



HELLENIC REPUBLIC

**MINISTRY OF ENVIRONMENT, ENERGY  
AND CLIMATE CHANGE**

SECRETARIAT-GENERAL FOR ENERGY AND  
CLIMATE CHANGE

DIRECTORATE FOR ENERGY EFFICIENCY  
AND  
SAVING



## **REPORT**

PURSUANT TO ARTICLE 7(9) OF DIRECTIVE 2012/27/EU,  
OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL,  
ON ENERGY EFFICIENCY, AMENDMENT OF DIRECTIVES 2009/125/EC AND  
2010/30/EC AND REPEALING DIRECTIVES 2004/8/EC AND 2006/32/EC

**Athens, December 2013**

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## 1. General

This report was drafted by the Directorate for Energy Efficiency and Savings of the Secretariat-General for Energy and Climate Change of the Ministry of Environment, Energy and Climate Change, with the support of the Centre for Renewable Energy Sources (CRES) and the working group that was set up to harmonise national law with Directive 2012/27/EU (Online Publication No: BA170-4M5).

The report notifies the European Commission of the policy measures Greece intends to adopt in order to set up an energy efficiency obligation scheme, as provided for in Articles 7 and 20 of Directive 2012/27/EU.

## 2. Energy savings target

### 2.1 Calculation of the overall energy savings target

Article 27(1) of the Directive provides that, the energy savings target calculation “shall be at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1.5 % of the annual energy sales to final customers of all energy distributors or all retail energy sales companies by volume, averaged over the most recent three-year period prior to 1 January 2013. The sales of energy, by volume, used in transport may be partially or fully excluded from this calculation”.

The total final energy consumption in 2010, 2011 and 2012, as well as its distribution between the final consumption sectors is presented in Table 1. Final energy consumption for 2010 and 2011 was determined on the basis of the final energy balances of the Ministry of Environment, Energy and Climate Change and of Eurostat, whereas for 2012 it was based on an estimate of the current energy balances using the data provided so far by the Ministry of Environment, Energy and Climate Change.

Final energy consumption (ktoe)	2010	2011	2012
Industry	3 471	3 322	2 799
Transport	8 178	7 666	5 800
Other sectors	7 378	7 847	7 911
Total of sectors	19 027	18 835	16 511

**Table 1:** Final energy consumption in the three-year period 2010-2012 (Source: Ministry of Environment, Energy, and Climate Change, Eurostat).

NB: final energy consumption in the transport sector has been excluded from the calculation of the final energy consumption used to determine the target provided for in Article 7.

Moreover, since the goal to be achieved refers to the annual sales of energy, by volume, to the final consumers, the quantities of RES which are not for sale are also excluded from the final energy consumption calculation (Table 2). Specifically, the exclusion concerns charcoal and solid biomass. During the period 2010-2012, 21.1% of the biomass used was consumed without the prior purchase of the quantities in question, whereas the remaining percentage was sold.

2010	2011	2012
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Final RES energy consumption which is not for sale (ktoe)	385	435	460
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**Table 2:** Final energy consumption in the three-year period 2010-2012, which is generated from RES and is not for sale (Source: Ministry of Environment, Energy, and Climate Change, Eurostat, General Directorate of Forest Protection, ELSTAT, CRES).

The above estimates were drawn from combined data processed by CRES and came from:

- the General Directorate of Forest Protection of the Ministry of Environment, Energy, and Climate Change, with regard to the quantities of incompletely collected forestry residues which are distributed free of charge and
- the research into energy consumption in households conducted by the Hellenic Statistical Authority in the period 2011-2012 with regard to the number of households using biomass distributed free of charge to cover their heating needs.

Table 3 below gives the final energy consumption data used to determine the energy savings target for 2010, 2011 and 2012 pursuant to Article 7. The average energy consumption in the three-year period 2010-2012 is 10 483 ktoe.

	2010	2011	2012	Three-year period average
<b>Final energy consumption (ktoe)</b>	<b>10 464</b>	<b>10 734</b>	<b>10 250</b>	<b>10 483</b>

**Table 3** Final energy consumption in the three-year period 2010-2012 used in calculating the target.

According to the above information and on the basis of Article 7(1) of the Directive, the energy savings target is equivalent to new savings of 157.2 ktoe per year (1.5 % of the average final energy consumption in the three-year period, i.e. 10 483 ktoe) which amounts to total new annual savings of 1 100.4 ktoe in the period 2014-2020. The total energy saving in the same period equals 4 401.6 ktoe cumulatively, as illustrated in Table 4 below:

Year	Energy savings per year (ktoe)							Total
<b>2014</b>	157.2							157.2
<b>2015</b>	157.2	157.2						314.4
<b>2016</b>	157.2	157.2	157.2					471.6
<b>2017</b>	157.2	157.2	157.2	157.2				628.8
<b>2018</b>	157.2	157.2	157.2	157.2	157.2			786.0
<b>2019</b>	157.2	157.2	157.2	157.2	157.2	157.2		943.2
<b>2020</b>	157.2	157.2	157.2	157.2	157.2	157.2	157.2	1 100.4
<b>Total</b>								<b>4 401.6</b>

**Table 4:** Energy savings required in the period 2014-2020 under Article 7(1) of Directive.

In calculating the energy savings target, Article 7(2) of the Directive is used to achieve up to 25% decrease in the cumulative energy savings required as shown in Table 4, and specifically it was decided to combine the effects of:

- subparagraph (a) on applying a progressive energy savings rate (1% in 2014 and 2015, 1.25% in 2016 and 2017 and 1.5% in 2018, 2019 and 2020)
- and subparagraph (b) on excluding part of the energy sales used in industrial activities listed in Annex I of Directive 2003/87/EC from the calculation

until the maximum allowable decrease in required energy savings (25%) was reached.

More specifically, the maximum allowable decrease of 25% was reached by subtracting the energy equivalent of 552 ktoe which represents part of the heating energy consumption for industrial activities falling within the scope of Directive 2003/87/EC from the average final energy consumption in the three-year period 2010-2012 (10 483 ktoe) which is used to calculate the target under Article 7. According to data received by the Office of Emission Allowances Trading of the Ministry of Environment, Energy and Climate Change, the heating energy consumption of the activities in question is approximately 700 ktoe.

**The average final energy consumption in the three-year period 2010-2012 is: 10 483 - 552 = 9 931 ktoe.**

Then, by applying the progressive energy saving rate (1% in 2014 and 2015, 1,25% in 2016 and 2017 and 1,5% in 2018, 2019 and 2020) to the above final energy consumption (9 931 ktoe), the energy savings target for the period 2014-2020 is found, which is calculated cumulatively and amounts to 3 301.8 ktoe, out of which 893.8 ktoe represents the total new annual savings, as shown in Table 5 below.

Year	Energy savings per year							Total
2014	99.3							99.3
2015	99.3	99.3						198.6
2016	99.3	99.3	124.1					322.7
2017	99.3	99.3	124.1	124.1				446.8
2018	99.3	99.3	124.1	124.1	149.0			595.8
2019	99.3	99.3	124.1	124.1	149.0	149.0		744.8
2020	99.3	99.3	124.1	124.1	149.0	149.0	149.0	893.8
<b>Total</b>								<b>3 301.8</b>

**Table 5:** Energy savings target in the period 2014-2020 under Article 7(1) and (2) of Directive)

## 2.2 Intermediate periods and intermediate energy savings targets

The intermediate periods for monitoring the progress towards reaching the total energy savings target, and the new savings, will be:

a) 2014-2015, during which the intermediate total energy savings target will be 835 ktoe and the total annual new savings 297.9 ktoe.

b) 2015-2018, during which the intermediate total energy savings target will be 2 253 ktoe and the total annual new savings 1663.5 ktoe.

### **3. Method of reaching the energy savings target**

Meeting the energy saving target requires exclusively the adoption of appropriate policy measures without setting up an energy efficiency obligation scheme for obligated parties (retail energy sales companies and energy distributors).

Policy measures are implemented by the competent public authorities while the final beneficiaries are the central government and the wider public sector, public and private sector businesses, as well as the final consumers.

### **4. Policy Measures**

The policy measures taken cover all final energy consumption sectors including the residential, the tertiary and the transport sectors, as well as the industries which fall within the scope of Directive 2003/87/EC.

It is noted that the energy savings resulting from policy measures 4.1, 4.2, 4.3, 4.12, 4.14 and 4.17 contribute to the total target under Article 7 as from 2014, due to the possibility to count them up to 3 years later, as set out in Article 7(7).

Annex I provides a summary table of all policy measures.

#### **4.1 “Save Energy at Home” programme**

The Programme provides incentives for citizens to make the most important interventions in order to improve the energy efficiency of their home. Specifically, the programme provides home owners with capital subsidy and low interest loans combined with an interest rate subsidy and covers the cost of energy inspections. The eligible categories of interventions for improving energy efficiency are:

- Replacing window frames and installing shading systems.
- Installing thermal insulation in the building envelope, including the flat roof/roof and '*pilotis*'.
- Upgrading the heating and hot water system

**The implementation period of the measure will be from 2011 to 2015 and the total new energy savings in the period 2014-2020 are estimated to be 82.4 ktoe.**

The Programme concerns interventions in buildings and provides for the issuing of an Energy Performance Certificate (EPC). The methodology used for calculating energy savings is based on analysing and evaluating the EPC data issued in connection with the Programme. Specifically, after processing the results of the EPCs from buildings on which all the programme's interventions have been fully implemented, it appears that the average primary energy consumption is 420.5 kWh/m<sup>2</sup>, the average energy savings achieved by the Programme is approximately 39% and, consequently, the average primary energy savings are 161.4 kWh/m<sup>2</sup>. Moreover, the average surface area of the buildings in the Programme is 106.5 m<sup>2</sup>. In order to calculate the final energy savings, the conversion factors under Ministerial Decision No Δ6/B/off. 5825 "Adoption of Regulations on Energy Efficiency in Buildings" are used to convert the final energy consumption of a building to primary energy.

Energy source	Conversion factor for converting into primary energy
Heating oil	1.10
Electrical energy	2.90

Source: Ministerial Decision No Δ6/B/off. 5825 "Adoption of Regulations on Energy Efficiency in Buildings", Table B1.

Given that the majority of interventions implemented through the programme concern measures to reduce the home heating load, 80% of the total primary energy savings represents thermal energy and 20% electrical energy.

In view of the above, the savings per m<sup>2</sup> of a residential building are calculated as follows:

$$ES_f = ES_p * (CF_h / PE_t + CF_e / PE_e) \quad (1)$$

Where:

*ES<sub>f</sub>*: Final energy savings

*ES<sub>p</sub>*: Primary energy savings

*CF<sub>h</sub>*: Conversion factors for converting final heating oil energy into primary energy.

*CF<sub>e</sub>*: Conversion factors for converting final electrical energy into primary energy.

*PE<sub>t</sub>*: Percentage of thermal energy savings

*PE<sub>e</sub>*: Percentage of electrical energy savings

Consequently, the final energy savings amount to:

$$161.4 \text{ kWh/m}^2 * (0.8/1.1 + 0.2/2.9) = 128.5 \text{ kWh/m}^2$$

It is estimated that during the time the measure is in force (2011-2015), 70 000 homes with an average surface area of 106.5 m<sup>2</sup>/home will join the Programme. The final energy savings amount to:

$$128.5 \text{ KWh/m}^2 * 106.5 \text{ m}^2/\text{home} * 70.000 \text{ homes} = 958.0 \text{ GWh or } \mathbf{82.4 \text{ ktoe}}$$

The average energy savings per home amount to:

$$82.4 \text{ ktoe} / 70.000 \text{ homes} = 0.001177 \text{ ktoe/home}$$

The participating parties involved in this measure are the Ministry of Environment, Energy and Climate Change, the Ministry of Development and Competitiveness, the National Fund for Entrepreneurship and Development (ETEAN), energy inspectors, suppliers, installers and home owners.

The targeted sector is the residential sector and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be scaled savings and it consists of estimating the achieved savings in final energy consumption based on primary energy savings, which will be calculated while preparing the EPCs of homes where interventions will be implemented.

The country's climate variability will be taken into account in the energy inspection and issuing of EPC.

The monitoring and verification of the energy target is achieved through energy inspections by energy inspectors included in the Register of Energy Inspectors. ETEAN S.A. and the Hellenic Energy Inspectorate of the Ministry of Environment, Energy and Climate Change conduct sample checks to verify the proper implementation of interventions and energy inspections.

## **4.2 “SAVE” Programme**

The **“SAVE” Programme for Local Authorities** concerns implementing actions and recognised good practices to reduce energy consumption in the urban environment, with emphasis on the building sector (public buildings) and the upgrade of public spaces and, secondly, in the municipal and private transport sector, as well as in energy-intensive municipal facilities. This will be achieved through the implementation of technical interventions, awareness-raising actions and mobilisation of citizens, local government, businesses and bodies. Eligible categories of intervention are:

- Municipal buildings
  - Energy upgrade of the building envelope through actions, such as exterior insulation, replacement of glazing and window frames, installing roofing, awnings and special coatings to provide protection from the sun.



- Energy upgrade of electro-mechanical heating and cooling installations
- Upgrade of the natural/ artificial lighting system
- Installing energy management system in buildings (BEMS)
- Communal areas
  - Integrated energy saving and management interventions in municipal lighting
  - Bioclimatic interventions to improve microclimate and energy efficiency in urban areas.
- Transport
  - Interventions in municipal fleet vehicles to improve their energy efficiency
  - Urban mobility studies
  - Transport studies
- Technical infrastructure
  - Improving energy efficiency of Municipalities' technical infrastructure, including biological treatment of waste, pumping stations, etc.
- Dissemination, networking and information
  - Networking and informing energy managers and officials of Municipalities
  - Changing energy behaviour and raising awareness in the local community

**The implementation period of the measure will be from 2011 to 2015 and the total new energy savings in the period 2014-2020 are estimated to be 3.7 ktoe.**

The target calculation methodology is based on the analysis and evaluation of the data in the technical sheets of proposals submitted under the Programme. By processing the results obtained from the analysis of the interventions specified in the technical proposal sheets from the 104 municipalities which joined the "SAVE" programme, the savings per priority axis resulting from the implementation of the interventions are presented in the table below.

<b>Axis</b>	<b>Primary energy savings (ktoe)</b>
Axis 1: Buildings - Technical sheets of proposals	2.35
Axis 2 Street lighting - Technical sheets of proposals	2.56
Axis 3 Infrastructure - Technical sheets of proposals	1.05
Total primary energy savings	5.96

In the conversion of primary energy into final energy, depending on the impact of each axis on the thermal and electrical loads of municipalities, the following percentages of the total primary energy savings represent thermal and electrical energy savings.

Axis	Saving percentage (%)	
	Thermal energy	Electrical energy
Axis 1: Buildings - Technical sheets of proposals	80	20
Axis 2 Street lighting - Technical sheets of proposals	-	100
Axis 3 Infrastructure - Technical sheets of proposals	100	-

Taking into account the conversion factors for converting final energy consumption into primary energy and the equation (1) set out in the methodology for calculating the "Saving Energy at Home" Measure (point 4.1), the resulting savings amount to:

$$ES_f = 2.35 \text{ ktoe} * (0.8 / 1.1 + 0.2 / 2.9) + 2.56 \text{ ktoe} / 2.9 + 1.05 \text{ ktoe} / 1.1 = \mathbf{3.7 \text{ ktoe}}$$

The average energy savings per municipality amount to:

$$3.7 \text{ ktoe} / 104 \text{ municipalities} = 0.036 \text{ ktoe} / \text{municipality}$$

The participating parties involved in this measure are the Ministry of Environment, Energy and Climate Change, the Ministry of Development and Competitiveness, the Ministry of Interior, the Municipalities and the Centre for Renewable Energy Sources and Saving (CRES), as the intermediary in the project implementation.

The targeted sector is Local Authorities and the life time of the measure is more than ten years.

The calculation methodology to be used will be scaled savings and it consists of the assessment made by the technical service or the technical adviser of the municipality, and that service or advisor will be monitored by the CRES and will have been designated as an intermediary in the Programme.

The energy target is monitored and verified through the studies submitted, as well as by the municipalities' technical services. CRES, as an intermediary in the Program, conducts sample checks to verify the proper implementation of interventions.

### 4.3 "SAVE II" Programme

**The Programme for improving energy efficiency in Local Authorities' existing buildings and infrastructure ("SAVE II")** concerns implementing actions and recognised good practices to decrease energy consumption in existing buildings and infrastructure. Eligible categories of intervention are:

- Energy upgrade of the building envelope through actions, such as exterior insulation, replacement of glazing and window frames, installing roofing, awnings and special coatings to provide protection from the sun.

- Energy upgrade of EM installations
- Upgrade of the natural/ artificial lighting system
- Installing energy management system (BEMS)
- Interventions in the energy upgrade of technical infrastructure/ other facilities of LAs.

**The implementation period of the measure will be from 2011 to 2015 and the total new energy savings in the period 2014-2020 are estimated to be 8.3 ktoe.**

The Programme "SAVE LA II" is targeted at interventions concerning Municipalities' building facilities and provides for the issuance of an EPC. The target calculation methodology is based on the analysis and evaluation of the data in the EPCs issued under the Programme and the energy savings are estimated according to the methodology developed in the "Saving Energy at Home" Measure (point 4.1).

From processing the results from the issuing of EPCs in the 36 Municipalities which have joined the Programme so far, the primary energy savings from the implementation of the interventions are equal to 2.71 ktoe.

Taking into account the conversion factors for converting final energy consumption into primary energy and equation (1) set out in the methodology for calculations under the "Saving Energy at Home" Measure (point 4.1), the resulting savings amount to:

$$2.71 \text{ ktoe} * (0.8/1.1 + 0.2/2.9) = 2.16 \text{ ktoe}$$

The average energy savings per municipality amount to:

$$2.16 \text{ ktoe} / 36 \text{ municipalities} = 0.060 \text{ ktoe/municipality}$$

Before the measure expires, a total of 139 Municipalities are expected to join. Consequently, the total final energy savings resulting from the measure's implementation amount to:

$$0.060 \text{ ktoe/Municipality} * 139 \text{ Municipalities} = \mathbf{8.3 \text{ ktoe.}}$$

The participating parties involved in this measure are the Ministry of Environment, Energy and Climate Change and First Level Local Authorities (Municipalities).

The targeted sector is Local Authorities and the life time of the measure is more than ten years.

The calculation methodology to be used will be scaled savings and it consists of the assessment made by the technical service or technical adviser of the Municipality and that service or adviser will be monitored by the Special Service for Coordination and Implementation of Actions in the Fields of Energy, National Resources and Climate Change of the Ministry of Environment, Energy and Climate Change which is designated as an intermediary in the Programme.

The energy target is monitored and verified through the studies submitted as part of the Programme, as well as by the Municipalities' technical services. The Special Service for

Coordination and Implementation of Actions in the Fields of Energy/National Resources, as an intermediary body, conducts sample checks to verify the proper implementation of interventions.

#### **4.4 Energy upgrade of residential buildings**

The measure provides home owners with capital subsidy and low interest loans combined with an interest rate subsidy and covers the cost of energy inspection, enabling them to make the most effective interventions to improve the energy efficiency of their homes. The eligible categories of interventions for improving energy efficiency will include:

- Replacing window frames and installing shading systems.
- Installing thermal insulation in the building envelope, including the flat roof/roof and 'pilotis'.
- Upgrading the heating and hot water system

**The implementation period of the measure will be from 2014 to 2020 and the total new energy savings in the period 2014-2020 are estimated to be 176.5 ktoe.**

The target calculation methodology is based on the use of the results of the estimation under the "Saving Energy at Home" Measure (point 4.1), according to which the average energy savings from implementing the "Saving Energy at Home" measure amount to 0.001177 ktoe per house.

The measure is expected to be implemented in 150 000 homes leading to final energy savings of

$$0.001177 \text{ ktoe /home} * 150\,000 \text{ homes} = \mathbf{176.5 \text{ ktoe.}}$$

The participating parties involved in this measure will be the Ministry of Environment, Energy and Climate Change, the Ministry of Development and Competitiveness, the special purpose fund, energy inspectors, suppliers, installers and home owners.

The targeted sector is the residential sector and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be scaled savings and it consists of the estimation of the achieved savings in final energy consumption based on primary energy savings which will be calculated while preparing the energy performance certificates (EPCs) for homes where interventions will be implemented.

The country's climate variability will be taken into account in the energy inspection and the issuing of EPC.

The energy target is monitored and verified by energy inspectors entered in the Register of Energy Inspectors. The special purpose fund and the Special Service of Energy Inspectors will conduct sample checks to verify the proper implementation of interventions and energy inspections.

#### **4.5. Energy upgrade of public buildings**

The measure concerns implementing actions and recognised good practices to reduce energy consumption in existing buildings of the public and general public sector. Eligible categories of intervention will include:

- Energy upgrade of the building envelope
- Energy upgrade of EM installations
- Upgrade of the natural/ artificial lighting system
- Installing an energy management system
- Installing systems for Cogeneration of Heat and Power
- Installing Renewable Energy systems

**The implementation period of the measure will be from 2014 to 2020 and the total new energy savings in the period 2014-2020 are estimated to be 12.8 ktoe.**

The target calculation methodology is based on the analysis and evaluation of the data from Energy Performance Certificates (EPCs) issued for office buildings in the tertiary sector. Specifically, after processing the results from the EPCs issued in relation to office buildings, the average specific consumption was calculated per square meter (m<sup>2</sup>), taking into account the climate zone of the buildings examined. The specific primary energy consumption amounts to 410 kWh/m<sup>2</sup>.

Taking into account the conversion factors for converting final energy consumption into primary energy and equation (1) set out in the methodology for calculations under the "Saving Energy at Home" Measure (point 4.1), the resulting savings amount to:

$$410 \text{ kWh/m}^2 \times (0.8/1.1 + 0.2/2.9) = \mathbf{326 \text{ kWh/m}^2}$$

The energy upgrade of public sector buildings will be implemented through a combination of interventions to improve energy efficiency with resulting energy savings equal to 65% of total energy consumption, in order to fulfil the obligations under Directive 2010/31/EC on Energy Performance of Buildings (EPBD) in combination with the obligations under Article 5 of Directive 2012/27/EU on Energy Efficiency.

Consequently, the final energy savings amount to:

$$326\text{kWh/m}^2 * 65\% = 212 \text{ kWh/m}^2$$

The estimated average surface area of public sector office buildings is 2 500 m<sup>2</sup>. The measure is expected to be implemented in 280 buildings leading to final total energy savings of:

$$212 \text{ kWh/m}^2 * 2\,500\text{m}^2 \text{ contracted capacity} / \text{building} * 280 \text{ buildings} = 148.4 \text{ GWh or } \mathbf{12.8 \text{ ktoe}}$$

The participating parties involved in this measure will be the whole public and general public sector, energy inspectors, suppliers and installers.

The targeted sector will be the State and wider public sector and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be scaled savings and it consists of the estimation of the achieved savings in final energy consumption by a technical service or technical adviser based on the primary energy savings which will be calculated while preparing the energy performance certificates (EPCs) for public buildings where interventions will be implemented.

The energy target is monitored and verified through studies submitted under the Programme, as well as through sample checks conducted by the Special Service of the Programme to verify the proper implementation of interventions.

#### **4.6 Energy upgrade of commercial buildings**

The measure provides incentives through subsidising actions and recognised good practices to decrease energy consumption in existing commercial buildings by intervening effectively to improve their energy efficiency. Eligible categories of intervention will include:

- Energy upgrade of the building envelope
- Energy upgrade of electro-mechanical installations
- Upgrade of the natural/ artificial lighting system
- Installing an energy management system
- Installing systems for Cogeneration of Heat and Power
- Installing Renewable Energy systems

**The implementation period of the measure will be from 2014 to 2020 and the total new energy savings in the period 2014-2020 are estimated to be 33.9 ktoe.**

The target calculation methodology is based on the analysis and evaluation of the data from Energy Performance Certificates (EPCs) issued for office buildings in the tertiary sector. Specifically, after processing the results from issuing EPCs in relation to buildings in the tertiary sector and taking into account the climate zone of the buildings examined, the weighted specific primary energy consumption in the specific categories of buildings equals 550 kWh/m<sup>2</sup>.

The final energy consumption is calculated taking into account the conversion factors used to convert final energy consumption into primary energy and equation (1) set out in the methodology of calculation under "Saving Energy at Home" Measure (point 4.1).

More specifically, the specific final energy consumption in tertiary sector buildings amounts to:

$$550 \text{ kWh/m}^2 \cdot (0.8/1.1 + 0.2/2.9) = 437.8 \text{ kWh/m}^2$$

It is estimated that 4 000 buildings with average surface of 500 m<sup>2</sup> will join the programme and measures will be implemented to improve energy efficiency which will potentially lead to energy savings in the region of 45%. Therefore, the resulting final energy savings are:

$$437.8 \text{ kWh/m}^2 \cdot 500 \text{ contracted capacity}^2/\text{building} \cdot 4\ 000 \text{ buildings} \cdot 45\% = 394 \text{ GWh or } \mathbf{33.9 \text{ ktoe}}$$

The participating parties involved in this measure will be the Ministry of Environment, Energy and Climate Change, the Ministry of Development and Competitiveness, the special purpose Fund, suppliers, installers and owners of commercial buildings.

The targeted sector will be the tertiary sector, and in particular offices and stores and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be scaled savings and it consists of the estimation of the achieved savings in final energy consumption by a technical service or technical adviser based on primary energy savings which will be calculated while preparing the energy performance certificates (EPCs) of public buildings where interventions will be implemented.

The energy target is monitored and verified through studies submitted under the Programme, as well as through sample checks conducted by the Special Service of the Programme to verify the proper implementation of interventions.

#### **4.7 Implementing an energy management system in public and general public sector agencies according to the ISO 50001 standard**

The measure involves implementing energy management in public and general public sector agencies in accordance with the ISO 50001 standard, in order to manage, measure and constantly improve energy efficiency in their buildings and facilities.

**The measure will be in force from 2014-2020 and the total new energy savings in the period 2014-2020 are estimated to be 25.2 ktoe.**

The target calculation methodology is based on the analysis and evaluation of the data from Energy Performance Certificates (EPCs) issued for office buildings in the tertiary sector.

An energy management system is expected to be implemented in 3 600 buildings of the public and general public sector. Consequently, using the methodology and specific consumption described in the above measure 4.5 “Energy upgrade of public buildings”: (specific final energy consumption of 326 kWh/m<sup>2</sup> and estimated average surface area for buildings of 2 500 m<sup>2</sup>) and assuming a 10% decrease in final energy consumption, as evidenced by relevant bibliographic references to documented 10% decreases as a result of behavioural measures, (Guidance note on Directive 2012/27/EU, Article 5: Exemplary role of public bodies’ buildings, Commission Staff Working Document and Achieving energy efficiency through behaviour change: what does it take?, EEA) the resulting total final energy savings are equal to:

$$3\,600 \text{ buildings} \times 326 \text{ kWh/m}^2 \times 2\,500 \text{ m}^2 \text{ contracted capacity} / \text{building} \times 10\% = 293.4 \text{ GWh or } \mathbf{25.2 \text{ ktoe}}$$

The participating parties involved in this measure will be the whole of the public and general public sector, the buildings’ energy managers and the bodies which certify the standard.

The targeted sector will be the State and wider public sector and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be projected savings, using a standard saving factor of 10% of each building’s final energy consumption and it will be verified in maintaining the standard.

#### **4.8 Energy upgrade of commercial buildings through Energy Service Companies**

The measure provides incentives to boost the business activity of Energy Service Companies (ESCOs) by creating specific financial means (guarantee or lending special purpose Fund), which improve the financial activity and/ or liquidity of the businesses concerned and enable them to implement energy performance contracts. Making effective use of ESCOs will result in:

- the improvement of energy efficiency in energy-intensive facilities and infrastructure (e.g. industrial installations, hospitals, large office buildings, swimming pools, warehouses) as well as in entire disadvantaged areas.
- the construction of energy-efficient buildings
- energy planning for outdoor spaces



- integration of the best energy generation technologies (Cogeneration of High-Efficiency Electricity and Heat and Renewable Energy Sources), as appropriate, meeting future demands for low-energy and low-emission buildings.

**The measure is in force from 2014-2020 and the total new energy savings in the period 2014-2020 are estimated to be 50.8 ktoe.**

The target calculation methodology is based on analysing and evaluating the data from the Energy Performance Certificates (EPCs) issued for office buildings in the tertiary sector. Specifically, the weighted specific primary energy consumption, as derived from both the Energy Performance Certificates issued for categories of buildings in the tertiary sector and estimations from case studies, amounts to 550 kWh/m<sup>2</sup>. The final energy consumption is calculated taking into account the conversion factors used to convert final energy consumption into primary energy and equation (1), which are set out in the calculation methodology of the "Saving Energy at Home" Measure in para.4.1

Specifically, the resulting specific final energy consumption on the buildings in question is equal to:

$$550 \text{ kWh/m}^2 * (0.8/1.1 + 0.2/2.9) = \mathbf{437.8 \text{ kWh/m}^2}$$

It is estimated that 1 500 buildings with an average surface of 1 000 m<sup>2</sup> will join the programme and measures will be implemented to improve energy efficiency which will potentially lead to energy savings in the area of 45%. Therefore, the resulting final energy saving is:

$$437.8 \text{ kWh/m}^2 * 1\,000 \text{ m}^2/\text{building} * 3\,000 \text{ buildings} * 45\% \text{ savings} = 591 \text{ GWh} \text{ \u2248 } \mathbf{50.8 \text{ ktoe}}$$

The participating parties involved in this measure will be the Ministry of Environment, Energy and Climate Change, the Ministry of Development and Competitiveness, the special purpose Fund, suppliers, Energy Service Companies, installers and owners of commercial buildings.

The targeted sector will be the tertiary sector, and in particular offices and stores and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be scaled savings and it consists in the estimation of the achieved savings in final energy consumption by a technical service or technical adviser based on primary energy savings which will be calculated while preparing the energy performance certificates (EPCs) of commercial buildings where interventions will be implemented.

The energy target is monitored and verified through studies submitted under the Programme, as well as through sample checks conducted by the Special Service of the Programme to verify the proper implementation of interventions.

#### **4.9 Education and training actions for tertiary sector staff**

The measure concerns education and training actions for tertiary sector staff to raise their energy awareness and improve their energy behaviour.

**The implementation period of the measure will be from 2014 to 2020 and the total new energy savings in the period 2014-2020 are estimated to be 64.0 ktoe.**

The target calculation methodology is based on the estimation that a total of 40 000 tertiary sector technical staff working in various buildings will be educated, while it is admitted that 85% of them will be finally influenced, while the influence in question will result in a reduction of final energy consumption by 10%, as evidenced by relevant bibliographic references supporting behavioural measures (Guidance note on Directive 2012/27/EU, Article 5: Exemplary role of public bodies' buildings, Commission Staff Working Document and Achieving energy efficiency through behaviour change: what does it take?, EEA).

Consequently, using the methodology and specific consumptions described in Measure 4.6 ("Energy Upgrade of commercial buildings") (specific final energy consumption of 437.8 kWh/m<sup>2</sup> and building's estimated average surface area of 500 m<sup>2</sup>), the resulting final energy savings are calculated at:

$$40\,000 \text{ buildings} * 85\% * 437.8 \text{ kWh/m}^2 * 500 \text{ contracted capacity}^2/\text{building} * 10\% = 744.26 \text{ GWh} \\ \text{or } \mathbf{64.0 \text{ ktoe}}$$

The participating parties involved in this measure will be the Ministry of Environment, Energy and Climate Change, the Ministry of Development and Competitiveness, the special purpose Fund, the suppliers, installers and owners of commercial buildings.

The targeted sector will be the tertiary sector, and in particular offices and stores and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be projected savings using a standard saving factor of 10% of each building's final energy consumption.

The energy target is monitored and verified through an annual briefing by the buildings' energy consumption staff to the Programme's Special Service.

#### **4.10 Developing smart metering systems for final electrical energy consumption**

The measure involves replacing 80% of existing conventional electricity meters (7 200 000 \* 80% = 5 760 000 meters) of the final electrical energy consumption in the Hellenic Electricity Distribution Network with respective smart metering systems, which provide more information than conventional meters and include telemetry for consumption, remote control, two-way communication with consumers and the use of multiband invoices 24 hours a day. The development of smart systems to distribute electrical energy is expected to greatly facilitate planning and coordination for the purpose of balancing demand with energy generation, as it will allow new market mechanisms to develop (e.g. flexible energy invoices, load management programmes), further contributing to energy saving. Smart metering systems for final electrical energy consumption will be installed in both the residential and the tertiary sectors.

**The implementation period of the measure will be from 2014 to 2020 and the total new energy savings in the period 2014-2020 are estimated to be 96.8 ktoe.**

The target calculation methodology is based on the Dutch consulting company in the energy sector DNV KEMA (Smart metering in Greece: Roadmap and cost benefit analysis, August 2012). Taking the above information into account and assuming that 95% of the meters will be installed in the residential sector, which consumed 1 516 ktoe of electrical energy in 2011, and the remaining 5% in the tertiary sector, which consumed 1 446 ktoe in 2011, the final energy savings are equal to:

$$80\% * (95\% * 1\,516 \text{ ktoe} + 5\% * 1\,446 \text{ ktoe}) * 8\% = \mathbf{96.8 \text{ ktoe}}$$

The parties involved in this measure will be the Ministry of Environment, Energy and Climate Change, the Hellenic Electricity Distribution Network Operator and the electrical energy consumers.

The targeted sectors will be the residential sector and the tertiary sector and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be projected savings, using a standard saving factor of 8% of final energy consumption in the residential and tertiary sectors.

#### **4.11 Replacing old public and private light trucks**

The purpose of the measure is to replace old public and private light trucks meeting EURO III standards with new vehicles meeting EURO V standards. Private new technology light trucks (up to 2 000 cc), bought in place of old ones, will be partially or wholly exempted from the specific registration fee. Old vehicles are sent for scrapping (retired) under the approved system for alternative management of End-of-Life Vehicles (ELVs). Public vehicles of the same kind will be gradually retired.

**The implementation period of the measure will be from 2014 to 2020 and the total new energy savings in the period 2014-2020 are estimated to be 11.3 ktoe.**

The target calculation methodology is based on data (from relevant references by the Association of Motor Vehicle Importers Representatives - AMVIR, statistical data and

estimations by CRES studies, as well as market data) according to which the specific consumption of old light trucks amounts to 15 lt/100 km, the specific consumption of new technology light trucks is 9 lt/100 km and the average distance covered by vehicles in this category is 25 000 km. Moreover, it is assumed that they are all petrol vehicles and that their replacement will not alter their use.

The following formula shows the resulting energy savings:

$$ES_o = SC_o * D - SC_n * D \quad (2)$$

Where:

ES<sub>o</sub>: Energy savings

SC<sub>o</sub>: Specific energy consumption of old light trucks

SC<sub>n</sub>: Specific energy consumption of new light D trucks Annual distance covered

Consequently, energy savings amount to:

$$\begin{aligned} 25\,000 \text{ km/vehicle} * (15 \text{ lt/ per } 100 \text{ km} - 9 \text{ lt/ per } 100 \text{ km}) &= 1\,500 \text{ lt/ vehicle} \\ &= 0.72 \text{ kg/lt} * 1\,500 \text{ lt/vehicle} = 1\,080 \text{ kg/vehicle} \\ &= 1\,080 \text{ kg/vehicle} * 12.222 \text{ kWh/kg} = 13\,200 \text{ kWh/vehicle or } \mathbf{0.0113 \text{ ktoe/vehicle}} \end{aligned}$$

While this measure is in force, 10 000 vehicles are expected to be replaced, with resulting energy savings of:

$$0.0113 \text{ ktoe/vehicle} * 10\,000 \text{ vehicles} = \mathbf{11.3 \text{ ktoe}}$$

The parties involved in this measure will be the Ministry of Finance, the Ministry of Infrastructure, Transport and Networks, the Ministry of Environment, Energy and Climate Change, the Ministry of Administrative Reform and e-Governance, public bodies and the private sector.

The targeted sector will be the whole public and private sector and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be projected savings, using a standard saving factor of 40% of petrol consumption due to the vehicles' replacement.

#### 4.12. Replacing old private passenger vehicles

The measure aims at replacing public and private old passenger vehicles which meet EURO III standards with new vehicles which meet EURO V standards. Under the measure, private new technology passenger vehicles (up to 2000 cc) bought in place of old ones, will be partially or wholly exempted from the specific registration fee. Old vehicles are sent for scrapping (retired) under the approved system for alternative management of End-of-Life Vehicles (ELVs).

**The implementation period of the measure will be from 2011 to 2013 and the total new energy savings in the period 2011-2015 are estimated to be 22.7 ktoe.**

The target calculation methodology is based on estimating energy savings based on specific consumption and the average kilometres covered by these vehicles. According to existing data (from relevant references by the Association of Motor Vehicle Importers Representatives - AMVIR, statistical data and estimations by CRES studies, as well as market data), the specific consumption of old passenger vehicles amounts to 10 lt/100 km, whereas the specific consumption of new technology passenger vehicles is 6 lt/100 km. The average distance covered by vehicles in this category is 15 000 km. Moreover, it is assumed that they are all petrol vehicles and that their replacement will not alter their use.

Equation (1), set out in the calculation methodology under measure 4.11 , "Replacing public and private old light trucks", is used to calculate energy savings per vehicle":

$$\begin{aligned} 15\,000 \text{ km/vehicle} * (10 \text{ lt/ per } 100 \text{ km} - 6 \text{ lt/ per } 100 \text{ km}) &= 600 \text{ lt/ vehicle or } 0.000464 \\ &\text{ktoe/vehicle} \\ &= 0.72 \text{ kg/lt} * 600 \text{ lt/vehicle} = 432 \text{ kg/vehicle} \\ &= 432 \text{ kg/vehicle} * 12.222 \text{ kWh/kg} = 5\,279.9 \text{ kWh/vehicle or } \mathbf{0.000454 \text{ ktoe/vehicle}} \end{aligned}$$

The measure concerns replacing 50 000 old passenger vehicles (according to relevant references by the Association of Motor Vehicle Importers Representatives - AMVIR), with resulting energy savings of:

$$0.000454 \text{ ktoe/vehicle} * 50\,000 \text{ vehicles} = \mathbf{22.7 \text{ ktoe}}$$

The participating parties involved in this measure will be the Ministry of Finance, the Ministry of Infrastructure, Transport and Networks, the Ministry of Environment, Energy and Climate Change, as well as owners of passenger vehicles.

The target sector is the private sector (owners of passenger vehicles) and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be projected savings, using a standard saving factor of 40% of petrol consumption due to the vehicles' replacement.

#### **4.13 LPG passenger vehicles**

Under this measure, incentives for subsidy will be provided in order to replace the fuel of existing private passenger vehicles with liquefied petroleum gas (LPG) by installing an LPG system, enabling vehicles to be fuelled either with LPG or with petrol (with an option to alternate fuels automatically).

**The implementation period of the measure will be from 2014 to 2020 and the total new energy savings in the period 2014-2020 are estimated to be 9.9 ktoe.**

The target calculation methodology is based on estimating energy savings based on specific consumption and the average kilometres covered by these vehicles.

According to existing data (from relevant references by the Association of Motor Vehicle Importers Representatives - AMVIR, statistical data and estimations by CRES studies, as well as market data), the specific consumption of a passenger vehicle using petrol amounts to 10 lt/100 km, whereas for the same vehicle using LPG it is 11 lt/100 km. Petrol's calorific value is equal to 8.8 kWh/lt, whereas LPG's to 7.3 kWh/lt.

The averaged distance covered annually by vehicles of this category is estimated to be 15.000 km, while the vehicles are considered to be fuelled entirely by LPG.

Equation (1), set out in the calculation methodology under measure 4.11 , "Replacing public and private old light trucks", is used to calculate energy savings per vehicle":

$$15\ 000\ \text{km/vehicle} * (10\ \text{lt/per}\ 100\ \text{km} * 8.8\ \text{kWh/lt} - 11\ \text{lt/per}\ 100\ \text{km} * 7.3\ \text{kWh/lt}) = 1\ 155\ \text{kWh/vehicle or } \mathbf{0.000099\ \text{ktoe/vehicle}}$$

While this measure is in force 100 000 vehicles are expected to be replaced, with resulting energy savings of:

$$0.000099\ \text{ktoe/vehicle} * 100\ 000\ \text{vehicles} = \mathbf{9.9\ \text{ktoe}}$$

The participating parties involved in this measure will be the Ministry of Finance, the Ministry of Infrastructure, Transport and Networks, the Ministry of Environment, Energy and Climate Change, as well as owners of passenger vehicles.

The target sector is the private sector (owners of passenger vehicles) and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be projected savings using the standard saving factors for specific fuel consumption and converting it into energy in the replaced vehicles.

#### **4.14 Increasing excise duty on heating oil consumption**

The measure concerns the increase in excise duty on heating oil imposed in 2012 (which was set at EUR 0.33 per litre) and resulted in a significant decrease in heating oil consumption in the residential sector.

**The implementation period of the measure will be from 2012 to 2020 and the total new energy savings in the period 2014-2020 are estimated to be 225.1 ktoe.**

The target calculation methodology is based on the heating oil price elasticity of demand, estimated to be -0,44 in the residential sector, confirming that the demand for heating oil is inelastic as heating oil is an energy product which covers the basic heating needs of households, while, at the same time, being a commodity with a limited number substitutes. The price elasticity was set in the framework of a study conducted by the Foundation for Economic and Industrial research (FEIR) on determining the expected benefit in tax revenues from equalizing excise duty on heating oil and diesel fuel.

Equalising excise duty led to an increase in the price of heating oil of approximately 25%. More specifically, using the fuels' average retail prices in the whole of Greece, in the heating period 2012-2013, as determined by the Ministry of Development and Competitiveness ([www.fuelprices.gr](http://www.fuelprices.gr)), heating oil prices increased from €1.037/lt (price on 27 April 2012) to €1.273/lt (price on 26 April 2013). The Ministry of Environment, Energy and Climate Change has adopted a heating allowance for the most economically disadvantaged households, laying down specific criteria. More specifically, in 2012 the provision of a €0.28/lt allowance was established by Ministerial Decision (No Δ33 5042999 ΕΞ2012 (Β' 3049)). Based on the above data, it was estimated that a total of 285.7 million lt of heating oil (9.5% of the total heating oil consumed in 2011) was traded at a price of €0.993/lt, whereas the remaining heating oil quantity in 2012 (2 714.3 million lt.- 90.5%) was traded at €1.273/lt. This leads to a weighted average selling price for heating oil of approximately €1.246/lt for all households

The decrease in the demand for heating oil consumption is calculated through the elasticity of demand  $E_D$ , determined by the ratio of the percentage change in the demand for a commodity ( $\Delta Q/Q_1$ ) to the percentage price change ( $\Delta p/p_1$ ) of:

$$E_D = \frac{\Delta Q / Q_1}{\Delta P / P_1}$$

Consequently, in relation to heating oil, taking into account that initial demand is  $Q_1 = 2\,534$  ktoe in 2011 and that the price increase amounts to  $\Delta P = \text{€}0.209$  /lt ( $P_1 = \text{€}1.037$ /lt,  $P_2 = \text{€}1.246$ /lt), it is estimated that the decrease in energy consumption is equal to  $\Delta Q = \mathbf{225.1}$  ktoe in 2012.

The tax in question will be imposed during the whole period under examination, up to 2020.

Moreover, due to the burden on the residential sector, combined with the economic recession, the heating allowance is expected to continue.

The targeted sector is the residential sector and the implementing public authority is the Ministry of Finance.

The calculation methodology to be used is measured savings and it consists of calculating on an annual basis until 2020, and based on the price of oil, the energy consumption, the excise duty on diesel fuel and heating oil consumption, as well as the amount of the allowance provided according to the above estimation.

#### **4.15 Information and training actions for domestic users**

This measure concerns actions to inform domestic users (owners and tenants) of the energy efficiency of their home, rational energy use, and also of interventions which will improve their energy efficiency. They will be informed as part of the action framework which concerns the issuing of an Energy Performance Certificate (EPC) by energy inspectors who are entered in the Register of Energy Inspectors and who will take the role of an energy consultant as well as appropriate action by appropriately educated engineers - energy consultants. Energy consultants will inform users on issues which affect a building's energy efficiency (thermal insulation in the building envelope, heating systems, rational behaviour, etc.) and will suggest specific interventions and practices which can improve energy efficiency and save energy with the ultimate aim to improve users' energy awareness and energy behaviour.

**The implementation period of the measure will be from 2014 to 2015 and the total new energy savings in the period 2014-2020 are estimated to be 19.6 ktoe.**

The target calculation methodology is based on the estimation that a total of 75 000 households (owners, tenants, managing agents of blocks of flats) will be informed, and it is assumed that finally 85% of them will be influenced and that this will result in decreasing final energy consumption by 10%, as evidenced by relevant bibliographic references on documenting behavioural measures (Guidance note on Directive 2012/27/EU, Article 5: Exemplary role of public bodies' buildings, Commission Staff Working Document and Achieving energy efficiency through behaviour change: what does it take?, EEA).

Consequently, using the methodology and consumptions described in Measure 4.1 ("Saving Energy at Home") (specific primary energy consumption of  $420.5$  kWh/m<sup>2</sup> and an estimated average surface area of buildings of  $106.5$  m<sup>2</sup>), the resulting final energy savings are estimated to be:



Taking into account the conversion factors used to convert final energy into primary energy and equation(1), set out in the methodology of calculation under measure 4.1., “Saving Energy at Home”, the resulting savings per household are:

$$420.5 \text{ kWh/m}^2 * (0.8/1.1 + 0.2/2.9) * 10\% = 33.5 \text{ kWh/m}^2.$$

It is estimated that during time the measure is in force (2014-2015), 75 000 homes with an average surface area of 106.5 m<sup>2</sup>/home will be informed. The final energy savings amount to:

$$33.5 \text{ kWh/m}^2 * 106.5 \text{ contracted capacity}^2/\text{home} * 75\ 000 \text{ homes} * 85\% = 227.44 \text{ GWh or } \mathbf{19.6 \text{ ktoe}}$$

The parties involved in the measure are the Ministry of Environment, Energy and Climate Change, energy inspectors, energy consultants and household users (owners, tenants, managing agents).

The targeted sector is the residential sector and the lifetime of the measure is more than ten years.

The calculation methodology to be used will be projected savings, using a standard savings factor of 10% of each building’s final energy consumption.

#### **4.16 Thessaloniki Metro development**

This measure concerns the construction of an underground railway (metro) in Thessaloniki, to serve passengers and thereby replace private means of transport. Specifically, the Thessaloniki metro includes 13 modern stations with a central platform, 9.6 kilometres of lines with two independent single-track tunnels, 18 super-automatic state-of-the-art trains, automated gate systems on each station platforms to ensure the best service and maximum safety for passengers, the creation of a depot area of 50 000 m<sup>2</sup> and the construction of underground garages with a total capacity of 3 700 parking spaces. In addition, the construction contract for the Thessaloniki metro extension to Kalamaria was signed in June 2013 and includes 4.78 kilometres of lines and 5 stations.

The implementation period of the measure starts from the beginning of 2017, when the basic metro line will start operating, while the extension to Kalamaria is expected to be completed in 2018.

**The total new energy savings in the period 2017-2020 are estimated to be 21.4 ktoe.**

The target calculation methodology is based on a study by the ATHENS METRO S.A. The study concerns estimating the passengers served daily in the 13 stations, which is the main work, the extension to Kalamaria with 5 stations added, as well as the replacement of private passenger vehicles with the use of the underground railway network.

Specifically, the estimated daily passenger traffic in the 13 stations in the main work is 247 000 passengers, whereas in the 5 stations of the extension to Kalamaria it is 63 000 passengers. Consequently, the total daily passenger traffic in the stations will be 310 000 passengers.

The target calculation methodology is based on the estimation of energy savings based on specific consumption and average kilometres covered by vehicles replaced by the use of the underground railway network.

According to existing data, the average passenger vehicle's specific consumption is 9 lt/100km and the average daily distance covered per vehicle per passenger is 15.2 km. Moreover, the kilometres covered by the vehicle are increased by a rate of 1.2 due to finding a parking space, a factor of 1.5 because of the ratio of passenger to private vehicle, i.e. 1 vehicle represents 1.5 passenger and 22% of the metro passengers who would otherwise use a private vehicle.

The following formula shows the resulting energy savings:

$$ES_0 = SC_p * D - C_1 * C_2 \quad (3)$$

Where:

ES<sub>0</sub>: Energy savings

SC<sub>p</sub>: Vehicles' specific energy consumption

D: Average distance covered daily

C<sub>1</sub>: coefficient of increase in distance due to finding a parking space

C<sub>2</sub>: correlation coefficient between passengers and private vehicles

Therefore,

15.2 km/vehicle \*(9 lt/ per 100 km)\*1.2 / 1.5private vehicle passenger/vehicle = 1.09 lt/private vehicle passenger = 0.72 kg/lt \* 1.09 lt/private vehicle passenger = 0.78 kg/private vehicle passenger = 0.78kg/private vehicle passenger\* 12.222 kWh/kg = 9.53 kWh/private vehicle passenger or 0.00000082 ktoe/private vehicle passenger

Assuming that 22% of the metro passengers used private vehicles before, the annual energy savings are:

310 000 passengers/day \* 22% \* 0.00000082 ktoe/private vehicle passenger \* 365 days/year = **21.4 ktoe**

The participating parties involved in implementing the measure are the Ministry of Finance, the Ministry of Infrastructure, Transport and Networks, Athens Metro S.A. and passengers in Thessaloniki.

The targeted sector is the travelling public in Thessaloniki and the lifetime of the measure is more than ten years.

The calculation methodology to be used to achieve energy savings will be projected energy savings, based on facts on passenger traffic, the replaced vehicle-kilometres, as well as the energy savings indicator per private vehicle passenger.

#### 4.17 Extension of Athens metro

This measure involves extending the Athens underground (metro), to serve passengers and thereby replace private means of transport. The table below lists the extensions, the estimated average daily passenger traffic on each one and dates on which they started/will start operating:

<b>Athens Metro extensions</b>			
<b>Line 2</b>	<b>Number of Stations</b>	<b>Daily Passenger Traffic</b>	<b>Start of operation:</b>
Extension to Anthoupoli	2	45 000	04/2013
Extension to Elliniko	4	85 000	07/2013
Extension to Agia Marina	1	30 000	01/2014
<b>Line 3</b>			
Extension to Piraeus	6	130 000	2017

**The total new energy savings in the period 2017-2020 are estimated to be 29.34 ktoe.**

The target calculation methodology is based on a study by the company ATHENS METRO S.A. The study concerns estimating the numbers of passengers served daily in the Athens Metro since 2011 and the replacement of private vehicles with the use of the underground railway network.

According to existing data, an average passenger vehicle's specific consumption is equal to 9 lt/100km and the daily average distance covered per vehicle per passenger is 20 km. Moreover, an increase in the kilometres travelled by the vehicle is estimated by rate of 1.2 due to finding a parking space, a factor of 1.3 because of the passenger/private vehicle ratio, i.e. 1 vehicle corresponds to 1.3 passengers and 22% of metro passengers who would otherwise use a private vehicle. Using equation 3 of measure Development of Thessaloniki Metro (point 4.16) on the daily energy savings per vehicle results in the following formula:

$$20 \text{ km/vehicle} * (9 \text{ lt/ per 100 km}) * 1.2 / 1.3 \text{ private vehicle passenger/vehicle} = 1.66 \text{ lt/private vehicle passenger} = 0.72 \text{ kg/lt} * 1.66 \text{ lt/private vehicle passenger} = 1.2 \text{ kg/private vehicle passenger} = 1.2 \text{ kg/private vehicle passenger} * 12.222 \text{ kWh/kg} = 14.67 \text{ kWh/private vehicle passenger} \text{ or } 0.00000126 \text{ ktoe/private vehicle passenger}$$

Assuming that 22% of metro passengers used private vehicles before, the annual energy savings will be:

$$290 \ 000 \text{ passengers/day} * 22\% * 0.00000126 \text{ ktoe/private vehicle passenger} * 365 \text{ days/year} = \mathbf{29.34 \text{ ktoe}}$$

The participating parties involved in implementing the measure are the Ministry of Finance, the Ministry of Infrastructure, Transport and Networks, Athens Metro S.A. and passengers in Thessaloniki.

The targeted sector is the travelling public in Thessaloniki and the lifetime of the measure is more than ten years.

The calculation methodology to be used to achieve energy savings will be projected energy savings, based on facts on passenger traffic, the replaced vehicle-kilometres, as well as the energy savings indicator per private vehicle passenger.

## Annex I - Summary table of policy measures

S/N	Policy measures to save energy	Number of interventions	Implementation period of the measure	Lifetime of the measure	Calculated final energy savings(ktoe)
1	“Saving Energy at Home” programme	70 000 homes	2011-2015	2014-2024+	82.4
2	“SAVE” Programme for Local Authorities	104 Municipalities	2011-2015	2014-2024+	3.7
3	“SAVE II” Programme for Local Authorities	139 Municipalities	2011-2015	2014-2024+	8.3
4	Energy upgrade of residential buildings	150 000 homes	2014-2020	2014-2024+	176.5
5	Energy upgrade of public buildings	280 public buildings	2014-2020	2014-2024+	12.8
6	Energy upgrade of commercial buildings	4 000 buildings	2014-2020	2014-2024+	33.9
7	Implementing an energy management system in public and general public sector agencies in accordance with the ISO 50001 standard	3 600 buildings	2014-2020	2014-2024+	25.2
8	Energy upgrade of commercial buildings through Energy Service Companies	1 500 buildings	2014-2020	2014-2024+	50.8
9	Education and training actions for tertiary sector staff	40 000 individuals	2014-2020	2014-2024+	64.0
10	Developing smart metering systems	60 000 meters	2014-2015	2014-2024+	96.8
		160 000 meters	2014-2016		
		5 540 000 meters	2016-2020		
11	Replacing old public and private light trucks	10 000 vehicles	2014-2020	2014-2024+	11.3

12	Replacing old private passenger vehicles	50 000 vehicles	2011-2015	2014-2024+	22.7
13	Private LPG passenger vehicles	10 000 vehicles	2014-2020	2014-2024+	9.9
14	Increasing excise duty on heating oil consumption		2014-2020	2014-2020	225.1
15	Information and training actions for domestic users	75 000 households	2014-2015	2014-2024+	19.6
16	Thessaloniki Metro development		2017-2020	2017-2024+	21.4
17	Extension of Athens metro		2013-2020	2013-2024+	29.34
<b>Total volume of final energy savings (ktoe) due to the policy measures</b>					<b>893.8</b>