for premises falling within the scope of the emissions trading scheme, as long as the subsidies have no direct impact on the applicant's emissions allowances or the impact is of minor financial significance to the viability of the investment.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, Energy Authority, Finnish Energy, Motiva, participating businesses, Tekes

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements scheme (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

A total of 95 businesses and their more than 130 offices have joined the Energy Services Action Plan associated with the energy efficiency agreement for businesses. Just under a third of the participating offices are involved in electricity sales and just over a third in both district heating and electricity distribution. Businesses that have joined the Energy Services Action Plan represent almost 90% of Finland's electricity distribution businesses, just over 90% of all electricity sales and 86% of all district heating sales.

Signatories joining the energy efficiency agreement between 2017 and 2025 will set an annual energy saving target (MWh/a) for the period 2020–2025. The target is calculated from the signatories' energy use at the time of signing. Another key objective for the signatories is to carry out measures that improve the energy efficiency of their customers, compared to development without such measures.

For more information about the agreements for the period 2008–2016, see http://www.energiatehokkuussopimukset.fi/en and for further details on the new agreement period 2017–2025 go tohttp://www.energiatehokkuussopimukset2017-2025.fi/.

Businesses that have signed the energy efficiency agreement submit annual reports, via a web-based monitoring system, on measures aimed at increasing the energy efficiency of their customers, as well as on their own energy consumption, any energy saving measures implemented, and progress made with their other contractual obligations. The energy saving measures included in the reports can be measures identified during the course of energy audits or analyses, or otherwise identified by the businesses.

This measure relates to the effects of energy services companies' own operations. Measures taken by customers under the Energy Services Action Plan have been discussed in measure EP–02–TEM.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations include all energy saving measures identified during the course of energy audits and analyses that have been reported by the participating organisations as 'implemented' (I) in their annual reports, as well as other energy efficiency measures reported by businesses. With regard to businesses that implemented the previous energy saving agreements
(1997–2007), account has also been taken of measures reported during the previous contracting period and their saving effects.

The savings (GWh/a) used in the calculations up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. As of 2016, annual savings have been estimated on the basis of the average in 2008−2015. The data cover approximately 95% of offices that implement the Energy Services Action Plan, as the signatories have been diligent in submitting reports.

With regard to measures reported in annual reports unrelated to energy audits, operational and technical measures are reported separately. The lifetime of individual technical measures has not been assessed separately; instead, an average lifetime of 25 years has been used, which is typical of these kinds of system upgrades and other investments. A lifetime of five years has been used for operational measures, because one of the obligations laid down in the energy efficiency agreement involves monitoring consumption efficiently and reacting promptly to faults.

The assumption was that half of the saving effects of the proposed measures will materialise during their year of implementation.

This calculation attributes the effects of all measures included in this action plan to the emissions trading sector, even though only a small percentage of businesses involved in district heating generation and that have joined the Energy Services Action Plan actually belong to the emissions trading scheme.

Baseline data

The baseline data is based on the annual reports submitted via the monitoring system by the participating organisations, and data relating to the previous contracting period.

In its annual report, each participating organisation includes at least the following information for each of its offices:

- General information (contact details, line of business, participation in the emissions trading scheme, etc.)
- Detailed energy consumption data
- Status of energy saving measures proposed in connection with energy audits and analyses
  - I = implemented, D = decided, P = possible, A = abandoned
- Energy saving measures other than those identified during the course of energy audits and the following information concerning the same:
  - estimated energy saving (electricity, heating, fuels) in MWh/a
  - implementation year, size of investment, payback period, etc.
  - information relating to energy efficiency systems concerning energy consumption monitoring, energy efficiency plans and environmental systems, etc.
  - other information relating to the use of renewable forms of energy, how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, the energy efficiency of transport and logistics, etc.

The accuracy of calculations of reported savings correlates with the level of accuracy that can be achieved by normal field testing; some of the baseline data is based on design values or estimates, since measurement is not always possible. In most cases, the savings achieved by saving measures are not verified by retrospective measurement, since measuring is often difficult in practice and results in extra costs.

Motiva checks the orders of magnitude of the data as well as its accuracy in other respects after all reports have been submitted, and asks the participating businesses for additional information if necessary.

Overlap

There is no overlap with other assessments.

Impact assessment

The assessment covers the effects of measures taken by businesses that have joined the Energy Services Action Plan to improve the energy efficiency of their own operations. Although some of these savings relate to the ESD, this assessment attributes the full extent of the savings to the emissions trading sector and they do not therefore contribute towards the ESD target.

The annual energy saving (ES) is based on the energy saving effects (electricity + heating + fuels) of measures reported by the participating organisations as 'implemented' (I).

Annual energy savings (ES) are calculated using the following formula:

ES[GWh/a] = ES(heating + fuels) + ES(electricity)

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects (ES) calculated for each year on the basis of the aforementioned principles.

Parties responsible for impact assessment

Energy Authority/Motiva

ENERGY SAVING GWh/a	2010	2016	2020

ESD	**EP–01–TEM**	Energy efficiency agreement for businesses – energy services, own operations	**0**	**0**	**0**
NON-ESD	**EP–01–TEM**	Energy efficiency agreement for businesses – energy services, own operations	132	466	679

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy efficiency agreement for businesses – energy services, customers	4	EP–02–TEM

IMPLEMENTATION PERIOD **Start** (1997) 1/2008 **End** Continuing

MEASURE TARGET Customers of businesses that engage in the supply and distribution of electricity, district heating and district cooling

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** No

FINANCING AND BUDGET

Businesses participating in energy efficiency agreements do not receive support for those measures of the Energy Services Action Plan that are targeted at customers.

Businesses that have joined the agreement can apply for energy audit subsidies and funding towards measures relating to increasing their own energy efficiency. These kinds of subsidies are discussed in Annex 2 (EP–01–TEM Energy efficiency agreement for businesses – energy services, own operations).

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Companies participating in the Energy Services Action Plan, Finnish Energy, the Energy Authority, Motiva

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and 2017–2025 and the earlier energy saving agreements scheme (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

In addition to measures to increase the efficiency of businesses' own energy use, the Energy Services Action Plan for the agreement period 2008-2016 sets participating businesses the goal of engaging in joint energy efficiency measures targeted at their energy services customers, in order to meet the indicative 9% energy saving target laid down in the ESD with regard to the energy consumption of these customers between 2008 and 2016, compared to progress without

energy efficiency measures. In particular, the obligation applied to those customer groups, such as private households, that are not otherwise governed by energy efficiency agreements. The businesses' obligation to improve their energy efficiency is also included in the contractual obligations of businesses implementing the Energy Services Action Plan in the agreement period between 2017 and 2025.

A total of 91 businesses and their more than 130 offices had joined the Energy Services Action Plan associated with the energy efficiency agreement for businesses by the end of 2016. Just under a third of the participating offices were involved in electricity sales and just over a third in both district heating and electricity distribution. Businesses that have joined the Energy Services Action Plan represented 88% of Finland's electricity distribution businesses, 86% of all electricity sales and 86% of all district heating sales. This description relates to measures targeted at the customers of these businesses. Measures relating to the businesses' own energy consumption are described in measure EP–01–TEM in the Annex.

For more information about the agreements for the period 2008−2016, see http://www.energiatehokkuussopimukset.fi/en and for further details about the new agreement period 2017−2025, seehttp://www.energiatehokkuussopimukset2017-2025.fi/.

Businesses that have signed an energy efficiency agreement submit annual reports, via a web-based monitoring system, on measures aimed at improving the energy efficiency of their customers. The measures reported in the monitoring system relate to the provision of advice, communications, consumption data and billing. Quantitative information on the implementation of measures and their target groups are also reported.

Some such measures that are reported by businesses are discussed below. The participating businesses represent most electricity and district heating/cooling sales in Finland; the information therefore paints a very reliable picture of the market. Energy companies in Finland also have much experience of carrying out measures targeted at customers and even a single year's data provides an accurate impression of the scope of the activities. Such measures are continuous and information on measures and target groups is available across the contracting period of

2008–2015. The number of measures to be implemented and their target group will be substantial during the 2008–2016 contracting period.

Advice

A total of 98% of the participating businesses reported that they had provided energy saving advice for their customers during the contracting period. The most popular consultancy measures are as follows:

- Telephone-based provision of energy saving advice

- Consumption meter hire
- Email-based or web-based provision of advice
- On-site provision of energy saving advice
- Events for customers and stakeholders

Communication

97% of the companies had engaged in energy saving communication during the contract period. The most popular communications measures are as follows:

- Articles about energy efficiency in customer magazines
- Information about energy efficiency on websites

Consumption data

The most popular measures relating to consumption data are:

- Access to personal consumption data online
- Remote metering
- Provision of energy consumption reports for customers
- Installation of kilowatt-hour meter and customer's monitoring of its consumption on the Internet

Invoicing

- Most of the companies invoice their customers either monthly or at least 4–6 times a year on the basis of actual consumption.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland's national BU calculation system, used for the calculation of equivalent savings for the monitoring of Article 7 of the EED. (See NEEAP-4 Annex 1: EED Annual Report 2017, Annex 3)

Premises and assumptions

In the earlier NEEAP-3, this measure did not yet have a quantitative saving estimate; it was only expressed as a verbal estimate. Measures targeted at customers and their energy saving effects in units of energy are nevertheless evaluated for the purposes of monitoring the cumulative energy saving target laid down in Article 7 of the Energy Efficiency Directive (EED).

The annual saving effect presented here corresponds to the estimate in the calculation in question. The lifetime of calculations on the saving effect of advice is 12 months.

Baseline data

The annual saving effect is the same as the annually calculated information for the monitoring of Article 7 of the EED. **Overlap**

None.

Parties responsible for impact assessment

Energy Authority, Motiva

ENERGY SAVING GWh/a			2010	2016	2020
ESD	EP–02–TEM	Energy efficiency agreement for businesses – energy services, customers	**1,061**	**1,003**	**995**

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy efficiency agreement for businesses – energy production	4	ET–01–TEM

IMPLEMENTATION PERIOD	Start	(1997) 1/2008	End	Continuing

MEASURE TARGET	Electricity and heating generation

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	No

FINANCING AND BUDGET

Businesses implementing the Energy Production Action Plan associated with the energy efficiency agreement for businesses received a total of EUR 1.1 million in subsidies towards energy audits between 2008 and 2015 and EUR 9.0 million in investment subsidies towards the implementation of energy saving measures.

In general, signatories are entitled to subsidies amounting to 40% of the eligible labour costs of energy audits. Since the implementation of the Energy Efficiency Directive began on 5 June 2014, large enterprises have been ineligible for energy audit subsidies. In some cases, the signatories can also receive investment subsidies towards implementing conventional saving investments, for which the ceiling is usually 20%. Subsidies can also be granted for premises falling within the scope of the emissions trading scheme, as long as the subsidies have no direct impact on the applicant's emissions allowances or they are of minor financial significance to the viability of the investment.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Economic Affairs and Employment, Energy Authority, Finnish Energy, Motiva, participating businesses, Tekes

DESCRIPTION OF THE MEASURE

The energy efficiency agreement scheme for the years 2008–2016 and the earlier energy saving agreements scheme (1997–2007) have been important elements of Finland's climate and energy policy since 2001.

A total of 39 businesses and their more than 212 offices have joined the Energy Production Action Plan associated with the energy efficiency agreement for businesses. Electricity generation by the participating businesses accounted for more than 86% of Finland's electricity generation and 74%.

Businesses implementing the Energy Production Action Plan have committed themselves to incorporating the continuous improvement of energy efficiency into their environmental and/or management systems. This is done by integrating energy considerations with the aforementioned systems in the manner described in the Energy Efficiency System set out in the action plan, and by committing to implementing the system throughout the contracting period. Businesses also have an obligation to set their own targets for increasing the efficiency of primary energy consumption and electricity generation when adopting the Energy Efficiency System. For more information on energy efficiency agreements in general and on continuous improvement and the Energy Efficiency System, visit http://www.energiatehokkuussopimukset.fi/en.

Businesses that have signed the energy efficiency agreement submit annual reports, via a web-based monitoring system, on their energy consumption, any energy saving measures implemented and progress with their other contractual obligations. The energy saving measures included in the reports can be measures identified during the course of energy audits or analyses, or otherwise identified by the businesses.

ASSESSMENT OF ENERGY SAVING IMPACT

Method of calculation

Finland has its own national BU calculation system, which has been used in previous NEEAP calculations.

Premises and assumptions

The calculations include all energy saving measures identified during the course of energy audits and analyses that have been reported by the participating organisations as 'implemented' (I) in their annual reports, as well as other energy efficiency measures reported by businesses. With regard to businesses that also implemented the earlier energy saving agreement (1997–2007), account has also been taken of measures reported during the previous contracting period and their saving effects. The savings (GWh/a) used in the calculations up to the year 2015 are based on the saving effects of measures reported by the participating organisations in their annual reports. As of 2016, annual savings have been estimated on the basis of the average in 2008−2015. The records cover nearly all of the businesses that have signed the energy efficiency agreement, as practically all of these businesses have submitted annual reports each year.

With regard to measures reported in annual reports unrelated to energy audits, operational and technical measures are reported separately. The lifetime of individual technical measures has not been assessed separately; instead an average lifetime of 25 years has been used, which is typical to investments relating to production processes. A lifetime of five years has been used for operational measures, because one of the obligations laid down in the energy efficiency agreement involves monitoring consumption efficiently and reacting promptly to

faults.

The assumption was that half of the saving effects of the proposed measures materialise during their year of implementation. The effects of all these measures are attributed to the emissions trading sector.

Baseline data

The baseline data is based on the annual reports submitted via the monitoring system by the participating organisations, and data relating to the previous contracting period.

In its annual report, each participating organisation includes at least the following information for each of its offices:

- General information (contact details, line of business, participation in the emissions trading scheme, etc.)
- Detailed energy consumption data
- Status of energy saving measures proposed in connection with energy audits and analyses
  - I = implemented, D = decided, P = possible, A = abandoned
- Energy saving measures other than those identified during the course of energy audits and the following information concerning the same:
  - estimated energy saving (more efficient electricity production, saving of primary energy)
  - implementation year, size of investment, payback period, etc.
- information relating to energy efficiency systems concerning energy consumption monitoring, energy efficiency plans and environmental systems, etc.
- Other information relating to how energy efficiency has been factored into planning and procurement, the provision of energy efficiency training for personnel, communications relating to energy savings and energy efficiency, etc.

The accuracy of calculations of reported savings correlates with the level of accuracy that can be achieved by normal field testing; some of the baseline data is based on design values or estimates, as measurement is not always possible. In most cases, the savings achieved by saving measures are not verified by retrospective measurement, since measuring is often difficult in practice and results in extra costs.

Motiva checks the orders of magnitude of the data as well as its accuracy, in other respects, after all reports have been submitted and asks the participating businesses for additional information, if necessary.

Overlap

There is no overlap with other assessments.

Impact assessment

The assessment covers the effects of energy efficiency agreements relating to energy production. The estimated savings are subject to the emissions trading scheme, which is why they cannot contribute towards the target set in the ESD.

The annual energy saving (ES) is based on the saving effects (increased efficiency of electricity generation and increased efficiency of primary energy consumption) of measures reported by the participating organisations as 'implemented' (I). The reported increase in the efficiency of electricity generation and the increase in the efficiency of primary energy consumption do not overlap.

The total energy saving effect during the years shown in the table below has been calculated by combining the saving effects calculated for each year on the basis of the aforementioned principles.

ES More efficient primary energy use and ES more efficient electricity production.

Parties responsible for impact assessment

Energy Authority/Motiva

PRIMARY ENERGY SAVINGS (PRIM) AND MORE EFFICIENT ELECTRICITY PRODUCTION GWh/a			2010	2016	2020
PRIM NON-ESD	ET–01–TEM	Energy efficiency agreement for businesses – energy production	273	1,712	2,516
ELECTRICITY NON-ESD	ET–01–TEM	Energy efficiency agreement for businesses – energy production	222	795	1,152

ANNEX 3 DESCRIPTION OF ENERGY EFFICIENCY MEASURES – EXCLUDING IMPACT ASSESSMENT

TABLE OF CONTENTS

MEASURE		MEASURE CODE
Tax administration		HO–01–VM/LVM/YM

IMPLEMENTATION PERIOD	Start	End
		Continuing

MEASURE TARGET All energy users

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water**

FINANCING AND BUDGET

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PARTIES RESPONSIBLE FOR IMPLEMENTATION

VM

DESCRIPTION OF THE MEASURE

Energy taxation

Excise duties are levied on petrol, diesel, ethanol, biodiesel, light and residual fuel, as well as electricity and heat production fuels such as hard coal, brown coal, coke, peat, liquid gas and natural gas. Solid and gaseous biomass, such as wood, on the other hand, are not taxed.

Electricity tax is levied on all electricity regardless of the method of generation, and electricity taxation is not based on the specific carbon dioxide emissions of the fuels used in electricity generation. Electricity tax is split into the general tax band I and the lower tax band II, which applies to electricity consumed by the industrial sector and greenhouses. The fuels used in electricity generation are tax-free, while tax is levied on fuels used in heat generation.

Energy-intensive industry and the agricultural sector benefit from partial energy tax refunds.

2008 energy tax increase

Energy taxes on transport, heating and electricity were raised by 9.8% on average as of the beginning of 2008, while the structure of taxation stayed the same. The tax increase boosted energy tax revenue by approximately EUR 300 million.

2011 structural energy tax reform and tax increase

The structure of energy taxation was reformed as of the beginning of 2011, whereby the energy content of fuels and the specific carbon dioxide emissions attributable to combustion were made the basis for tax on heating and transport fuels (energy content tax and carbon dioxide tax). The structure of taxation remained mostly unchanged in other respects. The tax on peat is lower than that on other fuels. In order to maintain the competitiveness of energy-efficient cogeneration and to reduce steering overlaps with emissions trading, the carbon dioxide tax applied to fuels used in cogeneration has been halved.

A gradually increasing excise duty was imposed on peat in connection with the 2011 structural reform, and the excise duties on fuel oils, hard coal, natural gas and electricity were raised by approximately EUR 730 million net. The unit for calculating the carbon dioxide tax was raised to EUR 50 per one tonne of carbon dioxide for transport fuels and to EUR 30 per one tonne of carbon dioxide for heating fuels.

The most important goals of the structural reform and the increase in the tax on fossil fuels and electricity include encouraging energy savings, increasing energy efficiency and promoting renewable forms of energy.

2012 tax increase on transport fuels

The tax on transport fuels was raised by approximately five percent. The increase was implemented by changing the unit for calculating the carbon dioxide tax. The diesel subsidy was reduced by 7.9 cents a litre. In the same year, the taxation of transport fuels was changed to factor in each fuel's greenhouse gas emissions during its life cycle.

2013 tax reform

The carbon dioxide element of the tax on heating fuels was reinforced as of the beginning of 2013, by raising the unit for calculating the carbon dioxide tax to EUR 35 per tonne of carbon dioxide. The reform had no impact on tax revenue, as the unit for calculating the energy content tax on heating fuels was lowered correspondingly. The tax on peat was raised.

2014 tax increase on transport fuels

The tax on transport fuels was raised by approximately five percent. The increase was implemented by changing the unit for calculating the carbon dioxide tax.

2015 tax increase on transport fuels

The tax on transport fuels was raised by approximately 1-2 percent. The carbon dioxide tax of heating fuels was raised by increasing the unit for calculating the tax to EUR 44 per tonne. Peat tax was lowered gradually, and a tax was imposed on liquid gas, effective as of the beginning of 2016. The energy tax subsidies for mining were removed.

2016 tax increase on transport fuels

The carbon dioxide tax of heating fuels was raised by increasing the unit for calculating the tax to EUR 54 per tonne. The energy tax subsidies for mining were reintroduced at the beginning of 2017.

2017 tax increase on transport fuels

The tax on transport fuels was raised by approximately 3-5 percent, and that of heating fuels by about 7 percent. The increases were made on the energy content and carbon dioxide tax. The unit for calculating the carbon dioxide tax was raised to EUR 62 per tonne of carbon dioxide for transport fuels and to EUR 58 per tonne of carbon dioxide for heating fuels.

Transport taxation

Transport taxation comprises a car tax payable in connection with registering vehicles, an annual vehicle tax and a tax on transport fuels. Transport taxes are therefore levied on vehicle purchases, availability and actual use. Both the car and vehicle tax and the tax on transport fuels are mainly based on the emissions attributable to the vehicle.

The car tax is a one-off tax levied at the time of registering a vehicle. Car tax is levied on all cars, vans and motorcycles registered for the first time in Finland or taken into use in Finland.

The amount of car tax payable on a vehicle is based on the general retail value of the vehicle in the Finnish market. The percentage of tax levied on cars and vans is determined on the basis of the vehicle's specific carbon dioxide emissions or, in the absence of emissions information, the total mass of the vehicle. The tax on cars and vans amounts to 3.8–50% of the vehicle's taxable value. The percentage of tax levied on motorcycles is based on the size of the engine, which usually correlates to the vehicle's emissions. The tax on motorcycles amounts to 9.8-24.4% of the vehicle's taxable value.

The emissions-based car tax was introduced for cars at the beginning of 2008 and for vans in April 2009. The structure of car tax was revised to make the tax more effective in steering consumers' choices in April 2012. After this, a decision was made to reduce the car tax in four stages between 2016 and 2019 for cars with a specific carbon dioxide emission below 140 g per kilometre. This means that taxes on cars with low emissions reduced the most. After the adoption of the emissions-based car tax and the new vehicle emission standards, the average carbon dioxide emissions of new cars sold in Finland has dropped by approximately 32% from the 2007 figures (by the end of 2012).

The vehicle tax is a daily tax payable for all vehicles kept on the road, which is levied ex-ante for each 12-month tax year. The tax is calculated on the basis of each vehicle's specific carbon dioxide emissions or total mass similarly to the car tax. Vehicle tax comprises a base rate applied to all cars and vans, and a power source tax levied on cars powered by fuels other than petrol.

The vehicle tax base rate became emissions-based in 2011 and the base rate was raised in January 2013 to make the tax more effective in steering consumers' choices. The power source tax applicable to cars powered by fuels other than petrol was also raised as of the beginning of 2013. The base rate was increased again in 2015, 2016 and 2017.

The vehicle tax base rate is currently levied on around 2.9 million vehicles. Similarly to the car tax, the tax is calculated on the basis of each vehicle's specific carbon dioxide emissions or total mass. The base rate amounts to EUR 106-654 per year.

The power source tax applies to cars, vans and lorries that are powered by a fuel other than petrol. In addition to diesel-powered cars, the power source tax is levied on fully electric cars, rechargeable hybrid cars and gas-powered cars. The power source tax is designed to balance out the differences in the running costs of vehicles powered by fuels that are taxed differently. A different rate of power source tax applies to different sources of power. The latest power source tax bands have been determined while taking account of the average fuel or energy consumption of each power source, and the annual average distance travelled. The tax on fully electric cars is the lowest stipulated in the Finnish Vehicle Tax Act, i.e. EUR 106 per year.

Tax credits for households

Private individuals have the right to deduct costs incurred from having work done in their homes, through a special tax credit scheme. The maximum amount of the tax credit was raised to EUR 3,000 per spouse as of the beginning of 2009, and limitations on the kinds of works that are eligible were removed. As of the beginning of 2014, the maximum amount of the tax credit is EUR 2,400. Tax credits are awarded for renewing, improving or repairing the home's heating systems, and for the construction and installation of heating systems that use renewable energy sources.

ASSESSMENT OF ENERGY SAVING IMPACT

The impacts on energy consumption have not been assessed.

Overlap

The impacts of the measure overlap with those of multiple other measures.

MEASURE	MEASURE CATEGORY	MEASURE CODE
Sustainable development and energy efficiency in the national curriculum	5	HO–02–OKM

IMPLEMENTATION PERIOD	Ongoing activity	Start	End

MEASURE TARGET	Comprehensive school and upper secondary school teachers and students

MEASURE CONCERNS	Heat	Electricity	Fuel	Water
	Yes	Yes	Yes	Yes

FINANCING AND BUDGET

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PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Education and Culture, National Board of Education, Motiva, universities and other interested parties

DESCRIPTION OF THE MEASURE

National curriculum

The national curriculum (2014) emphasises a set a basic values on which the education is built. One of the basic values is the necessity of Sustainable development and ecosocial education. The schools will act accordingly, guiding students to adopt a lifestyle based on sustainable choices. Basic education involves discussions of discrepancies in consumption and production methods in relation to a sustainable future, while seeking and implementing solutions through joint efforts to correct our lifestyle in the long term.

One of the seven principles of the operating culture of basic education provided in educational establishments and schools is 'Responsibility for the environment and moving towards a sustainable future'. Schools are implementing their responsible approach to the environment through daily choices and actions. Material choices and operating practices that waste raw materials and energy and disrupt biodiversity will be replaced by sustainable alternatives.

In terms of the curricula for individual subjects, energy issues are covered most extensively in physics, but also in environmental studies, home economics, chemistry as well as biology and geography.

The basic values of the upper secondary school curriculum also emphasise the necessity of a sustainable lifestyle and ecosocial education, and stress that competences should be built on an economy that promotes the environment and wellbeing. Students must learn to understand the impact of their own actions and that of global responsibility in terms of the sustainable use of natural resources, prevention of climate change and maintenance of natural biodiversity.

The subject themes are socially significant educational challenges in upper secondary schools. One of the themes is 'Sustainable lifestyle and global responsibility'. Its objective is to encourage students to lead a sustainable lifestyle and act on behalf of sustainable development. The objective with respect to sustainable development is to secure the opportunity for current and future generations to lead a good life locally, regionally and globally. The starting point is that human action should be adjusted to the load capacity of the natural environment and limited natural resources, and that ecosystem services are always available.

Energy issues are mainly addressed by the upper secondary curricula in the subjects of geography and physics.

Teaching resources

Energy efficiency is being promoted in education, by developing new teaching resources for schools. Ready-made resources that make use of various teaching methods are already available for pre-schools, primary and secondary schools and upper secondary schools.

www.edu.fi

Edu.fi – an online service for teachers – is maintained by the Finnish National Board of Education to support and develop teaching and education. The site specifically supports the use of information and communication technology in education. The site contains online study material and other learning-based content, such as competitions and theme days. The site also has theme-based content on sustainable development (www.edu.fi/teemat/keke) under the national curriculum; the subject is approached through various themes, including Energy production and use.

STEM centres

The objective of Finland's STEM centres is to encourage collaboration and promote the teaching and learning of science, technology, engineering and mathematics at all levels of education, from pre-school to university, as well as to get children and young people interested in science, technology and mathematics. In addition to the national STEM centre, there are 10 regional STEM centres in Finland which operate in connection with universities and university consortia. STEM centres provide in-service training for teachers, as well as online teaching resources for

chemistry, biology, physics and mathematics. Teaching resources designed for physics include energy-related elements.

An initiative called the Year 2 Energy Saving Week, which is a thematic event aimed at promoting energy efficiency, has been run annually since 1996, and approximately half of all year-2 groups in Finland take part each year. More detailed information on the initiative is included in the file HO-10-TEM/YM/LVM. www.heikaikkitoimii.fi

On its website (www.motiva.fi/julkinen_sektori/koulut_ja_oppilaitokset) Motiva has collected educational material related to energy saving and renewable energy sources, instructions on how the school environment can be used to study energy issues in practice, and tips on how the school can save energy.

Energy and sustainable development:

- Active Learning exercises, comprehensive school
- Hunt for Lost Energy Information, comprehensive school

Sustainable development education and environmental education:

- Mappa material bank

Climate change:

- Ilmari climate education project

ASSESSMENT OF ENERGY SAVING IMPACT

The impacts on energy consumption have not been assessed.

Overlap

The impacts of the measure may overlap with those of other measures, such as measures relating to communications and advice.

MEASURE	MEASURE CATEGORY	MEASURE CODE
Sustainable development and energy efficiency in vocational training	5	HO–03–OKM

IMPLEMENTATION PERIOD Ongoing activity **Start** **End**

MEASURE TARGET Providers of vocational training, teaching staff and students

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

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PARTIES RESPONSIBLE FOR IMPLEMENTATION

Finnish Ministry of Education and Culture, National Board of Education, providers of vocational training

DESCRIPTION OF THE MEASURE

Vocational training and vocational qualifications

There were a total of 351 vocational qualifications (52 basic-level vocational qualifications, 177 further qualifications and 122 specialist qualifications) in Finland at the beginning of 2017. Basic-level vocational qualifications can be obtained by completing vocational upper secondary education, or in the form of competence-based qualifications. All further qualifications and specialist qualifications are competence-based qualifications. Qualifications can be obtained from a vocational school or through an apprenticeship. Providers of vocational education decide on the actual educational content and its implementation on the basis of the qualification requirements. The evaluation of vocational education competence is based on the qualification requirements.

Basic-level vocational qualifications

Sustainable development has been incorporated into basic-level vocational qualifications as one of the key skills of life-long learning, and competence in sustainable development is assessed as part of vocational skills: “Students or candidates shall commit to acting in accordance with the ecological, economic, social and cultural principles of sustainable development in their occupations. They shall comply with key statutes, regulations and agreements governing sustainable development when carrying out work assignments within their field.” The common elements of basic-level vocational qualifications were changed in 2015. Environmental know-how was incorporated into social and cultural studies. The objectives of environmental competence include the promotion of energy and material efficiency, the prevention of waste creation and taking account of environmental impacts.

Sustainable development has been incorporated into the criteria for awarding vocational qualifications in specific fields. Energy efficiency is factored into the sustainable development elements of vocational education, particularly through life cycle management and eco-efficiency. In the case of construction, for example, ecological construction methods can be taught through the principles of life cycle management and examination of different insulation and heating solutions, and their effects on the energy consumption of the finished building or on emissions and costs resulting from heating. In basic-level vocational education, skills in sustainable development that are needed on the labour market and in students’ future careers are emphasised and promoted through in-service training and competence-based examinations in particular.

Vocational and specialist vocational qualifications

Sustainable development and energy efficiency are compulsory skills that students must demonstrate in a manner suitable for their chosen field, in order to obtain a further or specialist qualification. Energy efficiency and energy conservation issues relevant to each field will be taken into consideration when revising the criteria for awarding further and specialist qualifications.

The specialist vocational qualifications in the field of the environment were revised in 2015, with the addition of a competence area in resource efficiency. The competence requirements for the qualification components relating to expertise in resource efficiency consist of the following: acting in accordance with resource efficiency requirements and objectives; planning and implementing a resource efficiency assessment, and evaluating the results; and drawing up a resource efficiency development plan.

New qualifications, which will be added to the vocational education qualification system in 2018, include a vocational qualification related to the energy sector and a specialised vocational qualification related to the energy sector.

Providers of vocational education

Providers of vocational education can promote sustainable development and energy efficiency by developing the learning environments and functions. Many educational institutions have drawn up a sustainable development programme or environmental system.

Sustainable development has also been incorporated as part of quality management. One of the items in the self-assessment criteria concerning quality management systems for national vocational education is responsibility and the promotion of sustainable development as part of the education provider's strategic management and resource planning.

National education and training committees, and preparation

The national education and training committees completed their work at the end of 2016. The national education and training committees were responsible for monitoring, evaluating and forecasting changes in the kinds of skills that are needed in the labour market with regard to their respective fields, for making proposals to the Finnish Ministry of Education and Culture, the National Board of Education and other interested parties concerning the content of vocational education and qualifications and for encouraging universities to factor the skills needed in the labour market into their training programmes. A forward-looking forum and groups were established in early 2017 to anticipate future educational and competence needs.

The Finnish National Agency for Education began a forward-looking project in early 2016 to assess future competence needs. The project applied the operating model for the forecasting of national vocational competence needs. Workshops played an important role in the prediction process, involving an expert group discussing key, future changes likely to occur in the energy sector by means of various scenarios. The prediction process attempted to determine the competencies that would be required by energy sector companies 10–15 years later. The prediction report will be completed in spring 2017.

ASSESSMENT OF ENERGY SAVING IMPACT

The impacts on energy consumption have not been assessed.

Overlap

The impacts of the measure may overlap with those of other measures, such as measures relating to communications and advice.

MEASURE	MEASURE CATEGORY	MEASURE CODE
Sustainable development and energy efficiency in higher education	5	HO-04–OKM

IMPLEMENTATION PERIOD Ongoing **Start** **End**

MEASURE TARGET University students, students in further education and in-service training

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

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PARTIES RESPONSIBLE FOR IMPLEMENTATION

Universities, Finnish Ministry of Education and Culture

DESCRIPTION OF THE MEASURE

Higher education

Higher education is provided in Finland by 23 universities of applied sciences and 14 academic universities operating under the Ministry of Education and Culture. Universities of applied sciences tend to be multi-disciplinary, regional institutes of higher education that emphasise links to the labour market and regional development. Qualifications available from universities of applied sciences are university degrees with a vocational focus. The basic duty of universities is to promote free research and scientific and artistic education, and to provide the highest level of research-based education. Universities interact with society and promote the adoption of scientific discoveries therein.

Institutions of higher education are independent and have the power to decide on the content of the education that they provide. Each university signs an agreement with the Finnish Ministry of Education and Culture for four years at a time, which includes both institution-specific objectives and objectives that are the same for all higher education institutions. Promoting the principles of sustainable development is an objective shared by all institutions of higher education (in 2017–2020).

The energy technology education offered by universities of applied sciences provides students with the skills needed to work in various roles in power plants, energy companies and industrial energy units. Courses provided by universities of applied sciences in electrical engineering and heating, plumbing and air-conditioning engineering also teach students skills that are useful in the energy industry. Depending on the priorities of different universities of applied sciences, energy technology may also be included as a field of specialisation in courses focusing on automation technology, machinery and process technology, and environmental technology. Energy efficiency can also feature in courses focusing on sustainable development, biotechnology and food technology, wood technology, logistics, rural industries and forestry.

Many universities offer courses relating to energy efficiency. The content and priorities of the education vary, depending on the university. Energy technology is taught as part of courses in electrical and energy engineering, energy and heating, plumbing and air-conditioning engineering, energy technology and environmental, and energy technology. Energy efficiency also features in many other university courses.

Postgraduate degrees are available for individuals who have obtained an undergraduate degree or a degree from a university of applied sciences or an adult education institute, or who have completed other, earlier university studies. Many universities offer master's degrees relating to energy efficiency.

Various courses on energy use and energy efficiency are offered by open universities and as part of further education in universities of applied sciences.

Further training

Institutions of higher education provide in-service training for individuals, businesses and other organisations for a fee. Most in-service training in the energy sector is provided in this manner. Further training in energy efficiency is available in a number of universities of applied sciences and universities.

According to the model on specialisation training for universities and universities of applied sciences, which entered into force in 2015, specialisation training was be implemented in sectors chosen by the institutions themselves. The specialisation training model is an extension of the earlier higher further education that took the form of apprenticeship; this included courses in energy efficiency.

ASSESSMENT OF ENERGY SAVING IMPACT

The impacts on energy consumption have not been assessed.

Overlap –

MEASURE	MEASURE CATEGORY	MEASURE CODE
Sustainable development certification schemes for schools and other educational institutions	5	HO–05–OKM

IMPLEMENTATION PERIOD	Start	End
	2010–	Continuing
	2006–	

MEASURE TARGET All schools from nurseries to universities

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

Certification of educational institutions' sustainable development is funded by the Ministry of Education and Culture and the Foundation for Education and Training. In the auditing of the application process for certificates, the educational institution covers the auditor's expenses. The Eco-Schools programme is funded by the Ministry of Education and Culture, the Ministry of the Environment and participating companies. Parties involved in the programme pay an annual participation fee.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Sustainable development certification schemes for educational institutions: Foundation for Education and Training, Osuuskunta Eco-One, providers of further education for teaching staff, Ministry of Education and Culture Eco-Schools FEE Finland (Finnish Foundation for Environmental Education), Finnish Society for Nature and Environment, regional promoters (such as nature and environmental schools)

DESCRIPTION OF THE MEASURE

One of the objectives laid down in Finland's sustainable development education strategies (Ministry of Education and Culture, the educational division of the Commission on Sustainable Development, 2006) was that all Finnish schools and other educational institutions should draw up their own sustainable development action plans. Another goal was for 15% of educational institutions to obtain external accreditation or certification for their sustainable development efforts by 2014. The Foundation for Education and Training and the Finnish Foundation for Environmental Education estimate that, by the end of 2014, certified schools and educational institutions accounted for around six percent of all schools and educational institutions. The promotion of certification was continued after 2014, as part of Finnish society's commitment to sustainable development within the framework of Finland's Commission on Sustainable Development.

In order to support educational institutions in this work, such institutions need tools for evaluating and improving the way in which sustainable development is factored into management, teaching and operational cultures. The website of the Finnish National Board of Education, www.edu.fi, includes instructions for drawing up sustainable development programmes (www.edu.fi/aihekokonaisuudet/kestava_kehitys). The National Board of Education has also joined forces with various stakeholders to prepare resources for drawing up sustainable development programmes and has granted funding towards the provision of in-service sustainable development training for teachers.

Sustainable development certification schemes for educational institutions:

The Foundation for Education and Training has been providing certification services since 2004 (environmental certification since 2010). The system offers evaluation tools, resources, advice and training in support of the sustainable development efforts of schools and educational institutions. Each educational institution can set up a sustainable development programme of its own to incorporate the promotion of sustainable lifestyles in teaching and the day-to-day running of the institution. The creation of such programmes is based on various themes, including energy and water, which focus on different elements of sustainable development. The premise is that each educational institution can choose its own priorities according to its objectives.

Educational institutions can also seek external accreditation, i.e. certification, for their programmes. Sustainable development certification is available for primary schools, secondary schools, sixth form colleges, vocational schools and adult education institutes. Certification is based on each institution's self-assessment, as well as an audit carried out by an external evaluator. 86 teachers and sustainable development experts have received external evaluator training so far. In addition to performing certification audits, the evaluators also act as development consultants and regional support persons for schools and other educational institutions. The Foundation for Education and Training had issued certificates for 92 schools or educational institutions by February 2017.

The Foundation for Education and Training and its certification partners provide advice, training and institution-specific consultancy in support of educational institutions' development efforts. Many of these services are funded by the education administration and are therefore free of charge.

Eco-Schools

The Eco-Schools programme is a sustainable development scheme for nurseries, schools, other educational institutions and providers of activities for children and young people. The programme is run by the Foundation for Environmental Education The Eco-Schools logo also serves as an international eco-label for the education sector. Organisations that meet the programme criteria are entitled to use the logo in their publications.

The principles of the Eco-Schools programme are as follows:

- Inclusiveness: Children and young people must be included in the planning, implementation and evaluation of projects.
- Lowering environmental loading
- Incorporating sustainable development education in daily routines
- Continuous improvement: far-sighted and systematic development
- Interaction with the local community

The international Eco-Schools programme operates in almost all European countries and is rapidly becoming more popular in other parts of the world. The Finnish Association for Environmental Education has developed an operating model and resources suitable for the Finnish day care and school system.

The Eco-Schools programme generates savings for local governments, thanks to lower energy consumption and waste costs. For education professionals, the Eco-Schools programme provides the opportunity to incorporate sustainable development and inclusiveness objectives in their teaching and early learning curricula. At the beginning of 2017, the programme involved 296 nurseries, schools and educational institutions.

ASSESSMENT OF ENERGY SAVING IMPACT

The impacts on energy consumption have not been assessed.

Overlap

The impacts of the measure overlap with those of other, similar measures relating to communications and education.

MEASURE	MEASURE CATEGORY	MEASURE CODE
Environmental education for young people	6	HO–06–OKM

IMPLEMENTATION PERIOD	Ongoing activity	Start	1981 2006–	End	ongoing

MEASURE TARGET	Children and young people

MEASURE CONCERNS	Heat	Electricity	Fuel	Water
	Yes	Yes	Yes	Yes

FINANCING AND BUDGET

Funding from the Finnish Ministry of Education and Culture: annual operating grants for national youth centres (2016: EUR 3.915 million and investment grants (2016: EUR 997,000)

PARTIES RESPONSIBLE FOR IMPLEMENTATION

National youth centres, national nature and environmental education network, local government services for young people, organisations working with young people

DESCRIPTION OF THE MEASURE

Energy saving efforts of national youth centres

The Finnish Ministry of Education and Culture provides funding for 10 national youth centres and their umbrella organisation, Finnish Youth Centres, on the basis of the Finnish Youth Act. Youth centres receive state aid for their activities and development. The centres organise approximately 330,000 days of youth activities each year, the majority of which comprise off-site education camps, outdoor school activities and activities aimed at promoting active citizenship and social empowerment among young people. The first centres were established in 1981 and the most recent one, Anjala, in 2000.

The primary purpose of the national youth centres is to support teachers in their work and to promote national and international youth work. To do this, youth centres provide services relating to off-site education camps, nature and activity camps, training courses, meetings, family and recreational holidays and youth events. The goal is to provide young people with personal moments of success and shared experiences, intended to guide their development while promoting the objectives of youth education. The operations of youth centres are governed by the Finnish Youth Act and the Finnish Youth Decree, which was amended in early 2017.

Youth centres are independent units that form a nationwide network. Youth centres interact with each other directly and through Finnish Youth Centres and cooperate in the youth sector in general.

The 10 national youth centres and their owners are as follows:

- Ahtela, Sauvo (City of Turku)
- Oivanki, Kuusamo (Nuoriso- ja matkailukeskus Oivanki Oy)
- Anjala, Anjalankoski (Ankkapurhan kulttuurisäätiö)
- Piispala, Kannonkoski (Municipality of Kannonkoski)
- Hyvärilä, Nurmes (Loma-Nurmes Oy, Town of Nurmes)
- Pikku-Syöte, Pudasjärvi (Syötekeskus Oy)
- Marttinen, Virrat (Town of Virrat)
- Vasatokka, Inari (Youth and Nature Travel Centre Inari)
- Metsäkartano, Rautavaara (Rautavaara Course and Camping Centre Foundation)
- Villa Elba, Kokkola (Villa Elba Ltd)

Off-site education camps and outdoor school activities are the most common services of youth centres. Youth centres organise about 1,000 off-site education camps each year. Each centre has its own special features and strengths. Youth centres also coordinate nature-based programmes aimed at young people, some of which are significant on a national scale. The youth centres have also implemented more long-term environmental outdoor school activities. According to the shared strategy of youth centres, the centres strive to increase environmental awareness and raise environmentally responsible young adults.

Each centre has implemented energy savings programmes and taken account of sustainable development in their activities. The energy saving efforts of youth centres comprise various saving measures that have been incorporated into daily activities, such as the use of energy-saving light bulbs and window blinds, turning off unnecessary lights and using hot water sparingly. The centres have adopted geothermal heating systems wherever possible, and energy savings and sustainable development are taken into consideration in all investments.

Promoting environmental education

Environmental education has been promoted by granting funding to national youth organisations that organise

nature-based and environmental activities, other organisations that engage in youth work, and the national nature and environmental education network.
ASSESSMENT OF ENERGY SAVING IMPACT The impacts on energy consumption have not been assessed. **Overlap** –

MEASURE		MEASURE CODE
Motiva		HO–07–TEM

IMPLEMENTATION PERIOD **Start** 1993 **End** Continuing

MEASURE TARGET Central government, local governments, businesses, non-governmental organisations and consumers

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water** Yes

FINANCING AND BUDGET

Motiva consists of the central government's in-house company Motiva Oy on the one hand, and on the other Motiva Services Oy, which serves the private and municipal sector. Motiva's turnover totalled EUR 6.5 million in 2016 (unconfirmed), and it employed 64 people at the end of 2016, of which 48 worked for Motiva Oy. The Energy Authority (until the end of 2013, the Ministry of Economic Affairs and Employment) has commissioned an annual work programme from Motiva, primarily concerning the promotion of energy efficiency (about EUR 2.7 million in 2017). Other energy efficiency work undertaken by Motiva on commission from central government amounted to approximately EUR 1.6 million in 2016.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Most projects implemented by Motiva are the responsibility of various ministries and agencies operating under them. The most important of these agencies is the Energy Authority working under the administrative branch of the Ministry of Economic Affairs and Employment. Motiva and its subcontractors, which comprise firms and non-governmental organisations, are responsible for practical implementation. There is also a great deal of cooperation with other operators, such as various industry associations and organisations.

Motiva is a consultancy and services company that promotes the sustainable use of energy and materials, as well as renewable sources of energy, in a variety of ways.

Motiva was founded in 1993, when the Finnish Ministry of Trade and Industry (now the Ministry of Economic Affairs and Employment) launched an organisation called the Energy Information Centre. Motiva became a state-owned limited company on 1 November 2000. Motiva comprises Motiva Ltd, which is an in-house unit of central government and provides services for the state, and Motiva Services Ltd (founded on 12 December 2008), which provides services for businesses, local government and non-governmental organisations. Motiva Ltd is fully owned by the Finnish State, and Motiva Services Ltd is fully owned by Motiva. Motiva's role resembles that of a national energy agency.

Motiva works together with its customers, developing operating models and tools that help its customers to achieve their goals. Motiva provides advice, disseminates information, helps operators to form networks and become more active, creates tools, runs campaigns and produces information. Another important task is to monitor the progress of measures and assess their impacts.

Motiva communicates via a variety of channels: websites, campaigns aimed at promoting energy efficiency, publications and information packs, seminars, exhibitions and networking events. Communication is increasingly becoming electronic, while use is being made of the social media. Motiva strives to activate and provide the media with services for communications purposes. A total of 64 press releases were issued in 2016. A total of 16 new publications were released, one of which was a reprint. A total of 13 publications were added to the energy efficiency agreements reporting series. The total number of printed publications came to almost 36,900, which is less than previously, because the dissemination of electronic information is becoming more and more prominent. Website publications number 324.

Websites developed and administered by Motiva were visited a total of around 1.1 million times in 2016. Media hits totalled about 1,300 throughout Motiva in 2016.

Motiva's services support central government in the implementation of the National Energy and Climate Strategy and EU Directives, such as the Energy Efficiency Directive, the Energy Performance of Buildings Directive, the Ecodesign Directive and the Renewable Energy Directive. Services are also offered to local governments, businesses, non-governmental organisations and consumers. Motiva nationally coordinates the provision of energy advice for consumers and mobility management, and runs an advice service on public procurement. Motiva combines various methods, technology and communications into efficient service concepts.

Motiva's key operating areas are as follows:

- Energy efficiency agreements: administration, development, support and monitoring
- Energy audits and analyses: administration, development, customer support, auditor training, quality control and progress monitoring
- Energy consumption management: management systems, continuous improvement
- Advice and communications: influencing attitudes and habits, best practices, procurement services, coordination of the provision of energy advice for consumers, coordination of mobility management
- Follow-up and evaluation: effectiveness of programmes and measures

- Renewable energy: promotion of sustainable consumption, promotion of the adoption of different technologies
- Material efficiency: efficient use of materials, material audits and promotion of life cycle management
- Environmentally friendly technology: promotion of the adoption of new technologies
- Eco-labelling: Nordic Ecolabel, EU-Ecolabel

Additional information http://www.motiva.fi

ASSESSMENT OF ENERGY SAVING IMPACT

The impact of Motiva's operations is mainly assessed by evaluating the projects coordinated by Motiva. Impact assessment is one of the key elements of the annual project (working programme) carried out for the Finnish Energy Authority. Systems for monitoring the effectiveness of energy audits and energy efficiency agreements are mainly managed and developed by Motiva, which also evaluates the effects of these programmes.

MEASURE		MEASURE CODE
Energy advice for consumers		HO–08–TEM/YM/LVM

IMPLEMENTATION PERIOD	Start	1/2010	End	Continuing

MEASURE TARGET	Consumers' (private households') energy consumption: housing and choices in appliances, new development and renovations, choices in heating systems, transport

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	Yes

FINANCING AND BUDGET

The Finnish Ministry of Economic Affairs and Employment appointed Motiva Ltd as the national coordinator and developer of energy advice in December 2010. At the core of Motiva's advice services lies the eneuvonta.fi website, which was launched in 2013, and organisations that provide regional advice in different parts of the country (advice was available in 15 regions at the end of 2016). Approximately EUR 1 million a year was allocated for the provision of energy advice for consumers between 2011 and 2014. The budget for 2015 was EUR 290,000, and EUR 250,000 for 2016 and 2017.

EUR 210,000 had been reserved in 2016 for national coordination to promote mobility management (and EUR 270,000 in 2014). The operations are funded by the Finnish Transport Agency and implemented by Motiva Oy. A further approximately EUR 950,000 (EUR 500,000 in 2014) can be allocated to mobility management through state aid and assigned for use anywhere in Finland, particularly in rapidly growing towns.

The Finnish Ministry of the Environment promotes comprehensive renovation communications and makes use of the existing renovation consultancy network, as well as hosting the korjaustieto.fi renovation information website as part of a renovation consultancy network targeted at consumers and property owners. In addition to promoting energy efficiency, advice is provided on 13 other themes, such as property management and maintenance, recycling and material efficiency, damp and mould problems and accessibility. Advice provided by Motiva, on the energy certificates commissioned by the Ministry of the Environment, is also available as part of the implementation of the Energy Efficiency Directive.

In addition to the provision of advice, a range of informative means are used to encourage consumers and other small-scale energy users to conserve energy. This work is coordinated by the relevant ministries, as well as energy companies which also have a statutory duty to promote energy efficiency. Many energy companies, consumer associations and non-governmental organisations have been producing and disseminating consumer information for years.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Energy advice for consumers

Motiva acts as a nationwide coordinator and provider, while funding is provided by the Finnish Energy Authority (until the end of 2013 by the Ministry of Economic Affairs and Employment). There is a national steering group for supporting the coordination of advice, which includes representatives of the Finnish Energy Authority and the Finnish Ministry of Economic Affairs and Employment, as well as the Finnish Ministry of the Environment, the Finnish Ministry of Transport and Communications, the Finnish Ministry of Agriculture and Forestry, the Association of Finnish Local and Regional Authorities and Finnish Energy Industries. Energy advice is provided in the provinces by a variety of operators, some of whom have a long history of working as a local or regional energy office. The advice material is currently being transferred from their website (http://www.eneuvonta.fi/) to become part of Motiva's online service, and personal Messenger advice will be added to the current advice provided by email.

Promoting mobility management

Motiva acts as the coordinator, and the funding mainly comes from the Finnish Transport Agency. Coordination is controlled by a steering group (LOKO) consisting of representatives of the Finnish Transport Agency and Motiva. Projects are coordinated by local governments, energy offices, non-governmental organisations and consultants.
For more information: http://www.motiva.fi/ratkaisut/kestava_liikenne_ja_liikkuminen

Renovation consultancy network and communications

The renovation consultancy network is coordinated by the Finnish Ministry of the Environment. The renovation consultancy network comprises parties offering advice on renovation, property maintenance and the properties of buildings. The network currently consists of approximately 50 consultancy organisations across the country, such as public bodies, local governments, regional museums, renovation centres and property, and construction sector organisations such as trade unions. The network operates nationwide. For more Information go to: www.korjaustieto.fi

Other

The relevant ministries, as well as other operators such as energy companies, consumer associations and numerous non-governmental organisations

DESCRIPTION OF THE MEASURE

Energy advice for consumers

Energy advice targeted at consumers has been developed in connection with the implementation of the National Energy and Climate Strategy, the Consumer Policy Programme and the Government Resolution on energy efficiency. According to the Government Resolution (of 4 February 2010), "An energy advice system for consumers will be adopted and a national coordination centre appointed to run the activities". The goal is to use reliable energy advice as a means of encouraging consumers to use energy more efficiently and to increase their use of renewable forms of energy, which will help to reduce greenhouse gas emissions. In accordance with the new National Energy and Climate Strategy (11/2016), advice for consumers is being increased and consumers are becoming more engaged. In addition, measures will be taken alongside local and regional operators to ensure that comprehensive and timely energy advice, based on the adoption of good practices, is made available.

The Finnish Ministry of Economic Affairs and Employment appointed Motiva Ltd as the national coordinator and developer of energy advice in December 2010. The 24 pilot projects carried out in different parts of Finland in 2010 and 2011, the external evaluation performed on consumer energy advice services in the autumn of 2011, and the regional consultancy services launched in 2012 have created a solid foundation for the system. In cooperation with the steering group and the advice network, Visio2022 work to improve advisory services began in the summer of 2016.

The aim is to provide as much advice needed by consumers as possible from a single source, covering everything from housing to transport, purchases, renovation and construction. This principle is supported by the eneuvonta.fi website, which was launched in 2013 and is also increasing equality among citizens with regard to access to state-funded advice services. Advice is not given on specific choices of appliances, nor do advisors provide detailed design services or consultancy.

At the core of the advice lies not just the aforementioned website, but also the various parties providing regional consultancy in different parts of the country. At the end of 2016, advice was available in 11 different regions and some of the providers had a long history of acting as regional or local energy offices. The methods used to provide advice and disseminate information vary (one-to-one advice, targeted seminars, consultancy workshops, etc.). The energy advice website is closely linked to other websites and online services, and includes contact details for regional consultancy providers. During 2016, some 50,000 consumers searched for information via the online portal.

There is a national steering group for coordinating the provision of advice, which includes representatives of the Finnish Energy Authority and the Finnish Ministry of Economic Affairs and Employment, as well as the Finnish Ministry of the Environment, the Finnish Ministry of Transport and Communications, the Finnish Ministry of Agriculture and Forestry, the Association of Finnish Local and Regional Authorities and Finnish Energy Industries.

Operators providing advice are networked, and they are offered online training and advice material. Cooperation with established sector-specific consultancy services (e.g. mobility management, renovation) continues. The most important of these include Advice on renovations (Ministry of the Environment) and the smart mobility network, Vili (Finnish Transport Agency), coordinated by Motiva.

Mobility management

The energy efficiency of the transport sector is being promoted as part of nationwide mobility management, which the Finnish Transport Agency has commissioned Motiva to coordinate. Mobility management is a means of controlling demand for transport, which is aimed at reducing private car use and increasing forms of transport that are better for the environment and society, such as walking, cycling, public transport, car-pooling and economic driving styles. Versatile communications are important to disseminating information on these issues.

Local mobility management development projects have also been funded, through a joint R&D funding programme by multiple funding agencies in 2010–2013. In addition, the Finnish Transport Agency granted state aid to regional councils and local governments in 2012, in order to promote operating models and forms of cooperation related to mobility management. Motiva supports networking and communications relating to the projects. The mobility management network (LIVE), currently known as the smart mobility network (VILI), was also established to increase cooperation and the exchange of information. VILI has some 550 members. VILI links Finland to the international EPOMM (European Platform on Mobility Management) network, and the Finnish Transport Agency has been a member since 2010. Motiva acts as Finland's national EPOMM point of contact.

It is also important to make consumers regard fuel-economy and energy-efficient cars as ways of being smart about transport. Lessons in fuel-economy have been integrated into each of the three stages of driving school. Fuel-economy is also one of the elements assessed in the driving test. This has been recorded in the curriculum approved by the Finnish Transport Safety Agency. Lessons in economical driving styles are also available from other sources.

Tools have been developed to help consumers factor in energy efficiency when choosing a new car, for example

(see below for more information). Information about new forms of driving power, such as electric cars, is now available with the purpose of boosting their popularity.

Advice on renovations

As part of the action plan for implementing the National Renovation Strategy, the Finnish Ministry of the Environment has been hosting and developing an informative website at www.korjaustieto.fi since 2011, which contains renovation tips for housing associations and owners of detached houses, information on the services of public authorities and contact details for providers of renovation advice and consultancy. The information on the website has been compiled by experts and is aimed at residents, property owners, housing associations and property management professionals. The tools, consultancy services, news and tips available on the website, as well as the renovation professional search function, provide commercially independent, impartial and timely advice and guidance.

Renovation consultants promote sustainable, economical, safe, healthy and energy-efficient living by providing reliable and impartial information to help Finns make smart choices. The provision of renovation advice involves disseminating scientifically proven information and practical experience on different areas of property management and renovation. It is not about providing engineering services or professional consultancy. The key themes in renovation-related communications include energy efficiency and systematic property management, as well as healthy indoor air.

As part of the sustainable production and consumption (KULTU II) programme, (Getting more from less 2013–2015), a range of experiments and services have been implemented in relation to energy use by consumers.

ASSESSMENT OF ENERGY SAVING IMPACT

An external assessment of the effectiveness of the provision of energy advice for consumers was completed towards the end of 2011, but did not include an assessment of energy saving effects.

Methods deployed by other countries have been studied to assess the impacts of mobility management. The so-called MaxSumo method is currently used for some projects.

MEASURE		MEASURE CODE
Energy efficiency advice for SMEs		HO–09–TEM

IMPLEMENTATION PERIOD	Start	6/2009	End	Continuing

MEASURE TARGET	SMEs operating in the chemical industry, food processing industry and technology industry, as well as the tourism and hospitality industry, which have signed an energy efficiency agreement

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	Yes

FINANCING AND BUDGET

The energy advice services of SMEs have been funded by the Ministry of Economic Affairs and Employment, the Energy Authority and signatories of Energy Efficiency Agreement for Industries. Operations began in 2009 with a total budget of around EUR 320,000, of which the Ministry of Economic Affairs and Employment accounted for EUR 271,000 and federations EUR 49,000. Projects providing actual advice were introduced in the same year. In recent years, the Energy Authority has provided EUR 170,000 for various operations and around EUR 47,000 for industry associations. The figures exclude the costs of other supporting projects.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Energy efficiency advice for SMEs is provided by Motiva (management, coordination, practical implementation and communications), industry associations (feedback, steering and communications) and the Energy Authority (until 2013, the Ministry of Economic Affairs and Employment) (feedback, steering and communications).

Manufacturers and consultants also contribute indirectly to the provision of advice, particularly on the practical implementation of energy efficiency measures. The SMEs forming the target group contribute to developing these services by providing feedback and participating in workshops.

DESCRIPTION OF THE MEASURE

Of the industry associations that implement the energy efficiency agreement for businesses, those providing energy advice for SMEs have included the Finnish Plastics Industries Federation (no longer involved as of 2013), the Chemical Industry Federation of Finland, the Federation of Finnish Technology Industries, the Finnish Food and Drink Industries' Federation and the Finnish Hospitality Association, in addition to the Finnish Ministry of Economic Affairs and Employment (the Energy Authority since 2014). Preparations for the provision of advice were coordinated between the aforementioned industry associations and the Finnish Ministry of Economic Affairs and Employment in 2007 and 2008. The service itself was launched in 2009.

Energy issues are often of secondary importance to SMEs, and the resources available for addressing energy issues are often limited. That is why energy efficiency is not always factored in, measures that might improve energy efficiency are not implemented and the potential savings are left unrealised. The energy efficiency agreement for businesses and thereby the energy efficiency agreement they have signed play a key role in Finland in terms of implementing the Energy Efficiency Directive.

Motiva began providing energy efficiency advice on 1 June 2009. The service is targeted at members of the aforementioned five industry associations that have signed up to the action plans, for medium-sized industrial organisations, associated with the energy efficiency agreement for businesses.

The provision of advice focuses on the following themes:

- Annual reporting associated with the energy efficiency agreement
- Obligations arising from the energy efficiency agreement. In 2012 and 2013, priority was given to activating passive signatories. In 2014-2016, the emphasis in communications was on reporting any actions taken to achieve the objectives of the Energy Efficiency Directive.
- Identifying key areas of individual plants' energy consumption on a general level.
- Assistance in prioritising planned energy efficiency measures
- Internal communications and training, and the associated resources
- Assistance in creating contacts between businesses and other relevant parties (energy auditors, Centres for Economic Development, Transport and the Environment, manufacturers, similar businesses)

Energy efficiency advice for SMEs has mainly been provided by the following means:

Telephone and email support

In addition to providing advice, the service includes compiling answers and solutions to questions and problems that have been raised.

Energy efficiency seminars

Five sector-specific seminars relating to the service were held in 2009. In 2010, energy efficiency seminars were local events targeted at businesses representing multiple sectors. Four local seminars were held in 2010, in addition to a separate seminar for businesses operating in the tourism and hospitality sector. Seminars were held for the

technology industry and for businesses operating in the plastics, chemistry and food processing industries in 2011. The seminars held in 2011 focused on sharing best practices and practical tips.

Seminars were also held for various industrial sectors in 2012 and 2013, with themes ranging from heat recovery to measuring energy efficiency. The seminars were held in various locations around Finland, in order to reach as many SMEs as possible.

The seminars held in 2014 and 2015 focused on the utilisation of excess heat and energy solutions for industrial properties.

Visits to businesses

The need for visits to businesses has grown every year. In addition to providing advice, the objective of visits to businesses is to learn about the operations and/or production processes of each business, in order to better identify practical opportunities and challenges.

Producing educational materials

Educational materials were produced in 2009 in particular, including sector-specific information packs on energy efficiency for all of the aforementioned industry associations. Between 2010 and 2016, the focus was mainly on increasing awareness of existing public resources and disseminating information packs associated with seminars. Educational materials are produced and updated as needed. Recent examples include brochures on best practices in different sectors and handbooks on topics such as the energy efficiency of SMEs' industrial properties. Brochures were created on the successes and results achieved by companies during the energy efficiency agreement period.

Cooperation between Motiva and participating industry associations

Information on advice services is regularly communicated to the contact persons of the participating industry associations. Motiva's energy efficiency advice team also needs information and feedback from industry associations and businesses. Meetings relating to the service are organised when needed and as agreed. This ensures that information and feedback can be exchanged back and forth. The industry associations are also asked to fill in annual feedback questionnaires.

Collecting ideas for projects as part of the advice service

Brainstorming about potential projects with various stakeholders groups is an important element of the advice service.

Other activities

In addition to the energy efficiency advice provided for SMEs, various ongoing development projects targeted at energy-intensive industrial organisations also benefit SMEs. Such projects include programmes and seminars relating to energy efficiency management, a project relating to measuring energy efficiency, a project relating to the energy efficiency of steam/condensate systems, and an initiative relating to making use of excess heat. These projects are aimed at helping the energy-intensive industry to satisfy the obligations laid down in the action plan associated with the sector's energy efficiency agreement.

ASSESSMENT OF ENERGY SAVING IMPACT

The project is specifically targeted at businesses that have signed an energy efficiency agreement. Its energy saving effects are therefore included in the impact assessments of the energy audits and action plans of medium-sized industrial organisations and the service sectors which have signed up to the energy efficiency agreement for businesses.

Monitoring and impact assessments are also regularly carried out by contacting businesses directly and by collecting feedback on seminars. A feedback survey was conducted in 2010 among businesses that had used the advice service.

Industry associations are also asked to provide written feedback on advice services on an annual basis.

MEASURE		MEASURE CODE
Standardised communications and awareness-raising campaigns		HO–10–TEM/YM/LVM

IMPLEMENTATION PERIOD	Start	1996	End	Continuing

MEASURE TARGET	Energy users widely represented

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	Yes

FINANCING AND BUDGET

The Energy Saving Week is coordinated by Motiva as part of the Communications and Exchange of Information section of the energy working programme commissioned by the Energy Authority (Finnish Ministry of Economic Affairs and Employment until the end of 2013). Motiva coordinates Mobility Week in Finland as part of its mobility management work, under commission from the Finnish Transport Agency.

The campaigns involve businesses and non-governmental organisations. Mobility Week mainly involves municipalities.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Energy Saving Week is coordinated by Motiva under the Communications and Exchange of Information section of the energy working programme commissioned by the Energy Authority (Finnish Ministry of Economic Affairs and Employment until the end of 2013). Motiva coordinates Mobility Week in Finland, as part of its mobility management work under commission from the Finnish Transport Agency.

The campaigns involve businesses and non-governmental organisations. Mobility Week mainly involves municipalities.

DESCRIPTION OF THE MEASURE

Far-sighted and consistent communications and advice are needed in order to achieve energy efficiency in practice. One approach involves organising events held at the same time each year involving the dissemination of information and operating models, and encouraging different sectors of society to implement energy efficiency measures. Energy Saving Week and Mobility Week are examples of established annual measures of this kind.

National Energy Saving Week is held during the second week of October each year. The objective of Energy Saving Week is to disseminate information on recent developments relating to energy efficiency and to share energy-saving tips with businesses, non-governmental organisations, local governments and consumers. There is no fixed format for Energy Saving Week. Each operator can organise an Energy Saving Week in their own style, focusing on topics that are relevant to them. In 2017, Energy Saving Week will be celebrated for the 20th time. In 2016, 386 organisations took part in Energy Saving Week. Visibility on Facebook amounted to 251,000 visits, which included 17,000 viewings of video downloads or picture animations. Between 20 September and 16 October, the number of commitments was 5,500 (like, share, comment). Twitter impressions related to the Energy Saving Week totalled 117,000. www.energiansaastoviikko.fi

International Mobility Week is celebrated between 16 and 22 September each year. Mobility Week is designed to encourage people to pay more attention to their daily choices of forms of transport and the effects of such choices on the environment and society. Motiva coordinates Mobility Week in Finland as part of its mobility management work. This includes liaising with domestic stakeholder groups and the European network, as well as marketing the event across Finland. In 2016, 27 municipalities and cities took part in Mobility Week. www.liikkujanviikko.fi

Regular annual campaigns targeted at children include Year 2 Energy Saving Week (www.heikaikkitoimii.fi), which has been organised every autumn since 1996. Almost half of all Year 2 groups in the country participate. Several energy companies contribute to organising the event. In some areas, energy companies organise an “Energy in Finland” school event for 9th-graders and teachers (www.energiaasuomessa.fi). Information on sustainable operating practices is also increased by linking your own school building to the system, for example under the Eco-Schools programme, which currently involves some 300 schools and nurseries (www.vihrealippu.fi).

The Climate Campaign of the Association of Finnish Local and Regional Authorities is aimed at reducing greenhouse gas emissions by local government, in accordance with the principles of sustainable development. The Climate Campaign focuses on disseminating information and a total of 56 local governments and two joint authorities are participants (2/2015). The campaign is related to the Cities for Climate Protection campaign of the international association ICLEI. For more information, see www.kunnat.net and www.iclei.org.

Local government activities include a project promoting carbon-neutral local governments (HINKU), in which local government, businesses, residents and experts brainstorm and implement joint solutions for lowering greenhouse gas emissions. The project is coordinated by the Finnish Environment Centre and is supported by the HINKU forum, which brings together local government, businesses that provide climate-friendly products and services, and climate experts. www.hinkufoorumi.fi Eight municipalities are currently members of the Finnish Sustainable Communities network, which has a service centre provided by Motiva and the Finnish Environment Institute SYKE. www.fisunetwork.fi

The Ministry of the Environment ran an action plan, dealing with damp and mould problems, in 2010-2016 www.hometalkoot.fi. Its objective was to support owners of detached houses, in particular, in maintaining their properties and thereby preventing damp and mould problems. The project has an energy efficiency dimension.

For more information, see the description of the measure HO–11–TEM/YM/LVM.

ASSESSMENT OF ENERGY SAVING IMPACT

The effectiveness of communications actions and campaigns is mainly monitored with the help of special indicators, such as the number of participants, feedback received and, where applicable, media visibility. There are plans to develop better ways of assessing the effectiveness of communications actions and campaigns.

According to a feedback questionnaire associated with Energy Saving Week, the campaign reached around 220,000 people through 386 participant organisations. The online service had 17,384 visits, Facebook visibility was 251,000 and Twitter impressions numbered 117,000. There were around 200 media hits during and immediately after Energy Saving Week. A total of 27 towns and cities participated in Mobility Week.

MEASURE		MEASURE CODE
Online services and learning resources		HO–11–TEM/YM/LVM

IMPLEMENTATION PERIOD **Start** **End** Continuing

MEASURE TARGET Companies, organisations and consumers

MEASURE CONCERNS **Heat** Yes **Electricity** Yes **Fuel** Yes **Water**

MEASURE FUNDING AND BUDGET Case by case.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Various ministries, Motiva and other interested parties

DESCRIPTION OF THE MEASURE

Various kinds of online services and electronic tools can be used to provide targeted and intuitive information in support of other sources of information, such as guides, brochures and regularly published newsletters. A wide range of online services is currently available. Below are a few examples of key services. Many energy companies, non-governmental organisations and other operators also have a host of online services and tools for promoting energy efficiency. Ensuring the reliability of information and resources for keeping information up to date is crucial in the context of online services and electronic tools.

General energy efficiency awareness and ecological living

A website called eneuvonta.fi was launched for consumers in 2013, with the aim of disseminating reliable information to promote energy efficiency. The website brings together all key services in a user-friendly manner and guides consumers towards other sources of information. The website includes information on ecological living, renovation, construction and transport.

Motiva's website, www.motiva.fi, and many of the approximately 20 other websites linked to it provide reliable information for consumers and small-scale energy users. For example, the www.topten-suomi.fi website is a web-based tool for consumers, which lists the most energy-efficient products and services on the market. The www.lampputieto.fi service is an e-learning course focusing on light bulbs, which has been developed by light bulb importers, various ministries (Ministry of Economic Affairs and Employment, Ministry of the Environment and Ministry of Social Affairs and Health) and the Finnish Safety and Chemicals Agency. It is also one of Motiva's most popular services (112,000 visitors in 2016). The website includes the intuitive light bulb selector service, which helps consumers to choose the right kinds of light bulbs.

Housing, construction

Under commission from the Finnish Ministry of the Environment, Motiva has been hosting a website on the energy certificates of buildings at www.motiva.fi/energiatodistus since 2009. The website contains basic information about energy certificates and the parties that issue them, as well as answers to frequently asked questions. There is also a telephone helpline on two mornings per working week on +358 (0)4 2428 1291, as well as brochures and guides. The website has about 30,000 visitors a year.

www.energiatehokaskoti.fi is a website aimed at promoting almost zero-energy construction and the objectives of the Energy Performance of Buildings Directive (Article 9). The case studies featured on the website disseminate best practices. The energy-efficient homes project has been coordinated by Motiva since 2005 and approximately 20 kit house designers, building services engineering companies and heating firms, as well as non-governmental organisations, have taken part each year.

The BUILD UP Skills Finland -project (http://www.motiva.fi/buildupskills) has been producing training material, based on best practices and in five languages, for construction trainers and employees; further education programmes for the competence development of trainers and construction workers; and pilot training. In the first phase of the two-phase project, implementation of the training material and courses was in line with the objectives of the national plan for competence development in the field. The project was implemented by Motiva in cooperation with Tampere University of Technology and the Work Efficiency Institute. It was funded by the European Commission's IEE programme, the Energy Authority and the Ministry of the Environment.

https://www.motiva.fi/koti_ja_asuminen/saasta_sahkoa/sahkolammityksen_tehostamisohjelma_elvari was a programme aimed at increasing the efficiency of electrical heating systems, which was coordinated and implemented by Motiva in collaboration with energy companies.

(material published via the Elvari programme)

Various applications have been developed to help compare different heating systems.

There are also websites based on renewable energy, such as www.motiva.fi/bioenergia,, as well as the solar electricity and heating sites www.motiva.fi/aurinkosahko and www.motiva.fi/aurinkolampo.

www.korjaustieto.fi is a website developed and hosted by the Finnish Ministry of the Environment, which focuses on property maintenance and repair. The website was launched in 2011 and is targeted at residents, property owners and housing associations, as well as property management professionals. The website provides practical tools, news and tips as well as a search function for finding renovation professionals. Korjaustieto.fi is one of the key sources of

renovation information in Finland (see Energy advice for consumers).

The Finnish Ministry of the Environment has published a report on the development of government oversight for renovations. The report is based on the National Renovation Strategy, which was drawn up under the supervision of the Finnish Ministry of the Environment, and the associated Government Resolution on renovation. The report examines and analyses approximately 150 weaknesses in the current system. Approximately 10% of these relate to energy efficiency. Case evaluations and procedural instructions have been published: www.korvo.fi. The service is targeted at construction professionals and public authorities, but also benefits engineering firms.

Www.energiahukka.fi is a joint campaign launched in 2016 by the Ministry of the Environment and the real estate and energy sectors to improve the energy efficiency of Finnish housing companies. The campaign offers instructions for a gradual reduction in energy consumption.

Transport, mobility

Information about smart mobility is available online at www.motiva.fi/en/transport. The eneuvonta.fi website also contains information to help people make smart transport choices. The Finnish database of walking and cycling www.kulkulaari.fi (Finnish Transport Agency) contains more detailed information on mobility management.

Various applications have been developed to promote mobility management. For more information about biofuels used in transport see the e10bensiini.fi service, for example.

Acquisitions

A range of online services have been developed for promoting energy-efficient purchasing.

A website dedicated to promoting smart car choices is located at www.valitseautoviisaasti.fi.

The Car Comparison Service athttp://autovertaamo.trafi.fi/ displays an energy marking for both new passenger cars for sale and cars sold after 2000. The website is based on information received by the Association of Automobile Importers in Finland from the Finnish Transport Safety Agency and manufacturers.

Advice on sustainable public procurement is available via Motiva's service www.motivanhankintapalvelu.fi, which also provides a telephone service on +358 (0)424 281 246). The data bank available on the website contains environmental information on the environmental impact of various products and services, and how this can be taken into account in public procurement. The focus is on product groups that the public sector buys in large volumes and that have considerable impacts on the environment. In addition to the information materials, the website includes guidance on efficient procurement processes.

Businesses and non-governmental organisations

Many online services benefit several target groups simultaneously. However, certain websites, such as www.energiatehokkuussopimukset.fi., which provide information about and promote energy efficiency are clearly targeted at businesses and non-governmental organisations Energy efficiency operations cover about 80% of Finland's total energy use (including energy production), and the energy use of the signatories accounts for about half of Finland's final energy consumption. Information for organisations producing energy efficiency plans for the public sector is available at

at www.motiva.fi/energiatehokkuussuunnitelmat.

The WWF Green Office is an environmental system for offices. It helps work communities to lower their environmental loading, achieve savings and slow down climate change. The Finnish Green Office network currently includes 156 offices. (www.greenoffice.fi)

Brochures and learning resources

In addition to websites, more and more brochures and information packs are now available electronically.

Information and advice for consumers on sustainable consumption and acquisitions (such as energy markings of various pieces of equipment) and daily choices is available on Motiva's website at (https://www.motiva.fi/koti_ja_asuminen). The www.ekosuunnittelu.info website offers information and advice on the ecological planning and energy markings of products for the benefit of manufacturers, importers and retailers. The site is maintained by the Energy Authority.

A wide range of information and brochures designed for different target groups are available from Motiva, energy companies, various non-governmental organisations and other operators. For example, you can order 324 publications (mainly electronic, but also some printed material) on the Motiva website. It is vital that this information is up to date and reliable. The publications section of Motiva's website was visited 49,979 times in 2016.

Brochures and other information are disseminated at various events such as seminars and exhibitions, which are organised in collaboration with a range of operators. The media also actively seeks information. In addition to press releases, media efforts to promote and disseminate information on energy efficiency are supported in number of ways.

ASSESSMENT OF ENERGY SAVING IMPACT

The effectiveness of communications is mainly measured by means of operational indicators such as the number of visitors and volume of feedback received. Efforts are made to continuously develop new tools for evaluating the effectiveness of online services and other communications measures.

MEASURE		MEASURE CODE
Promotion of energy efficiency in civil engineering		HO–12–YM

IMPLEMENTATION PERIOD	Start	End	Continuing

MEASURE TARGET	Construction firms, kit house designers and component manufacturers, engineers, independent builders and developers

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water

FINANCING AND BUDGET

The Finnish State has budgeted a total of EUR 60 million towards civil engineering subsidies between 2016 and 2019. Subsidies are tied to the implementation of letters of intent between the state and local governments relating to land use, transport and housing. During 2013-2015, civil engineering subsidies totalled EUR 45 million. The subsidies were used to promote letters of intent between the state and local governments, relating to land use, transport and housing.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Municipalities

DESCRIPTION OF THE MEASURE

Infrastructure subsidies

A new Government Decree (267/2016) was issued in 2012 concerning state aid towards civil engineering in residential areas between 2016 and 2019. This state aid is designed to promote and speed up infill and the building of new residential areas in growing towns where local governments have signed a letter of intent on land use, housing and transport with the state. The objective of the subsidy is to increase housing production in a manner that unifies the community structure. Another objective is a responsible housing policy and a combination of reasonably priced and energy-efficient housing production. The Ministry of the Environment published a guide on zoning that promotes environmental objectives (Suomen ympäristö SY 3/2015). A guide was previously published on the effects of zoning on community structure (Suomen ympäristö SY 13/2013).

Evaluation of the effectiveness of the Finnish Land Use and Building Act

The effectiveness of the Finnish Land Use and Building Act has also been evaluated. A comprehensive assessment of the effectiveness of the act was completed at the beginning of 2014 (Finnish Environment, 1/2014). The evaluation focused on assessing the overall effectiveness of the engineering system and the importance of land use policy to the development of local infrastructure. General local plans set the direction for developing urban infrastructures, and their contents must be improved to better support strategic priorities.

National and regional cooperation to improve the integrity of local communities

Effective land use and good mobility are promoted in urban areas through legislative changes and the development of land use planning systems, the revamping of national land use objectives and agreements between the state and municipalities. Ensuring the integrity of regions and communities and efficient use of space are viewed as the key ways, with the longest-term effects, of promoting energy efficiency. For this reason, both national and regional targets have been set, mainly relating to planning and coordination between different public authorities.

Finland's national land use guidelines represent the Finnish Government's priorities regarding nationally important land use issues. With regard to land use, the guidelines emphasise sustainability in matters such as energy, social cohesion and transport volumes (including good transport links and rail transport capacity). Agreements relating to land use, transport and housing are made with the country's largest urban areas (Helsinki, Tampere, Turku, Oulu). The agreements support cooperation in urban municipalities, and between municipalities and the State, in community structure guidance and the harmonisation of land use, living and traffic. The agreements specify issues such as objectives for land use development and housing production, and any key transport network development projects for the coming years. The agreements are a continuation of the agreements for 2012-2015.

Projects of the Association of Finnish Local and Regional Authorities, the municipalities and many other parties (such as Kokonaisuuden hallinta ja ilmastonmuutos kunnan päätöksenteossa ("Overall management and climate change in municipal decision-making") and Kuntien ilmastokampanja, "Climate Campaign") have significantly improved climate work within and between municipalities. Municipalities and cities are taking part in a number of development projects and networks.

Municipalities are seeking solutions for reducing greenhouse gas emissions, by means such as brainstorming and implementing a project promoting carbon-neutral local governments (HINKU), in which local governments, businesses, residents and experts are involved. The project is also supported by the HINKU forum, which brings together local governments, businesses that provide climate-friendly products and services, and climate experts (www.hinku-foorumi.fi).

Methods of assessing the energy efficiency of infrastructure

The Finnish Environment Institute (SYKE) has been developing a zone method combining land use and a traffic system, and an evaluation of the future development of community structure in urban areas (Urban Zone projects 1-3) in close cooperation with the participating cities and regional councils. The analysis tool developed for urban planning is applied extensively in a range of practical design projects in the form of pilots (about a dozen Finnish cities and urban areas).

KEKO (kaavoituksen ekolaskuri, eco counter for zoning) is an assessment tool designed to support the ecological sustainability of land use planning. It can be used to assess the environmental impacts of community planning and the operational phase. Sustainable regional planning tools and emission calculators have been compiled into an interactive cooperation platform.
(http://alueportaali.figbc.fi/)

Example of energy-efficient town planning

The objective of the ECO2, an eco-efficiency project by the City of Tampere, was to implement the city's climate commitments and develop low-carbon urban development and cleantech business. 2020 is the year in which the EU's climate commitments should be realised. ECO2 has helped with the development of eco-efficient urban planning tools, such as zoning energy assessments, calculation of the carbon footprint, energy criteria related to land transfer, and energy advice related to construction guidelines. The objective is for these practices to become standard procedure in the city. Partnership projects will be made more comprehensive, increasing their financial and environmental impacts. The project is funded not only by the City of Tampere, but also by the Finnish Innovation Fund Sitra. The ECO2 project ended on 31 May 2015, but projects that have already started will continue as planned.

ASSESSMENT OF ENERGY SAVING IMPACT

The impacts on energy consumption have not been assessed. The measure's impacts overlap with those related to buildings and traffic, on which community planning and zoning have an effect.

MEASURE		MEASURE CODE
Energy audits in Finland		HO–14–TEM/YM/MMM/LVM

IMPLEMENTATION PERIOD	Start	1/2010	End	Continuing

MEASURE TARGET	Energy end users

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	Yes

FINANCING AND BUDGET

The Finnish Ministry of Trade and Industry/the Finnish Ministry of Economic Affairs and Employment have been granting funding towards energy audits in the private and public service sector, the industrial sector and the energy sector since 1992. Between EUR 1.2 million and EUR 3.4 million was granted each year between 2003 and -2015, with the average being about EUR 1.7 million per year. A total of EUR 3.42 million in audit subsidies were granted in 2014, while the figure for 2015 was only EUR 0.42 million. The lower amount of subsidies is due to the fact that large companies have been ineligible for energy audit subsidies since 5 June 2014.

In 2017, micro enterprises and SMEs can apply for a subsidy from the Ministry of Economic Affairs and Employment covering up to 50% of energy audit expenses, provided that the energy audits are carried out and reported in accordance with Motiva's energy audit templates and their implementation instructions. The amount of subsidy for other energy audit, analysis or research projects can account for a maximum of 40% of the audit's expenses. Local governments are entitled to up to 60% of the costs of renewable energy audits. The limited amount of energy subsidies has not restricted the number of projects.

Energy audits for farms have involved subsidies of up to 85% for the related energy plans for the period until 2016.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

The Finnish Ministry of Economic Affairs and Employment and the Finnish Energy Authority, the Finnish Ministry of Transport and Communications and the Finnish Transport Safety Agency, the Finnish Ministry of the Environment and Housing Finance and Development Centre of Finland, the Finnish Ministry of Agriculture and Forestry and Finnish Agency for Rural Affairs, regional Centres for Economic Development, Transport and the Environment, the Finnish Funding Agency for Innovation Tekes and Motiva Ltd

DESCRIPTION OF THE MEASURE

Energy Audit Programme of the Finnish Ministry of Economic Affairs and Employment (1994–)

The Finnish Ministry of Trade and Industry (Finnish Ministry of Economic Affairs and Employment as of 1 January 2008) has been providing funding towards energy audits in service sector and industrial properties since 1992. The energy audit programme has been in existence in its current format since the beginning of 1994. Only one universal energy audit template was in use when the subsidised energy audit programme was launched in 1994. In 2017, energy subsidies can be granted towards audits carried out in accordance with four different templates for the service sector, three for the industrial sector and two for the energy sector. Energy subsidies are also available towards energy audits carried out in accordance with two special templates, one for transport chains and one – on the use of renewable energy – for local governments. Energy audits for transport chains are performed from the viewpoint of the transport service customer, but also cover the perspectives of transport company management and administration, transport planning, the fleet and drivers.

Responsibility for the practical coordination of voluntary, subsidised energy audits lies with Motiva, which is in charge of promoting, developing and monitoring the progress of energy audits, training energy auditors and quality control. The Finnish Ministry of Economic Affairs and Employment confirms the general guidelines for energy audits each year.

Energy subsidies can be granted towards all energy audits that are coordinated by individuals who have been trained and certified by Motiva. In addition, energy audits must implemented and reported using Motiva's official energy audit templates and according to Motiva's instructions. Energy support applications were previously processed in the 15 regional ELY-centres, but the Finnish Funding Agency for Innovation Tekes has been in charge of application processing since the beginning of 2017.

Around 50 individuals take part in the energy auditor training provided by Motiva each year. Almost 2,100 people have been certified to act as principal energy auditors since 1993.

The impacts of energy audits have been evaluated in accordance with a special monitoring system since 1994. The monitoring system covers records of all energy audits that have been launched and reported in Finland. Motiva uses the records included in the monitoring system to draw up annual reviews on the progress of energy audits. A total of almost 10,000 energy audits were launched in Finland between 1992 and 2015. Of these, almost 5,600 were audits of local government service buildings, around 2,400 audits of private sector service buildings, about 1,700 audits of industrial buildings and 240 audits of energy generation plants. A total of EUR 38.0 million has been

granted towards energy audits in the form of energy subsidies.
Voluntary energy saving agreements (1997–2007) and the subsequent energy efficiency agreements (2008–2016 and 2017–2020/2025) have had a considerable impact on the volume of energy audits. Energy audits were incorporated as compulsory elements in the energy saving agreements of the Finnish Ministry of Trade and Industry in 1997, and are also included –to assess any energy saving potential – in the obligations laid down in the current energy efficiency agreements of the Finnish Ministry of Economic Affairs and Employment.

Large companies' energy audits (2015–)

The energy audit obligation applicable to large companies, pursuant to paragraph 4 of Article 8, is laid down in the Finnish Energy Efficiency Act, which entered into force on 1 January 2015. The Act obliges large companies to carry out an energy audit every four years; the first audit had to be carried out by 5 December 2015. An energy audit of large companies identifies the energy consumption profile of all sites of a company or group and examines any potential for energy saving. The national minimum requirements of energy audits of large companies are laid down in the new Finnish Energy Efficiency Act, and in decrees issued thereunder by the Government and the Ministry of Economic Affairs and Employment.

According to the Finnish Energy Efficiency Act, large companies that have adopted an ISO 50 001 certified energy management system, or both an ISO 14 001 certified environmental system and a national Energy Efficiency System EES+ certified by a body accredited for the certification of ISO 14 001, are exempt from mandatory energy audits of large companies. If a company covered by the energy efficiency agreement scheme adopts an Energy Efficiency System EES+ covered by the energy audit obligation, the company is regarded as having fulfilled the obligation to conduct mandatory energy audits applicable to large companies. In such a case, the EES+ need not be certified.

Responsibility for official duties relating to mandatory energy audits of large companies is arranged so that the Finnish Energy Authority is responsible for the certification of persons responsible for energy audits of large companies, as well as for quality assurance and oversight in all sectors.

By the beginning of 2017, the Finnish Energy Authority had certified a total of 427 persons responsible for energy audits of large companies. The register of persons responsible for energy audits of companies is available on the Finnish Energy Authority's website.

In order to implement monitoring and quality control, key data on all audit reports must be submitted to the Finnish Energy Authority within three months of the completion of each report. The results of energy audits are monitored through the same special monitoring system as those of subsidised energy audits. Key information on all energy audit reports submitted to the Finnish Energy Authority is recorded in the monitoring system. Motiva uses records contained in the monitoring system to draw up annual reviews on the progress of energy audits. By March 2017, the Finnish Energy Authority had received key data from a total of 826 audits, 685 from the private services sector, 120 from industry and 21 from the energy sector. The Finnish Energy Authority does not have accurate details on the current number of ISO50001, ETJ^{+} and ISO14001 certificates held by large companies. The total number of ISO 50 001 certificates in Finland was 30 at the end of 2015. By the beginning of 2017, less than 100 companies in total had met their obligations by means other than the mandatory energy audit.

All key data on audits sent to the Finnish Energy Authority is verified as part of the Finnish Energy Authority's control and quality assurance. In addition, the Finnish Energy Authority performs checks, based on statistical random sampling, on a statistically considerable portion of all audits of large companies and companies employing other means of fulfilling the statutory obligation.

Finnish Ministry of the Environment – energy audits of residential properties

The energy audit template for apartment blocks, last updated in 2005, is used for energy audits of residential properties. The same template is applied to energy audits of terraced houses. The audit template is freely available on Motiva's website. The first energy audit template for apartment blocks was completed in 2002.

In Finland, the energy performance certificate for detached houses serves as the energy audit for the same. National legislation (Act on energy performance certificates of buildings/Laki rakennuksen energiatodistuksesta 50/2013) and regulations issued thereunder lay down provisions on the energy performance certificate. The Act includes provisions on the qualifications required for issuing certificates. The energy performance certificates, their quality and qualified issuers of certificates are supervised by an independent authority, ARA Housing Finance and Development Centre of Finland. Information and advice on the energy performance certificate and details of qualified issuers of the energy performance certificates are available for the general public on the websites of Motiva, the Finnish Ministry of the Environment and ARA Housing Finance and Development Centre of Finland.

Finnish Ministry of Agriculture and Forestry – energy audits on farms

Energy audits on farms began in Finland in connection with the Farm Energy Programme in 2010; following the transition stage in 2015, they were transferred entirely under the rural development programme for continental Finland 2014–2015 (Rural Development Programme).

The energy audit template for farms is titled the Energy plan for farms. A total of around 330 energy plans had been drawn up with the support of the programme by the end of 2015. In 2015–2016, 121 energy plans were

implemented under the Rural Development Programme.

The 15 regional Centres for Economic Development, Transport and the Environment are responsible for granting subsidies. Until the end of 2015, under commission from the Finnish Agency for Rural Affairs, Motiva Ltd was responsible for controlling the quality of energy plans for farms. At the end of 2016, a total of 43 energy planners had been trained and certified by the Finnish Agency for Rural Affairs.

Changes to be introduced to energy audits in Finland

The currently high standard, cost-effective energy audits will continue in Finland. Each of the relevant ministries (the Ministry of Transport and Communications, Ministry of Agriculture and Forestry, Ministry of Economic Affairs and Employment and Ministry of the Environment) is responsible for ensuring the availability of cost-effective energy audits of a high standard within its respective administrative sector. In the Ministry of Economic Affairs and Employment's administrative sector, further investigations will be conducted on matters such as how subsidised energy audits could be made more attractive for SMEs.

ASSESSMENT OF ENERGY SAVING IMPACT

No comprehensive assessment of the energy saving effects of energy audits has been carried out.

The saving effects of the energy audit programme implemented within the administrative sector of the Finnish Ministry of Employment and the Economy are discussed in connection with sector-specific descriptions (NEEAP-4, Annex 2).

MEASURE		MEASURE CODE
Improving the energy efficiency of vans		LI–02–LVM

IMPLEMENTATION PERIOD	Start	06/2011	End	Continuing

MEASURE TARGET	Van buyers

MEASURE CONCERNS	Heat	No	Electricity	No	Fuel	Yes	Water	No

FINANCING AND BUDGET

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Contributing to the drafting of EU regulations: Finnish Ministry of Transport and Communications; Taxation: VM

DESCRIPTION OF THE MEASURE

Measures for improving the energy efficiency of cars include the following:

1) development of EU legislation and

2) taxation.

EU legislation

Regulation No 510/2011 of the European Parliament and of the Council setting emission performance standards for new passenger cars (binding CO2 ceiling for cars) entered into force in June 2009. The objective is to raise the new van stock's average carbon dioxide emissions to the level of 175 g/km by 2017. In 2016, the CO_2 emissions of newly registered vans in Finland averaged 167.9 g/km. Regulation (EU) No 253/2014 of the European Parliament and of the Council that entered into force in 2014 confirmed the new ceilings for 2020, setting the target at 147 g CO_2/km.

Taxation

The emissions-based car tax was introduced for vans in April 2009. The structure of car tax was revised to make the tax more effective in steering consumers' choices in April 2012. The amount of vehicle tax depends on the general retail sale value of the vehicle in the Finnish market and its CO_2 emissions. The percentage of tax levied on vans is based on full or reduced tax. In 2017, the percentage of vehicle tax levied on vans varies between 3.8 and 50 percent of the general retail value of the vehicle, depending on the CO_2 emissions (g/km) or total weight and driving power. Vans are subject to lower vehicle tax, on certain preconditions defined by law. The percentage of vehicle tax levied on vans is reduced by 9.8–21.7 percentage points, depending on the total weight of the vehicle. However, the tax percentage is always at least the lowest percentage of tax specified in the Vehicle Tax Act.

The vehicle tax system was also revised in 2007, to make the amount of tax payable based on the specific emissions of each vehicle. The basic rate was initially set at between EUR 19 and EUR 606 per year depending on the amount of specific carbon dioxide emissions attributable to each vehicle. The lowest tax band applies to vehicles with carbon dioxide emissions amounting to 0 g/km. The highest tax band applies to vehicles with carbon dioxide emissions amounting to 400 g/km or more. The Vehicle Tax Act was also revised towards the end of 2011. The lowest basic rate band was raised from EUR 19 to EUR 43 per year, while the highest rate band remained unchanged (EUR 606 per year). The vehicle tax was raised again in 2015. The tax increase was carried out by increasing the amount of tax based on the CO_2 emissions. This means that the lowest tax went up from EUR 43 to EUR 69.71 and the highest tax went up to EUR 617.94. From the beginning of 2017, the vehicle tax was raised with all taxable vehicles subject to an increase of EUR 36.50 regardless of the emissions level. This put the lowest amount of tax at EUR 106.21 and the highest at EUR 654.46.

In addition to the basic rate of the vehicle tax that is applied, a driving power tax based on the vehicle's total weight is levied on passenger cars, vans and lorries using other than motor gasoline as fuel or for driving power.

ASSESSMENT OF ENERGY SAVING IMPACT

No assessment of impacts on energy consumption is available for enhancing the energy performance of vans. An assessment of saving impact from enhancing the energy efficiency of cars is presented in Annex 2 to the NEEAP-4 (LI -01-LVM)

Overlap

None

MEASURE		MEASURE CODE
Promoting fuel economy		LI–06–LVM

IMPLEMENTATION PERIOD **Start** 1994 (HA = cars) **End** Continuing
1997 (LA = buses and coaches)
1996 (KA = lorries)

MEASURE TARGET Drivers of cars (HA), buses and coaches (LA) and lorries (KA)

MEASURE CONCERNS **Heat** No **Electricity** No **Fuel** Yes **Water** No

FINANCING AND BUDGET

Cars

Basic-level lessons in fuel economy are paid for by learners. In certain cases, when training is included in vocational education and training, the cost is paid for by the educational institution providing the training (vocational school/Finnish Ministry of Education and Culture). The further training of drivers is provided on market terms.

Buses, coaches and lorries

The further training of professionally qualified drivers is provided on market terms. Training for the basic level qualification is financed by several parties (the Finnish Defence Forces, the National Board of Education, the Ministry of Economic Affairs and Employment, funding on market terms)

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Cars

Finnish Ministry of Transport and Communications/Finnish Transport Safety Agency/driving instructors

Buses, coaches and lorries

Finnish Ministry of Transport and Communications, Finnish Transport Safety Agency, Finnish Defence Forces, Finnish Ministry of Education and Culture

DESCRIPTION OF THE MEASURE

Cars

In legislation, the safety of drivers comprises three elements: safety, economy and social aspects. These basic skills of responsible drivers are included in mandatory driving instruction.

Finnish Transport Safety Agency Trafi approves the curricula applied in the instruction of drivers. The basic knowledge and competencies required for economic driving are specified as curricular content. Attainment of the targets of driving instruction is tested in the driving test, the contents of which are defined by the Finnish Transport Safety Agency in compliance with international regulations.

In most cases, a separate course must be completed providing in-depth training in economic driving. Provision and attendance of training depends on individual consideration and interest.

Buses, coaches and lorries

Basic level training for professional qualification

Basic level training for professional the qualification has been required from new drivers of buses and coaches since 10 September 2008, and from lorry drivers since 10 September 2009.

Basic level training for professional qualification must include instruction on proactive driving in order to promote a safe, economic and environment-friendly driving style (Government Decree on the professional qualification of lorry, bus and coach drivers /Valtioneuvoston asetus kuorma- ja linja-auton kuljettajien ammattipätevyydestä 640/2007, section 2). Depending on the duration of training, at least 14 or 20 hours of training in proactive driving is required. Practical training must account for at least seven hours of such training. Approximately 4,800 goods transport drivers and some 1,000 passenger transport drivers complete basic level training for the professional qualification.

Further training for professional qualification

Further training for the professional qualification is provided in order to maintain professional competence: a total of 35 hours across five years. Such instruction must be provided in periods of at least seven hours. Further training includes at least seven hours of instruction to enhance a safe, economic and environmentally friendly driving style. This training can be provided in the form of theoretical lessons, driving instruction, practical exercises or various combinations of the three. Further training has been provided for lorry, bus and coach drivers since 1 August 2007. An average of 92,000 days was provided during the 2009–2016 further training period for the professional qualification. Approximately one fifth of the further training comprises instruction in order to enhance a safe, economic and environment-friendly driving style.

In September 2016, a total of 127,950 drivers were professionally qualified. All of them have received instruction

aimed at enhancing a safe, economic and environmentally friendly driving style, in either basic level training for the professional qualification or further training.
ASSESSMENT OF ENERGY SAVING IMPACT The impacts on energy consumption have not been assessed. **Overlap** None

MEASURE	MEASURE CATEGORY	MEASURE CODE
Energy labelling of windows	6	RA–06–TEM

IMPLEMENTATION PERIOD	Start	10/2006	End	Continuing

MEASURE TARGET	Developers and renovators

MEASURE CONCERNS	Heat	Yes	Electricity	Yes	Fuel	Yes	Water	No

FINANCING AND BUDGET

The activities are market-based, with the exception of the label development stage.

PARTIES RESPONSIBLE FOR IMPLEMENTATION

Window manufacturers, Motiva/Finnish Ministry of Economic Affairs and Employment/Finnish Ministry of the Environment

DESCRIPTION OF THE MEASURE

A voluntary energy labelling scheme for windows was adopted in Finland in October 2006 as a result of a development project funded by the Finnish Ministry of Trade and Industry (now the Finnish Ministry of Economic Affairs and Employment), the Finnish Ministry of the Environment and businesses. The purpose of the scheme is to make it easier for builders and renovators to choose between different window systems. The labelling scheme categorises windows on a scale from A to G, similar to the categorisation of household appliances. The comparative figure calculated for windows indicates the need for heating caused by the window structure per year.

In May 2011, the label was improved by adding two new categories, A+ and A++, since the standard set in the 2010 building regulations already required windows of at least category A, with a U value of 1.0 W/m^2K at most.

The categorisation regulations were renewed in summer 2013; the EU standard dimensions for windows are used: height = 1,480 mm and width = 1,230 mm. The calculation formula was also amended for the air leakage value (L) in the table figures (with the exception of wood-frame windows and wood-aluminium frame windows). The total impact of the amendments in calculation results was almost marginal.

The annual energy consumption (E) on which the energy categorisation of windows is based is now calculated using the following formula:

E = 140 x Uw - 160 gw + 20 x L, where

E = annual energy consumption (kWh/m2,a)

Uw = heat transfer coefficient for windows (W/m2,K)

gw = total solar transmittance through windows (-)

L = air permeability of windows (m3/m2 h) at a pressure difference of 50 Pa

The energy efficiency of windows is significant in terms of the energy consumption of buildings, as windows account for approximately 15-25% of a building's demand for heating regardless of its age. In fact, windows are a building's weakest link in terms of thermal insulation. Windows are also made in large volumes, as they are needed in renovation projects as well as new development.

At present, some 1,600 window models are energy classified on the Finnish market. They are listed at www.energiaikkuna.fi. The website contains an abundance of technical information about windows and guidelines for purchasing windows. At present, the best E-value of a categorised window is 14, which means that the calculated annual "energy consumption" of the window model in question is only 14 kWh per window square metre.

ASSESSMENT OF ENERGY SAVING IMPACT

No assessment is available of the saving impact of the voluntary energy labelling of windows.

Long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private

FINLAND

Notification pursuant to Article 4 of the Energy Efficiency Directive (2012/27/EU) to the European Commission in April 2017

Name of the report Long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private – update 2017	
Contact person and contact details Ministry of the Environment Jyrki Kauppinen P.O. Box 35 FI-00023 Government	Reference YM28/612/2016

Foreword

Article 4 of the EED is designed for identifying ways of mobilising investment in the energy efficiency of public and private residential and commercial buildings, and implementing these in a systematic and timely manner in connection with renovations.

In connection with the transposition of the Energy Performance of Buildings Directive (EPBD) in Finland, comprehensive requirements were set for renovating the building stock with regard to energy performance. Cost-optimal levels of minimum energy performance requirements for renovations entered into force in 2013. The objectives of the Renewable Energy Sources (RES) Directive are also promoted by a range of means with regard to buildings undergoing thorough renovation.

This updated version of the strategy was drawn up in collaboration with the Ministry of the Environment, local authorities, property owners, service providers specialising in energy performance renovations, research organisations, educational and training institutions, financial institutions and other stakeholders. Technical updating was carried out by research scientists from Tampere University of Applied Sciences (TAMK) and VTT Technical Research Centre of Finland.

11 April 2017

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Table of contents

1. Article 4 of the Energy Efficiency Directive

Article 4 of the Energy Efficiency Directive (EU, 2012), which was adopted in 2012, urges Member States to take measures to encourage investment in the deep renovation of both public and private residential and commercial buildings. This report has been structured as follows on the basis of the requirements laid down for such a strategy:

Member States shall establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private. This strategy shall encompass:

(a) an overview of the national building stock based, as appropriate, on statistical sampling;

Chapter 2. Overview of Finland's building stock.

(b) identification of cost-effective approaches to renovations relevant to the building type and climatic zone;

Chapter 3. Cost-effective, deep renovations suitable for Finland's climate, and their financing.

(c) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations;

Chapter 4. Policies and measures that promote deep renovations.

(d) a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions; (e) an evidence-based estimate of expected energy savings and wider benefits

Chapter 5. Scenarios and impacts and Chapter 3.

2. Overview of Finland's building stock

2.1. Gross floor area of the building stock, as well as its owners and their tenure status

Gross floor area

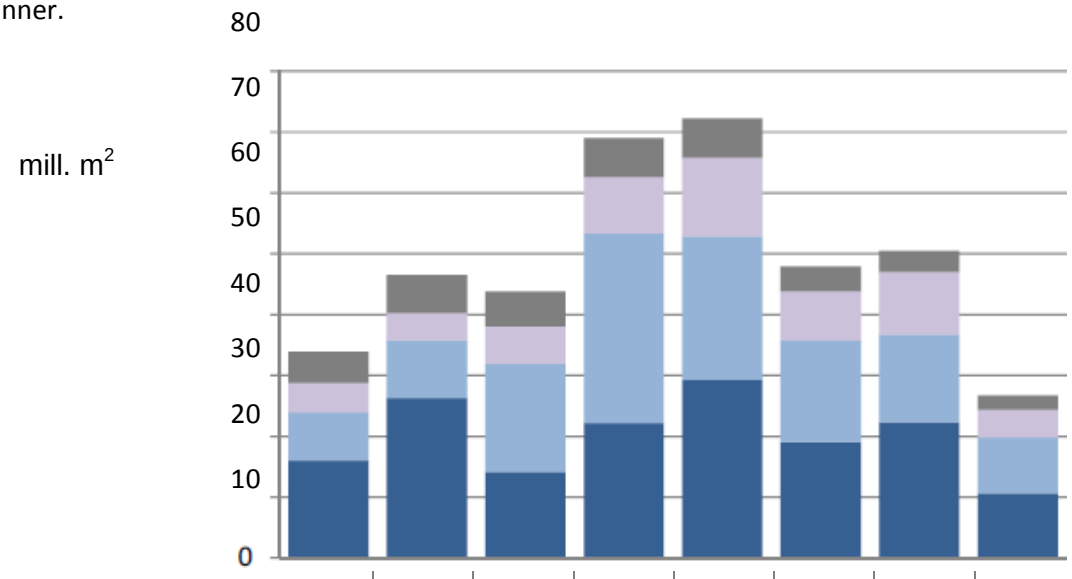
The total gross floor area of residential, commercial and public buildings in Finland is 390 million square metres (Figure 1). One-dwelling buildings account for 41 percent of the total gross floor area, multiple-dwelling buildings for 33 percent, commercial buildings for 16 percent and public buildings for 10 percent.

Ownership

Private households own 65 percent of all buildings, either directly or through the housing company system. They have the highest share of ownership in one-dwelling buildings (91%) and through the housing company system in multiple-dwelling buildings (71%). Enterprises own 20 percent of all buildings. Their share of ownership is highest in the case of commercial buildings, either directly or through the joint-stock property company system. Municipalities and the State own less than 10 percent and approximately one percent of all buildings, respectively (Table 1).

Tenure status

Of one-dwelling buildings, 85 percent are occupied by the owner, while just 3 percent are rented and 10 percent are not permanently occupied. Of the dwellings in buildings with multiple dwellings, 42 percent are occupied by the owner, 21 percent are rented from non-profit organisations (subsidised housing production) and 22 percent are rented on the open market, either from private households or enterprises. Some dwellings are not permanently occupied (Table 2). The tenure of commercial buildings is divided, half-and-half, between owners and tenants (KTI & RAKLI, 2014). The buildings of municipalities are usually managed by their facilities administration and rented internally to their education services, social services and other departments. The Finnish State's building stock is managed by Senate Properties, which rents out the buildings or premises to State organisations in a similar manner.



	-1939	1940-59	1960-69	1970-79	1980-89	1990-99	2000-09	2010–
Public buildings	5	6	6	6	6	4	3	2
Commercial buildings	5	5	6	9	13	8	10	5
Multiple-dwelling buildings	8	9	18	31	24	17	14	9
One-dwelling buildings	16	26	14	22	29	19	22	11

Figure 1. The gross floor area of Finland's building stock totals 390 million square metres. Half of the building stock (gross floor area) has been built since 1980. Source: Statistics Finland, Buildings and free-time residences, 2016.

Table 1. Owners of the building stock in Finland. Source: Population Register Centre, Building and Dwelling Register, 2016.

	Proportion of one-dwelling buildings, %	Proportion of multiple-dwelling buildings, %	Proportion of commercial buildings, %	Proportion of public buildings, %
Private households	91%	2%	12%	1%
Housing companies	6%	71%	4%	1%
Joint-stock property companies	0%	12%	37%	10%
Businesses	1%	8%	38%	14%
Municipalities	1%	2%	5%	57%
State	0%	0%	2%	4%
Others (parishes, non-governmental organisations, etc.)	0%	4%	3%	12%
Total	100%	100%	100%	100%
	mill. m^2	mill. m^2	mill. m^2	mill. m^2
Gross floor area	160	130	60	40

One-dwelling buildings: detached houses

Multiple-dwelling buildings: terraced houses and apartment blocks

Commercial buildings: commercial buildings, office buildings, transport and communications buildings

Public buildings: health care and social services buildings, educational buildings and assembly buildings

Housing company: a company established to own and administer a residential building (or buildings)

Joint-stock property company: a company established to own and administer a building or the facilities of a building with no limitation on the purpose of use Tenement buildings are joint-stock property companies regardless of the fact that they are used for housing.

Residential buildings

The total number of dwellings is 2.85 million, of which 1.15 million are in one-dwelling buildings and 1.7 million are in multiple-dwelling buildings (Figure 2). The housing construction of the 1970s and 1980s is the result of strong rural-urban migration. Migration has accelerated again since 2010. Due to long-standing migration, approximately 15 percent of dwellings constructed before 1970 and 8 percent of dwellings constructed after 1970 have been left empty. Of the housing stock, 10 percent is not permanently occupied. Projections indicate that the population will decrease in many locations and that the number of empty dwellings will grow further in the coming years (Figure 3).

Table 2. *Housing tenure status. Source: Dwellings and housing conditions, 2016.*

	Owner-occupied housing	Rented dwelling subsidised by the State/with an interest support loan	Other rented dwelling	Right of occupancy dwelling; other tenure status	Not permanently occupied	Total
One-dwelling buildings	85%	0%	3%	2%	10%	100%

Multiple-dwelling buildings	42%	21%	22%	5%	10%	100%

Arava dwellings (later ARA dwellings) social housing dwellings produced through government Arava loans in the period 1949–2005, with restrictions on use and transfer. Arava loans were used for the construction of both owner-occupied and rented dwellings.
Social housing built with Arava loans was replaced by a system of interest subsidy loans in 2006. Interest subsidy is available for both new development and renovations.
Right of occupancy dwelling is an intermediate stage between owner-occupied dwelling and rented dwelling.

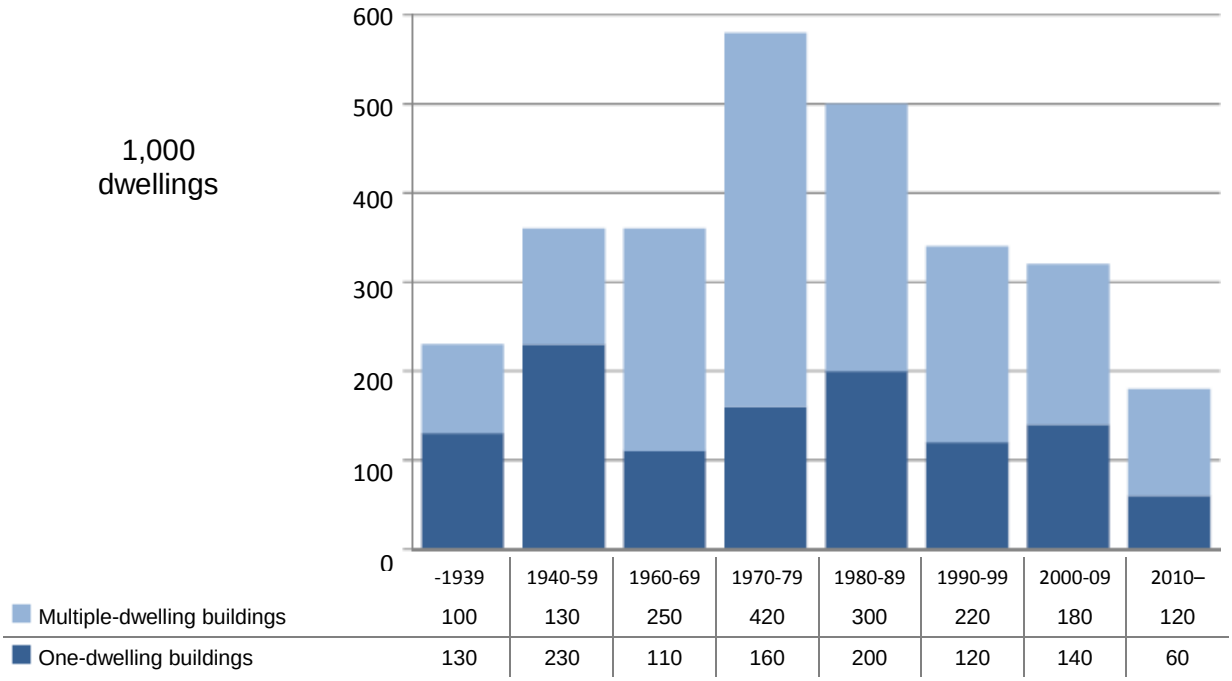


Figure 2. Age structure of the housing stock. One-dwelling buildings include a total of 1.15 million dwellings and multiple-dwelling buildings 1.7 million dwellings. The total number of dwellings is 2.85 million, of which 0.29 million are not permanently occupied. Source: Statistics Finland, Dwellings and housing conditions, 2016.

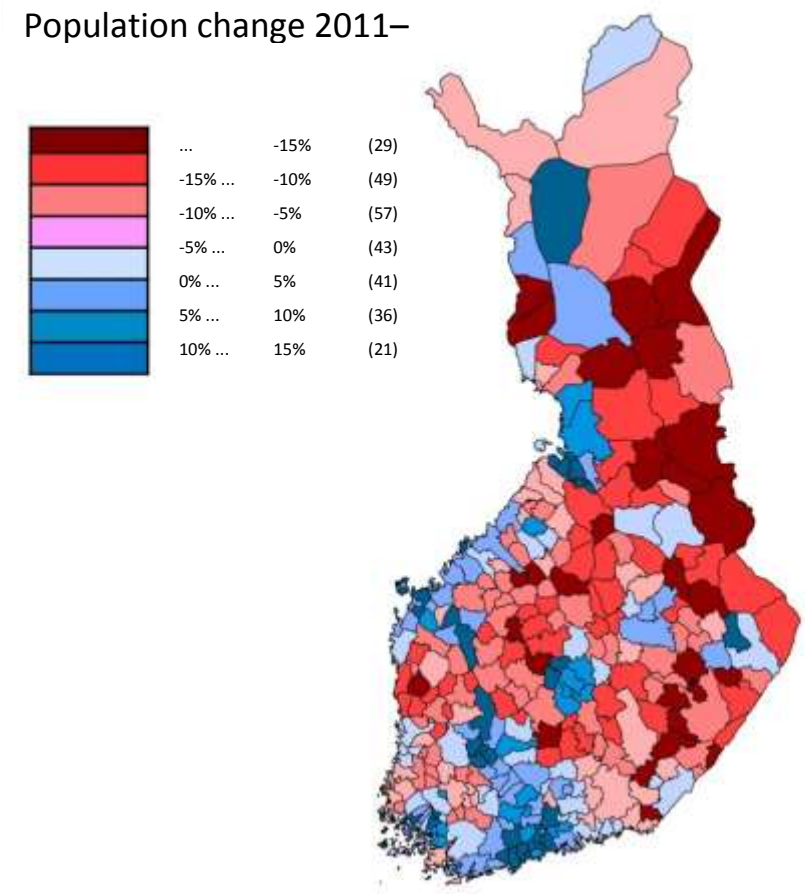
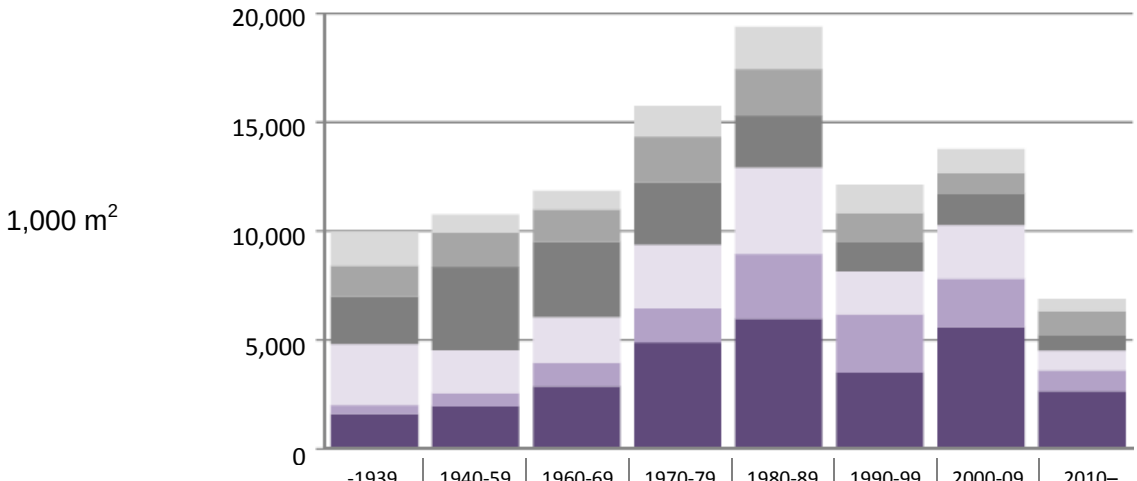


Figure 3. Increase of population proportionate to the population of each municipality. Population will decrease in 60 percent of all municipalities (red rasters in the figure). In these municipalities, some residential, commercial and public buildings will become under-occupied or will be left empty. Source: Statistics Finland, Population projection, 2015.

Commercial buildings and public buildings

Commercial buildings include commercial buildings, office buildings, transport and communications buildings. The occupancy rate of commercial buildings is relatively high, as the owners manage their real estate properties actively, whereas there is a high oversupply of office buildings. Economic restructuring and technological development have changed the needs of businesses to such an extent that out-of-date office premises are unsuitable for businesses. The proportion of empty office premises varies across regions, ranging from 10 to 20 percent. It is very high in the Helsinki metropolitan area (KTI, 2016). New uses are being sought for empty premises, for example by converting them into flats.

Public buildings include educational buildings, health care and social services buildings and assembly buildings. Due to migration, the population – and thereby the need for such premises – is decreasing in many municipalities. Premises will also be left empty as a result of the currently ongoing regional administration reform. According to an expert on municipal premises, municipalities have an excess of 30 percent of premises to manage (Ympäristölehti, 2015).



	-1939	1940-59	1960-69	1970-79	1980-89	1990-99	2000-09	2010–
Assembly buildings	1,560	840	850	1,410	1,930	1,300	1,080	550
Health care and social services buildings	1,430	1,560	1,500	2,100	2,150	1,340	930	1,140
Educational buildings	2,170	3,820	3,450	2,860	2,370	1,340	1,470	680
Office properties	2,800	1,980	2,110	2,900	3,990	1,970	2,450	900
Transport and communications buildings	410	600	1,060	1,570	2,970	2,670	2,240	960
Business properties	1,610	1,960	2,880	4,900	5,970	3,510	5,590	2,660

Figure 4. The gross floor area and age structure of commercial and public buildings in Finland. The gross floor area of commercial buildings is 60 million square metres and that of public buildings is 40 million square metres. Source: Statistics Finland, Buildings and free-time residences, 2016.

2.2. Energy performance of residential, commercial and public buildings

The turn of the 1970s and 1980s was the first milestone with regard to the energy performance of residential, commercial and public buildings. The first U-value requirements for new buildings were set in 1976 (Finnish Ministry of the Environment, 2012). Half of Finland's building stock (gross floor area) was built after the U-value requirements entered into force (Figure 1). The requirements have been tightened on several occasions.

The 1970s energy crises triggered efforts to improve the energy performance of existing buildings. With buildings being renovated after 30–40 years of use, almost all buildings built before the energy crises had been renovated at least once by 2017.

Another milestone for the energy performance of buildings was the year 2010, when thermal insulation regulations were significantly tightened for all buildings (Table 3). The impact of this tightening is shown by energy certificates: buildings constructed before 2010 are placed in a clearly poorer energy class than buildings constructed after 2010 (Figure 5, Figure 6 and Figure 7). In renovations, windows and technical systems have been renovated to correspond to the standards of new construction at the time, while adding insulation to external walls is relatively rare.

Table 3. *Properties of building components affecting the energy performance of residential, commercial and public buildings in buildings of different ages. Source: EKOREM, 2005; Finnish Ministry of the Environment(2012, National Building Code of Finland C3).*

U-values, W/(K·m²)	-1975	1976-2003	2003-2010	2010–

External walls	0.30..0.60	0.28..0.40	0.24..0.25	..0.17
Roofs	0.20..0.45	0.22..0.35	0.15..0.16	..0.09
Floors	0.40..0.50	0.36..0.40	0.24..0.25	..0.09/0.17
Window(s)	1.00..2.50	1.00..2.10	1.00..1.40	..1.00

Properties of technical systems

- All buildings have separate ventilation (no window ventilation during the heating season)
- Ventilation with heat recovery has been required since 2003, systems with heat recovery have been installed voluntarily since the 1980s. In connection with renovations, even old buildings have been equipped with heat recovery.
- Water circulation radiators are equipped with thermostat valves.
- All electricity meters are read remotely, and customers can monitor their electricity consumption via an online service.
- Remote reading is in use in almost all houses connected to district heating networks, and customers can monitor their district heating consumption via an online service.
- All new and the majority of old buildings have water saving taps and sanitary ware.

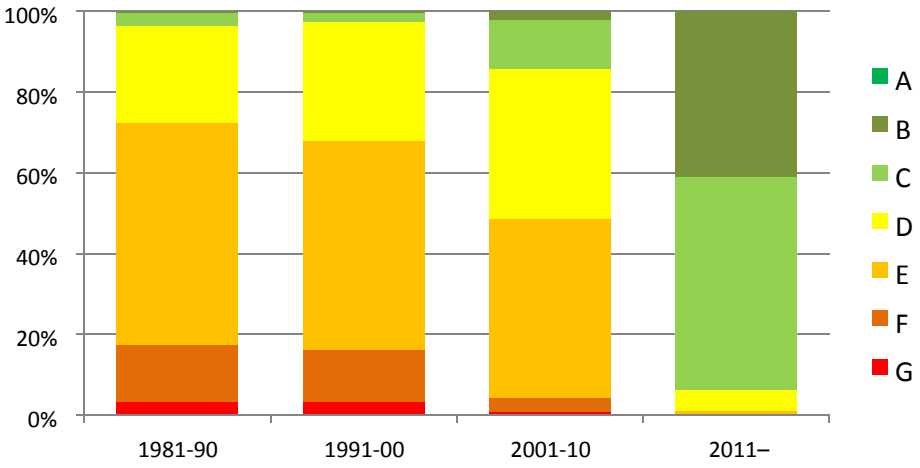


Figure 5. Energy class distributions of one-dwelling buildings of different ages. Source: ARA, Energiatodistukset, 2016.

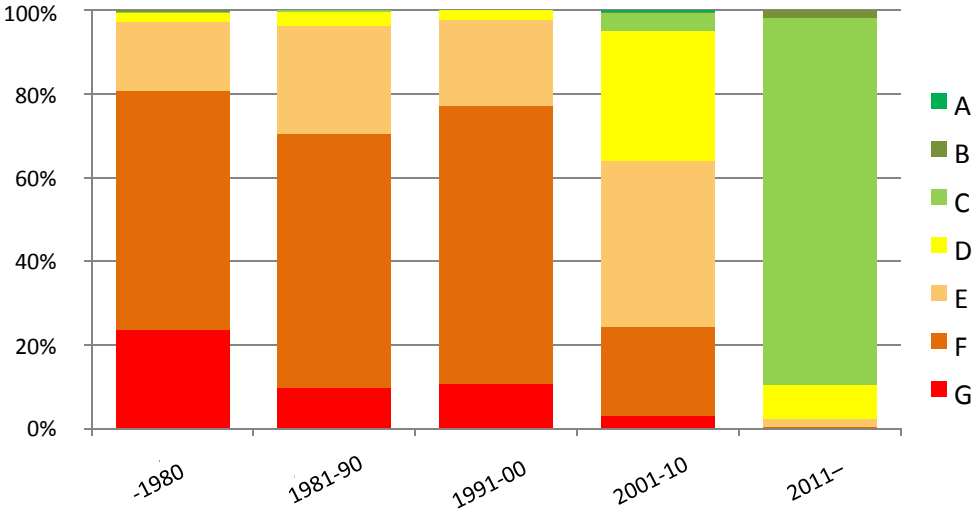


Figure 6. Energy class distributions of multiple-dwelling buildings of different ages. Source: ARA, Energiatodistukset, 2016.

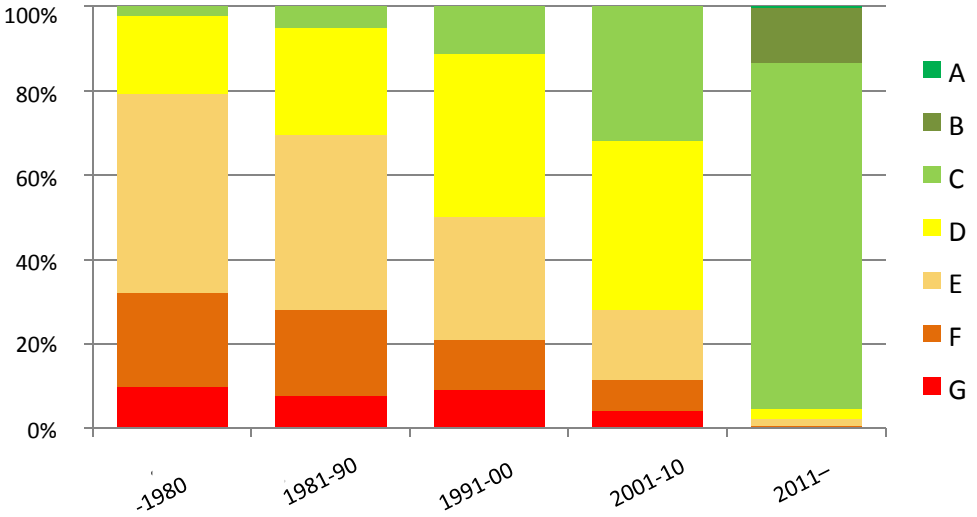


Figure 7. Energy class distributions of commercial and public buildings of different ages Source: ARA, Energiatodistukset, 2016.

2.3. Energy consumption

Energy end-use and primary energy consumption

Residential, commercial and public buildings consume a total of 73,300 GWh of energy annually (Table *4*). Residential buildings account for 75 percent of total energy consumption. District heating is used for the heating of 90 percent of multiple-dwelling buildings and 75 percent of commercial and public buildings. One-dwelling buildings are heated with property-specific heating plants (55%) or electricity (45%).

The use of fossil fuels and electricity for heating increases the proportion of one-dwelling buildings of the total primary energy consumption (Table 5), while district heating in multiple-dwelling buildings, commercial buildings and public buildings decreases their proportion of total primary energy consumption. A significant proportion (32%) of district heating is produced by means of renewable energy sources (Finnish Energy, 2017). In addition, 70 percent of district heating is produced by CHP plants. To avoid peak periods in electricity consumption, it is inadvisable to replace district heating with property-specific renewable energy systems (Finnish Climate Change Panel, 2013).

Table 4. *Heating of the spaces and hot water of residential, commercial and public buildings, including standard electricity consumption for lighting, technical systems and household electricity consumption (final energy). Source: Finnish Environment Institute, 2016.*

	One-dwelling buildings	Multiple-dwelling buildings	Commercial buildings and public buildings	Total	Rates
Electricity	10,400	4,200	1,800	16,400	22%
District heating	2,400	17,000	12,000	31,400	43%
Heat pumps	3,800	300	300	4,400	6%
Biofuels	13,100	200	800	14,100	19%
fossil fuel	2,900	1,100	3,000	7,000	10%
Total, GWh/year	**32,600**	**22,800**	**17,900**	**73,300**	100%

Rates of energy consumption	44%	31%	25%	100%	
Proportions of gross floor area	41%	33%	26%	100%	

Table 5. *Primary energy consumption of residential, commercial and public buildings. Source: Finnish Environment Institute, 2016.*

(energy form coefficients 2012)*	One-dwelling buildings	Multiple-dwelling buildings	Commercial buildings and public buildings	Total	Rates
Electricity (1.7)	17,700	7,100	3,100	27,900	39%
District heating (0.7)	1,700	11,900	8,400	22,000	31%
Heat pumps (1.7)	6,500	500	500	7,500	10%
Biofuels (0.5)	6,600	100	400	7,100	10%
Fossil fuels (1)	2,900	1,100	3,000	7,000	10%
Total, GWh/year	**35,400**	**20,700**	**15,400**	**71,500**	100%
*energy form coefficients will be revised in 2018					

District heating and heat pumps

In connection with the renovation of one-dwelling buildings, biofuel (wood) and oil have been replaced with electricity in heating (Figure 8). In recent years, the efficiency of electricity use has been improved with air-source heat pumps, air-water heat pumps and geothermal heat pumps (Figure 9). Most of the 60,000 heat pumps installed each year are installed in one-dwelling buildings. Compared to direct electric heating, heat pumps decrease primary energy consumption significantly, but not peak power demand during the coldest periods in winter.

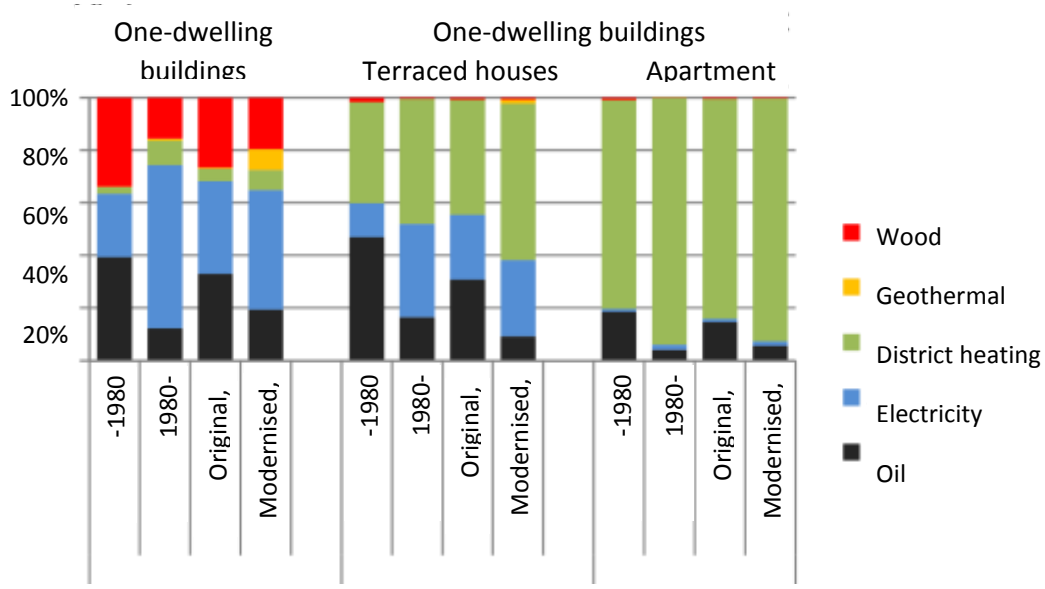


Figure 8. Original and modernised energy sources in residential buildings. Statistics Finland, Energy Statistics, 2013.

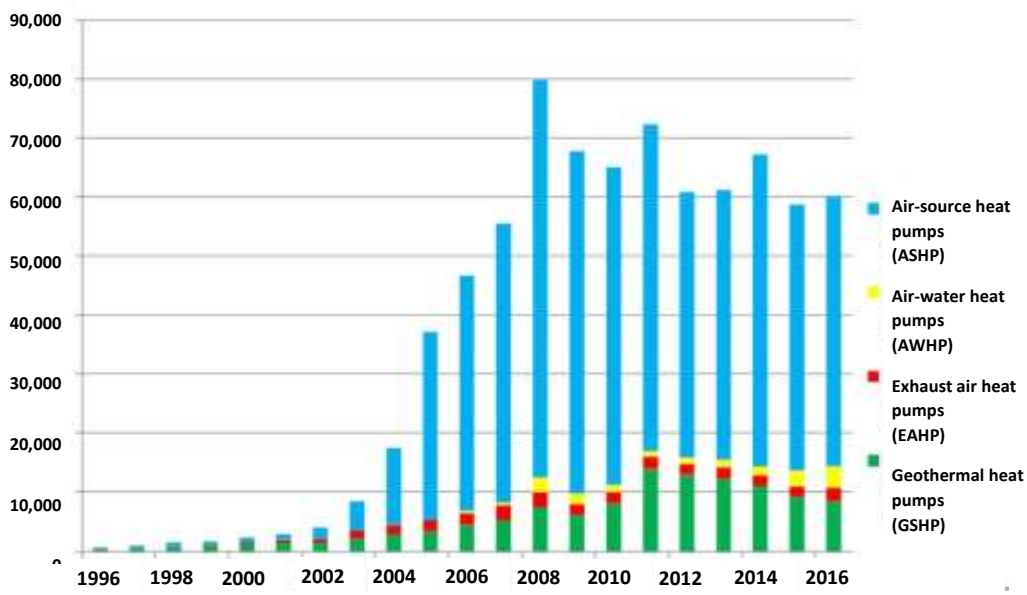


Figure 9. Number of introduced heat pumps. Source: Finnish Heat Pump Association (Sulpu), 2017.

In multiple-dwelling buildings, district heating is by far the most common energy source for heating. As Figure 10 demonstrates, some buildings were connected to the district heating network during the construction phase, while others were converted from property-specific heat production to district heating at a later stage.

The majority (75%) of commercial and public buildings are heated by means of district heating. Even in this case, some buildings were connected to the district heating network during the construction phase, while others were converted from property-specific heat production to district heating at a later stage (Figure 11).

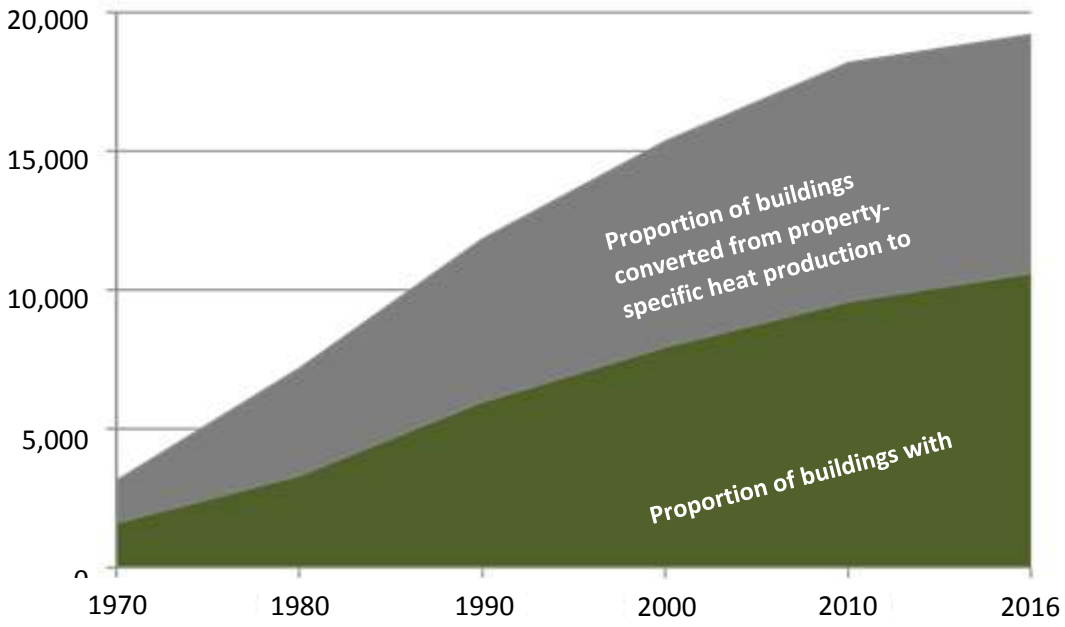


Figure 10. District heating supplied to multiple-dwelling buildings. Source: Statistics Finland, Energy Statistics, 2016 & Finnish Energy, Kaukolämpö, 2017.

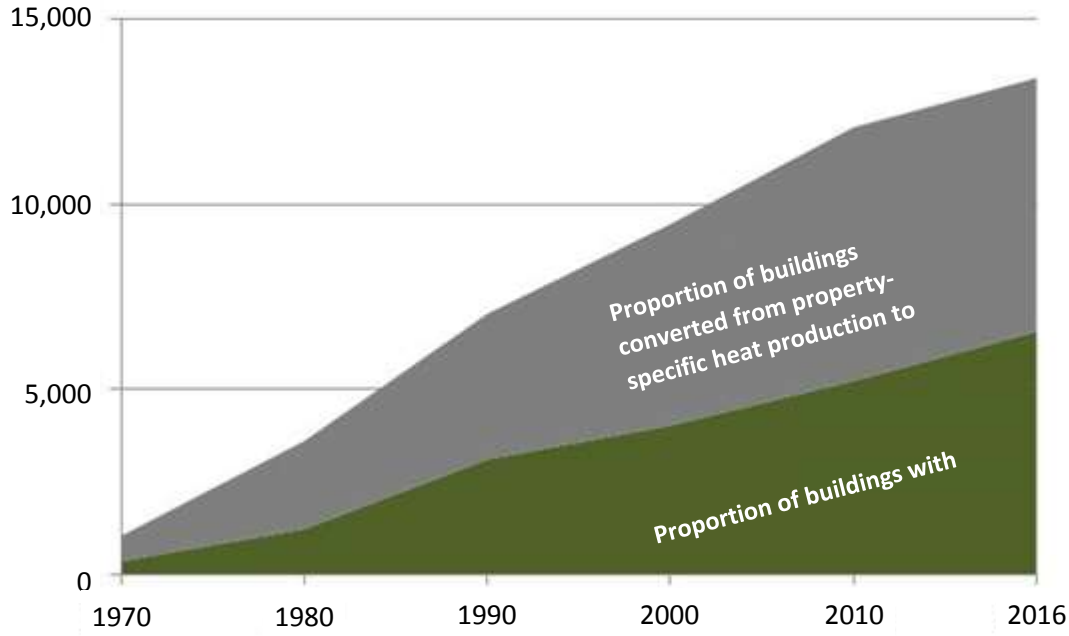


Figure 11. District heating supplied to commercial and public buildings. Source: Statistics Finland, Energy Statistics, 2016 & Finnish Energy, Kaukolämpö, 2017.

2.4. Finland's climate

Finland's climate is a so-called intermediate climate, combining the characteristics of both a maritime and a continental climate. The weather in Finland very much depends on the direction of the prevailing wind and the movement of weather disturbances, i.e. low and high pressure areas. Finland's mean temperatures are largely determined by its location in the middle latitudes, mainly between 60° and 70° North. The annual mean temperature varies from more than +5 degrees in southwestern Finland to a couple of degrees below zero in Northern Lapland (Finland's Climate Guide).

The warmest time of the year is towards the end of July (Figure 12). In continental Finland, the highest summer temperatures outside the long-term averages reach between 32 and 35 degrees. The highest temperature ever recorded in Finland dates back to July 2010: 37.2 °C at Joensuu airport in Liperi. The coldest time of year is around the end of January/beginning of February. The lowest winter temperatures in Lapland and Eastern Finland are between -45 and -50 degrees, in other parts of the country they are usually between -35 and -45 degrees. The lowest temperature recorded at Finland's meteorological observing stations in the 20th century was -51.5 °C in January 1999 (Pokka, Kittilä, 28 January 1999).

The map below shows the geographical distribution of Finland's building stock and the regional heating degree days (Figure 13).

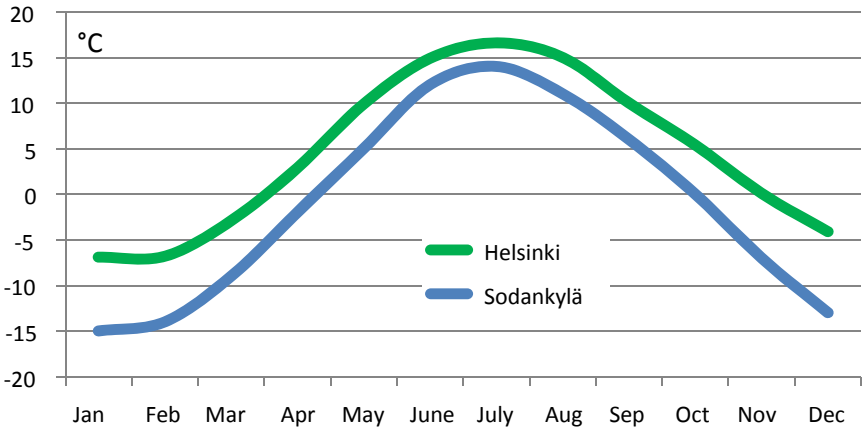
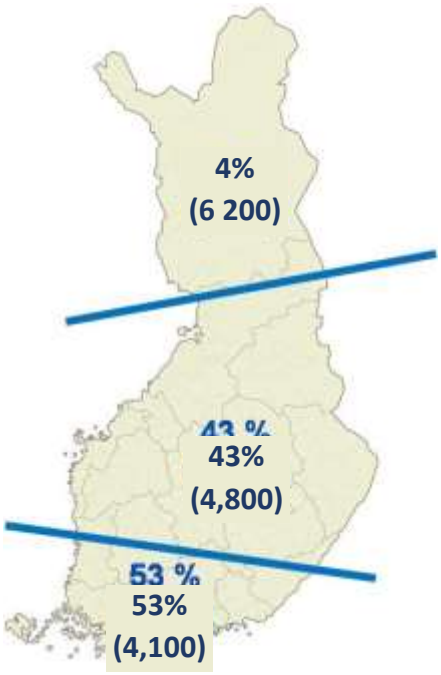


Figure 12. Long-term mean temperatures (1981–2010) in Helsinki (Southern Finland) and in Sodankylä (Northern Finland). Source: Finnish Meteorological Institute, monthly statistics.

Figure 13. Geographical distribution of residential, commercial and public buildings (percentages) and regional heating degree days (°C day).
Source: Statistics Finland, Buildings and free-time residences & Finnish Meteorological Institute, heating degree days



3. Cost-effective deep renovations suitable for Finland's climate and their financing.

3.1. Deep renovation

A renovation is extensive if the total costs of repairs relating to the external walls and roofs or technical systems of a building based on reconstruction costs exceed 25 percent of the value of the building, excluding the value of the building land. In connection with an extensive renovation, anyone undertaking repairs must demonstrate that the measures selected are at a cost-optimal level.

Energy performance can be improved by:

- *modernising building components and systems in stages (staged deep renovation; the most common way);*
- *renovating entire buildings (deep renovation); or*
- *demolishing entire buildings or parts of buildings if no suitable use can be found due to the building's location or condition, or for other reasons.*

The numerical values of the requirements are presented in sections 3.5.1, 3.5.2 and 3.5.3.

3.2. One-dwelling buildings

Methods and sources

The structure of energy consumption in old one-dwelling buildings is presented in the figure (Figure 14). The recommended renovation measures (Table 6) are based on a study by Tampere University of Technology (TUT) on the energy savings potential in the building stock in connection with renovations (Heljo & Vihola, 2012) and reports drawn up for the implementation of the EPBD (Airaksinen & Vainio, 2012; Kauppinen, 2013).

The most cost-optimal measures are based on a joint research project of Aalto University, TUT and VTT Technical Research Centre of Finland, which assessed the cost-optimal levels of minimum energy performance requirements for renovations (Finnish Ministry of the Environment, 2013b). It used the systematics of energy economical choices in refurbishment projects developed at TUT (Heljo & Kurvinen, 2012). In addition, energy advice material targeted at consumers (www.eneuvonta.fi) and coordinated by the Finnish Energy Authority was used.

The cost-optimal levels of measures to improve the energy performance of one-dwelling buildings have been assessed in accordance with Commission Delegated Regulation (EU) No 244/2012, on the basis of life cycle costs for a calculation period of 30 years, taking account of initial investment costs as well as energy costs, maintenance costs, replacement investments, the residual value of investments, the discount rate and the projected increase in the energy price. The selection systematics by TUT are based on additional costs arising from measures taken to improve energy performance and the energy savings achieved by taking the measures (Abel, 2010).

Measures to reduce energy consumption

One-dwelling buildings differ from large buildings due to the fact that 55 percent of one-dwelling houses have property-specific heat production. In one-dwelling buildings, it is possible to make large savings on primary energy and reduce emissions, by targeting measures at either heat production or energy consumption (Table 6).

Such measures can be implemented at the same time (deep renovation), but this is rare due to the differing service lives of structures and systems. All measures can also be taken individually as independent measures (staged deep renovation), but in certain cases care must be taken to ensure interaction between the measures. If heat loss through windows, external walls and roofs is reduced, the heating system should be adapted to correspond to changed consumption. Adding heat recovery from exhaust air to a building affects its original heating system.

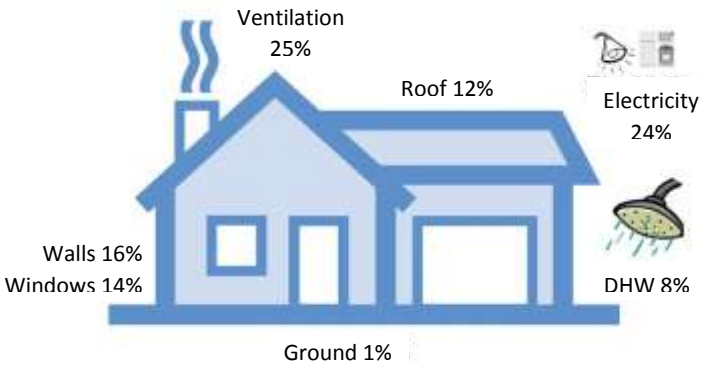


Figure 14. In an old one-dwelling building, heat loss through external walls and roofs accounts for 66 percent of total energy consumption, hot water for 8 percent and lighting, household appliances and other electrical equipment for 24 percent. Source: EKOREM, 2005.

Table 6. *Measures to improve the energy performance of one-dwelling buildings.*

Building component/system	Remedies	Can be implemented as an independent measure	Measures interact
Electricity	After the end of their technical service lives, replacing household appliances with new appliances that are as energy-efficient as possible Replacing light bulbs with energy saving lamps Acquiring photovoltaic panels	X	
ventilation	After the end of their technical service lives, replacing old heat recovery units with energy efficient units	X	
Domestic hot water	Replacing taps and sanitary ware with water saving ones	X	
Window(s)	Replacing windows in poor condition with new, better windows	X	X
External walls	Sealing of feedthroughs Additional insulation, when external cladding needs to be replaced	X	X
Roofs	Additional insulation if there is room Buildings with a flat roof: additional insulation during the renovation of a roof	X	

Floors	Socle: improving ground frost insulation	X	
Heating system	Direct electric heating: adding an air source heat pump Electric storage heaters: adding an air-water heat pump Oil heating: replacing with geothermal heating Fireplaces: replacing with energy efficient ones, for example, replacing an open fireplace with a heat-storing fireplace	X	X

The most cost-effective measures

The most cost-optimal measures **to reduce heat loss** include adding the thickest possible additional thermal roof insulation and replacing the original windows. When the cladding of external walls is replaced, it pays to add thermal insulation as well.

From the perspective of **heat production**, one-dwelling buildings include two relevant groups requiring measures: houses with oil heating and houses with electric heating. **District heating** is seldom available for one-dwelling houses.

Adopting the use of renewable energy sources in houses with oil heating: Oil heating is used to heat almost 20 percent of one-dwelling buildings. Finland's energy and climate strategy (TEM, 2016) sets the target of switching away from oil heating by 2050 in the case of residential buildings. After the end of their technical service lives, property-specific systems should be replaced by systems based on a heat pump (geothermal heat pump; air-water heat pump) or biofuel, as appropriate depending on which is the most sensible option given the geographical location of the building. The system can be switched even earlier if a functioning oil heating system is used as a supporting heating form, in order to level out the heating peak. **Switching from oil heating to geothermal heating is the most cost-optimal** way of meeting the requirements set for renovations (Finnish Ministry of the Environment, 2013a). The idea of replacing oil heating with less expensive heating systems is also supported by a report by the Finnish Ministry of the Environment on fuel poverty in Finland, which identified households with limited means in oil-heated dwellings as a risk group (Finnish Ministry of the Environment, 2013c).

Improving the energy performance of houses with electric heating: The share of houses with electric heating is 45% of all one-dwelling buildings (Figure 8). Many houses with electric heating were built

in the 1980s, and do not yet require renovation. However, there is a significant need to improve energy efficiency if the heating system is direct electric heating. The recommended renovation measure involves the installation of a heat pump (Table 7).

High-consumption buildings

The location of a building is an important factor when planning measures for a high-consumption building. In areas suffering from depopulation, property owners should consider the future of their dwelling, as there is risk that it will be left empty after their occupancy. If a short future occupancy period is foreseen for the building, a deep renovation is unlikely to be a profitable investment. If demand is expected, even in the long term, renovation measures should be prioritised on the basis of the condition of structures or systems. In terms of financing such renovations, it is a good idea to begin making energy cost savings by using free energy (such as geothermal energy). In growing urban areas, demolishing the building may be an option if an energy-efficient, new building with a significantly higher gross floor area can be built on the plot.

Steering of decision-making relating to renovation investments

Householders who own their homes make all decisions concerning their one-dwelling buildings and often carry out any necessary repairs themselves. A change of ownership provides a window of opportunity for deep renovations. Potential new owners are given information on the condition of a building and any renovation needs in the results of property inspections. **Property inspections** are voluntary, but are performed for most sales, particularly in the case of old buildings. The purpose of an inspection is to ensure that an excessive price is not paid for a building in poor condition, but that the condition is reflected in the price and resources are left over to enable the buyer to carry out renovations. The inspector is an external expert with a construction qualification. A technical education can be supplemented with a property inspector's professional degree.

In addition, the **energy performance certificate** required by the EPBD must be presented during a property sale. Individuals who issue energy certificates must have a suitable technical degree or corresponding work experience, and pass a test to demonstrate their familiarity with the drawing up of energy performance certificates and the related legislation. Individuals who issue energy certificates must present cost-effective measures for improving energy efficiency as part of the certificate. Guidance on identifying such measures and assessing their impacts is provided in training material produced by the Finnish Ministry of the Environment.

The joint Elvari project, carried out by the Finnish Energy Authority (energy advice for consumers) and Finnish Energy to improve the efficiency of electric heating, has led to the production of guidelines on reducing energy consumption for users of electric heating under the title "these guidelines will save you money" (Table 7). By following the guidelines, consumers can save 50% in heating costs. **An air source heat pump is a cost-effective technology for reducing the energy consumption of direct electric heating**. The guidelines also recommend the use of fireplaces in cold winter weather. This is important for both the household and the electricity system, as wood heating helps to cut electricity consumption peaks. Wood used for heating must be dry and clean so as to minimise particulate matter emissions.

The Finnish Home Owners' Association (http://www.omakotiliitto.fi/en), which is a lobbying and service organisation for single family house occupants, provides its members with energy saving tips. Its services also include a maintenance manual that provides property owners with guidance on the systematic management and maintenance of their properties.

Table 7. *Guidelines for owners of one-dwelling buildings. Source: www.eneuvonta.fi*

1. **Monitor and examine your electricity consumption.** Make use of the hourly monitoring service offered by your energy company. Determine whether your consumption is at a normal level. Rapidly address any deviations in consumption.
2. **Monitor and control indoor temperatures for each room separately**. Utilise automatic systems according to your needs or adjust room-specific heaters accurately. Seldom used rooms and storage spaces or garages should not be heated to a comfortable room temperature of 21–22 degrees.
3. **Adjust the ventilation system and use it correctly.** Adjust forced general ventilation according to need, override heat recovery during the summer period and restore it immediately after the warmest summer period. In cases of natural ventilation, set the valve of the air inlet window in the winter position and reduce the gap of the bathroom disc valve during winter.
4. **Check the temperature setting of the hot-water heater.** The recommended temperature is 55–60 degrees. Increase the temperature, if there is insufficient hot water for normal use. Also pay attention to your water use habits.
5. **Use your fireplaces if you have any.** One stacked cubic meter of dry firewood equates to approximately 1,000 kWh of delivered energy. Wood burning is of greatest benefit in mid-winter and in cold winter weather.
6. **Investing in an air source heat pump as a form of supplementary heating is almost always profitable.** Always adjust the basic heating system to a level that is 3–4 degrees lower than the pump. Learn to use the pump in an energy-efficient manner.
7. **Rationalise the consumption of household electricity.** Small changes in electricity consumption habits can bring considerable savings. Pay attention to your use of your sauna, lighting and standby modes of devices. Purchase energy-efficient equipment.

Financing of renovation investments

The state only grants regular renovation subsidies to special-needs groups. The form of assistance for normal households is **a tax credit for domestic expenses**, which can be claimed for work carried out by a business enterprise that has a valid registration for tax prepayment. In 2017, the proportion of the tax credit is 50 percent of the value of the work done, including VAT. However, tax payers must pay EUR 100 of the costs themselves, and the maximum tax credit is EUR 2,400 (Finnish Tax Administration, 2017). The tax credit for domestic expenses is personal and tied to residence, which means that all residents can claim a tax credit if they have contributed to the renovation costs.

Owners of one-dwelling buildings finance most renovations themselves **with savings or market-based loans**. Access to market-based loans is affected by collateral. For example, in areas with low property prices, the need for a loan may be too high compared to the market value of the residential property.

Other financial instrument options include financing from the sale of real estate property (e.g. the parcelling out of land) and financing arranged by product suppliers.

Barriers to renovations of one-dwelling buildings

The condition and energy performance of buildings are assessed when the owner or tenant changes. If no such changes are foreseen, assessing the state of a building is dependent on the initiative and activity of the owner. A renovation may also be prompted by service providers. In both cases, there is a risk that the renovations are haphazard measures rather than based on assessing the improvements required by the building as a whole, and taking account of all possible energy saving methods. It would be worth studying the German example of an “Individual Renovation Roadmap” for promoting renovations of one-dwelling buildings.

Figure 3 illustrates the change occurring in Finland's regional structure, which is leaving residential buildings without permanent residents. In areas suffering from depopulation, some one-dwelling buildings will not be renovated, as their useful life is expected to be short.

Practices in other EU Member States

The Individual Renovation Roadmap (the German approach) is a compact, intuitive and standardised tool, which takes account of customers' needs and is long term and future oriented. The key idea underlying standardised methods is the preparation of renovation roadmaps by energy consultants, who translate the building-specific consulting service into a format that the building owner can understand and handle as a description of the effects of individual measures on energy efficiency, while the economic efficiency of such measures strengthens the owner's willingness to invest.

http://www.buildup.eu/sites/default/files/content/build_up_webinar_08_2017-0202_building_passports_3_mpehnt.pdf

3.3. Multiple-dwelling buildings

Methods and sources

Old apartment blocks consume energy as described in the figure (Figure 15). **Almost all multiple-dwelling buildings are connected to the district heating network**. District heating began to become more popular in the 1970s. Access to district heating was ensured for new residential areas as part of preconstruction, and old buildings with property-specific heating systems switched to district heating (Figure 10).

Measures to improve the energy performance of multiple-dwelling buildings can be targeted at their technical systems or structures. The recommended renovation measures (Table 8) are based on a study by Tampere University of Technology (TUT) on the energy savings potential in the building stock in connection with renovations (Heljo & Vihola, 2012) and reports drawn up for the implementation of the EPBD (Airaksinen & Vainio, 2012; Kauppinen, 2013).

The most cost-optimal measures are based on a joint research project by Aalto University, TUT and VTT Technical Research Centre of Finland, which assessed the cost-optimal levels of minimum energy performance requirements for renovations (Finnish Ministry of the Environment, 2013b). It used the systematics of energy economical choices in refurbishment projects developed at TUT (Heljo & Kurvinen, 2012). Monitoring data from demonstration buildings monitored by VTT was also used.

The cost-optimal levels of measures to improve the energy performance of multiple-dwelling buildings have been assessed in accordance with Commission Delegated Regulation (EU) No 244/2012 on the basis of life cycle costs for a calculation period of 30 years, while taking account of initial investment costs and maintenance costs, replacement investments, the residual value of investments, the discount rate and the projected increase in the energy price. The selection systematics by TUT are based on additional costs arising from measures taken to improve energy performance and on the energy savings achieved by the measures (Abel, 2010).

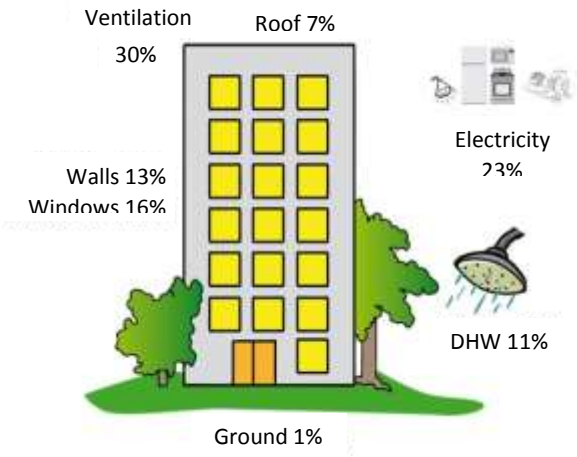


Figure 15. In an old multi-dwelling building, heat loss through the building envelope and ventilation accounts for approximately 66 percent of total energy consumption and hot water for 11 percent. The remaining 23 percent is accounted for by lighting, household appliances and other electrical equipment. Source: EKOREM, 2005.

Measures to reduce energy consumption

These measures can be implemented at the same time (deep renovation), but this is rare due to the differing service lives of structures and systems. All measures can also be taken individually as independent measures (staged deep renovation), but interaction between measures must be ensured in certain cases. If heat loss through windows and the building envelope is reduced, the heating system should be adjusted to correspond to the new situation. Adding heat recovery from exhaust air or waste water to a building affects its original heating system.

The most cost-effective renovation measures

The most cost-optimal measures relate to cutting the energy consumption for ventilation. Forced general ventilation should be equipped with **heat recovery from exhaust air** and the transfer of heat to either central heating or hot water heating. At the end of their service lives, **windows should be replaced** with new ones that have U-values similar to those used in new development. The supply of fresh air can be ensured with supply air valves for windows. An efficient way of saving on water consumption is to **reduce pressure**. Energy can be recovered from waste water centrally. Adding insulation to the building envelope is only financially viable if the surfaces of the envelope need to be replaced for other reasons.

Old buildings must be equipped with unit-specific water consumption measurement during replumbing, whereas unit-specific metering of heat consumption and the related billing would only increase costs (VTT, 2013). A more profitable measure would be to ensure **the settings and functioning of heating and ventilation systems centrally**.

Table 8. *Measures to improve the energy performance of multiple-dwelling buildings.*

Building component/system	Remedies	Can be implemented as an independent measure	Measures interact	
ventilation	Replacing old units with more energy efficient units after the end of their technical service lives Mechanical exhaust air system: adding an exhaust air heat pump	X		X

Electricity	LED lighting with occupancy sensors in common spaces	X		
Domestic hot water	Adjusting the water pressure Replacing taps and sanitary ware with water saving ones Heat recovery from waste water	X		X
Window(s)	Replacing windows in poor condition	X	X	
External walls	Additional insulation, when external cladding needs to be replaced Sealing of feedthroughs	X	X	
Roofs	Additional insulation if there is room Buildings with a flat roof: additional insulation in connection with the renovation of the roof	X		
Floors	Socle: adding insulation boards Isolating the ceiling of the basement in storage spaces	X		
Heating system	Balancing the heating system Replacing the automation system with a dynamic control system	X	X	X

High-consumption buildings

If a multiple-dwelling building requires expensive renovations in addition to measures taken to improve energy efficiency, demolishing the building may be an option worth considering. In areas with low demand, there are often several buildings in the same situation, and buildings in poor condition have low potential to succeed in the mutual competition for tenants or owner-occupants. Rental properties can apply for a demolition subsidy from the Housing Finance and Development Centre of Finland (ARA). In growing urban areas, it is possible to apply for rezoning for the plot so as to be able to construct a larger, energy-efficient, new building on the plot.

Steering of decision-making relating to renovation investments

Joint-stock property companies (rental properties) are governed by the Finnish Limited Liability Companies Act (624/2006) and separately issued statutes, such as statutes on the joint management and restrictions on the use and assignment of state-subsidised (Arava) Rental Buildings and on residential leases. Limited liability joint-stock property companies and housing companies that own residential properties are governed by the Finnish Limited Liability Housing Companies Act (1599/2009). The original Limited Liability Housing Companies Act was issued in 1926. Its most recent reform entered into force in 2010 (Finnish Limited Liability Housing Companies Act, 2009). The Limited Liability Housing Companies Act obligates the Board of Directors to draw up **a report regarding the need for any maintenance on buildings** during the five years following the General Meeting at which such a report must be presented. In addition, it is recommended that housing companies draw up a strategy for 10–20 years. In the case of staged deep renovation, this would be particularly useful to ensuring that account can be taken of interactions between the measures. When selling shares in a housing company, the vendor must present a certificate issued by the building manager, which includes technical details and the company's financial statements as well as the report on the need for maintenance on the property and the related **energy performance certificate.**

The Finnish Real Estate Federation (http://www.kiinteistoliitto.fi/en/) introduced a counselling service for its members in 2016. In addition, it has produced tools for property management and maintenance, which help companies to provide and prepare for future renovations and perform renovation projects in a controlled manner. These include a **condition estimate and a long-term**

maintenance plan based on the estimate. Construction, HVAC and electricity experts who issue condition estimates determine the methods, estimated costs and recommended schedule for the necessary renovation measures. Based on these, preparations for a future renovation can be started in good time, for example by commissioning a project plan and the necessary renovation plans and other contract documents from a qualified designer, applying for the necessary permits from authorities, and making the financial arrangements required by the renovation project.

In multiple-dwelling houses (limited liability housing companies), proposals on renovations and measures to improve energy efficiency are prepared by the Board of Directors, which consists of lay members. A guide has been prepared for this target group. It provides information on the energy consumption of buildings and its reduction, as well as on the management of renovation projects (Figure 15). The same group is also the target group of the **energy expert** training programme

(https://www.motiva.fi/en/home_and_household/housing_companies/energy_expert_activities). An energy expert is an occupant who monitors the energy consumption of the building, passes on information and helps other occupants to take account of energy efficiency. Exchanging and comparing energy consumption data is an important part of energy expert activities. Partly in relation to energy expert activities, case studies of energy efficiency investments, savings achieved and other impacts have been published (www.ekokumppanit.fi/tarmo/onnistumisia/).

Figure 16. ***Taloyhtiön energiakirja*** *(Energy management book for housing companies) provides guidance on the life cycle management of buildings and renovation project management. The book includes examples of* ***the impacts of renovation measures on heat and electricity consumption and life cycle costs****. Life cycle costs are compared to a situation where no renovation measures are implemented. Source: Virta & Pylsy, 2011.*

Financing of renovation investments

Renovation and energy subsidies for residential buildings were granted in the period 2003–2013. In addition, countercyclical energy subsidies and start-up assistance for renovation work have been granted (including for measures to improve energy efficiency). Subsidies have been granted for renovations aimed at improving energy efficiency, the replacement of heating systems and adoption of heating systems based on renewable forms of energy and as means-tested energy subsidies for detached houses and in support of the systematic maintenance of buildings.

As a general rule, shareholders in a housing company decide on renovations of the buildings and basic utility systems and jointly pay for them using either their own resources (savings, internal financing, reserves, funding) or market-based loans or, in exceptional cases, the interest subsidy granted by the Housing Finance and Development Centre of Finland (ARA). However, financing granted by ARA tends to be available for non-profit institutions only.

Market-based loan financing for housing companies is more easily available if the maintenance charges confirm that the company is able to manage its finances. A separate bank account is opened for paying renovation invoices. After a renovation has been completed and the invoices have been paid, the account is converted into a loan that will be repaid based on charges for common capital expenditure. According to the renovation barometer of the Finnish Real Estate Federation, the loan maturity period is less than 10 years for half of all housing companies that have taken out a loan (Finnish Real Estate Federation, 2013). In the case of rental properties and rented premises, renovation costs are passed onto either the rents of the property in question or those of the owner's entire building stock.

The amount of loan to be taken out can be reduced by pre-funding. A housing company can collect money for renovations into a renovation fund (balance sheet) for five years in advance. Another option is to make a residential building provision, which can be used to level out the financial result of the housing company over a maximum period of ten years (minimum EUR 3,500/year or maximum EUR 68/m^2/year).

Housing companies can apply for the right to construct additional spaces in a building (rooms in the attic; additional storeys) or on the plot and finance the renovation of the old building with the proceeds from their sales. This is also in the interests of municipalities in growing urban areas. It can save on the costs of building infrastructure and providing services, compared to new development undertaken in a new area (Nykänen, 2013).

In addition, financing arranged/offered by product suppliers is available for multiple-dwelling buildings.

Finnish housing companies are small. By combining projects, housing companies can create a larger renovation project that interests a larger number of contractors, thereby achieving a genuine tendering process. This approach can create benefits in the form of cost savings or a higher-quality outcome in terms of energy efficiency improvements. The Finnish Ministry of the Environment has developed, tested and implemented this approach together with the private sector (http://www.taloyhtio.net/ryhmakorjaus/). Cooperation has also been promoted through projects (www.ekokumppanit.fi/tarmo/).

Barriers to renovations of multi-dwelling buildings

Responsibility for the activities of a housing company lies with the Board of Directors, which usually consists of lay members who may lack the knowledge, skills and time to participate actively in the preparation and commissioning of renovation projects.

The shareholder base of housing companies is highly diverse. Renovations can be prevented by the limited means of shareholders or non-acceptance of renovation costs by owners of buy-to-let dwellings.

Figure 3 illustrates the change taking place in Finland's regional structure, which leaves residential buildings without permanent residents. In areas suffering from depopulation, some buildings will not be renovated as their useful life is expected to be short.

Public sector example: Energy triathlon

In Tampere, the city has organised energy triathlons in which housing companies can compete in three categories: savings in heating energy, electricity and water consumption.

Results of the 2016 Energy Triathlon

Heating	-22%
Electricity	-59%
Water	-10%

3.4. Commercial buildings and public buildings

Methods and sources

The distribution of energy consumption in old commercial and public buildings is shown in the figure (Figure 17). Most commercial and public buildings are connected to the district heating network, and thus measures to improve the energy performance of the buildings mainly relate to their technical systems and structures. The recommended renovation measures (Table 9) are based on a study by Tampere University of Technology (TUT) on the energy savings potential of the building stock in connection with renovations (Heljo & Vihola, 2012) and reports drawn up for the implementation of the EPBD (Airaksinen & Vainio, 2012; Kauppinen, 2013).

The most cost-optimal measures are based on a joint research project by Aalto University, TUT and VTT Technical Research Centre of Finland, which assessed the cost-optimal levels of minimum energy performance requirements for renovations (Finnish Ministry of the Environment, 2013b).

The cost-optimal levels of measures to improve the energy performance of multiple-dwelling buildings have been assessed in accordance with Commission Delegated Regulation (EU) No 244/2012 on the basis of life cycle costs for a calculation period of 30 years, taking account of the initial investment costs as well as maintenance costs, replacement investments, the residual value of investments, the discount rate and the projected increase in the energy price.

Measures to reduce energy consumption

All measures can be taken individually as independent measures (staged deep renovation) or in various combinations. Due to the differing service lives of structures and systems, it is rare for all of

the measures to be implemented at the same time (deep renovation). The interoperability of measures must be ensured if they are implemented individually. For example, if heat loss through windows and the building envelope is reduced, the heating system should be adapted to correspond to the change in consumption.

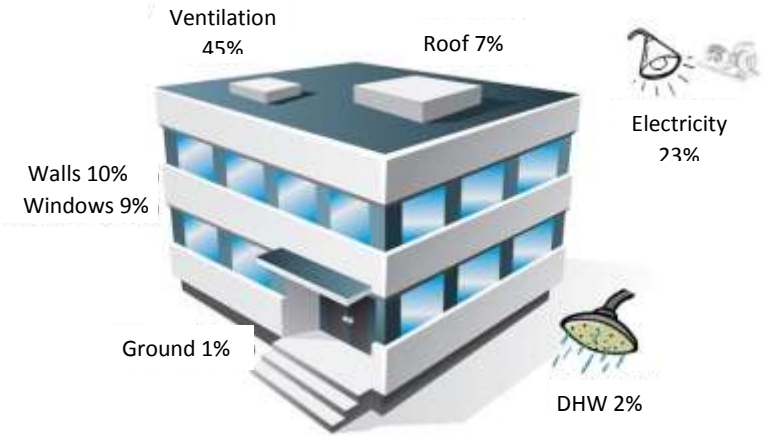


Figure 17. In old commercial and public buildings, heat loss through the building envelope and ventilation accounts for approximately 70 percent of total energy consumption, hot water for 2 percent and lighting and electrical equipment for 27 percent. Source: EKOREM, 2005.

Table 9. *Measures to improve the energy performance of commercial and public buildings.*

Building component/system	Remedies	Can be implemented as an independent measure	Measures interact	
ventilation	Installing heat recovery if not yet installed. Replacing the ventilation control system (ventilation according to need). After the end of their technical service lives, replacing old units with more energy efficient units. Paying special attention to the efficiency of heat recovery. (District cooling; geothermal cooling)	X		X
Electricity	Replacing fluorescent lighting with LED lighting Lighting systems with occupancy sensors Solar panels, if used around the year and not closed for the summer	X		
Heating system	Replacing the automation system with a dynamic control system Balancing the heating system Property-specific oil heating system: replacing with geothermal heating	X		X
external walls	Additional insulation, when external cladding needs to be replaced Sealing of feedthroughs	X	X	
Roofs	Additional insulation, if there is room Buildings with a flat roof: additional insulation in connection with renovating the roof	X	X	
Window(s)	Replacing windows in poor condition	X	X	

Floors	Socle: adding insulation boards Isolating the ceiling of the basement in storage spaces	X		
Domestic hot water	Adjusting the water pressure Replacing taps and sanitary ware with water-saving ones Heat recovery from waste water, if high volumes of water are used	X		X

The most cost-effective renovation measures

In commercial and public buildings, the most cost-effective measures relate to **ventilation** (efficient ventilation units, heat recovery, ventilation according to need, and district cooling, if appropriate) and **lighting** (LED lighting; control by occupancy sensors).

Even if commercial and public buildings have a water circulating central heating system, most heating and cooling is distributed to the premises by forced air through ventilation. That is why the amount of heat distributed through water circulating radiators is low, and metering and billing on such a basis would only increase costs. Ensuring that **heating and ventilation systems are well-functioning** is more profitable.

A renovation project tends to involve the identification of the building elements to be renovated and replaced and the building services to be replaced. Instead of old procurement practices, it is recommended that building services be purchased on the basis of requirements set for their **energy efficiency properties and technical performance**, so as to ensure the interoperability of system components.

Due to changes taking place in the regional and sectoral structure, the expected useful life of buildings may be too short for renovations to be profitable. In such cases, an alternative solution is to **increase space efficiency**. The aim is to reduce maintenance costs, while ensuring that the premises remain in good condition with respect to health and safety. Premises are used in a controlled way until they are no longer satisfactory and then the **building is demolished**.

High-consumption buildings

In the case of high-consumption buildings, consideration should be given to demolishing the building, as many such buildings also require renovation measures other than those taken to improve energy efficiency. In growing urban areas, it is worth investigating whether it is possible to apply for rezoning for the plot, so as to be able to construct a larger, energy-efficient new building there. In areas with low demand, several buildings are often in the same situation and buildings in poor condition have low potential to succeed in the competition for tenants.

Steering of decision-making relating to renovation investments

The buildings are either used by their owners or let out, either to external parties or, in the case of municipalities, internally. Decision-making regarding renovations is affected by the functional requirements set for the use of the building. Businesses and organisations that operate in their own premises pay little attention to property management costs. Properties that are let out, on the other hand, can provide a bigger return on the landlord's investment if energy costs are lower.

Property owners are encouraged to **increase the energy performance of their buildings by means of an agreement scheme** (Motiva, 2017), which is designed to help Finland meet its international obligations in mitigating climate change. Voluntary energy efficiency agreements have been signed with the property and building sector, the service sector and the municipal sector.

Businesses and non-governmental organisations that have signed an energy efficiency agreement set their own targets for increasing energy efficiency, carry out measures and report annually on their progress and other initiatives aimed at improving energy efficiency. One of the key goals of the agreement scheme is to promote **the adoption of new, energy-efficient technologies and services** and the exchange of information on successful measures to improve energy efficiency.

Financing of renovation investments

The state supports businesses and non-governmental organisations participating in an energy efficiency agreement in the performance of energy audits and analyses and, in some cases, can contribute towards energy efficiency investments and the costs of adopting new, energy-efficient technologies.

The Finnish Association of Building Owners and Construction Clients (www.rakli.fi) has developed a number of operating models and tools that are designed to improve eco-efficiency in contracts between landlords and tenants (RAKLI, 2011). Green lease and Light green lease agreements can be used to jointly agree on energy efficiency targets, forms of energy, metering and the sharing of costs arising from such measures.

Other financing options:

- Self-financing or other financing acquired by the business or organisation (a bank loan or other financial instrument)
- Financing by service providers (loan, leasing, transfer of accounts receivable to a third party, financing tied to the balance sheet of the service provider)
- ESCO projects: investment aid granted by ELY centres (requires a guarantee for energy savings).

Barriers to renovations of commercial buildings

In commercial buildings, the focus is on the activities carried out on the premises. Property management costs, including energy costs, are a minor cost item compared to other costs arising from the operations, and little attention is therefore paid to them.

Energy conservation and the use of renewable energy sources could remove barriers in terms of image.

Many commercial buildings are rented properties, where renovations are typically carried out when the tenants change. Such timing is not always optimal for carrying out energy efficiency improvements.

Some commercial buildings suffer from under-utilisation as clients (potential tenants) prefer modern premises.

Barriers to renovations of public buildings

Due to the 1970 energy crises, some measures were implemented in public buildings that were not interoperable with the old structures. For this reason, energy efficiency improvements still have a bad reputation as a cause of indoor air-quality problems.

If ventilation rates are increased to a level meeting current requirements or the level of air quality is raised, energy consumption increases instead of savings.

Finland's dependency ratio, low employment rate, industrial restructuring and trade deficit have led to budgetary problems. This is directly reflected in opportunities to invest in the renovations of public buildings.

Figure 3 illustrates the change occurring in Finland's regional structure, which leaves public buildings without permanent users. In areas suffering from depopulation, some buildings will not be renovated, as their useful life is expected to be short.

Public sector example

A protected building owned by the University of Helsinki, built to serve as a bank branch in 1932, was renovated in 2012–2014 to provide premises for the Finnish Ministry of the Environment.

In terms of energy performance, the building was renovated in accordance with the requirements set for new buildings, which is a remarkable achievement when renovating a protected building. The energy concept includes district heating, district cooling by sea water and a solar power station of 100 square metres. The building has an energy-efficient ventilation system, and lighting (LED), cooling and ventilation are controlled according to need using occupancy, environmental and daylight sensors. The lifts are equipped with a braking energy recovery system. Heat loss has been reduced by new energy-efficient windows, as well as additional roof, floor and basement wall thermal insulation. Space efficiency improved by +40%.

http://www.ym.fi/en-US/Latest_news/Press_releases/Press_releases_2015/The_Ministry_of_the_Environment_moves_to (33269)

3.5. Minimum requirements for measures to improve energy performance

Measures to improve energy performance are presented in Tables 6, 8 and 9. When implementing such measures, the following requirements set for renovations must be observed (sections 3.5.1, 3.5.2 and 3.5.3).

3.5.1. Second lamp envelope

1. External walls: Original U-value x 0.5, however not exceeding 0.17 W/(m^2 K). When changing the intended use of a building, original U-value x 0.5, however at least 0.60 W/(m^2 K).
2. Roofs: Original U-value x 0.5, however not exceeding 0.09 W/(m^2 K). When changing the intended use of a building, original U-value x 0.5, however at least 0.60 W/(m^2 K).
3. Floors: The energy performance is improved as far as possible.
4. The U-value of new windows and external doors must be at least 1.0 W/(m^2 K). When repairing old windows and external doors, the thermal resistance must be improved where possible.

3.5.2. Technical systems

1. The amount of heat to be recovered from extracted air originating from a building's ventilation system must equal at least 45% of the amount of heat required to heat the ventilation system; in other words, the annual heat recovery efficiency must be at least 45%.
2. The maximum specific fan power of a mechanical supply and exhaust air system is 2.0 kW/(m^3/s).
3. The maximum specific fan power of a mechanical exhaust air system is 1.0 kW/(m^3/s).
4. The maximum specific fan power of an air-conditioning system is 2.5 kW/(m^3/s).
5. The efficiency of heating systems must be improved where possible, when the related equipment and systems are renewed.*
6. With regard to modernising water and/or sewage systems, the provisions applicable to new buildings must be observed.

*Further specifications being prepared:

The efficiency of heating systems must be improved when the related equipment and systems are renewed with respect to the refurbished components. After the renewal

- The ratio between the efficiency of the building's main heat production system and the efficiency of the spaces' main heat distribution system must be at least 0.8. This ratio must be calculated as the quotient of the annual efficiencies achieved by the main heat production system and the main heat distribution system.

- The annual efficiency of the main heat production system or the spaces' main heat distribution system must be at least 0.73. If, following a renovation, the main heat production system of a building is a heat pump, the ratio between the SPF (Seasonal Performance Factor) of the heat pump and the annual efficiency of the spaces' main heat distribution system must be at least 2.4. The ratio must be calculated as the quotient of the SPF of the heat pump and the annual efficiency of the spaces' main heat distribution system.

- After the renovation, the specific electrical energy consumption of the accessories of the spaces' main heat distribution system must not exceed 2.5 kWh/net m^2 (per heated net area).

3.5.3. Ensuring the proper functioning

1. Building envelope and technical systems

   Anyone undertaking measures to improve the energy performance of the building envelope of a building must ensure that the building envelope and the joints between all windows or external doors and the surrounding structures are sealed, so that the thermal insulation layers are protected from the detrimental effects of air flow on the thermal insulation properties.

   When planning or implementing a renovation or replacement project concerning the building envelope or technical systems, the measures must be selected so as to ensure the correct functioning of the thermal and acoustic insulation, moisture barriers and fire insulation of the structures.

2. Ventilation

   If necessary, plans detailing measures to improve the energy performance of a building must demonstrate how the correct operation of the ventilation system and a sufficient supply of supply air are ensured if the building is equipped with a mechanical exhaust air system or natural ventilation system.

   If the energy performance of a building is improved by adopting unit-specific mechanical supply and exhaust air systems equipped with heat recovery, these must be designed and installed so that the air intake or exhaust at an external wall does not cause adverse health effects in other units.

3. Functioning of technical systems

   In connection with improving the thermal insulation or airtightness of the building envelope of a building or a considerable part thereof, or in connection with improving the energy performance of the same or after measures aimed at improving ventilation, proof must be

presented of the correct and energy-efficient functioning of the heating and ventilation system and that any necessary building service systems have been balanced and adjusted as needed.

Finland's cost-optimal levels of minimum energy performance requirements for deep renovation were defined in Finland's 2013 requirements for renovations that are subject to planning permission (Finnish Ministry of the Environment, 2013a).

4. Policies and measures that promote deep renovations

As part of the national implementation of the Energy Performance of Buildings Directive **(**EPBD**)** energy efficiency requirements have been set for individual building elements and systems as well as whole buildings in connection with renovations subject to planning permission (Finnish Ministry of the Environment, 2013a). All properties for sale or to let must have an energy performance certificate as of 2013.

Individuals who issue energy certificates must present cost-effective measures for improving the energy performance of old buildings.

4.1. Far-sighted property management

Energy efficiency can only be improved if the renovation project is carried out professionally and with the requisite quality from start to finish, and if the functioning of the building is considered as a whole. The client needs to specify what they want to achieve with the renovation in terms of energy efficiency, the engineers need to find means of meeting such objectives, and builders need to execute the measures and ensure that the energy efficiency targets set are achieved in practice. After this, responsibility usually returns to the owner of the building who must, either alone or together with service providers, ensure that the condition achieved due to the improvements is maintained.

Suggestions for promoting far-sighted property management:

⇒ *The **use of tools** developed to support property management **should be increased** (Property use and maintenance guide, Condition estimate, Long-term maintenance plan).*

⇒ *In addition to a short-term maintenance plan (5 years), property management and maintenance should be considered on a longer term basis (e.g. 10–15 years) by drawing up a **property strategy**.*

⇒ *Staged deep renovation would require **a longer period of validity for the building permit** than the current five years.*

4.2. Know-how, education and training of the labour force

In recent years, increasing attention has been paid to the concepts of energy efficiency and life cycle management in both education and training for young people and mature students, and continuing training for professionals who have already established themselves in the industry. At the level of universities of applied sciences, a specialisation option involving renovation has been established and specialisation courses (30 credit units) under the title “Energy performance of buildings” have been organised as continuing education. In addition, continuing education in renovation for professionals has been organised in relation to the preparation of energy performance certificates, condition surveys (qualifying to conduct such surveys) and the use of thermographic cameras. EU funding has been used to produce study material on best practices in energy-efficient construction in the Build Up Skills I and Build Up Skills II projects (https://www.motiva.fi/en/home_and_household/building/build_up_skills_finland). The Build Up Skills work continues.

Proposed measures relating to the know-how, education and training of the labour force:

⇒ *The **use of research data** in education is promoted by enhancing cooperation between universities, universities of applied sciences and vocational upper secondary education and training institutions. At the moment, the possibilities are being examined of integrating universities and universities of applied sciences into the same concerns.*

⇒ *Awareness among renovation operators and access, based on digital services, to information on the industry's processes and operating methods are being promoted by one of the Finnish Government's key projects, the "**Digitalisation of the built environment and construction sector**" project.*

⇒ *All parties in the renovation process are being supported in **acquiring knowledge and skills in new areas.** New areas include the use of renewable energy sources in buildings (solar energy and heat pumps) and the related building services, overall performance (hybrid systems), life cycle cost (LCC, costs versus the properties of a building, such as health and safety aspects, functionality, lightness and accessibility).*

⇒ *The **smooth implementation of renovation projects** is being promoted by means of agreement templates (falls within the responsibilities of Building Information), by adopting new contract models in addition to traditional ones (such as cooperative contracting, life-cycle contracting) and by recommending that local authorities responsible for construction supervision take a proactive role in renovation projects and improve the competence of lay clients (falls within the responsibilities of operators such as the Finnish Real Estate Federation).*

⇒ *Based on existing schemes, a voluntary certification scheme is being developed for renovation and the **life cycle management** of buildings. The aim is to increase competencies in renovation and property maintenance, improve the reliability of such activities and raise their prestige as a whole. Responsibility for the development of the certification scheme lies with the Finnish Ministry of the Environment, FISE Oy and the Construction Quality Association (RALA ry).*

4.3. Digitalisation, innovations and business

Building stock information, renovation permits and the information process associated with energy performance certificates have been part of the eServices and eDemocracy project (SADe) launched by the Finnish Ministry of Finance. This has involved the development of several digital services for improving the efficiency of information management during renovation, such as:

⇒ ***Electronic permit services** relating to the built environment, which have been adopted in 1/3 of all municipalities.*

⇒ ***Website on energy performance certificates**, which includes guidelines on drawing up an energy performance certificate, calculation guidelines, a service for storing certificates and a database (open data), for example.*

⇒ ***Property price information service** for old buildings (open data) and*

⇒ ***Electronic forms and services** of the Housing Finance and Development Centre of Finland (ARA).*

The digitalisation of renovation will continue on the basis of one of the Finnish Government's key projects, the Digitalisation of the built environment and construction sector project, Kiradigi 2017–2019 (www.kiradigi.fi). Experimental projects are selected on the basis of open competition. The joint objective of the public and private sectors is:

⇒ *To test **digital models** of buildings and put standards into practice.*

⇒ *To promote practices that enable the use of harmonised/compatible **digital information** in various processes (such as remote control of consumption, real time monitoring of consumption, power demand monitoring, room-specific consumption monitoring and various consumption simulations and measurements) throughout the entire life cycle of the built environment.*

⇒ *To develop solutions to facilitate **information sharing** between design and construction as well as construction and use, and thus speed up change in key practices in the industry.*

All properties in Finland using electricity and almost all properties connected to the district heating network are covered by real time remote reading. Customers can monitor their energy consumption via the Internet or mobile user interface. This technology also enables verification of the effectiveness of energy efficiency measures. Such information can be used to improve the quality of models used in energy efficiency improvements and design/simulations. Energy management systems are already available for major property owners. Such systems provide guidance on improving energy efficiency by comparing properties and producing information on the basis of which renovation and energy efficiency investments can be targeted at the right properties and thereby achieve optimal life cycle profitability.

Real time remote reading also enables billing based on monitoring energy production costs. For both customers and the energy system, the joint objective is to reduce electricity consumption peaks during which higher quantities of energy than normal must be produced temporarily.

⇒ *Technologies should be tested that help to **cut power demand** during peak periods, by introducing flexibility in the energy consumption of buildings (automatic short-time turn-off of consumption).*

Extensive research has been performed on renovation construction and, in particular, energy renovations focused on improving energy management. Sound technical and economic concepts have been developed.

⇒ *Investments in the **commercial exploitation of the results of R&D&I projects** and new business should be increased (experimental building, promotion of agile development).*

Developing an energy renovation business requires efficient coordination between products, service processes, customers and construction processes. If the property to be renovated is in use, more attention can be paid to the production process rather than the end result. In addition to mechanical and technical components, the process involves customer care and communication, and user training. Surprises, running over-schedule and careless conduct on site are particularly likely to lead to dissatisfaction among customers.

⇒ *Business should be developed so that **services tailored** to match the range of energy efficiency improvements are available, as well as suitable production systems covering design, engineering, commissioning and contracting models (such as life cycle and alliance contracting).*

4.4. Communications

Information on energy efficiency is provided and sector-specific projects are implemented centrally by the Motiva service of the Finnish Energy Authority. Motiva provides separate services targeted at

households (https://www.motiva.fi/en/home_and_household), municipalities (https://www.motiva.fi/en/public_sector) and businesses (https://www.motiva.fi/en/private_sector). Industrial associations and large cities also provide information accessible to all users, such as http://www.energiakorjaus.info/in-english/ offered by the City of Oulu.

The http://www.ymparisto.fi/korjaustieto website of the Finnish Ministry of the Environment offers information on information sources and research projects relating to the life cycle management of buildings, the systematic maintenance of properties and renovation construction. One of these information sources is the http://www.taloyhtio.net/korjausjaremontointi website of the Finnish Real Estate Federation, which includes a comprehensive selection of information on the planning of renovations, building element-specific measures, finances and the procurement of renovation services. Information on research projects is also provided by the RenoWiki database established by the Build Upon project at http://fi.buildupon.eu/

It is proposed that communications be further developed as follows:

⇒ *Promoting renovations by encouraging a domino effect**. Disseminating information on successful energy performance renovations** (the most cost-effective measures, technically and functionally feasible measures, indoor air quality improvements in connection with renovations) as well as risks relating to solution options.*

⇒ *Public database on **cost-effective measures** for experts issuing energy performance certificates.*

⇒ ***Indicators calculated per actual user** (kWh/resident or worker) or visitor (kWh/user or customer) for measuring energy efficiency if the efficiency of space utilisation is improved during a renovation project.*

⇒ *A **virtual model of implementing a renovation project** that requires planning permission (permits, design and engineering, supervision, surveys, inspections, implementation of the contract, commissioning and use).*

⇒ *Information on the **impacts of energy efficiency investments** on the value of the property and its operating costs throughout its life cycle for the market and customers (tax administration, insurance companies, tenants, owners).*

4.5. Financial incentives

Financial incentives should be long-lasting and predictable. Short-term, countercyclical incentives distort the markets and raise prices temporarily. Incentives should also be introduced for renovation projects that go above and beyond what is required, as well as for testing new technologies and concepts. Other proposals relating to financial incentives:

⇒ *Investigating the possibility of promoting deep renovation **by supporting project planning in the renovation of residential buildings**. The amount of such aid should be significant, for example, 50% of planning costs if it can be demonstrated that they result in an energy efficiency improvement that is significantly higher than the required level and an impact assessment confirms that higher quality has been achieved. Project plans and information on savings achieved should be publicly available for use, so as to ensure that best practices can be applied to the improvement of planning in similar projects.*

⇒ *Promoting measures that allow **tenants to influence** the level of their rent by saving on heating energy or electricity costs, for example.*

⇒ *Promoting measures that **support the smooth functioning of** residential and commercial property **markets**. Far-sighted property management and good property maintenance should be reflected in the prices and rents of dwellings and premises. Correspondingly, neglect of maintenance, low energy efficiency and aesthetic repairs should mean lower prices and rents on the market.*

5. Scenarios and impacts

5.1. Preparation of the scenarios

Six different scenarios have been prepared on the impact of the renovation of buildings on energy end-use and primary energy consumption. The premise is that measures to improve energy efficiency are performed when a decision has been made to renovate the building, building element or technical system for some other reason. This proportion of the building stock is included in the calculations, by using the coefficient “frequency of renovations in the building stock”. With respect to the frequency of renovations, two alternatives are examined. The number of renovations either remains at the current level (scenario 0, scenario 1, scenario 2 and scenario 3) or it is doubled (scenario 2B and scenario 4). The renovation frequency depends on the age of the building. Renovations are most frequently performed on buildings built in the 1960s and 1970s. The renovation frequency also varies among building elements and systems.

Energy efficiency is improved in either some or all renovations. This is defined by the coefficient ”frequency of energy renovations among renovations” (Table 11). The impact on energy consumption depends on the measures implemented. These variables are used to calculate the annual energy saving achieved (Figure 18).

Table 10. *The frequency of renovations in the scenarios varies according to type of building, age of building and building elements/technical systems.*

	ONE-DWELLING BUILDINGS					
	Conduction losses	**ventilation**	**Warm water**	**Electricity for building services**	**Electricity use by users**	**Cooling**
	1980-.					
Scenarios 0-3	1%	0.5%	0.5%	1%	1%	1%
Scenarios 2B,4	2%	1%	1%	1%	1%	1%
	1960-1979					
Scenarios 0-3	3%	2%	3%	1%	2.5%	1%
Scenarios 2B,4	5%	4%	5%	1%	2.5%	1%
	.-1959					
Scenarios 0-3	1%	1%	1%	1%	1%	1%
Scenarios 2B,4	2%	2%	2%	1%	1%	1%

	MULTIPLE-DWELLING BUILDINGS					
	Conduction losses	**Ventilation**	**Warm water**	**Electricity for building services**	**Electricity use by users**	**Cooling**
	1980-.					
Scenarios 0-3	1%	0.5%	0.5%	1%	1%	1%
Scenarios 2B,4	2%	1%	1%	1%	1%	1%
	1960-1979					
Scenarios 0-3	3%	2%	3%	1%	2.5%	1%
Scenarios 2B,4	5%	4%	5%	1%	2.5%	1%
	.-1959					
Scenarios 0-3	2%	2.5%	4%	1%	2.5%	1%
Scenarios 2B,4	4%	4%	6%	1%	2.5%	1%

	COMMERCIAL AND PUBLIC BUILDINGS					
	Conduction losses	**Ventilation**	**Warm water**	**Electricity for building services**	**Electricity use by users**	**Cooling**
	1980-.					
Scenarios 0-3	1%	0.5%	0.5%	1%	1%	1%
Scenarios 2B,4	2%	1%	1%	1%	1%	1%
	1960-1979					
Scenarios 0-3	3%	2%	3%	1%	2.5%	1%
Scenarios 2B,4	5%	4%	4%	1%	2.5 %	1%
	.-1959					
Scenarios 0-3	2%	3%	4%	1%	2.5%	1%
Scenarios 2B,4	5%	4%	5%	1%	2.5%	1%

Building	X	Frequency of	X	Frequency of	X	Impact of	=	Energy saving

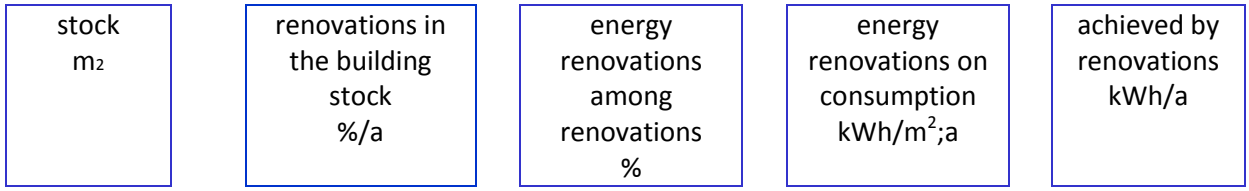


Figure 18. Energy saving achieved through energy efficiency improvements, evaluation principles.

Renovation measures included in the scenarios

Scenario 0 (Business as usual (BAU) in history)

Scenario 0 describes the situation in 2012 before the start of the national implementation of the Energy Performance of Buildings Directive **(**EPBD**)** in connection with renovations subject to planning permission (Finnish Ministry of the Environment, 2013a). Energy efficiency was improved in 25% of renovations of the building envelope or technical systems before the requirements were set. Measures were carried out as follows:

Conduction losses

In connection with façade renovations, the U-values of external walls were halved and windows modernised. In 1970s apartment blocks, for example, this means that the original wall U-value of 0.45 W/m^{2}K drops to 0.22 W/m^{2}K. The window U-value drops in 1970s apartment blocks from 2.0 W/m^{2}K to 1.0 W/m^{2}K. In detached houses, insulation is added to the roof so as to halve the roof U-value. In other types of buildings, insulation is added to the roof, where possible.

Hot water

In connection with replumbing old properties, the goal is to lower the pressure and introduce modern, economical bathroom suites. Hot water consumption is reduced by 25%.

Ventilation

Ventilation system remains unchanged.

Electricity consumption

Electricity consumption remains unchanged.

Type of heating

By 2050, the share of electrical heating systems will drop to 75% of the 2012 level. The share of oil heating systems will drop to 40% of the 2012 level. Oil heating systems will disappear from residential properties altogether by 2050.

Scenario 1 (BAU) = Scenario 0 plus the following:

When building elements are renovated, energy efficiency is improved in half of all renovations (building envelope, ventilation, hot water).

Scenario 2 (Pursuit) = Scenario 1 plus the following:

Energy efficiency is improved in all renovations of building elements (building envelope, ventilation, hot water). Insulation is added to external walls, even with respect to façade renovations of buildings completed after 1980.

Ventilation systems will be equipped with heat recovery units in all ventilation renovations performed after 2020.

By 2050, the share of electrical heating systems in the building stock will drop to 20% thanks to heat pumps.

Scenario 2B (Pursuit – double speed) = Scenario 2 plus the following:
The number of renovations has approximately doubled.

Scenario 3 (Ambitious) = Scenario 2 plus the following:
During the renovation of building elements, energy efficiency is improved to meet the requirements set for new buildings.

Scenario 4 (Ambitious – double speed) = Scenario 3 plus the following:
Half of all renovations carried out meet the requirements set for new buildings.

Table 11. *The level of ambition and number of renovations in the scenarios relative to current renovation construction.*

Level of ambition	Inclusion of energy efficiency improvements in renovations of building elements and technical systems			
	In one in every four	In one in every two	In all	Double the number
To meet requirements set for renovations	Scenario 0 (BAU in history)	Scenario 1 (BAU)	Scenario 2 (Pursuit)	Scenario 2B (Pursuit – double speed)
To meet the requirement set for new buildings			Scenario 3 (Ambitious)	Scenario 4 (Ambitious – double speed)

5.2. Energy consumption in the scenarios

Table 12 and Figure 19 show the impact of the energy efficiency improvements implemented in the scenarios and the decommissioning of buildings on **energy end-use, primary energy consumption(E indicator) and emissions.**

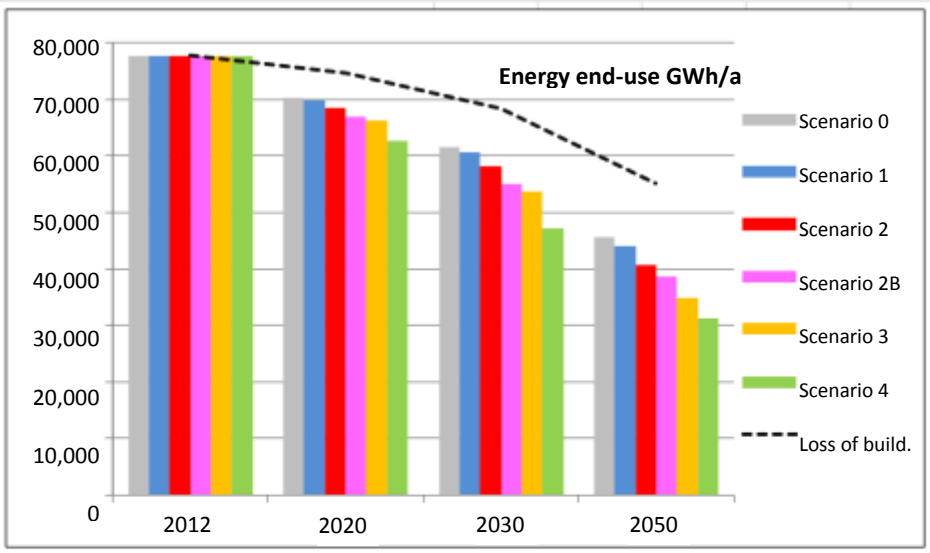
The number of structural renovations, in which measures to improve energy performance can be easily incorporated, is relatively low. That is why the energy savings achieved by means of renovations are also low. By 2020, renovations will only help to cut energy consumption slightly more than the loss of old buildings. By 2050, renovations will contribute more to the decrease in energy consumption than the loss of old buildings.

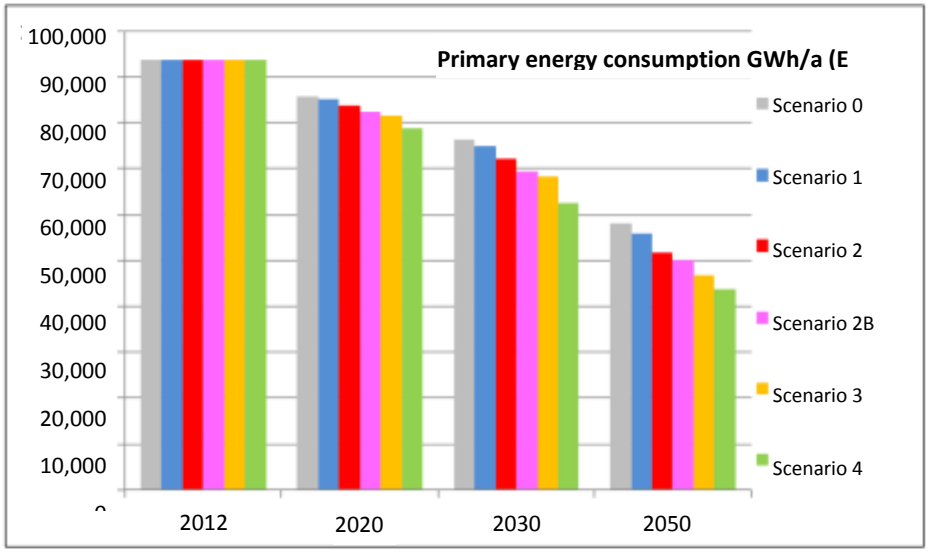
Table 12 The impact of the measures included in the scenarios and the loss of old buildings on energy end-use, primary energy consumption (E indicator or E-value) and carbon dioxide emissions. Decrease in comparison with the 2012 level. The figures include the impact of both renovations and the loss of old buildings.

	CURRENT STOCK (built before 2012 - loss)								
	2020			2030			2050		
	Energy	E	CO2-eq	Energy	E	CO2-eq	Energy	E	CO2-eq
Scenario 0	-10%	-8%	-14%	-21%	-19%	-31%	-41%	-38%	-58%
Scenario 1 Business as Usual	-10%	-9%	-15%	-22%	-20%	-32%	-43%	-40%	-59%
Scenario 2	-12%	-10%	-17%	-25%	-23%	-35%	-48%	-45%	-63%
Scenario 2B	-14%	-12%	-18%	-29%	-26%	-38%	-50%	-46%	-64%
Scenario 3	-15%	-13%	-19%	-31%	-27%	-40%	-55%	-50%	-68%
Scenario 4	-19%	-16%	-24%	-39%	-33%	-47%	-60%	-53%	-71%

It is important to promote and steer all measures aimed at improving energy efficiency. This is demonstrated by the 3.3% decrease in heating energy consumption by the end of 2015 compared to the 2012 level. This decrease corresponds to the target set when the effectiveness of the decree on

improving the energy performance of buildings undergoing renovation or alteration (4/2013) was assessed.





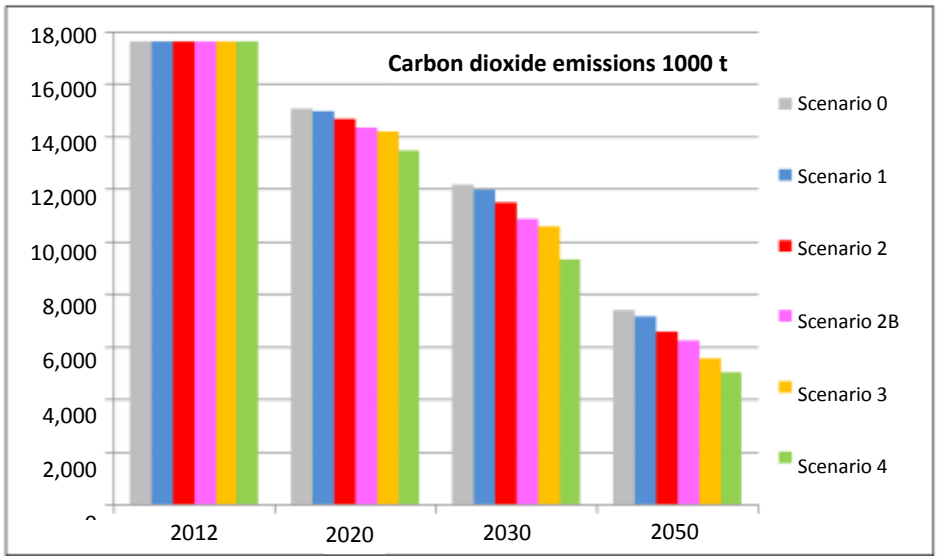


Figure 19. The impact of the measures included in the scenarios and the loss of old buildings on the energy end-use, primary energy consumption and greenhouse gas emissions (CO2-eq) of buildings built before 2012.

5.3. The increase in costs attributable to measures to improve energy efficiency in the scenarios

Renovations cover all refurbishment, modernisation and maintenance. A total of approximately EUR 10 billion was spent on repairs in the kinds of residential, commercial and office buildings discussed in this report in Finland in 2016. Between 20 and 30 percent of these renovations are such that they may incorporate measures to improve energy efficiency (scenario 1, BAU).

The increase in costs attributable to measures to improve energy efficiency is EUR 1 million/saving of 0.8 GWh for renovations (Finnish Environment Institute, 2016), and EUR 0.1 million/saving of 0.8 GWh for buildings that are demolished (Nippala & Heljo 2010). Calculated using these unit costs, the costs given in the scenarios are as shown in the figure (Figure 20). When the number of renovations and the level of ambition increases under these scenarios, the increase in costs attributable to measures to improve energy efficiency compared to normal renovations increases from 8 percent to 19 percent. The annual cost and total cost for the period of 2012–2050 for improving energy efficiency is calculated in the table below (Table 13).

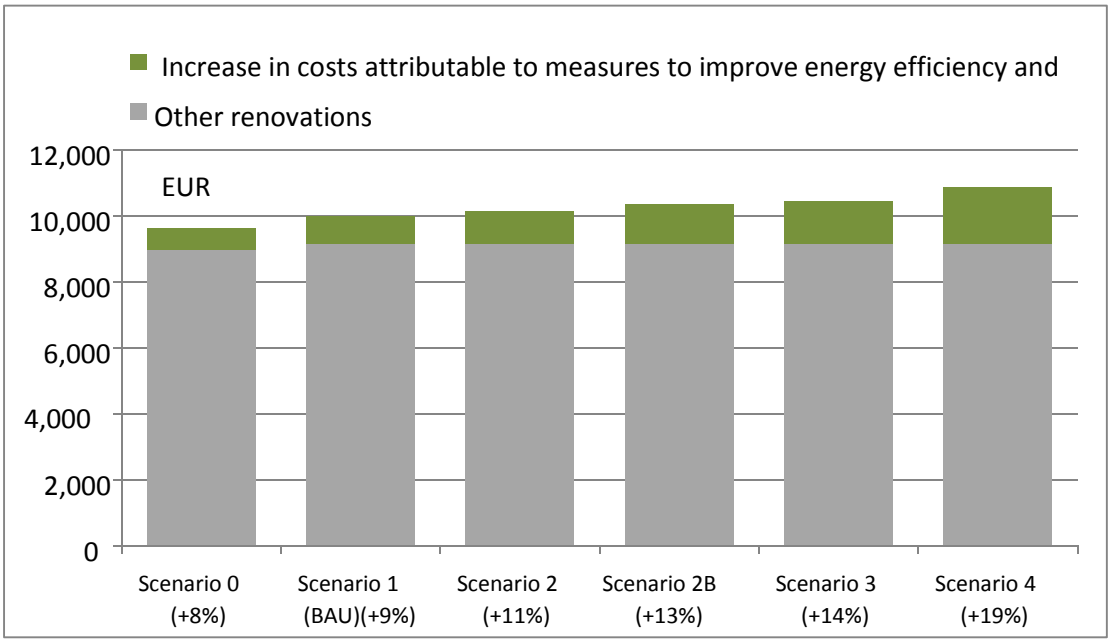


Figure 20. Increase in costs attributable to measures to improve energy efficiency and the costs of conventional renovations under the scenarios.

Table 13. *Increase in costs attributable to the energy efficiency measures included in the scenarios Annual cost (*) relates to the years 2012–2020. In the long-term, the cost per GWh saved decreases as the impact of the loss of buildings increases.*

	Decrease/year* GWh	Cost/year* EUR mill.	Decrease/2012-2050 GWh	Cost/2012-2050 EUR mill.
Scenario 0 (+8%)	930	790	32,200	9,500
Scenario 1 (BAU) (+9%)	990	850	33,700	10,700
Scenario 2 (+11%)	1,150	1,010	37,200	13,500
Scenario 2B (+13%)	1,350	1,210	39,200	15,100
Scenario 3 (+14%)	1,450	1,310	43,000	18,200
Scenario 4 (+19%)	1,880	1,740	46,500	21,000

5.4. Positive impact of the renovation services market on the economy and employment

More business

For renovations to have a genuine impact on energy consumption, the number of renovations, including renovations that improve energy efficiency, should be considerably higher than at the moment. This is possible, since the maintenance backlog of the building stock is estimated to be significant (ROTI, 2017). This can be further stimulated by businesses developing their offering, i.e. products and systems suitable for renovations. In this respect, international cooperation and interaction should be sought so that **advanced technology and affordable products** can be brought to the market.

For many businesses in the construction sector, renovations have represented a market that can be used to level the effects of economic fluctuations in new development. Operating in several market segments has been important for the continuity of their operations, as such businesses seem to last longer than specialised businesses. Some construction products are suitable for both renovations and new buildings. While the best managed businesses in the sector focus on current customer needs, they may miss future business opportunities, i.e. products and services designed for renovations. Deep renovations offer **new businesses the opportunity** to focus on the development of products for renovations and to dominate future markets.

As a rule, measures to improve energy efficiency are carried out as part of normal renovations. The Finnish Ministry of the Environment has commissioned a study on renovation needs in the period 2016-2035 (Figure 21). Businesses can even use information provided for the authorities to develop their own business activities.

A renovation project must be carried out professionally and with the requisite quality from start to finish. The owner of the property needs to specify what they want to achieve with the renovation in terms of energy efficiency, the engineers need to find the means to meet these objectives, and the builders need to perform the measures and ensure that the energy efficiency targets set are achieved in practice. After the completion of the project, the responsibility returns to the owner of the property who must ensure that the savings achieved are maintained.

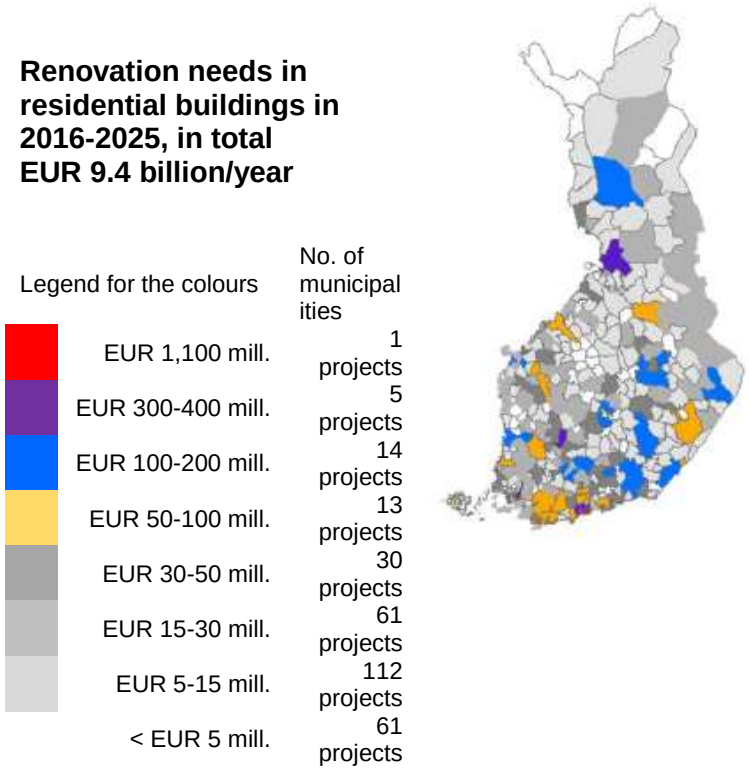


Figure 21. The annual renovation need of residential buildings in Finland in the period 2016–2025 is EUR 9.4 billion at 2015 prices. Of the total renovation need, 30 percent is accounted for by the six largest cities in Finland, i.e. Helsinki, Espoo, Vantaa, Turku, Tampere and Oulu. Source: Vainio & Nippala, 2016.

More jobs

The impact of renovations on employment is calculated on the basis of end products: the amount of work needed to design and make the products and services used in renovations, to deliver them to the construction site and to install them.

For example, adding insulation and a new coat of paint to existing façades on site requires more work than doing the same using elements pre-cast in a factory. Demolition requires labour force on site but contributes nothing to the construction products industry. Adjusting a heating system requires engineering and installation work, but few construction products.

Each million-euro investment in renovation provides employment for a total of approximately 16 people across the entire chain in Finland, including the engineering sector. A million-euro investment equates to eight person-years of work at a renovation site, to five person-years of work at an industrial site, and to three person-years of work in the service sector (Vainio, 2013). Demolition provides three person-years of work per million-euro investment. Improving energy efficiency in connection with a renovation project increases workload by 3–12%, depending on the scenario in question, compared to a normal renovation of a residential, commercial or office building carried out before 2013 (Table 14).

Table 14. *Impact of renovations and associated measures to improve energy efficiency on the volume of residential, commercial and office buildings and employment across the entire chain, including contractors' purchases.*

	Normal renovation and energy efficiency improvements, person-years of work	Increase in employment attributable to energy efficiency improvements, person-years of work	Increase, %
Scenario 0 (BAU before 2012)	152,900		
Scenario 1 (BAU after 2012)	156,800	3,900	3%
Scenario 2	159,300	6,400	4%
Scenario 2B	162,500	9,600	6%
Scenario 3	164,000	11,100	7%
Scenario 4	170,900	18,000	12%

Income for households and revenues for the public sector

Renovations are paid for by property owners, the majority of whom are private householders (detached houses, housing companies) and businesses. In renovation projects, labour accounts for approximately 30%, domestic construction products for 50% and imported products for 15% of costs. The remainder is made up of machinery costs, taking into account depreciation. In demolition, all work is carried out by machinery on site.

The construction chain includes businesses from multiple sectors (construction, trade, transport and manufacturing). With the help of the input-output model used in national economy statistics, labour costs and imported products used in manufacturing can be separated from the contribution of manufacturing industry.

The volume of work is substantial. Depending on the scenario, net income for households would increase by EUR 13–95 million. The state, municipalities and church would receive EUR 13–97 million in tax revenue and levies and insurance companies EUR 7–47 million in insurance premiums. High quantities of metal industry products (building services) are used in renovation projects, which increases the percentage of products that need to be imported. A total of 80% of construction products imported by Finland originate in the EU. The combined profits and capital expenditure of the businesses involved in the chain amount to EUR 10–74 million (*Table 15*).

Table 15. *Conversion of the added costs resulting from measures taken to improve energy efficiency included in the scenarios on how revenue benefits the national economy. The analysis is based on the year 2016.*

increase in income/revenue, EUR mill.	Households	Construction and specialist works	Other services and industry	Insurance	Taxes and social insurance contributions	Imports	Total
Scenario 0	174	32	103	87	178	229	790
Scenario 1 (BAU)	187	34	111	94	191	247	850
Scenario 2	222	40	131	111	227	293	1,010
Scenario 2B	266	48	157	133	272	351	1,210
Scenario 3	288	52	170	144	295	380	1,310
Scenario 4	383	70	226	191	392	505	1,740
Change, EUR mill.							
Scenario 1 (BAU)	13	2	8	7	13	18	60
Scenario 2	35	6	20	17	36	46	160

Scenario 2B	44	8	26	22	45	58	200
Scenario 3	22	4	13	11	23	29	100
Scenario 4	95	18	56	47	97	125	430

6. Summary

Overview of Finland's building stock

Finland has 290 million square metres of residential buildings and 100 million square metres of commercial and public buildings. Half of the building stock was built after 1980 and heat loss through the building envelope is relatively low, as the energy efficiency requirements applicable to new buildings were tightened in 1978 in response to the 1970s energy crises. The most cost-effective renovation measures with the greatest impact on energy efficiency and emissions relate to the heating and ventilation systems of buildings.

Most multiple-dwelling buildings (more than 90% of the gross floor area) as well as commercial and public buildings (more than 60%) are connected to the district heating network. Three quarters of all district heating is produced by means of cogeneration (CHP). The proportion of renewable fuels is 32%. Finland's energy and climate strategy aims to replace fossil fuels used for heat production with renewable fuels and heat pumps.

Electricity currently accounts for 45% of the heating energy of one-dwelling buildings, and oil for 19%. According to Finland's energy and climate strategy, unit-specific oil heating systems will disappear altogether by 2050. Biocomponents will be added to fuel oil during the transitional period. Alternatives to oil include heat pumps and biofuels. In addition, it is recommended that consumption in buildings with direct electric heating be reduced by installing air-source heat pumps.

Cost-effective deep renovations suitable for Finland's climate

(deep renovation; staged deep renovation)

A Ministry of the Environment decree, on improving the energy performance of buildings undergoing renovation or alteration, was issued in Finland in 2013. The decree requires energy performance improvements in connection with the renovation of a building, changes to its intended use, and the replacement of its technical systems. The decree introduces cost-optimal levels of minimum energy performance requirements for individual building elements and for total energy consumption.

The levels laid down in the decree also double as Finland's deep renovation levels. The decree includes guidelines for both one-off deep renovations and staged deep renovations.

Policies and measures that promote deep renovations

This national strategy emphasises digitalisation, innovation, communications, skilled labour and education. Information on the best ways of improving energy efficiency and successful projects must be communicated to professionals and students in the industry, as well as to property owners and property managers.

In **one-dwelling buildings**, the most cost-effective measures for reducing heat loss include adding the thickest possible additional thermal roof insulation and replacement of the original windows. If the cladding of external walls needs to be replaced, it pays to add thermal insulation as well. With respect to heating systems, switching to renewable energy sources is a profitable measure.

In **multiple-dwelling buildings**, the most cost-effective measures for reducing heat loss relate to using ventilation to reduce consumption. Forced general ventilation should be equipped with heat recovery and the transfer of heat to either central heating or hot water heating. If windows have reached the end of their service lives, they should be replaced with new ones that meet the requirements set for new buildings. Lowering the pressure is an efficient way of reducing water

consumption. Energy can be recovered from waste water centrally. If external wall cladding needs to be replaced, it also pays to add thermal insulation.

In **commercial and public buildings**, the most cost-effective measures relate to ventilation (efficient ventilation units, heat recovery, ventilation according to need) and lighting (LED lighting).

Decision-making, service provision and financing related to deep renovations

With regard to renovation projects, crucial decisions are made in connection with target-setting before planning begins. In Finland, such decisions are mainly taken by householders, as they own 65 percent of buildings. Property owners cannot be obliged to renovate structures and systems that are otherwise sound simply in order to improve their energy performance, as this is not cost-effective. That is why property owners are encouraged to introduce structural energy efficiency improvements in connection with normal renovation measures and fault repairs.

In Finland, public subsidies to incentivise the renovation of residential buildings have been targeted at the owners of one-dwelling buildings (tax credit for domestic expenses), social housing (interest-subsidy loans for the renovation of rental and right-of-occupancy dwellings), housing companies (deficiency guarantee), ARA rental properties (demolition subsidy) and improving the housing conditions of special-needs groups. The measures required by the Decree of the Finnish Ministry of the Environment must be carried out during a renovation (Finnish Ministry of the Environment, 2013a).

Businesses and the public sector are encouraged to conserve energy through energy efficiency agreements and green leases, which are based on an agreement between the landlord and tenant and set obligations on both parties to conserve energy.

Expected energy savings and other benefits

Improvements of energy efficiency during renovations undertaken for other reasons (e.g. to repair structural damage or convert spaces for new uses) in accordance with this strategy are expected to lead to an energy saving of at least 10 percent during the period 2012–2020. Carbon dioxide emissions will decrease by more than energy consumption (15%), as fossil fuel heating systems are replaced by low-emission fuels due to renovations.

Measures to improve energy efficiency are expected to increase the annual volume of renovations by approximately EUR 1,000 million at 2016 prices. This would increase the workload in property renovations, measured in person-years of work, by three percent. This figure is similar to expected growth in GDP. Increases in employment generate income for households and tax revenue for the public sector.

Proposal for measures to be promoted during the next three years, developed in cooperation with property owners and local authorities as well as businesses, educational institutions and research institutes in the sector

Proposed measures relating to systematic and far-sighted property management

- ⇒ *Promoting the use of tools developed in support of property management (Property use and maintenance guide, Condition estimate, Long-term maintenance plan).*
- ⇒ *Investigating the possibility of granting a building permit with a longer period of validity for staged deep renovation projects.*

Proposed measures relating to the know-how, education and training of the labour force

- ⇒ *Launching specialisation training in renovations*

- ⇒ *Increasing the utilisation of research results by enhancing cooperation between universities and universities of applied science.*
- ⇒ *Supporting all parties to the renovation process in acquiring knowledge and skills in new areas (renewable energy sources, new energy production technologies and building services, hybrid systems, life cycle cost, benefits/costs).*
- ⇒ *Promoting the awareness of renovation operators and broadening the scope of the renovation industry's processes and operating methods to digital material, via the "Digitalisation of the built environment and construction sector" project.*

Proposed measures relating to digitalisation, innovations and business

- ⇒ *Consolidating electronic permit services relating to the built environment and the related electronic forms and services of the Housing Finance and Development Centre of Finland (ARA).*
- ⇒ *Increasing use of website on energy performance certificates and the property price information service for old buildings when developing services.*
- ⇒ *Testing and trying out data models and data exchange standards in practical applications.*
- ⇒ *Promoting the smooth implementation of renovation projects by means of agreement templates developed by Building Information and by adopting new contract models.*
- ⇒ *Promoting the commercial exploitation of the results of R&D&I projects and new business (experimental building, promotion of agile development).*

Proposed measures relating to communications

- ⇒ *Promoting renovations by encouraging a domino effect. Disseminating information about successful energy performance renovations (the most cost-effective measures, technically and functionally feasible measures, indoor air quality improvements in connection with renovations), as well as risks relating to solution options.*
- ⇒ *Information on the impacts of energy efficiency investments on the value of a property and its operating costs throughout its life cycle, for the market and customers (tax administration, insurance companies, tenants, owners).*

Proposed measure relating to financial incentives

- ⇒ *Exploring the possibility of promoting deep renovation by supporting project planning.*

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ANNEX 5 ENERGY CONTENT OF SELECTED FUELS FOR END USE – CONVERION TABLE

The table shows the energy commodities listed in Annex IV to the Energy Efficiency Directive and the energy content (kJ) given for each commodity in said annex, as well as the energy content (kJ) of the same energy commodities as reported by Statistics Finland in 2013, 2014 and 2015.

ENERGY COMMODITY	EED[1] Annex IV kJ (NCV)	FINLAND[2] 2013 kJ average (NCV)	FINLAND[2] 2014 kJ average (NCV)	FINLAND[2] 2015 kJ average (NCV)
1 kg coke	28,500	29,300	29,300	29,300
1 kg hard coal	17,200-30,700			
hard coal (steam)		24,878	24,795	24,708
coking coal		29,300	29,300	29,300
1 kg brown coal briquettes	20,000	..[3]	..[3]	..[3]
1 kg black lignite	10,500-21,000	..[3]	..[3]	..[3]
1 kg brown coal	5,600-10,500	..[3]	..[3]	..[3]
1 kg oil shale	8,000-9,000	..[3]	..[3]	..[3]
1 kg peat	7,800-13,800	9,638	9,986	10,050
1 kg peat briquettes	16,000-16,800	..[3]	..[3]	..[3]
1 kg residual fuel oil (heavy oil)(low sulphur fuel oil (S<1%))	40,000	40,400[4]	40,400	40,400
1 kg light fuel oil	42,300	43,100	43,100	43,100
1 kg motor spirit (petrol)	44,000	41,927[56]	41,862[5]	41,989[5]
1 kg paraffin	40,000	..[3]	..[3]	..[3]
1 kg liquefied petroleum gas	46,000	46,300	46,300	46,300
1 kg natural gas	47,200	[6]	[6]	[6]
1 kg liquefied natural gas	45,190	49,320	49,320	49,320
1 kg wood (25% humidity)	13,800	..[7]	..[7]	..[7]
1 kg pellets/wood bricks	16,800	16,900	16,900	16,900
1 kg waste	7,400-10,700	..[7]	..[7]	..[7]
1 MJ derived heat	1,000	1,000	1,000	1,000
1 kWh electrical energy	3,600	3,600	3,600	3,600

1 Source: Eurostat

2 Source: Statistics Finland

3 Not relevant

4 Fuel oil - low sulphur

5 Including biocomponents

6 Energy content of natural gas: 1 m3 = 10 kWh = 36 MJ

7 The unit used directly in the statistics is TJ