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Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services

EMEEES bottom-up case application 4: Residential condensing boilers in space heating

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ARMINES

Consistent with case application 8, “non residential space heating improvement” by eERG, PoliMi

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coordinated by

Wuppertal Institute for Climate, Environment and Energy

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The Project in brief

The objective of this project is to assist the European Commission in developing harmonised evaluation methods. It aims to design methods to evaluate the measures implemented to achieve the 9% energy savings target set out in the EU Directive (2006/32/EC) (ESD) on energy end-use efficiency and energy services. The assistance by the project and its partners is delivered through practical advice, technical support and results. It includes the development of concrete methods for the evaluation of single programmes, services and measures (mostly bottom-up), as well as schemes for monitoring the overall impact of all measures implemented in a Member State (combination of bottom-up and top-down).

Consortium

The project is co-ordinated by the Wuppertal Institute. The 21 project partners are:

Project Partner	Country
Wuppertal Institute for Climate, Environment and Energy (WI)	DE
Agence de l'Environnement et de la Maitrise de l'Energie (ADEME)	FR
SenterNovem	NL
Energy research Centre of the Netherlands (ECN)	NL
Enerdata sas	FR
Fraunhofer-Institut für System- und Innovationsforschung (FhG-ISI)	DE
SRC International A/S (SRCI)	DK
Politecnico di Milano, Dipartimento di Energetica, eERG	IT
AGH University of Science and Technology (AGH-UST)	PL
Österreichische Energieagentur – Austrian Energy Agency (A.E.A.)	AT
Ekodoma	LV
Istituto di Studi per l'Integrazione dei Sistemi (ISIS)	IT
Swedish Energy Agency (STEM)	SE
Association pour la Recherche et le Développement des Méthodes et Processus Industriels (ARMINES)	FR
Electricité de France (EdF)	FR
Enova SF	NO
Motiva Oy	FI
Department for Environment, Food and Rural Affairs (DEFRA)	UK
ISR – University of Coimbra (ISR-UC)	PT
DONG Energy (DONG)	DK
Centre for Renewable Energy Sources (CRES)	EL

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Contents

1 Summary

1.1 Title of the case application

Residential condensing boilers and other improvements in space heating systems with distribution by a water loop

1.2 Type of EEI activities covered

End-use EEI action	
Sector	residential
Energy end-use	heating
Efficient solution	Condensing boiler with modulated burner operating with a return-water temperature not exceeding 60°C, which can be associated or not with an improvement in heat distribution
EEI Facilitating measure	
Types of EEI facilitating measures	White certificates, plans for renovation of building stock, application of article 6 of EPBD, etc. Improvement of heating system efficiency by: ▪ Information and legislative-informative measures → Energy labelling schemes (see Directive 92/42/CE Classification) ▪ Financial instruments → Subsidies (Grants), energy efficiency public procurement, Bulk Purchasing ▪ Energy services for energy savings → Guarantee of energy avings contracts EEI mechanisms → Public service obligation for energy companies on energy savings including “White certificates” ,

1.3 Detailed definition of EEI activities covered

The EEI activities are listed in section 1.2 ahead. Additional information includes: EEI measures usually target at both, improving the insulation rate and quality and the heating system. By doing so, the temperature regime of emitters is changed in a way favourable to condensing boilers. See paper on Tertiary Heating where an integrated approach to the heating system improvement is suggested.”

1.4 General specifications

For the calculation of the energy savings, there are strict conditions. The unitary saving ΔE is associated with a replacement of a boiler in place by a condensing boiler as defined in Boiler Efficiency Directive 92/42/EC. Even if this directive is no longer in force, it's still the best definition, and it is still the definition based on harmonised standards that the manufacturers use. Estimated unitary annual energy savings should be referred to end-use actions related to the installation of condensing boilers with modulated burners operating with a return-water temperature not exceeding 60°C. The present case application has hence to be used only for end-use actions fulfilling these specifications.

Moreover it is necessary to differentiate between three alternatives:

- Regular replacement after the end of the lifetime of the old boiler (also valid for new buildings)
- (if possible and data is available): Early replacement of defect old boilers (instead of repair)
- Early replacement through conscious action, as an impact of information, advice, funding schemes etc.

Only the first and last (regular and early) are considered in most cases. In any case it is possible to use well-documented country-specific energy data. However more simple approaches are presented here.

In principle unitary gross annual energy savings computed for each building are multiplied by area treated in each building then added aggregated nationally (by doing so, the interactions with other measures, like the insulation of the same building which decreases the demand, and the other improvements taking place at the same time can be taken into account).

Alternatively, if the national conditions require a different procedure of data collection, the total area treated can be collected and added first, then multiplied by unitary gross annual energy savings; the other improvements have then to be neglected.

Finally, when only the number of dwellings treated is known, the average area of buildings of a certain type can be determined nationally (census…) and the multiplication between both is made at national level, which leads to more uncertainty.

1.5 Formula for unitary gross annual energy savings

For this method, the unit used in the formula for the unitary gross annual energy savings is the area of the building.

Consequently, the equation (S1) used in section 3, step 1 is unitary gross annual energy savings = (1/efficiency of replaced plant – 1/efficiency of condensing plant) * E (equation S1)

the replaced plant efficiency is different between regular and early replacement; that does not change the formula.
where equation 2 is used for combining components efficiencies to obtain plant efficiency;

and E, the heating need, is on EU-25 average 86 kWh/m2, but must be corrected for heating degree days HDD or E determined nationally (e.g., according to the Ecoboiler study)

It could be logical to only accept energy savings from early replacements, because, at least in a number of MS, replacement of failed boilers by condensing boilers is already the standard. If the MS do not make a common rule, there needs to be a correction on high free-rider shares for some countries, if the aim is to calculate energy savings additional to autonomous progress.

The result of the calculation for EU average values is given in the following table S1 with the adequate security coefficient of 0.80.

1.6 Indicative default value for unitary gross annual energy savings (according to replacement type)

Table S1 level 1 unitary gross annual energy savings for a change of boiler only – value for EU average conditions

	ΔE *in kWh/m2/a for regular replacement°*	ΔE *in kWh/m2/a for early replacement**
E = 86 kWh/m^2/year	5.6	14.7
Based on the following default values for seasonal average boiler efficiency:		
Efficient condensing boiler	94%	94%
Replaced boiler	89%	82%

° if the aim is to calculate energy savings **additional** to autonomous progress

* also for regular replacement, if the aim is to calculate **all** energy savings

These values need to be modified for each Member State. This could be done either by heating degree days or by the values for the annual useful heating energy demand per m^2 from the Ecoboiler study (p.58 of ecoboiler task 3 final report; useful heating energy demand is termed “heat load” in that source). It needs to be discussed what is the better choice. Heating degree days reflect the climate and would thus reward countries who have already a better insulated building stock. The annual the annual useful heating energy demand per m^2 will better reflect the actual situation of the building stock. Chapter 3 is providing more information on the adaptation factors per MS that either choice would entail.

1.7 Formula for total ESD annual energy savings

If all correction factors are included, the formula for the total ESD (net) annual energy savings will read, as presented in section 5:

total gross annual energy savings = unitary gross annual energy savings * area * (1 – double-counting coefficient) * (1 – free-rider fraction + multiplier effect)

(equation S2)

1.8 Indicative default value for energy savings lifetime

CWA 27 gives an harmonised lifetime of 17 years.

1.9 Main data to collect

Level 1 : number of treated dwellings and average dwelling area in country

Level 2 : area treated in each dwelling and exact location for climatic correction

For levels 1 and 2 also: data on technical interaction with thermal insulation

Level 3 : area treated in each dwelling and the other improvements at the level of each building (by doing this the interactions with other measures, like the insulation of the same building which decreases the demand and the distribution network improvements that increase the gain are taken into account)

For all three levels: data on double-counting between facilitating measures, free-rider, and multiplier effects

2 Introduction

2.1 Twenty bottom-up case applications of methods

Within EMEEES, task 4.1 provided methodological materials in the internal working paper "Definition of the process to develop harmonised bottom-up evaluation methods", version 20 April 2007; an update has been published as an Appendix to the report on Bottom-up methods at www.evaluate-energy-savings.eu. Based on this draft report, concrete bottom-up case applications were developed by EMEEES partners within task 4.2, and reference values were to be specified within task 4.3.

This report deals with case application 4 "Residential condensing boilers in space heating" developed by Armines.

Eleven project partners have developed concrete bottom-up case applications for a specific type of technology or energy efficiency improvement measure or end-use action. All gave comments and input to the methods developed by the other organisations.

The 20 case applications developed are presented in the table below:

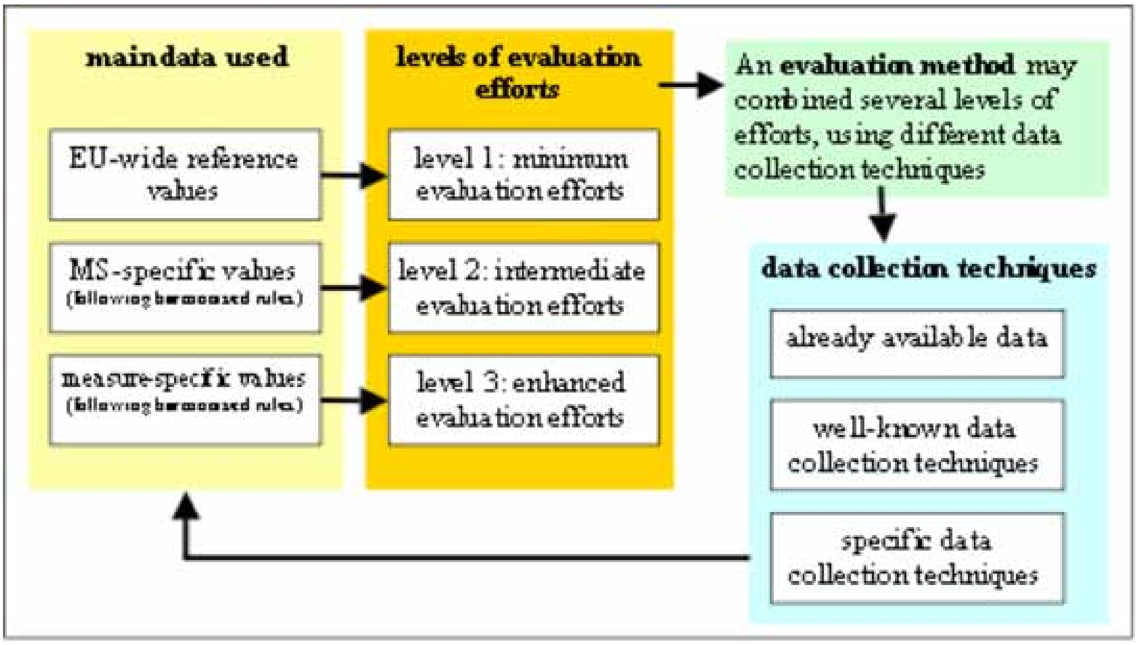
N°	End-use or end-use action, technology, or facilitating measure	Sector	Responsible organisation
1	Building regulations for new residential buildings	Residential	SenterNovem
2	Improvement of the building envelope of residential buildings	Residential	AEA
3	Biomass boilers	Residential	AGH-UST
4	Residential condensing boilers in space heating	Residential	Armines
5	Energy efficient cold appliances and washing machines	Residential	ADEME
6	Domestic Hot Water – Solar water heaters	Residential	AGH-UST
7	Domestic Hot Water - Heat Pumps	Residential	AGH-UST
8	Non residential space heating improvement in case of heating distribution by a water loop	Tertiary	eERG
9	Improvement of lighting systems	Tertiary (industry)	eERG
10	Improvement of central air conditioning	Tertiary	Armines

N°	End-use or end-use action, technology, or facilitating measure	Sector	Responsible organisation
11	Office equipment	Tertiary	Fraunhofer
12	Energy-efficient motors	Industry	ISR-UC
13	Variable speed drives	Industry	ISR-UC
14	Vehicle energy efficiency	Transport	Wuppertal Institute
15	Modal shifts in passenger transport	Transport	Wuppertal Institute
16	Ecodriving	Transport	SenterNovem
17	Energy performance contracting	Tertiary and industry end-uses	STEM
18	Energy audits	Tertiary and industry end-uses	Motiva
19	Voluntary agreements – billing analysis method	Tertiary and industry end-uses	SenterNovem
20	Voluntary agreements with individual companies – engineering method	Tertiary and industry end-uses	STEM

2.2 Three levels of harmonisation

In order to be as practicable as possible and to stimulate continued improvement, the harmonised reporting on bottom-up evaluation is structured on three levels (cf. figure 1).

Figure 1: Three levels of harmonisation



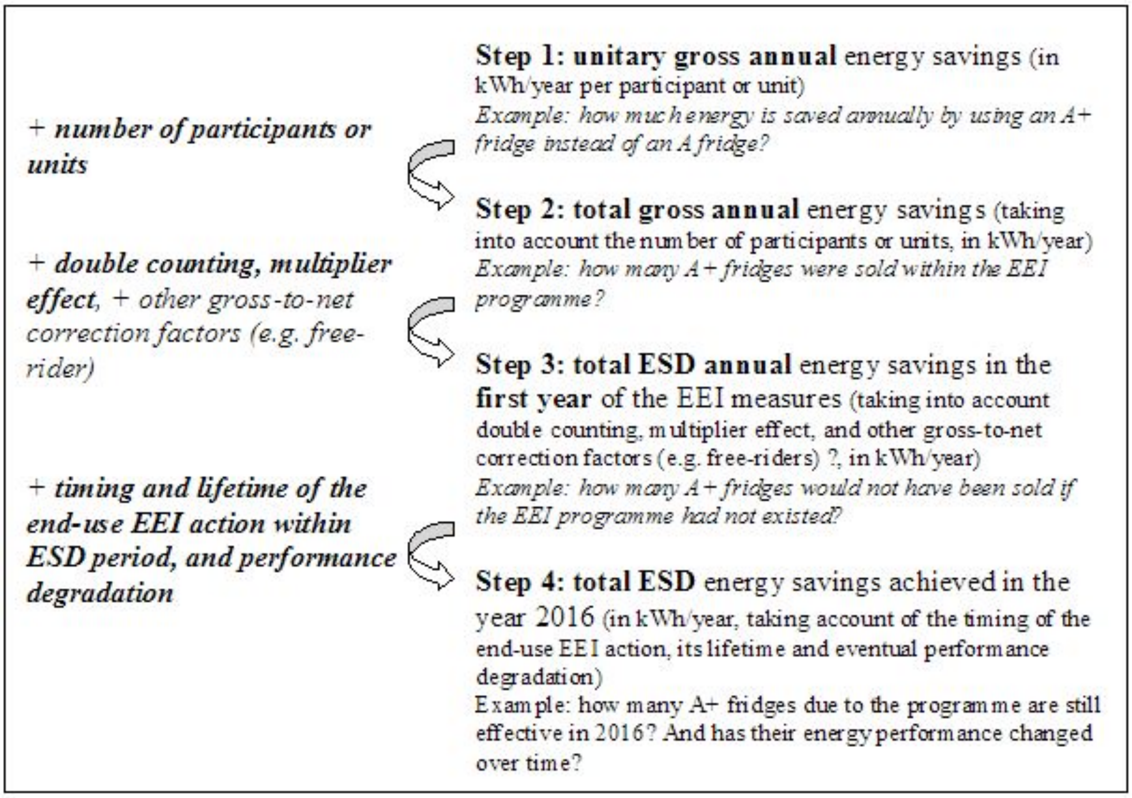
As a consequence, the EMEEES case applications for bottom-up evaluation methods present:

- EU wide reference values, if applicable;
- Guidelines how Member States can use country-specific values following harmonised rules;
- Guidelines how measure- or action-specific (national) values can be developed, following harmonised rules.

2.3 Four steps in the calculation process

The harmonised rules for bottom-up evaluation methods are organised around four steps in the calculation process (cf. figure 2). These steps are presented in detail in the report for WP 4.1.

Figure 2: Four steps in the calculation process



The reports on the concrete bottom-up case applications follow the format of these four steps and they each hold six chapters plus some annexes:

1. summary
2. introduction
3. step 1: unitary gross annual energy saving
4. step 2: total gross annual energy savings
5. step 3: total ESD annual energy savings
6. step 4: total ESD energy savings for year “i”

2.4 Pilot tests

Additional to the development of the 20 bottom-up case applications, some of these cases were tested in practice in Work Package 8.
Pilot tests of the following case applications were performed by EMEEES partners in Italy, France, Denmark, and Sweden:

EMEEES case application	Sector	Italy	France	Denmark	Sweden
Building envelope improvement	Residential		X		
Energy-efficient white goods	Residential	X			
Biomass boilers in the residential sector	Residential		X		
Condensing Boilers	Residential	X	X		
Improvement of lighting system	Tertiary (industry)				X
High efficiency electric motors	Industry	X			
Variable speed drives	Industry	X			
Energy audits	Tertiary and industry end uses			X	
Energy performance contracting	Tertiary and industry				X

The following EEI measures were evaluated ex-post using the above-mentioned EMEEES bottom-up case applications:

Country	Subject	Sector(s) addressed
France	Condensing boilers, building envelope improvements and compact fluorescent lamps under the French White Certificates.	Residential
Italy	Schemes under the Italian White Certificates system	Residential, tertiary, industry
Sweden	Energy Efficiency Investment Programme for Public Buildings (2005-2008)	Public non-residential buildings
Denmark	Energy audits performed in Denmark between 2006 and 2008	Industry, tertiary

As a result of the pilot tests, some of the case applications tested were updated to reflect the findings of the tests.

3 Step 1: Unitary gross annual energy savings

3.1 Step 1.1: General formula and calculation model (from PoliMi)

For this method on residential heating, the unit is a square meter being heated by a water loop and a boiler. A detailed modelling of ΔE, the unitary savings, has been made but simple default values have been generated.

ΔE = unitary gross annual energy savings = (1/efficiency of replaced plant – 1/efficiency of condensing plant) * E (equation 1)

the replaced plant efficiency is different between regular and early replacement; that does not change the formula. Equation 2 below may be used for combining components efficiencies to obtain plant efficiency; and E, the heating need, is on average 86 kWh/m2, but corrected for HDD or nationally (Ecoboiler study, part 3, page 58)

The same formula can be used to develop more precise Level 2 and Level 3 Country and Action specific estimates of energy savings. The paper on heating systems in the tertiary sector gives examples of this.

Note: for level 1 data, the efficiency of standard components is the EU average efficiency of the equipment, considering the stock or the market baseline. Similarly, the EU level average value is used for the efficient equipment.

In the case that a European Member State Government decides to provide incentives for efficiency measures directed to improving the heating system as a whole, the energy savings can be evaluated by considering the improvement of the efficiency values as indicated by the equation (2). The standard and efficient efficiency values for the single steps (heat generator, emission, control, distribution) can be estimated following the procedures reported hereunder.

efficiency of replaced plant = efficiency of replaced boiler* efficiency of replaced emitter* efficiency of replaced distribution network* efficiency of replaced controller

efficiency of efficient plant = efficiency of efficient boiler* efficiency of efficient emitter* efficiency of efficient distribution network* efficiency of efficient controller
(note: not all components need to be made efficient. If they are not made efficient, the efficiency of the replaced/standard component shall be used.)

(equation 2)

3.2 Step 1.2: Baseline

- before/after: current market inefficient?

level 1	EU default baseline: *Efficiency of inefficient share of the market (European average)= 89% based on Net Calorific Value*[1] *; for the stock, 82%; efficiency of the condensing boiler at 94%;* Based on PoliMi study of tertiary boilers
level 2	guidelines: *Same based on the national sales data:* *every MS should prove that its market situation differs from the average showed above*
level 3	guidelines: *A single participant may require a different baseline level by proving that in his specific case the market condition differs meaningfully from that here considered or that the boilers to be substituted have been found as worse, for instance through audit, building certification or inspection*

Table 1, extracted from PoliMi report, presents the proposed level 1 EU default values for the two types of baselines relevant:

- "before/after" baseline ("Non efficient" **stock** values), to be used for early replacements and when the aim is to calculate **all** energy savings, including autonomous progress,
- "with and without" baseline ("Non efficient" **market** values), to be used when the aim is to calculate energy savings **additional** to autonomous progress,

With the definitions taken by PoliMi the reference values are the following:

Table 1 efficiency of condensing boilers (on NCV) and other efficiencies from PoliMi report

System	Stock Baseline (%)	Market inefficient Baseline (%)	Minimum efficiency for efficient solutions (%)
Heat generation	82,0	89,0	94,0
Emission	78,0	83,0	93,0
Distribution	93,0	-	97,0

As all of these are average values for the stock or the market, they should be reassessed and, if necessary, adapted, from time to time.

1 Net Calorific Value is recommended by the directive but Gross Calorific Value (including latent heat of water vapor) is often used by practioners; in case for some reason national values based on GCV are used, about 11% should be included in the following formula: $efficiency_{GCV} = efficiency_{NCV} / 1,11$ to obtain the national value based on NCV; note also that there are at least two types of natural gas in Europe, one with High calorific value (called gas H) and one with Low calorific value (called gas L)

3.3 Step 1.3: Requirements for normalisation factors

How to estimate E: Thermal demand per unit surface (kWh/m2/year)? VHK Preparatory Study on EcoDesign of Boilers (2007) (http://www.ecoboiler.org), provides specific data of heating needs in Europe, in the context of the Ecodesign of EnergyUsing Products Directive 2005/32/EC. PoliMi referred to this source for most estimations. We keep the heat demand value E (on a European average) as 86 kWh/m2/a. This has to be adapted to each Member State (cf. chapter 3.4.3) and potentially even within Member States. Furthermore, in real ex-post calculations, this value has to be corrected for heating degree days between different years, which are the main normalisation factor to take into account (for unitary gross annual energy savings).

normalisation factor 1 ; heating degree days	
level 1	default coefficient: *see table 3, based on a simplified normalisation with HDD by Eurostat*
level 2	guidelines: *if there is specific climatic condition (altitude, etc.) it is possible to document the specific location of condensing boilers installed* data required: long term HDD guaranteed by a meteorological office
level 3	guidelines: as for level 2 data required: as for level 2

3.4 Step 1.4 Specifying the calculation method and its three related levels

level 1	deemed savings in table 2, corrected for HDD or heating needs as given in tables 3 and 4
level 2	Use of equations 1 and 2 with country-specific data
level 3	Simulation of a condensing boiler being significantly more efficient than the directive can lead to differenciate the savings according to boilers types

3.4.1 **Conversion factors** (when relevant)

Net Calorific Value is recommended by the directive but Gross Calorific Value (including latent heat of water vapor) is often used by practioners; in case for some reason national values based on GCV are used, about 11% should be included in the following formula: $\text{efficiency}_{GCV} = \text{efficiency}_{NCV} / 1{,}11$ to obtain the national value based on NCV; note also that there are at least two types of natural gas in Europe, one with High calorific value (called gas H) and one with Low calorific value (called gas L)

3.4.2 Considering the direct rebound effect

This section applies for measures related to the internal temperature of dwellings, and so is not relevant here : unlike insulation, for instance, occupants don't feel the difference generated by a new boiler and wont change their behaviour at home.

The direct rebound effect is not explicitly mentioned in the ESD. It is created by final energy consumers who increase the intensity of the use of energy-efficient equipment after an EEI measure, e.g., when the internal temperature of a building is increased after insulation. This reduces the energy savings achieved in comparison to the baseline of autonomous consumption changes. Consequently, including energy savings "eaten up" by the direct rebound effect in the total ESD annual energy savings would mean to include too high energy savings compared to the autonomous energy consumption changes. It has not yet been decided by the European Commission and the ESD committee, whether this effect shall be included in the total ESD annual energy savings or eliminated from them.

In case further studies indicate that direct rebound takes place when a condensing boiler is installed in place of a standard boiler, a decision will need to be taken whether it will be taken into account. When this change is performed alone, without visible impact on end users, it is not certain presently that any direct rebound effect occurs.

3.4.3 From EMEEES tasks 4.2 to 4.3: defining values and requirements

3.4.3.1 Default values for energy consumption and/or related parameters

Benchmarks and default values have been computed as in PoliMi method.

Table 2 Energy saving to be used as level 1 estimate for unitary gross annual energy savings for substitution of present boiler by a condensing boiler without other changes in the heating system

	ΔE *in kWh/m2/a for regular replacement°*	ΔE *in kWh/m2/a for early replacement**
E = 86 kWh/m²/year	5.6	14.7
Based on the following default values for seasonal average boiler efficiency:		
Efficient condensing boiler	94%	94%
Replaced boiler	89%	82%

° if the aim is to calculate energy savings **additional** to autonomous progress

* also for regular replacement, if the aim is to calculate **all** energy savings

These values need to be modified for each Member State. This could be done either by heating degree days or by the values for the annual useful heating energy demand per m^2 from the Ecoboiler study (p.58 of ecoboiler task 3 final report; useful heating energy demand is termed "heat load" in that source). It needs to be discussed what is the better choice. Heating degree days reflect the climate and would thus reward countries who have already a better insulated building stock. The annual the annual useful heating energy demand per m^2 will better reflect the actual situation of the building stock. Tables 3 and 4 are providing more information on the adaptation factors per MS that either choice would entail.

Table 3 factors to adapt the EU level default value for unitary gross annual energy savings to each EU Member State based on heating degree days

Member State	**Heating degree days (Kelvin*day/year)**	**Adaptation Factor**
MT	**581**	0.18
CY	**704**	0.22
PT	**1364**	0.43
EL	**1596**	0.50
ES	**1926**	0.60
IT	**2031**	0.63
FR	**2469**	0.77
IE	**2682**	0.84
NL	**2716**	0.85
BE	**2734**	0.85
HU	**2951**	0.92
SK	**2953**	0.92
UK	**3100**	0.97
LU	**3107**	0.97
SI	**3119**	0.97
DE	**3162**	0.99
DK	**3254**	1.01
CZ	**3518**	1.10
PL	**3533**	1.10
AT	**3606**	1.12
LT	**4031**	1.26
LV	**4199**	1.31
EE	**4313**	1.34
SE	**5183**	1.62
FI	**5415**	1.69
EU-25	**3207**	**1**

Basis: data for 2004 and 2005

Table 4 factors to adapt the EU level default value for unitary gross annual energy savings to each EU Member State based on heating needs from Ecoboiler study

Member State	Heating needs (kWh/m²/year)	Adaptation Factor
MT	**16**	0,19
PT	**25**	0,29
CY	**32**	0,37
ES	**37**	0,43
IT	**54**	0,63
NL	**61**	0,71
EL	**69**	0,80
DK	**79**	0,92
FR	**80**	0,93
HU	**90**	1,05
SK	**93**	1,08
UK	**94**	1,09
DE	**100**	1,16
IE	**101**	1,17
LV	**102**	1,19
CZ	**104**	1,21
PL	**104**	1,21
AT	**113**	1,31
SE	**118**	1,37
LU	**123**	1,43
SI	**124**	1,44
BE	**141**	1,64
LT	**149**	1,73
FI	**158**	1,84
EE	**186**	2,16
EU-25	**86**	**1**

Source: VHK Preparatory Study on EcoDesign of Boilers (2007) (http://www.ecoboiler.org), Task 3 final report, p. 58

3.4.3.2 Requirements to define level 2 and level 3 values

The conditions for which level 2 or 3 values are required are the following : heating degree days differing significantly from the country average as stated by Eurostat, condensing boiler being significantly more efficient than the directive can lead to differenciate the savings according to boilers types, targeted population of substituted boilers being significantly different from the reference boiler used here.

4 Step 2: Total gross annual energy savings

4.1 Step 2.1: Formula for summing up the number of actions

In principle, unitary gross annual energy savings computed for each building are multiplied by area treated in each building, then aggregated nationally (by doing so, the interactions with other measures, like the insulation of the same building which decreases the demand, and the other improvements taking place at the same time can be taken into account). This is the level 3 approach.

For level 3 calculations:

total gross annual energy savings = Σ (unitary gross annual energy savings of a building * floor area of a building affected)

(equation 3a)

Alternatively, if the national conditions require a different procedure of data collection, the total area treated can be collected and added first, then multiplied by unitary gross annual energy savings; the other improvements have then to be neglected. This will be a level 2 approach.

For level 2 calculations:

total gross annual energy savings = average unitary gross annual energy savings * floor area of all buildings affected

(equation 3b)

Finally, on level 1, when only the number of dwellings treated is known, the average area of buildings of a certain type can be determined nationally (census…) and the multiplication between both is made at national level, which leads to more uncertainty.

For level 1 calculations:

total gross annual energy savings = average unitary gross annual energy savings per m^2 * average m^2 per dwelling of a type * number of all buildings of the type affected

(equation 3c)

4.2 Step 2.2: Requirements and methods for accounting for the number of actions

Financial incentive schemes, e.g,, under White certificates, plans for renovation of building stock, application of article 6 of EPBD, etc. give all the necessary data. The just need to be monitored.

5 Step 3: Total ESD annual energy savings

In this section, the correction factors required by the ESD and potential further correction factors are dealt with. Applying these factors will allow to calculate the total ESD annual energy savings from the gross annual energy savings calculated in step 2.

5.1 Step 3.1: Formula for ESD annual savings

total ESD annual energy savings = total gross annual energy savings * (1 – double-counting coefficient) * (1 – free-rider fraction + multiplier effect)

(equation 4)

5.2 Step 3.2: Requirements for avoiding double counting

No double counting has been analysed up to now. When several EEI measures/programmes are related to same sector or end-use (like audit programmes, white certificates, tax subsidies), it is better to evaluate them as a package, this avoids the problem of double counting. In case of overlap, the decision to allocate the corresponding energy savings to one or another EEI measure is up to the Member-States.

5.3 Step 3.3: Requirements for taking account of technical interactions

The interactions with insulation which reduces the load and “packaged” improvements of the heating system that show positive interactions have been described and solutions proposed in the case application 2 on existing buildings.

5.4 Step 3.4: Requirements for multiplier energy savings

This has to be estimated nationally. However there is some evidence of a multiplier effect around 2 in the UK in the 90’s that has still to be investigated.

5.5 Step 3.5: Requirements for the free-rider effect

The free-rider effect is not explicitly mentioned in the ESD. Free riders are final energy users who are counted when monitoring the effects of facilitating measures but would have taken the end-use actions promoted also without the facilitating measure. Consequently, including energy savings achieved by free riders in the total ESD annual energy savings would mean to include a part of the autonomous energy efficiency improvements. It has not yet been decided by the European Commission and the ESD committee, whether this effect shall be included in the total ESD annual energy savings or eliminated from them.

This has to be estimated nationally. The PoliMi study estimates an EU average of 20% of purchasers that would have selected a condensing boiler without any measure, which may correspond to some countries. However, it will be much higher in other countries, where condensing boilers alredy have a high market share, approaching 100 %. There are also values for the free riders in the other segments of the heating systems.

6 Step 4: total ESD energy savings for 2010 and 2016

The ESD text is interpreted so that only for those EEI measures that have not reached the end of their energy saving lifetime in the years of the intermediate (2010) and final (2016) targets, energy savings will be counted towards a Member State's intermediate or final energy savings target under the ESD.

6.1 Requirements for the energy saving lifetime

CWA 27 gives a harmonised lifetime of 17 years.

6.2 Special requirements for early actions

The definition of early actions may include two possibilities (to be clarified by the European Commission and the ESD Committee):

- *early (EEI) facilitating measures*, and only those energy savings that result from end-use actions that are implemented during 2008-2016, as a result of these facilitating measures that still have a lasting effect during 2008-2016, are eligible

OR

- *early energy savings* from end-use actions initiated between 1995 and 2008, with the end-use actions having a lasting effect in 2010 (for the intermediate target) or 2016 (for the overall target).

Note:

If early energy savings are accepted, a contribution to the target in 2016 can only be counted if the energy saving lifetime is greater than 8 years plus the time between installation and 2008. This needs to be proven. The same holds, respectively, for the intermediate target in 2010.

Taking the CWA value given in chapter 6.1, early savings from 1999 onwards would be eligible for condensing boilers.

6.3 Reminder to treat uncertainties

This part of the analysis could not be done for this case application. The reader is kindly referred to case application 3 on biomass boilers and case application 10 on non-residential heating systems.

Appendix I: Justifications and sources

- EC, Boiler Efficiency Directive 92/42/EC
- EC, Directive 2005/32/EC on eco-design requirements for energy-using products.
- EC, Directive 2006/32/EC on energy end-use efficiency and energy services
- eERG: EMEEES Task 4.2, case application 8, Non residential space heating improvement in case of heating distribution by a water loop
- SAVE II Labelling & other measures for heating systems in dwellings, 1999. Contract no. 4.1031/Z/99-283.
- Odyssee database (http://www.odyssee-indicators.org).
- Preparatory Study on Eco-Design of Boilers, Task 2 Report (final) Market Analysis, VHK, September 2007 (http://www.ecoboiler.org)
- Preparatory Study on Eco-Design of Boilers, Task 3 Report (final) Consumer Behaviour & local infrastructure, VHK, September 2007 (http://www.ecoboiler.org)