

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

Task 8.1: National report from the pilot tests of

Case application 12, Energy Efficient Motors;

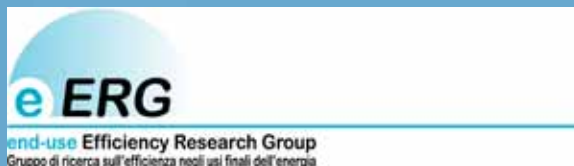
Case application 13, Variable Speed Drives

Case application 4, Condensing Boilers in space heating

Case application 5, White appliances

Performed under
the Italian white certificate scheme

Author: Nicola Labanca



April 2009



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).

1.1 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 la 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

1.2 Contact

Dr. Stefan Thomas, Dr. Ralf Schüle
Wuppertal Institute
for Climate, Environment and Energy
Döppersberg 19
42103 Wuppertal, Germany

Tel.: +49 (0)202-2492-110
Fax.: +49 (0)202-2492-250
Email: info@evaluate-energy-savings.eu
URL: www.evaluate-energy-savings.eu www.wupperinst.org

Task 8.1: National report from the pilot tests performed under the Italian tradable white certificate scheme

Author: Nicola Labanca

Contents

The Project in brief	1
1.1 Consortium	1
1.2 Contact	2
Executive summary	5
Introduction	7
Description of the EEI facilitating measure considered for the pilot tests ..	9
1. EMEEES case application n. 12: Energy Efficient Motors	12
1.1 Testing activity description	12
1.2 Main data sources used for the pilot test.....	12
1.3 Test of methodology application step by step	12
1.4 Methodology test on early actions and additionality issues.....	20
1.5 Method comparison and interactions with already existing evaluation methods	20
1.6 Evaluation of costs related to method application	21
1.7 Target group perspective	22
1.8 Specific conclusions	23
1.9 General conclusions	24
1.10 Needs and potentials for improvement of the method tested	25
2. EMEEES case application n. 13: Variable Speed Drives	26
2.1 Testing activity description	26
2.2 Main data sources used for the pilot test.....	26
2.3 Test of methodology application step by step	26
2.4 Methodology test on early actions and additionality issues.....	33
2.5 Method comparison and interactions with already existing evaluation methods	33
2.6 Evaluation of costs related to method application	34
2.7 Target group perspective	34

2.8 Specific conclusions	35
2.9 General conclusions	36
2.10 Needs and potentials for improvement of the method tested	37
3. EMEEES case application n. 4: Condensing Boilers in residential space heating	38
3.1 Testing activity description	38
3.2 Main data sources used for the pilot test.....	38
3.3 Test of methodology application step by step	38
3.4 Methodology test on early actions and additionality issues.....	44
3.5 Method comparison and interactions with already existing evaluation methods	45
3.6 Evaluation of costs related to method application	46
3.7 Target group perspective	46
3.8 Specific conclusions	47
3.9 General conclusions	48
3.10 Needs and potentials for improvement of the method tested	49
4. EMEEES case application n. 5: Energy Efficient Cold Appliances and Washing machines	50
4.1 Testing activity description	50
4.2 Main data sources used for the pilot test.....	50
4.3 Test of methodology application step by step	51
4.4 Methodology test on early actions and additionality issues.....	53
4.5 Method comparison and interactions with already existing evaluation methods	54
4.6 Evaluation of costs related to method application	54
4.7 Target group perspective	54
4.8 Specific conclusions	54
4.9 General conclusions	55
4.10 Needs and potentials for improvement of the method tested	56
References	57
Appendix I: List of persons involved in the pilot tests	58

Executive summary

The EMEEES case applications on energy efficient motors, variable speed drives, condensing boilers for space heating and energy efficient white goods have been tested under the tradable white certificate (TWC) scheme that is running in Italy as of 2005.

These pilot tests mainly consisted in a comparison of the calculation formulas and approaches developed under the EMEEES case applications with those adopted under the Italian white certificates scheme for the energy saving deemed estimates produced and in a series of interviews with Italian stakeholders involved in energy policy evaluation as well as in energy efficiency project implementation and assessment. Unfortunately, the pilot tests could not rely on real experimental data related to energy efficiency projects implemented under the Italian TWC scheme and evaluated according to the evaluation methods existing under this scheme, except the statistical data on the number of energy efficiency projects implemented and on the related number of white certificates issued that are made available yearly by the TWC scheme regulator.

The analyses performed indicate that the general EMEEES bottom-up evaluation approach (i.e. the three level evaluation efforts and the four steps in the energy saving calculation process) fits very well with the Italian TWC scheme evaluation approach and the TWC scheme calculation procedures adopted to perform the unitary energy saving deemed estimates considered during the pilot tests.

This analyses also showed that the EMEEES case application related to the installation of condensing boilers in the domestic sector could be simplified in some points, as e.g. providing EU default values for energy efficiency improvements related to parts of the heating system like emitters, heat control systems and heating distribution systems might introduce large uncertainties in the evaluation. Better providing a single default value to only allow the evaluation of the energy efficiency improvement due to condensing boiler installation and ensuring that the method is applied only in case simple and effective operation standards are fulfilled (e.g. only in case condensing boilers with modulated burners are installed in heating systems where the return-water temperature does not exceed 60 °C) than attempting to capture effects that are too difficult to estimate. The field tests also indicated that the energy savings due to domestic hot water production by condensing boilers (not considered in the EMEEES case application) are considerable.

As far as the EMEEES case application related to energy efficient motors is concerned, the field tests performed showed that the EU default values provided for the motor load factors in case of different application types may make the EMEEES evaluation method more reliable than the corresponding method used under the Italian white certificate scheme. On the other hand, the default values provided for the number of motor operating hours appear too rough and may make EMEEES estimates not conservative. In general it might be more appropriate and simpler to provide just the energy saving EU default values for various motor application types and motor power ranges rather than providing default

values for load factors, operating hours and motor efficiency that are supposed to be used in an energy saving calculation formula by the evaluator.

As far as the EMEEES case application related to the installation of variable speed drives (VSDs) is concerned, the field tests showed that this case application aims at covering a range of VSD technological applications that is probably too wide. This would cause that this method would disadvantage e.g. Italy with respect to other EU countries. Indeed a highly specific method for VSDs used for water pumping systems has been developed under the Italian white certificate scheme and the application of this method may result in less energy savings with respect to the energy savings estimated through the EU default values provided by the EMEEES case application. These tests seem to confirm the general principle that it is better to propose a sufficiently accurate calculation method for a specific application than aiming at covering very different applications by too rough energy saving estimates.

Concerning the EMEEES case application on energy efficient white goods it has to be pointed out that the Italian TWC scheme regulator revoked the existing class A washing machine energy saving deemed estimates. For this reason and also because detailed information about Italian energy efficiency projects addressing washing machines are missing, the pilot test on the EMEEES case application part related to these domestic appliances could not be performed. As far as the EMEEES case application part related to energy efficient cold appliances is concerned, the analyses performed proved that not all the assumptions and hypotheses made in this EMEEES methodology application are clearly justified and understandable. For this reason, this case application resulted quite difficult to be used.

Introduction

The pilot tests described in this report have been performed by comparing some evaluation methodologies presently adopted under the Italian tradable white certificate scheme (TWC) with those developed in the framework of the EMEEES project and applied to some specific case studies. These pilot tests mainly consisted in a comparison of the calculation formulas and approaches developed under the EMEEES case applications with those adopted under the Italian white certificates scheme and in a series of interviews with Italian stakeholders involved in energy policy evaluation as well as in energy efficiency project implementation and assessment. In general these comparisons and interviews allowed mainly establishing whether and to what extent the EMEEES evaluation methods may be adapted to white certificate evaluation methods and requirements, how the energy savings estimated under the Italian TWC may be converted into ESD savings, whether EMEEES assumptions and definitions to calculate energy savings are compatible with TWC assumptions, how EMEEES methods and concepts may be used to improve TWC methods and vice versa¹. As the TWC evaluation approach is bottom up, only bottom-up EMEEES case applications were considered for the pilot tests. Therefore the general EMEEES bottom-up approach concerning e.g. baseline definitions, the three evaluation effort levels and additionality issues might be tested. Unfortunately the pilot tests performed could not rely on experimental data related to energy efficiency projects implemented under the Italian TWC scheme and evaluated according to the evaluation methods existing under such scheme. This was due on the one hand to privacy reasons impeding the TWC scheme Regulator (i.e. the Authority for Electrical Energy and Gas – AEEG) to provide information about energy efficiency projects implemented under the scheme as well as about project implementers. On the other hand, considering that the pilot tests might address only EEI actions for which deemed estimates of the energy savings have been produced by the AEEG, it is quite unlikely that, even in case such information would have been accessible, energy efficiency project implementers collected further data besides the few ones needed for the deemed estimates. Because of this lack of information the EMEEES case application level 1 default values accuracy could be tested only by a comparison with TWC deemed estimates and not by using real data resulting by on-field measurements. The table below reports the list of case applications tested.

¹ As explained in the report sections dedicated to the condensing boiler EMEEES case application the pilot tests allowed indeed individuating areas for improvement for the Italian TWC evaluation method adopted for **** gas boiler energy saving deemed estimates.

	EMEEES case applications tested (bottom-up)	Sector
1	Case application 12 – Energy Efficient Motors	Industry
2	Case application 13 – Variable Speed Drives	Industry
3	Case application 4 – Condensing Boilers in Space Heating	Residential
4	Case application 5 – Energy efficient cold appliances and washing machines	Residential

Description of the EEI facilitating measure considered for the pilot tests²

Title of the EEI measure	<i>ITALIAN WHITE CERTIFICATE SCHEME</i>
Category	<i>EEI mechanism</i>
Regional application	<i>The measure is effective all over Italy</i>
Sector(s) addressed	<i>All end-use energy sectors</i>
Target group	<i>Target groups are represented by all energy end-users. However actors obliged and eligible to participate in the mechanism (by implementing EEI actions at the end-users and/or exchanging related white certificates on the market organised) are gas and electricity grid distribution companies (both obliged and eligible), ESCOs (eligible) and energy managers (eligible) in the industry, tertiary and public sectors appointed because of the Italian law 10/91. Average annual additional energy savings to be achieved in the period 2005-2009 represent about 0.47 % of total final energy consumption in 2004 (such ratio being calculated as the mean additional annual primary energy to be saved over the total primary energy consumed in Italy)³. However both the energy saving amount to be achieved yearly and the total final energy consumed and considered for the calculation include some end-use energy sectors that are presently excluded by the ESD (i.e. energy intensive industry)</i>
End-use EEI action targeted	<i>Eligible EEI actions are defined in Article 5 of the July 20, 2004 decrees related to the mechanism implementation. Paragraph 1 states that obliged actors (i.e. gas and electricity grid distribution companies) have to reach their saving targets through energy efficiency measures typically belonging to a series of different typologies grouped in the 14 categories listed below:</i> <i>- Electrical re-phasing</i> <i>- Electric motors and their applications</i>

² For more information see for example M. Pavan, "Tradable energy efficiency certificates: the Italian experience", Energy Efficiency Journal, Volume 01, Issue 04, November 2008; pagg. 257-266

³ The ratio reported has been calculated before the energy saving targets for 2008 and 2009 were increased and new targets were set for the period 2010-2012 by the Ministerial Decrees published on December 21, 2007.

	<ul style="list-style-type: none"> - Lighting systems - Electricity leaking (stand-by, etc.) - Actions to employ energy vectors more appropriate than electricity (substitution of electric boilers, etc.) - Reduction of electricity consumption for thermal uses - Reduction of electricity consumption for cooling - Very efficient appliances and office equipment - Substitution of systems for combustion of non-renewable energy sources with more efficient ones. - Substitution of electricity vector or other energy vector with more efficient ones - Room conditioning and heat recovering in buildings via renewable energy sources (district heating, etc.) - Installation of renewable energy systems by end-users (solar panels, biomass, pv panels, etc.) - Natural gas and electric vehicles - Education, information, training of end-users on energy saving
<p>Expected annual energy savings in 2016 and 2010</p>	<p>No saving objectives for 2016 have been established yet. 2.4 Mtoe are supposed to be saved in 2010 by electricity grid distribution companies and 1.9 Mtoe by gas grid distribution companies. However EEI actions could be implemented in any energy sector. It is therefore impossible to quantify such expected savings in terms of final energy. Given the scheme design assumed it is not possible to establish how much of such objectives will be achieved via early actions either.</p> <p>The conversion factor presently used for electricity savings is 1 KWh (final energy) = 0.00022 toe (primary energy). However this conversion factor is going to be updated. Notice that while converting energy savings attributed to given EEI actions (e.g. actions related to building envelopes) it is necessary to take into account that only a part of such savings might be due to electricity savings (the mix of electricity and not-electricity savings depending on the specific action considered and the assumptions made for the saving evaluation).</p>
<p>Status of implementation and exact timeframe</p>	<p>The Italian white certificate scheme started on January 1, 2005 and its initial phase of implementation (supposed to cover the period 2005-2009) has been recently extended up to 2012. Considering that a given EEI action implemented under the scheme may yield energy savings for 8 years maximum (see the scheme description provided in the Annex II below) only EEI</p>

	<p><i>actions implemented as of 2009 might be in principle claimed for the achievement of the saving target established for 2016 (in case of EEI actions not related to the building envelopes a life time of 5 years is assumed. Therefore these kind of actions could be considered only if implemented as of 2012). Concerning the intermediate target established for 2010 only EEI actions implemented as of 2003 (if related to the building envelopes) or 2006 (if others) could be considered. Notice that EEI actions implemented as of 2001 are eligible for the achievement of the saving targets established under the Italian white certificate scheme.</i></p>
--	--

1. EMEEES case application n. 12: Energy Efficient Motors

1.1 Testing activity description

The EMEEES case application on energy efficient motors has been compared with the corresponding TWC evaluation method developed by the AEEG after consultations with the main stakeholders involved in the implementation, monitoring and evaluation of EEI actions addressing this technology (see Delibera 111/04, scheda tecnica n.11). General specifications and assumptions of the two methods have been compared and the EMEEES level 1 default values have been confronted with the deemed estimates provided by the calculation technical sheets developed by the AEEG for energy efficient motors. The document illustrating the EMEEES case application has been submitted to Antonio Capozza (CESI Ricerca), Emanuele Regalini (AEEG) and Alessandro Pascucci (ESCO Italia). A questionnaire addressing the aspects considered for the test has been prepared and submitted to these persons during phone interviews held once they had read the EMEEES case application report. Such persons have been selected and interviewed because CESI Ricerca has been involved together with the AEEG in the development of the technical sheets used under the Italian TWC scheme, whereas ESCO Italia had implemented EEI actions addressing energy efficient motors and used the related TWC technical sheets to get the white certificates issued by the AEEG. The testing activities performed are further illustrated in the report subsections reported below.

1.2 Main data sources used for the pilot test

Data used for the pilot test were those related to the assumptions and the default values considered for the deemed estimates of the energy savings yielded by energy efficient motors installation as reported in the AEEG calculation technical sheets. Such information were found in the final versions of the consultation documents⁴ which the deemed estimates reported in the calculation technical sheets are based upon. Additional data sources are represented by the information provided by the interviewees.

1.3 Test of methodology application step by step

In the following the EMEEES case application is illustrated step by step and a comparison with the corresponding evaluation method developed under the Italian TWC scheme is presented.

Step 1 and step 2

The EMEEES formulas proposed for the calculation of level 1 and level 3 unitary and total annual gross energy savings (step 1 and step 2 of the EMEEES methodology) are reported in the figure 1 below.

⁴ See in particular "Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all'articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001", January 16, 2003

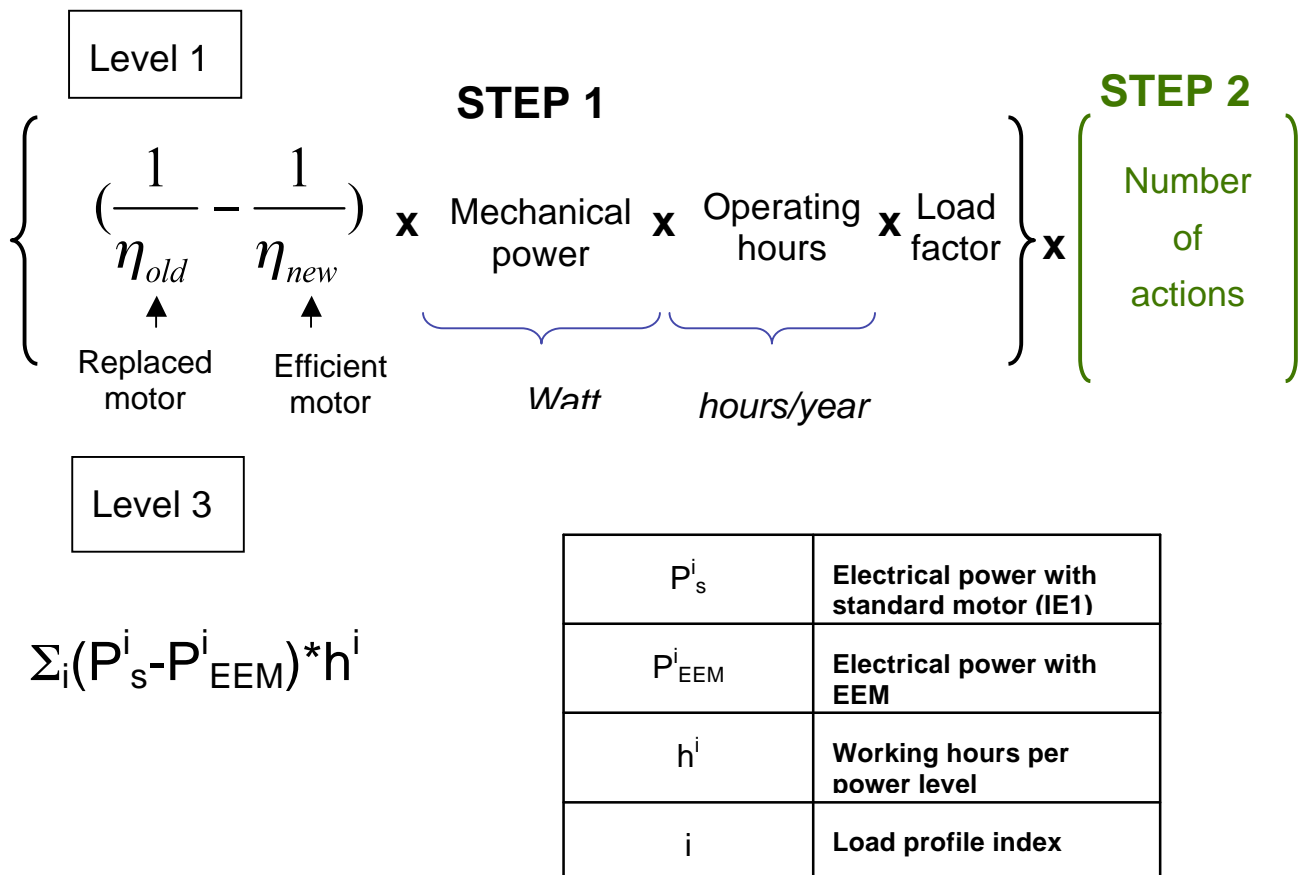


Figure 1: EMEEES Level 1 and level 3 formulas for the calculation of unitary and total gross annual energy savings

The EMEEES default values to be used for the motor efficiencies η_{old} and η_{new} included in the level 1 calculation formula above are supposed to be those of the norm IEC 60034-30 and are reported in the figure 2 below, IE1 being the efficiencies to be considered for the replaced solutions, IE2 or IE3 being the efficiencies of the new solutions for different power levels. Level 1 default values to be considered for the other parameters included in the level 1 formula are based on existing SAVE studies and are reported in the figure 3 below for different power ranges and application types.

P _N (kW)	Efficiency		
	Standard (IE1)	High Efficiency (IE2)	Premium Efficiency (IE3)
0,75	72,1	81,1	84,0
1,1	75,0	82,7	85,3
1,5	77,2	83,9	86,3
2,2	79,7	85,3	87,5
3	81,5	86,3	88,4
4	83,1	87,3	89,2
5,5	84,7	88,2	90,0
7,5	86,0	89,1	90,8
11	87,6	90,1	91,7
15	88,7	90,9	92,3
18,5	89,3	91,4	92,7
22	89,9	91,7	93,1
30	90,7	92,4	93,6
37	91,2	92,8	94,0
45	91,7	93,1	94,3
55	92,1	93,5	94,5
75	92,7	94,0	95,0
90	93	94,2	95,2
110	93,3	94,5	95,4
132	93,5	94,7	95,6
160	93,8	94,9	95,8
200 up to 370	94	95,1	96,0

Figure 2: Level 1 default efficiency values for the replaced solutions (IE1) and the new solutions (IE2 or IE3) for different power levels as reported in the norm IEC 60034-30.

Power ranges	Type of Applications	Industry		Tertiary	
		Hours (h)	Load factor	Hours (h)	Load factor
[0,75;4[	Pumps	3861,03	0,55	3800	0,55
[4;10[		4501,94	0,58	3050	0,60
[10;22[		5040,47	0,59	3000	0,60
[0,75;4[	Fans	4910,47	0,53	2250	0,60
[4;10[		4137,76	0,56	2500	0,65
[10;22[		5210,64	0,59	2500	0,65
[0,75;4[	Air Compressor	2177,99	0,63	1030	0,40
[4;10[		4057,72	0,60	1000	0,45
[10;22[		4625,99	0,68	980	0,45
[0,75;4[	Conveyors	3060,75	0,42	621	0,61
[4;10[		2787,90	0,41	916	0,53
[10;22[		3908,61	0,51	725	0,49
[0,75;4[	Cooling Compressors	5051,90	0,60		
[4;10[		1890,63	0,65		
[10;22[		5066,59	0,70		
[0,75;4[	Refrigeration			4200	0,70
[4;10[				4170	0,70
[10;22[				4050	0,75
[0,75;4[	Others	3086,64	0,34	500	0,30
[4;10[		2859,49	0,39	530	0,30
[10;22[		2299,44	0,45	570	0,30

Figure3: Level 1 default values of the parameters other than motor efficiencies included in the level 1 formula for different power ranges and application types.

The EMEEES case application is proposed for EEI actions implemented in the industry and in the tertiary sectors and referring to motors running over 20% of the rated power most of the time and operating for more than 4000 hours per year. As already mentioned energy performances of replaced and new motors are supposed to be classified according to the norm IEC 60034-30, whereas variable speed drives possibly installed on these motors are supposed to fulfill the CEI EN 61800-2 (Part 2) on general prescriptions and general specifications of VSDs.

According to the EMEEES case application the data to be collected in case of a level 2 evaluation effort should relate to national statistics and sales data about motor market segmentation per power range and end-use plus average values for the number of working hours, the load factor and the mechanical power. For a level 2 evaluation effort the total gross energy savings should result from a summation over the total gross energy savings estimated per power range and end-use. It may be worth mentioning that a pure

EMEEES level 1 evaluation may be performed only in case the EEI facilitating measure being evaluated addresses only one of the motor application types listed in figure 3 or in case the EEI facilitating measure addresses different motor application types and the information about the number of EEI actions implemented for each motor application type is collected. In case such information were not collected the motor application type mix should be somehow estimated according to a level 2 evaluation effort and the EMEEES evaluation effort being considered would be a combination of levels 1 and 2.

Deemed estimates performed under the Italian TWC scheme for energy efficient motor installation are based on a calculation formula that is identical to the one proposed by the EMEEES case application for the level 1 evaluation effort of unitary gross energy savings (see figure 1). Nevertheless under the Italian TWC scheme the energy savings are estimated in terms of primary energy and not in terms of final energy saved, the values considered for η_{old} and η_{new} correspond to the EFF2 and EFF1 efficiency values as defined under the CEMEP European motor manufacturer voluntary agreement in the power ranges of interest and not to the IE1, IE2 or IE3 efficiency values as defined under the norm IEC 60034-30⁵. Moreover the Italian TWC scheme method refers to the industry sector only whereas the EMEEES case application aims at covering both the industry and tertiary sector. No further constraints to the applicability of the Italian method is indicated in the AEEG calculation technical sheet besides the certification requirement according to the EN 60034/2 for the motor efficiency at full and $\frac{3}{4}$ of the load. In the table 1 below the default values considered under the Italian TWC scheme for the efficiency improvement factor in different power ranges are reported.

Mechanical power range (KW)	$\left(\frac{1}{\eta_{old}} - \frac{1}{\eta_{new}}\right)$
$P \leq 1,5$	9,5%
$1,5 < P \leq 3$	6,5%
$3 < P \leq 5,5$	4,5%
$5,5 < P \leq 11$	3,2%
$11 < P \leq 22$	2,5%
$22 < P \leq 45$	1,6%
$P > 45$	1,2%

Table 1: default values considered under the Italian TWC scheme for the efficiency improvement factor included in the formula reported in figure 1⁶

⁵ Notice however that IE1 and IE2 values equal CEMEP Eff2 and Eff1 values for 50 Hz motors.

⁶ The efficiency improvement factors listed in table 1 are calculated by considering the minimum value of

Under such scheme deemed estimates for specific gross savings (SGS) attributable to the installation of an energy efficient motor with mechanical power P are performed for the power ranges listed in the table 1 above by assuming a 0.75 load factor for all motor types installed⁷ and different motor use intensity values. SGS estimated values are listed in the table 2 reported below.

Electric power = P

Load factor = 0,75 for all motor types

Specific gross savings = SGS

Operating hours = different default values according to estimated use intensity

Unitary gross savings = SGS*P

	SGS= Specific gross savings (kWh/year/KW)						
Activity typology	P<1,5	1,5 < P < 3	3 < P < 5,5	5,5 < P < 11	11 < P < 22	22 < P < 45	22 < P < 45
Industrial – 1 shift	142,5	97,5	67,5	48	37,5	24	18
Industrial – 2 shifts	285	195	135	96	75	48	36
Industrial – 3 shifts	547,2	374,4	259,2	184,3	144,0	92,2	69,1
Industrial –seasonal	153,9	105,3	72,9	51,84	40,5	25,92	19,44
1 shift:	8 hours/day; 2000 hours/year						
2 shifts:	16 hours/day; 4000 hours/year						
3 shifts:	24 hours/dav: 7680 hours/year						
Seasonal:	24 hours/dav for three months per year: 2160 hours/year						

Table 2: deemed estimates of specific gross savings (SGS) for different motor power ranges and use intensities applied under the Italian TWC scheme.

The above estimates are performed by using the CEMEP efficiency values adopted at the European level and a default value for the load factor that may be assumed to be an

($1/\eta_{old} - 1/\eta_{new}$) among the possible CEMEP values in a given power range.

⁷ Notice also that the load factors considered under the EMEEES case application (see figure 3) are all well below the default value of 0,75 used under the Italian TWC scheme method.

average value representative of the Italian motor stock. These data together with the mechanical power P and the intensity use (i.e. the number of annual operating hours) of the specific energy efficient motor installed allow calculating unitary annual gross energy savings attributable to the EEI action being evaluated. It may hence be assumed that the Italian evaluation method is a combination of level 1, 2 and 3 evaluation efforts.

EMEEES level 1 default values have been compared to the Italian TWC scheme deemed estimates in the three power ranges considered in the EMEEES case application (see figure 3). This has been done by estimating the maximum and minimum value of the unitary specific gross savings according to the EMEEES method and the TWC scheme method in each of these three power ranges in case of class IE2 energy efficient motors installed in the industry sector. Such values have been calculated by assuming that motor annual operating hours were above 4000 (see EMEEES general specifications) and by considering the minimum value of the motor efficiency improvement factor ($1/\eta_{old} - 1/\eta_{new}$) in each power range⁸. Whereas for the EMEEES method the minimum and maximum values of the unitary specific gross savings (SGS) in each power range have been calculated over the different motor application types as well as over the variations of the load factor and the number of operating hours (see figure 3), for the TWC scheme method the variations of the unitary SGS were only due to the different number of operating hours that may be considered in each power range. Calculation outcomes are summarised in the figure 4 below reporting SGS variations resulting from the estimates of the SGS maximum and minimum value according to the EMEEES method and the TWC scheme method in each power range.

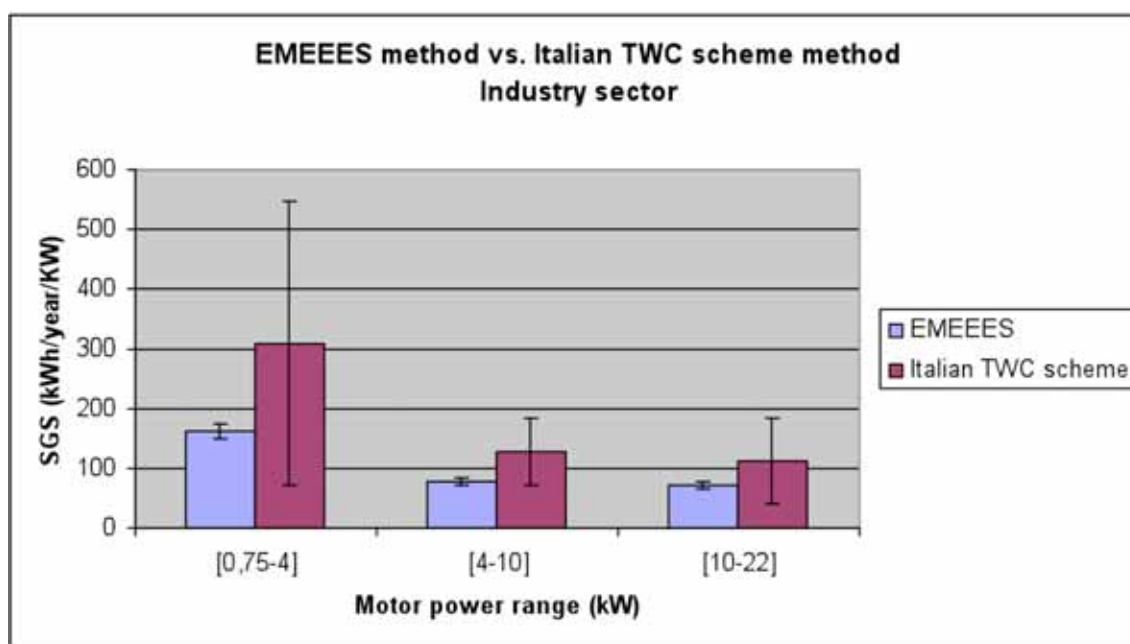


Figure 4: SGS variations in each of the motor power ranges considered by the EMEEES method as resulting from the estimates of the SGS maximum and minimum value performed according to the

⁸ Norm IEC 60034-30 efficiencies have been considered to estimate EMEEES specific gross savings, whereas CEMEP efficiencies have been used to calculate TWC scheme specific gross savings.

EMEEES method and the TWC scheme method.

The above graphic indicates that EMEEES level 1 default values may not always be very conservative with respect to the values provided by the Italian TWC scheme method.

It might be worth noticing that the comparison could not be performed for motor powers above 22 KW because the EMEEES case application does not provide level 1 default values for the energy savings generated by energy efficient motors with mechanical power above this value.

Step 3

Energy efficiency of electric motors is not yet sufficiently considered in the Italian industry sector, this implying that free-riders and multiplier effects are likely to be negligible for any EEI facilitating measure addressing this technology (including white certificates).

Technical interactions with EEI actions addressing variable speed drives might exist. Such interactions are not taken into account under the TWC scheme. Moreover information available does not allow to verify whether the EMEEES recommendation of reducing the energy savings attributed to energy efficient motor installation by a percentage ranging between 15% and 35% (depending on the motor application type) in case VSDs are also installed is reasonable or not in Italy.

Double counting may be in principle a major issue in Italy because a tax deduction amounting to 20% of the energy efficient motor sale prize is granted by the budget law to each natural or legal person installing these solutions. Presently no central database or registry allowing tracking which energy efficient motor installations implemented under the TWC scheme have been also granted a tax deduction is in place in Italy. In case the EMEEES method should be applied to estimate energy savings attributable to the TWC scheme only, this information would be necessary and its gathering would imply some costs for the government bodies in charge of granting the tax deduction and monitoring and verifying the energy savings yielded by the TWC scheme. However it is likely that in Italy the contribution of energy efficient motor installations to the achievement of the ESD target will be estimated by calculating the impact of the whole package of EEI facilitating measures addressing this technology. If this will be the case double counting will not be an issue.

Step 4

A life time of 5 years is assumed for energy savings yielded by energy efficient motor installation under the Italian TWC scheme, such an assumption representing a marked underestimation of the real energy efficient motor average lifetime. In Italy, a white certificate amount that is proportional to the energy savings yielded is issued yearly, while the savings are being generated by the installed energy efficient solutions (i.e. at the end of each year a number of certificates that is proportional to the energy savings generated in the year are issued). It may be argued that for the sake of simplicity, Italian policy makers preferred to assume a shorter energy efficient solution lifetime and a same amount of savings generated each year during this lifetime instead of applying a discount factor (as presently done under other white certificate schemes in place in Europe to take efficient solution performance degradation into account). The application of a discount

factor would have indeed implied that the number of yearly issued certificates would not remain constant.

The EMEEES method recommends to consider an 8 year lifetime and points out that this is a conservative estimate. EEI actions implemented as of 2009 might be considered for the achievement of the 2016 ESD target in case the EMEEES lifetime would be assumed, whereas only EEI actions implemented as of 2012 might be counted for the achievement of such target in case the Italian TWC scheme would be assumed.

1.4 Methodology test on early actions and additionality issues

Given the lifetime considered for energy efficient motors early actions do not represent an issue. Additionality is likely to be an issue because of the tax deduction in place in Italy, but not because of the presence of a copious amount of free riders that would install energy efficient motors even without exploiting the incentive of some EEI facilitating measure. It might be worth mentioning that only 12 energy efficiency projects⁹ addressing energy efficient motors were implemented and certified by the TWC scheme evaluation method being considered for the present pilot test between May 2005 and May 2008.

1.5 Method comparison and interactions with already existing evaluation methods

The comparison between the EMEEES case application on energy efficient motors and the corresponding Italian TWC scheme method has been the subject of the previous report sections. In general the two methods look quite consistent, although EMEEES level 1 default values are likely not to be as conservative as they should in order to stimulate level 2 or level 3 evaluation efforts. Assumptions about lifetimes may make a substantial difference in case policy makers would have to decide whether to use the EMEEES method or the TWC scheme method to estimate the contribution of energy efficient motor installation to the achievement of the ESD saving targets. Considering tighter power range spans would have probably contributed to make the EMEEES level 1 default values more accurate (only three power ranges have been considered below 22 KW, whereas the TWC scheme method is based on a tighter segmentation and considers five power intervals under 22 KW). On the contrary the different EMEEES L1 default values provided for the load factors appear very useful and might contribute to make estimates on energy savings derived from EMEEES method application more reliable than TWC scheme estimates. The specification for EMEEES method application on operating hours seems too tight, especially in the tertiary sector where a number of operating hours over 4000/year is unlikely to be reached. Finally it may be worth noticing that the energy saving unit of measure is primary energy under the Italian TWC scheme and that in Italy it is presently assumed that 1 kWh of electricity corresponds to 2.17 kWh of primary energy¹⁰. In case the electricity savings were reported at the ESD electricity factor of 2.5, the electricity

⁹ 282 white certificates corresponding to about 1.28 GWh of energy saved were issued because of these projects (see "Terzo rapporto annuale sul meccanismo dei titoli di efficienza energetica; situazione al 31 maggio 2008" published by the AEEG on October 2008). On the other hand the 2016 ESD target for Italy correspond to 118,464 GWh.

¹⁰ This is the conversion factor used to estimate the TWC scheme method unitary SGS maximum and minimum values represented in figure 4. Notice that this conversion factor is going to be updated by the AEEG.

savings claimed for the ESD target achievement by Italy would be increased by $(2.5/2.17-1)=13\%$.

1.6 Evaluation of costs related to method application¹¹

Estimating the costs related to the application of the EMEEES method under the Italian white certificate scheme is not an easy task. Hereunder the main cost types are listed for various evaluation effort levels and some indications about how the amount of such cost types may be assessed are provided. The EMEEES case application tested can be perfectly integrated into the Italian TWC scheme whose deemed estimates for energy efficient motors, as already mentioned, can be considered as a combination of level 1, 2 and 3 evaluation efforts. While analyzing the main cost types only the cases in which a) a combination of EMEEES level 1, 2 and 3 or b) a combination of levels 1 and 2 or c) a pure EMEEES level 1 is applied will be hence considered. The case a) will correspond to the application of the TWC scheme already in place in Italy whereas, as mentioned in section 1.3, the cases b) and c) will correspond respectively to the application of the EMEEES level 1 default values reported in figures 2 and 3 to evaluate EEI actions representing the installation of a given mix of energy efficient motor application types (case b) and the installation of a specific energy efficient motor application type (case c). The application of a pure level 2 or of a pure level 3 case seems quite unlikely as a pure level 2 case would probably result too inaccurate while a pure level 3 case is too costly. Therefore these cases will not be analysed.

Basically two types of costs have to be considered when assessing the evaluation costs of the Italian TWC scheme (i.e. a combination of level 1,2 and 3 EMEEES evaluation efforts, see the case a mentioned above):

1) Direct costs linked to the TWC scheme, including:

i) costs of getting the certificates registered:

- fees to submit files to the official TWC registry (fixed by law)
- internal costs for the obliged (or other eligible) actors to prepare the files before submissions (data gathering, quality control...);
- costs for the public regulator (i.e. the AEEG) to check the files submitted by the obliged (or eligible) actors¹², and to monitor the whole scheme.
- costs for the obliged (or eligible) actors to submit the requested files

ii) costs of developing the accounting system:

¹¹ The concepts illustrated in this section have been mostly taken from the EMEEES pilot test report produced for the white certificate scheme in place in France and have been adapted to the Italian context and to the information available for this country (see "National report from the pilot tests of Case application 2 -Residential building envelope improvement - and Case application 4 -Residential condensing boilers in space heating - performed under the French White Certificates Scheme" by Jean-Sébastien Broc, Dominique Osso, Luc Bodineau, Jérôme Adnot, Paul Baudry, Didier Bosseboeuf, Hervé Lefebvre)

¹² It has been estimated that both the costs for the public regulator to check the files submitted by the obliged (or eligible) actors and the costs born by these actors to submit their files correspond (in terms of working hours) to about half a work day.

- the TWC calculation technical sheets are typically developed by AEEG and possible subcontracted experts. Such sheets then undergo a consultation process in which scientific experts and the main stakeholders involved (e.g. ESCOs, gas and electricity distributors, industry manufacturers, etc.) are invited to participate.

2) Indirect costs including:

- actual costs of already available level 2 data (mainly for market analyses and recurring studies e.g. on use intensity, base line definitions, etc.).

Today, there has not yet been any official costs' assessment about the Italian TWC monitoring and verification system.

Looking at the calculation technical sheets, two types of costs related to their development can typically be distinguished: "hard costs" (surveys, campaigns, studies) and "soft costs" (work specially dedicated to develop the calculation technical sheets):

- For the first ones, we can observe that few additional studies have been implemented in order to set up a specific standardised action. In fact, actors typically use data available before TWC scheme implementation. Indeed, available data on an equipment or an action (e.g., market, energy savings campaign, potential) is a key issue to decide if it's worth to attempt standardising this action (i.e. defining its calculation technical sheet). Therefore so far, the direct "hard costs" are probably low, but part of the initial costs of these reference data should be taken into account as indirect costs.

- The "soft costs" might represent the essential development costs for the first period (2005-2009) of TWC scheme implementation. It is quite difficult to exactly quantify the effort of each actor involved in the process (because of wide spread costs), but we can give the following first assessments:

- 1) The AEEG, which is specifically in charge of defining standardised actions and calculation forms, bears a global effort through the participation of its members.
- 2) The working time necessary to develop a new TWC calculation technical sheet can be assessed between 20 and 50 hours on average (21 calculation technical sheet have been validated so far).

Concerning the indirect costs for recurrent studies (used as sources either for defining standardised actions, or for monitoring energy efficiency markets), the total costs, as already mentioned, should not be attributed only to the TWC scheme and sensibly depend on the specific study being considered.

If cases *b* and *c* above mentioned would be applied the evaluation costs would probably be lower. With respect to the case *a*, the direct costs of developing the participant specific accounting system and the technical calculation sheets should indeed not be considered, whereas indirect costs to collect level 2 information about the efficient motor application type mix installed should be considered only for the case *b* application.

1.7 Target group perspective

As already mentioned (see section 1.1), the document illustrating the EMEEES case application has been submitted to Antonio Capozza (CESI Ricerca), Emanuele Regalini (AEEG) and Alessandro Pascucci (ESCO Italia). Then a questionnaire addressing the

aspects considered for the test has been prepared and submitted to these persons during phone interviews held once they had read the EMEEES case application report submitted. In general the EMEEES case application was judged quite detailed and applicable under the Italian TWC scheme by the interviewees. They indicated double counting due to the tax deduction scheme in place in Italy as a potential issue, whereas free-riders and multiplier effects were judged negligible for the present case application. Different level 1 default values provided for the load factors have been judged very useful and potentially contributing to make estimates on energy savings derived from the EMEEES method application more reliable than those derived from the Italian TWC scheme application. Some perplexities have been expressed about the specification related to EMEEES method applicability, as the threshold of 4000 annual operating hours posed for EMEEES method applicability seems too high, especially in the tertiary sector. Moreover it has been pointed out that providing only unitary specific gross savings (instead of operating hours, load factors and efficiency values) as level 1 default values for each motor application type and power range would make national evaluators' calculation tasks simpler.

1.8 Specific conclusions

First of all it has to be considered that only 12 energy efficiency projects addressing energy efficient motors have been implemented under the Italian TWC scheme between May 2005 and may 2008. These data alone indicate how scarce the statistical data potentially available to verify the accuracy and the applicability of the EMEEES method are. The pilot tests were however mainly based on a confrontation on the paper between the EMEEES method and the corresponding deemed estimates of the unitary energy savings provided under the Italian TWC scheme and on interviews with stakeholders responsible for the development of the Italian TWC scheme methodologies or in charge of using such methodologies in order to submit to the Italian TWC scheme regulator the information necessary to get the number of certificates corresponding to the energy saving amount calculated.

Pilot test outcomes indicate that the EMEEES level 1 default values may not be very conservative for all motor application types. This implies that such values may not always represent an incentive to apply a level 2 or a level 3 evaluation effort. However the different level 1 default values estimated for the load factors of different motor application types and power range are very useful and may contribute to make estimates on energy savings derived from the EMEEES method application more reliable than those derived from the Italian TWC scheme method where a single default value of 0.75 for the load factors of all the possible motor application types and power ranges is assumed. It has also to be noticed that EMEEES level 1 default values for operating hours and load factors are presently provided only for power ranges up to 22 kW. In case reference data for higher power ranges were missing, a level 2 or a level 3 evaluation effort should be suggested or conservative level 1 default values should be provided for all application types with powers > 22 kW. As far as the indications provided by the EMEEES method for the level 2 and level 3 evaluation efforts are concerned, such indications look useful and sufficiently accurate. Also indications provided for the gross-to-net energy saving correction factors look accurate, although, except double counting and maybe technical interactions with VSD installations, such corrections are likely to be negligible in Italy.

Concerning lifetimes, a life time of 5 years is assumed for energy savings yielded by

energy efficient motor installation under the Italian TWC scheme, such an assumption representing a marked underestimation of the real energy efficient motor lifetime. The EMEEES method recommends to consider an 8 year lifetime and points out that this is a conservative estimate. EEI actions implemented as of 2009 might be considered for the achievement of the 2016 ESD target in case the EMEEES lifetime would be assumed, whereas only EEI actions implemented as of 2012 might be counted for the achievement of such target in case the Italian TWC scheme would be assumed.

Finally it may be worth noticing that the energy saving unit of measure is primary energy under the Italian TWC scheme and that in Italy it is presently assumed that 1 kWh of electricity corresponds to 2.17 kWh of primary energy. In case the electricity savings were reported at the ESD electricity factor of 2.5, the electricity savings claimed for the ESD target achievement by Italy would be increased by $(2.5/2.17-1)=13\%$.

1.9 General conclusions

Almost all the assumptions and hypotheses made in the EMEEES methodology are clearly justified and understandable. The EMEEES methodology does not indicate which among the different values of $(1/\eta_{old} - 1/\eta_{new})$ that is possible to calculate based on the information listed in figure 2 has to be considered for estimating the energy savings in each of the power ranges listed in figure 3. Based also on the approach adopted under the Italian TWC scheme it is recommended that the *minimum value* of $(1/\eta_{old} - 1/\eta_{new})$ in a given power range is used to estimate the energy savings yielded by the installation of an energy efficient motor whose power falls in that given range. Moreover it has also to be noticed that EMEEES level 1 default values for operating hours and load factors are presently provided only for power ranges up to 22 kW. In case reference data for higher power ranges were missing, it is recommended that a level 2 or a level 3 evaluation effort is suggested or conservative level 1 default values for all application types with powers > 22 kW are provided.

Concerning EMEEES method usability it has to be pointed out that providing only Specific Gross Savings (instead of operating hours, load factors and efficiency values) as level 1 default values for each application type and power range would make national evaluator calculation tasks simpler.

Concerning EMEEES method accuracy, the most important parameters affecting energy savings were identified in the case application produced. However providing a single level 1 default value for the number of operating hours of a given application type in a given power range might be too rough. Suggesting a level 3 evaluation effort whereby one among four default values for the operating hours is selected according to the use intensity of the energy efficient motors installed (as presently done under the Italian TWC scheme - see table 2) may serve to increase EMEEES method accuracy.

Concerning the consistency of the EMEEES method level 1 default values with the corresponding values estimated under the Italian TWC scheme, the results shown in the figure n. 4 indicate that the TWC scheme method values may be well below the EMEEES default values in some cases.

Concerning the costs implied by the application of the method tested it was not possible to perform quantitative estimates. However there is no reason to assume that these costs are higher than those caused by the development and application of the Italian TWC

scheme method.

The EMEEES method can be easily adapted to the Italian TWC scheme evaluation approach. The adoption of the EMEEES method under the Italian TWC scheme would not be very difficult if most of the potentials for improvement above mentioned and summarized in the following section will be taken into account.

1.10 Needs and potentials for improvement of the method tested

Needs and potentials for improvement of the method tested are listed hereunder.

- The EMEEES methodology does not indicate which among the different values of $(1/\eta_{old} - 1/\eta_{new})$ that is possible to calculate based on the information listed in figure 2 has to be considered for estimating the energy savings in each of the power ranges listed in figure 3. Based also on the approach adopted under the Italian TWC scheme it is recommended that the *minimum value* of $(1/\eta_{old} - 1/\eta_{new})$ in a given power range is used to estimate the energy savings yielded by the installation of an energy efficient motor whose power falls in that given range.
- EMEEES level 1 default values for operating hours and load factors are presently provided only for power ranges up to 22 kW. In case reference data for higher power ranges were missing, it is recommended that a level 2 or a level 3 evaluation effort is suggested or conservative level 1 default values for all application types with powers > 22 kW are provided.
- Providing only Specific Gross Savings (instead of operating hours, load factors and efficiency values) as level 1 default values for each application type and power range would make national evaluator calculation tasks simpler. However, the power range would need to be much narrower in this case than in the present EMEEES case application.
- Providing a single level 1 default value for the number of operating hours of a given application type in a given power range might be too rough. Suggesting a level 3 evaluation effort whereby one among four default values for the operating hours is selected according to the use intensity of the energy efficient motors installed (as presently done under the Italian TWC scheme - see table 2) may serve to increase EMEEES method accuracy
- The specification for EMEEES method application on operating hours seems too tight, especially in the tertiary sector where a number of operating hours over 4000/year is unlikely to be reached.

2. EMEEES case application n. 13: Variable Speed Drives

2.1 Testing activity description

As done with the case application on energy efficient motors, the EMEEES case application on variable speed drives has been compared with the corresponding TWC evaluation method that the AEEG has developed after consultations with the main stakeholders involved in the implementation, monitoring and evaluation of EEI actions addressing this technology (see Delibera 111/04, scheda tecnica n.09 and Delibera 70/05, scheda tecnica n. 16). General specifications and assumptions of the two methods have been compared and the EMEEES level 1 default values have been confronted with the deemed estimates provided by the calculation technical sheets developed by the AEEG for VSDs. The document illustrating the EMEEES case application has been submitted to Antonio Capozza (CESI Ricerca) and Emanuele Regalini (AEEG). A questionnaire addressing the aspects considered for the test has been prepared and submitted to these persons during phone interviews held once they had read the EMEEES case application report. The EMEEES case application on VSDs has been also discussed during the Italian EMEEES workshop organised on January 2008¹³. As explained in the next report sections the existing Italian TWC scheme method on VSDs refers only to a specific VSD application type (i.e. VSDs used for water pumping systems). Unfortunately the information available did not allow testing the EMEEES method under application types other than water pumping systems and mainly consisted in a comparison between the EMEEES method and the Italian TWC scheme evaluation method developed for VSDs installed on such systems.

2.2 Main data sources used for the pilot test

Data used for the pilot test were those related to the assumptions and the default values considered for the deemed estimates of the energy savings yielded by VSD installation as reported in the AEEG calculation technical sheets. Such information were found in the final versions of the consultation documents¹⁴ which the deemed estimates reported in the calculation technical sheets are based upon. Additional data sources are represented by the information provided by the interviewees and the participants in the Italian EMEEES workshop organised.

2.3 Test of methodology application step by step

In the following the EMEEES case application is illustrated step by step and a comparison with the corresponding evaluation method developed under the Italian TWC scheme is presented.

¹³ See "Report on national workshops – Italy" produced by eERG in the framework of the EMEEES project, January 31, 2008

¹⁴ See in particular "Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all'articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001" ; January 16, 2003

Step 1 and step 2

The EMEEES formulas proposed for the calculation of level 1 and level 3 unitary and total annual gross energy savings (step 1 and step 2 of the EMEEES methodology) are reported in the figure 5 below.

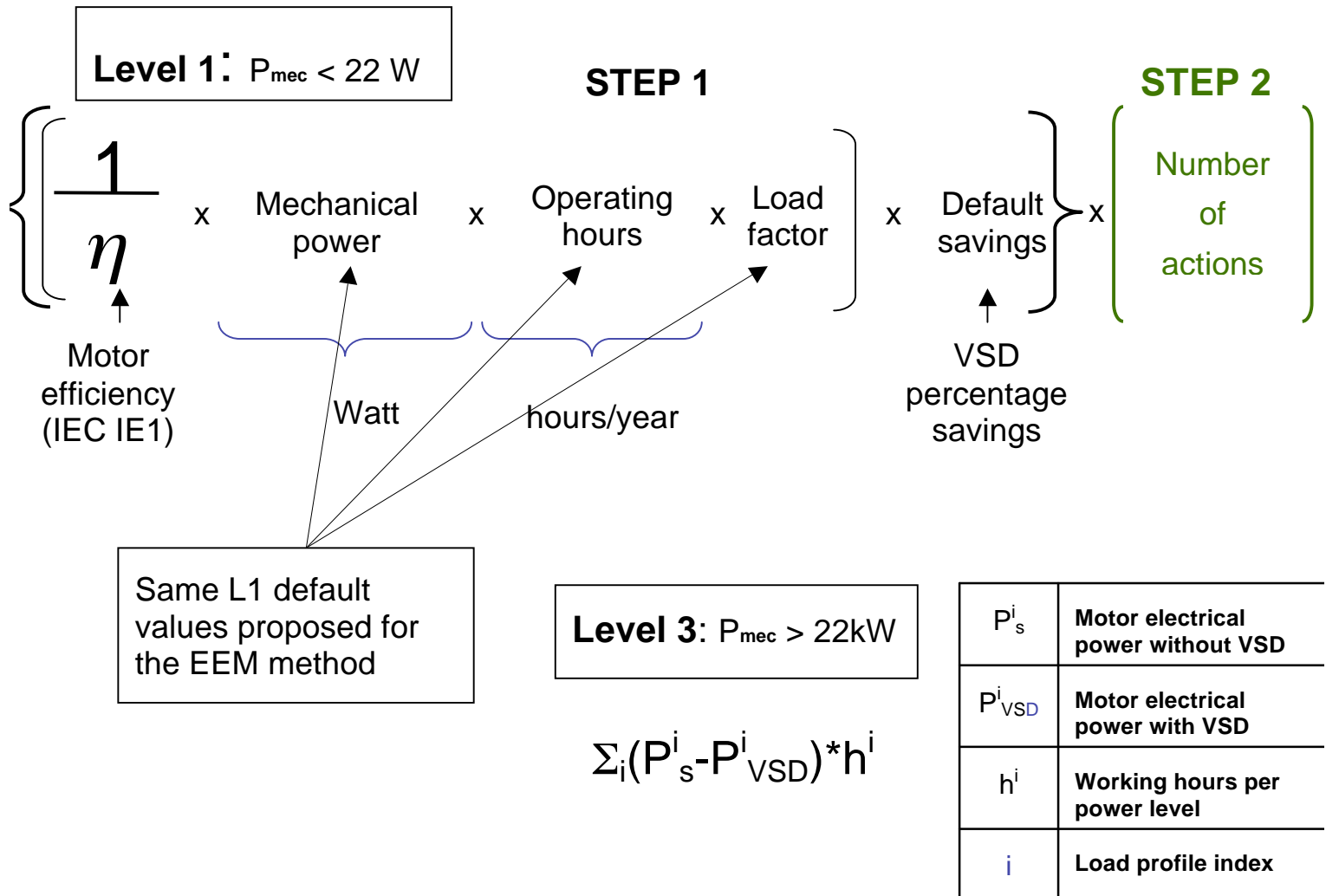


Figure 5: EMEEES Level 1 and level 3 formulas for the calculation of unitary and total gross annual energy savings for VSDs

The EMEEES default values to be used for the motor efficiency η included in the level 1 calculation formula above are supposed to be those of the IE1 energy efficiency class of the norm IEC 60034-30 and are reported in the figure 2 above. The Level 1 default values to be considered for the other parameters included in the level 1 formula (excepting the default savings for VSDs) are based on existing SAVE studies and are the same proposed for the EMEEES case application on energy efficient motors reported in the figure 3. A level 1 evaluation effort is proposed only for VSDs mounted on energy efficient motors with mechanical power below 22 kW, whereas a level 3 evaluation effort is recommended

for mechanical power above 22 kW.

Level 1 default values to be considered for the VSD percentage savings are reported in the table 3 below for different motor application types. These represent conservative estimates with respect to the corresponding values reported in the SAVE study mentioned as a reference in the EMEEES case application report. Although the EMEEES method is proposed for a variety of motor application types, the EMEEES case application report strangely mentions that the baseline to be considered should always be norm IEC 60034-30 IE1 motors with throttle control.

End use	Average* VSD savings (%)
Pumps	28
Fans	28
Air compressors	12
Cooling compressors	12
Conveyors	12
Other motors	12

Table 3: EMEEES Level 1 default values proposed for the VSD percentage savings for different motor application types.

The EMEEES case application is proposed for EEI actions implemented in the industry and in the tertiary sectors and referring to motors running over 20% of the rated power most of the time and operating for more than 2000 hours per year. The energy performances of the motors are supposed to be classified according to the norm IEC 60034-30, whereas variable speed drives installed on these motors are supposed to fulfill the CEI EN 61800-2 (Part 2) on general prescriptions and general specifications of VSDs.

According to the EMEEES case application the data to be collected in case of a level 2 evaluation effort should relate to national statistics and sales data about motor market segmentation per power range and end-use plus average values for the number of working hours, for their load factors and mechanical power and for percentage VSD savings. For a level 2 evaluation effort the total gross energy savings should result from a summation over the total gross energy savings estimated per power range and end-use. It may be worth mentioning that a pure EMEEES level 1 evaluation may be performed only in case the EEI facilitating measure being evaluated addresses only one of the motor application types listed in figure 3 or in case the EEI facilitating measure addresses different motor application types and the information about the number of EEI actions

implemented for each motor application type is collected. In case such information were not collected the motor application type mix should be somehow estimated according to a level 2 evaluation effort and the EMEEES evaluation effort being considered would be a combination of levels 1 and 2.

Deemed estimates performed under the Italian TWC scheme for VSD installation refer to specific VSD application, i.e. VSD installation on electric motors for water pumping systems used in the industry and tertiary sectors. Such estimates are performed only for pumps with electric power between 4 and 22 KW by assuming that the “before” situation is represented by an on-off asynchronous system whereby a tank S is filled by a standard electric pump asynchronously with respect to the load demand in such a way that the pump may work at a constant flow rate and at a constant speed while filling the tank whereas the tank hydraulic capacity may serve to fulfill the variable demand (see figure 6 below). This represents a conservative assumption about the before situation as another solution often adopted to fulfill the variable load demand in a water circuit where a standard electric pump is installed is represented by the application of a throttle valve determining a variable hydraulic resistance and a consequent dissipation of part of the energy generated by the constant speed pump¹⁵.

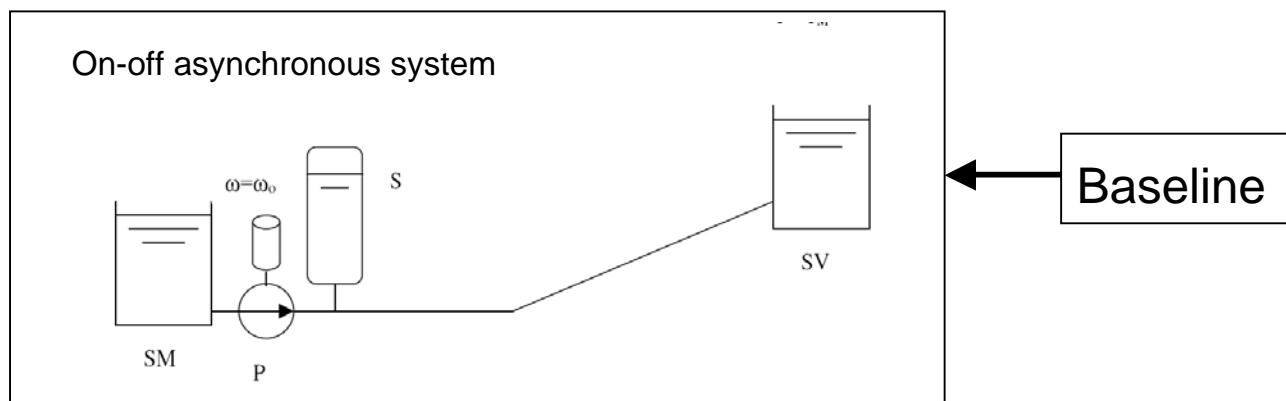


Figure 6: Baseline considered under the TWC scheme for the deemed estimate of the energy savings attributable to VSDs installed on water pumping systems.

In case of pumps with electric power above 22 KW the same EMEEES level 3 calculation approach recommended for motors with mechanical power above 22 kW is proposed under the Italian TWC scheme (see figure 5) to estimate the energy savings.

The general specifications considered under the Italian TWC scheme method relate to the

¹⁵ According to the industrial manufacturer association ANIMA, in 30% of the water pumping systems presently installed in Italy the water flow is regulated by a throttle valve, in 50% the water flow is regulated by an on-off asynchronous system as the one just described, whereas in 10% a VSD is installed (other solutions are adopted in the remaining 10%) – See “Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all’articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001” ; January 16, 2003

fulfillment of the CEI EN 61800-2 on general prescription and nominal specifications of VSDs (Part 2), the CEI EN 61800-4 on general prescription and nominal specifications of VSDs (Part 4), the CEI EN 60034-1 on rotating electrical machines (Part 1) for motors with electric power below 22 kW. The Italian TWC scheme method also mentions that VSD efficiency, as defined by norm CEI EN 61800-2, must be over 90%, although a proper standard for testing VSD efficiency does not yet exist. In case of VSDs mounted on motors with electric power over 22 kW the Italian TWC scheme method general specifications also include the fulfillment of the Norm CEI 13-35 providing guidelines on the applications of the norms for the measurement of electricity consumption and the CEI EN 60359 on the measurement of electric and electronic equipment performances.

Deemed estimates of the unitary specific gross savings (SGS) due to VSD installations on motors with electric power between 4 and 22 kW are summarized in the table 4 below.

	Specific Gross Savings (kWh/year/KW)			
	Static Head (% of nominal head)			
Activity typology	0	20	40	60
Industrial – 1 shift	445	340	236	132
Industrial – 2 shifts	889	681	472	263
Industrial – 3 shifts	1708	1307	906	505
Industrial – seasonal	480	368	255	142
1 shift:	8 hours/day; 2000 hours/year			
2 shifts:	16 hours/day; 4000 hours/year			
3 shifts:	24 hours/day; 7680/hours/year			
Seasonal:	24 hours/day for three months per year; 2160 hours/year			

Electric power = P
Specific gross savings = SGS
Unitary gross savings = SGS*P

Table 4: Deemed estimates of the unitary specific gross savings for different static heads and use intensities for motors with electric power between 4 and 22 kW under the Italian TWC scheme.

The calculation procedure followed by the AEEG to produce the above deemed estimates

is quite complicate and will not be illustrated in this report¹⁶. For the scopes of the present pilot test it will be enough to mention that motors in the CEMEP eff2 efficiency class with load profiles obtained from a European SAVE study¹⁷ have been considered. As both European default values (e.g. motor efficiency class and load profile) and participant specific default values (i.e. number of motor operating hours and motor electric power) are used in such calculation the Italian TWC scheme method for motors with electric power between 4 and 22 KW may hence be considered as a combination of the EMEEES level 1 and level 3 evaluation efforts. It might be worth mentioning that 20 energy efficiency projects¹⁸ addressing VSDs installed on motors with electric power below 22 KW and 88 energy efficiency projects¹⁹ addressing VSDs installed on motors with electric power above 22 KW were implemented and certified by the TWC scheme evaluation method being considered for the present pilot test between May 2005 and May 2008.

EMEEES level 1 default values could be compared to the Italian TWC scheme deemed estimates in only two out the three pump mechanical power ranges considered in the EMEEES case application (see figure 3). Indeed the Italian TWC scheme deemed estimates only relate to the electric power range between 4 and 22 kW, this implying that even if the EMEEES method may be applied for the electric power range between 0.75 and 4 KW, this power range cannot be considered for the comparison.

Such comparison has been performed by estimating the maximum and minimum value of the unitary specific gross savings according to the EMEEES method and the TWC scheme method in each of these two power ranges (i.e. between 4 and 10 KW and between 10 and 22 KW). For the calculation of the EMEEES default values IEC 60034-30 energy efficiency class IE1 pumps have been considered. Whereas for the EMEEES method the minimum and maximum values of the unitary specific gross savings (SGS) in each power range have been calculated over the variations of the load factor and the number of operating hours (see figure 3), for the TWC scheme method the variations of the unitary SGS were due to the different number of operating hours and the different static heads (see table 4) that may be considered in each mechanical power range. Calculation outcomes are summarised in the figure 7 below reporting SGS variations resulting from the estimates of the SGS maximum and minimum value according to the EMEEES method and the TWC scheme method in each of the two power ranges.

¹⁶ For more information see "Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all'articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001" ; January 16, 2003.

¹⁷ See the SAVE study "VSDs for Electric Motor Systems" , European Commission, DG TREN, SAVE II Programme, 2000 - ISR-University of Coimbra

¹⁸ 1471 white certificates corresponding to about 6.69 GWh of energy saved were issued because of these projects (see "Terzo rapporto annuale sul meccanismo dei titoli di efficienza energetica; situazione al 31 maggio 2008" published by the AEEG on October 2008).

¹⁹ 6402 white certificates corresponding to about 29.10 GWh of energy saved were issued because of these projects (see "Terzo rapporto annuale sul meccanismo dei titoli di efficienza energetica; situazione al 31 maggio 2008" published by the AEEG on October 2008). On the other hand the 2016 ESD target for Italy correspond to 118,464 GWh

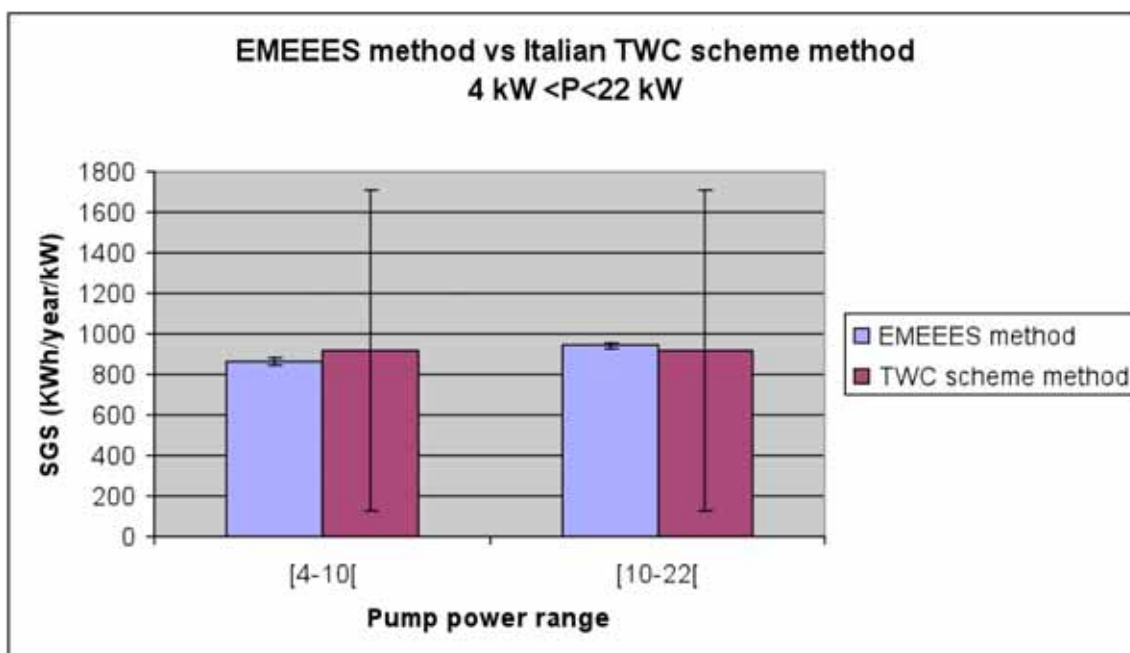


Figure 7: SGS variations in two motor mechanical power ranges considered by the EMEEES method as resulting from the estimates of the SGS maximum and minimum value performed according to the EMEEES and the Italian TWC scheme calculation methods.

The above graphic indicates that EMEEES level 1 default values may be substantially different and not always conservative with respect to the values provided by the Italian TWC scheme method.

Step 3

In principle multiplier effects may be relevant in those EU countries where VSD market penetration is not high. However VSD technology may not be considered very innovative and multiplier effects are hence likely to be rather low in several EU countries. On the contrary free riders may be relevant for this same reason. The EMEEES case application report mentions that VSDs are mostly used to decrease noise levels as well as in material handling applications for process control to improve performances and ensure the correct mean time between failures (in particular in the power range between 0.75 and 4 KW). In Italy free riders for the specific VSD application considered under the Italian TWC are estimated to be around 10%²⁰.

Technical interactions with EEI actions addressing energy efficient motors might exist. Such interactions are not taken into account under the TWC scheme. Moreover information available do not allow to verify whether the EMEEES recommendation of reducing the energy savings attributed to VSD by a percentage ranging between 1% and 1.5% in case energy efficient motors are also installed is reasonable or not in Italy.

Double counting may be in principle a major issue in Italy because a tax deduction

²⁰ See the information reported in the note n.15.

amounting to 20% of the VSD sale price is granted by the budget law to each or legal person installing VSD on motors with electric power between 7.5 and 90 kW. Presently no central database or registry allowing tracking which VSD installations implemented under the TWC scheme have been also granted a tax deduction is in place in Italy. In case the EMEEES method should be applied to estimate energy savings attributable to the TWC scheme only, this information would be necessary and its gathering would imply some costs for the government bodies in charge of granting the tax deduction and monitoring and verifying the energy savings yielded by the TWC scheme. However it is likely that in Italy the contribution of VSD installations to the achievement of the ESD target will be estimated by calculating the impact of the whole package of EEI facilitating measures addressing this technology. If this will be the case double counting will not be an issue.

Step 4

A life time of 5 years is assumed for energy savings yielded by VSD installation under the Italian TWC scheme, such an assumption representing a marked underestimation of the real VSD average lifetime probably motivated by the reasons already expressed for the other case applications described so far.

The EMEEES method recommends to consider an 8 year lifetime and points out that this is conservative estimate. EEI actions implemented as of 2009 might be considered for the achievement of the 2016 ESD target in case the EMEEES lifetime would be assumed, whereas only EEI actions implemented as of 2012 might be counted for the achievement of such target in case the Italian TWC scheme would be assumed.

2.4 Methodology test on early actions and additionality issues

Given the lifetime considered for energy efficient motors early actions do not represent an issue. Additionality is likely to be an issue because of the tax deduction in place in Italy, and because free riders that would install VSDs even without exploiting the incentive of some facilitating measure are estimated to be around 10%. During the pilot tests it was not possible to test the applicability of the methods proposed by the EMEEES case application to estimate the free-ridership.

2.5 Method comparison and interactions with already existing evaluation methods

Whereas the EMEEES method aims at covering a wide range of VSD technological applications, the Italian TWC scheme method is highly specific (VSD for water pumping systems only are considered). The comparison between the EMEEES case application on VSDs installed on water pumps and the corresponding Italian TWC scheme method has been the subject of the previous report chapter sections. In general the two methods look quite consistent, although EMEEES level 1 default values are likely not to be as conservative as they should in order to stimulate level 2 or level 3 evaluation efforts. This also implies that the application of the TWC scheme method might be penalising for Italy with respect to other EU Member States that might decide to use the EMEEES level 1 default values to estimate the contribution of VSD installations to ESD target achievement. Assumptions about lifetimes may make a substantial difference in case policy makers would have to decide whether to use the EMEEES method or the TWC scheme method to

estimate the contribution of VSD installation to the achievement of the ESD saving targets. Also assumptions about baseline seem to be different, as the EMEEES case application report mentions that the baseline to be considered should always be norm IEC 60034-30 IE1 motors with throttle control whereas under the Italian TWC scheme the baseline is represented by an on-off asynchronous system whereby a tank is filled asynchronously with respect to the load demand by a standard electric pump (see section 2.3). Moreover deemed estimates are performed only for pumps with electric power between 4 and 22 KW under the Italian TWC scheme whereas EMEEES level 1 default values are provided also for lower power ranges. Finally the Italian TWC scheme method also mentions that VSD efficiency, as defined by norm CEI EN 61800-2, must be over 90% (although a proper standard for testing VSD efficiency does not yet exist) and, in case of VSDs mounted on motors with electric power over 22 kW, requires also the fulfillment of the Norm CEI 13-35 providing guidelines on the applications of the norms for the measurement of electricity consumption and the CEI EN 60359 on the measurement of electric and electronic equipment performances.

2.6 Evaluation of costs related to method application

The same qualitative considerations made for the costs related to the efficient motor EMEEES method application (see section 1.6) can be referred to the EMEEES method on VSDs. In this case however, the Italian TWC scheme method can be considered as a combination of level 1 and level 3 EMEEES evaluation efforts (see the deemed estimate calculation procedure described in section 2.3). Such method is based on a very detailed and specific calculation procedure that surely cost much more in terms of time spent for its development than the Italian TWC scheme method on energy efficient motors. Nevertheless, although highly specific and more costly in terms of time spent for its development and in terms of time needed for the provision and the collection of the requested level 3 information, the Italian TWC scheme method on VSDs is clearly more accurate than the corresponding level 1 evaluation effort EMEEES method when applied to VSDs mounted on water pumping systems.

Needless to say that EMEEES method application costs would be markedly higher if, besides the case of VSDs for water pumping systems, all the other case applications covered by such method would be implemented under the Italian TWC scheme.

2.7 Target group perspective

As already mentioned (see section 2.1) the document illustrating the EMEEES case application has been submitted to Antonio Capozza (CESI Ricerca) and Emanuele Regalini (AEEG). Then a questionnaire addressing the aspects considered for the test has been prepared and submitted to these persons during phone interviews held once they had read the EMEEES case application report submitted. The EMEEES case application on VSDs has been also discussed during the Italian EMEEES workshop organised on January 2008 (see the report on Italian EMEEES workshop produced by eERG).

In general it has been pointed out that, if probably the EMEEES case application on VSDs aims at covering a too wide range of application types and therefore provides quite rough

level 1 estimates, the corresponding Italian TWC scheme method is probably too specific²¹.

Concerning the comparison between the EMEEES case application on VSDs installed on water pumps and the corresponding Italian TWC scheme method, some interviewees confirmed that EMEEES level 1 default values might not be very conservative and might penalise Italy with respect to other EU Member States. For some interviewees level 1 percentage savings attributed to VSDs installed on pumps and fans seemed to be overestimated, at least when referred to the Italian situation. In Italy a maximum of 26% has been indeed estimated against the 28% reported in the EMEEES methodology²². Moreover the additionality of VSDs installed on conveyors seemed questionable as savings attributable to such actions were judged to probably be negligible.

Concerning free-riders and multiplier effects, whereas the former were judged to be around 10% for VSDs mounted on water pumping systems, the latter were judged to be negligible, as VSDs are quite an old technology in place from several years in most EU Member States.

2.8 Specific conclusions

The pilot tests were mainly based on a confrontation on the paper between the EMEEES method and the corresponding deemed estimates of the unitary energy savings provided under the Italian TWC scheme for VSDs mounted on water pumping systems as well as on interviews with stakeholders responsible for the development of the Italian TWC scheme methodologies.

Pilot test outcomes indicate that the EMEEES level 1 default values may not be very conservative in the motor power ranges considered and may penalise Italy with respect to other MSs who may decide to use them for water pumping systems. The VSD application types covered by the EMEEES method are probably too many and the formula proposed for the calculation of the level 1 default values is consequently too rough. This method seems to confirm the general principle that is better to propose a sufficiently accurate calculation method for a few specific applications than aiming at covering very different applications by too rough energy saving estimates.

Concerning assumptions about the baseline, although the EMEEES method is proposed for a variety of motor application types, the EMEEES case application report strangely mentions that the baseline to be considered should always be norm IEC 60034-30 IE1 motors with throttle control. In case of VSD for water pumping systems such an assumption does not seem to be very conservative, as electricity consumption of water pumping systems with throttle control is higher than in case of on-off asynchronous systems (see the description provided in section 2.3).

As far as the indications provided by the EMEEES method for the level 2 and level 3 evaluation efforts are concerned, such indications look useful and sufficiently accurate. Also indications provided for the gross-to-net energy saving correction factors look accurate, although multiplier effects are likely to be negligible in Italy.

²¹ In this respect the AEEG is currently evaluating the possibility of providing deemed estimates also for VSDs installed on air compressed applications.

²² Information provided by Walter Grattieri (CESI Ricerca)

Concerning lifetimes, a life time of 5 years is assumed for energy savings yielded by VSD installation under the Italian TWC scheme, such an assumption representing a marked underestimation of the real energy efficient motor lifetime. The EMEEES method recommends to consider an 8 year lifetime and points out that this is conservative estimate. EEI actions implemented as of 2009 might be considered for the achievement of the 2016 ESD target in case the EMEEES lifetime would be assumed, whereas only EEI actions implemented as of 2012 might be counted for the achievement of such target in case the Italian TWC scheme would be assumed.

2.9 General conclusions

Almost all the assumptions and hypotheses made in the EMEEES methodology are clearly justified and understandable. The EMEEES methodology does not always clearly distinguish between mechanical and electric power of the motors mounting VSDs (e.g. it is not clarified whether the limit of 22 KW for the application of level 1 default values refers to the mechanical or the electric power and whether the power values corresponding to the different values of the motor efficiencies listed in table 1 and the power ranges for which load factors and operating hours are listed in table 2 represent mechanical or electric power²³). Moreover the case application report strangely mentions that the baseline to be considered should always be CEMEP EFF2 motors with throttle control, whereas the efficiency classes of the norm IEC 60034-30 IE1 is indicated as a reference and not all the VSD application types may be referred to systems with a throttle control.

Concerning EMEEES method usability the fact that the Italian TWC scheme method refers to motor electric powers whereas the EMEEES method level 1 default values reported in tables 1 and 2 and the 22 KW power limit for the applicability of such default values is likely to refer to the mechanical power may determine some confusion.

Concerning EMEEES method accuracy, the VSD application types covered by the EMEEES method are probably too many and the formula proposed for the calculation of the level 1 default values is consequently too rough.

Concerning the consistency of the EMEEES method level 1 default values with the corresponding values estimated under the Italian TWC scheme, the results shown in the figure n. 7 indicate that the TWC scheme method values may be well below the EMEEES default values in some cases.

Concerning the costs implied by the application of the method tested it was not possible to perform quantitative estimates. However it seems quite reasonable to assume that for the application of EMEEES level 1 default values related to water pumping systems below 22 kW these costs are lower than those caused by the development and the application of the Italian TWC scheme method, whereas for motor powers over 22 KW the EMEEES method and the Italian TWC scheme method look practically identical.

As far as energy efficient water pumping systems are concerned, adapting the EMEEES method to the Italian TWC scheme evaluation approach may require some precautions

²³ During the pilot test it has been assumed that such values represent the mechanical power.

with respect to the possibility of using EMEEES level 1 default values. The evaluation method presently adopted under the TWC scheme for such application indeed provides more accurate and appropriate estimates even if only EU default values were used in such estimates. The general approach followed by the AEEG while developing evaluation methods related to VSD applications seems very application specific, in the sense that the methods developed and the underlying assumptions (e.g. about baseline definitions, gross-to-net correction factors, etc.) for the existing and the planned energy saving deemed estimates related to VSD applications depend on the specific VSD application type considered. Level 2 or level 3 evaluation efforts should be hence always be preferred to EMEEES level 1 default values.

2.10 Needs and potentials for improvement of the method tested

Needs and potentials for improvement of the method tested are listed hereunder.

- The EMEEES methodology does not always clearly distinguish between mechanical and electric power of the motors mounting VSDs (e.g. it is not clarified whether the limit of 22 KW for the application of level 1 default values refers to the mechanical or the electric power and whether the power values corresponding to the different values of the motor efficiencies listed in the case application report table 1 and the power ranges for which load factors and operating hours are listed in table 2 represent mechanical or electric power²⁴).
- The EMEEES case application report strangely mentions that the baseline to be considered should always be CEMEP EFF2 motors with throttle control, whereas the efficiency classes of the norm IEC 60034-30 IE1 is indicated as a reference and not all the VSD application types may be referred to systems with a throttle control.
- Requiring the fulfillment of the norm CEI 13-35, providing guidelines on the applications of the norms for the measurement of electricity consumption and the CEI EN 60359 on the measurement of electric and electronic equipment performances as presently done under the corresponding Italian TWC scheme method may serve to assure that real energy savings are generated by EEI actions evaluated.

²⁴ During the pilot test it has been assumed that such values represent the mechanical power.

3. EMEEES case application n. 4: Condensing Boilers in residential space heating

3.1 Testing activity description

As done with the previous case applications considered in this report, the EMEEES case application on condensing boilers has been compared with the corresponding TWC evaluation method that the AEEG has developed after consultations with the main stakeholders involved in the implementation, monitoring and evaluation of EEI actions addressing this technology (see Delibera 234/02, scheda tecnica n. 3). General specifications and assumptions of the two methods have been compared and the EMEEES level 1 default values have been confronted with the deemed estimates provided by the calculation technical sheets developed by the AEEG for **** gas boilers. The document illustrating the EMEEES case application has been submitted to Antonio Capozza and Umberto Ciarniello (CESI Ricerca), Emanuele Regalini (AEEG) and Claudio Palmieri (Hera Modena). A questionnaire addressing the aspects considered for the test has been prepared and submitted to these persons during phone interviews held once they had read the EMEEES case application report. Such persons have been selected and interviewed because CESI Ricerca has been involved together with the AEEG in the development of the technical sheets used under the Italian TWC scheme whereas Hera Modena had implemented EEI actions addressing condensing boilers and used the related TWC technical sheets to get the white certificates issued by the AEEG. The testing activities performed are further illustrated in the report subsections reported below.

3.2 Main data sources used for the pilot test

Data used for the pilot test were those related to the assumptions and the default values considered for the deemed estimates of the energy savings yielded by **** gas boiler installation as reported in the AEEG calculation technical sheets. Such information were found in the final versions of the consultation documents²⁵ which the deemed estimates reported in the calculation technical sheets are based upon. Additional data sources are represented by the information provided by the interviewees.

3.3 Test of methodology application step by step

In the following the EMEEES case application is illustrated step by step and a comparison with the corresponding evaluation method developed under the Italian TWC scheme is presented.

²⁵ See in particular “Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all’articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001” , October 27, 2004

Step 1 and step 2

The EMEEES formula proposed for the calculation of level 1 unitary and total annual gross energy savings (step 1 and step 2 of the EMEEES methodology) is reported in the figure 1 below.

Level 1

STEP 1

$$\left(\frac{1}{\eta_{old}} - \frac{1}{\eta_{new}} \right) \times \text{Heating need (normalised)}$$

\uparrow Replaced boiler \uparrow Condensing boiler
 %_{NCV}

kWh/m²(or dwelling)/year

STEP 2

$$\times \left[\text{Number of actions} \right]$$

m²(or dwelling)

Figure 8: EMEEES Level 1 formula for the calculation of unitary and total gross annual energy savings

EMEEES default values to be used for the inefficient boiler η_{old} are 89% or 82% depending on whether the non efficient market or the non efficient stock is considered for the baseline, whereas the level 1 default value for the heating need is supposed to be 86 kWh/m²/year²⁶. The case applications also envisages the possibility that all the components of the heating system (i.e. boiler, emitters, heat distribution network and control systems) may be substituted with more efficient solutions. The formula below reported is proposed in this case:

$$\Delta E = \left(\frac{1}{\eta_{p,st} \cdot \eta_{e,st} \cdot \eta_{c,st} \cdot \eta_{d,st}} - \frac{1}{\eta_{p,eff} \cdot \eta_{e,eff} \cdot \eta_{c,eff} \cdot \eta_{d,eff}} \right) \cdot E \cdot S$$

- > ΔE = Total gross final energy savings from EEI Action
- > E: useful heat demand for the specific tertiary building and climatic zone (kWh/m²/year): average for level 1 or 2 calculations, building-specific for level 3 calculations
- > S: Heated surface area interested by Action (m²)

²⁶ Such value is supposed to be adapted to each Member States by using adaptation factors calculated on the basis of MS average degree days and listed in the case application report (see table 3 in such report).

- $\eta_{p,eff}$: efficiency of the efficient heat generator
- $\eta_{e,eff}$: efficiency of the efficient emitter system
- $\eta_{c,eff}$: efficiency of the efficient control system
- $\eta_{d,eff}$: efficiency of the efficient distribution system
- $\eta_{p,st}$: efficiency of the standard heat generator
- $\eta_{e,st}$: efficiency of the standard emitter system
- $\eta_{c,st}$: efficiency of the standard control system
- $\eta_{d,st}$: efficiency of the standard distribution system
- $\eta_g = \eta_p \cdot \eta_e \cdot \eta_c \cdot \eta_d$: global efficiency of the heating system

Figure 9: EMEEES general formula proposed for the calculation of unitary gross annual energy savings in case of EEI actions addressing all or some specific heating system components.

The level 1 default values below are proposed for the heating system component efficiencies. Both the case in which the non efficient stock and the non efficient market is assumed as reference baseline are considered.

Efficiencies	“Non efficient” stock values	“Non efficient” market values	“Efficient” values (condensing boilers, radiant panels, etc.)
Boiler	82%	89%	94%
Emitter	92.5%	92.5%	97%
Distribution	93%	93%	97%
Controller	84.8%	84.8%	96.7%

Table 5: EMEEES level 1 default values proposed for heating system component efficiencies either in case the non efficient stock or in case the non efficient market is considered as reference baseline.

As the information available only allowed performing a pilot test mainly consisting in a confrontation of the EMEEES case application with the corresponding Italian TWC scheme method developed, it has only been possible to test those cases in which the only heating system component replaced with a more efficient one is the boiler. For this reason the reference formula that will be considered in the following is that represented in figure 8.

Notice that a “pure” level 1 evaluation effort might be considered to be applied only in case the number of actions implemented were expressed in terms of number of dwellings treated and an EU per dwelling (and *not* per m²) average heating need were used in the

formula reported in figure 8. As the EU default value for the heating need proposed in the case application is expressed in terms of KWh/m²/year it might be assumed that using the EU default values proposed in the case application for the efficiencies and the heating need will result in a combination of level 1 and level 2 or a combination of level 1 and level 3 evaluation efforts depending on how the total dwellings' area treated in a country is estimated.

Deemed energy saving estimates for residential space heating are performed under the Italian TWC scheme in case of centralized **** gas boiler²⁷ installation. The formula used for such estimates is identical to the one reported in figure 8. Strangely the Italian formula includes nevertheless a negative addendum corresponding to a reduction of the energy savings attributable to the installation of fan coils, as if the installation of **** gas boilers were always accompanied by the installation of fan coils in Italy. This point has been discussed in detail during the interviews with the CESI Ricerca person involved in the development of the calculation procedure who admitted that the inclusion of such negative addendum representing fan coil additional electricity consumption is probably a mistake²⁸. Concerning the default values used for the parameters in the calculation formula, the new and old boiler seasonal efficiency values are assumed to be 94% and 82% respectively²⁹, an average value of 82 m² has been assumed for the area of the treated dwellings and different default values for the annual heating need per square meter have been considered according to the different Italian climatic zones where the EEI action may be implemented. Also the value used for the replaced boiler efficiency has been discussed during the interviews. According the documents illustrating the Italian TWC scheme method calculation procedure³⁰ the average efficiency of the inefficient boilers on the Italian market is 82% and for the interviewees also the average efficiency of the Italian inefficient boiler stock is around this value. Therefore the default value used for replaced boiler efficiency in the TWC scheme method calculation procedure may be considered to be representative both of the inefficient boiler market and the stock. In the tables 6 and 7 below the default values used in the Italian TWC scheme calculation procedure are summarized.

Seasonal efficiency	94%
----------------------------	------------

²⁷ See the EU Directive 92/42/EC for the definition of this energy efficiency class for boilers. The technology most widely used to achieve the **** energy efficiency standard is that of condensing boilers.

²⁸ A new technical calculation spreadsheet for **** boiler installation is presently under discussion. The mistake noticed while performing the pilot tests has been signalled to the AEEG and will be corrected during the consultation process that will lead to the production of the new version of the technical calculation sheet.

²⁹ All the efficiency values used for the pilot test of the condensing boiler case application are based on the Net Calorific Value.

³⁰ See "Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all'articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001", October 27, 2004

(**** gas boiler)	
Seasonal efficiency (replaced boiler)	82%
Average dwelling area (m²)	82

Table 6: Default values used in the formula reported in figure 8 for the Italian TWC scheme method unitary energy saving deemed estimates for ** gas boiler installation.**

Climatic zone	Heating need per dwelling	fan coil electric need
Degree Days - DD (Kelvin*days/year)	(kWh/m2/year)	(kWh/m2/year)
DD≤900	27	1,1
901<DD≤1400	46	2,0
1401<DD≤2100	72	2,7
2101<DD≤3000	103	3,4
DD>3000	139	4,4

Table 7: heating and fan coil electric need default values used in the Italian TWC scheme calculation procedure to estimate the energy savings due to ** gas boiler installation.**

Based on the information indicated in table 7 it may be worth observing that the heating needs per dwelling may vary up to a factor 5 whereas fan coils electric need may vary up to a factor 4 according to the various climatic zones in Italy.

The Italian TWC scheme method may be considered as a combination of the EMEEES level 2 and level 3 evaluation efforts as national default values are considered for the boiler efficiencies and the dwelling average area, whereas heating and fan coil electric need estimates to be used are participant specific.

Italian TWC scheme method deemed estimates have been compared with the EMEEES estimates when the level 1 default values and normalization factors related to Italy proposed in the case application are used to calculate the gross unitary energy savings. The EMEEES method estimates have been performed by assuming an average dwelling area of 82 m² (as done under the Italian TWC scheme) and a 82% seasonal efficiency for the replaced boiler, whereas for the other parameters in the energy saving calculation formula (e.g. normalized heating need and new boiler seasonal efficiency) the level 1

default values proposed in the EMEEES case application have been considered. The table 8 below reports the results of the estimates performed both according the Italian TWC scheme method and the EMEEES method.

Climatic zone	EMEEES savings	TWC scheme savings
Degree Days - DD (Kelvin*days/year)	(kWh/year)	(kWh/year)
DD≤900	6,9	4,7
901<DD≤1400	6,9	8,1
1401<DD≤2100	6,9	12,3
2101<DD≤3000	6,9	17,2
DD>3000	6,9	22,9

Table 8: Unitary gross energy saving estimates performed by using EMEEES level 1 default values (plus the EMEEES adaptation factor proposed for Italy) and the Italian TWC scheme method default values (in this case energy saving estimates do not include energy savings deriving from DHW production).

The EMEEES gross unitary energy savings have been estimated by correcting the heating need by the adaptation factor due to the degree days that is proposed for Italy (i.e.0.63 corresponding to 2031 DD) in the EMEEES case application report. The results reported in the table 8 above indicate that the EMEEES unitary gross energy saving estimated for Italy (i.e. 6,9 kWh/year) is quite conservative (as it should be) with respect to the Italian TWC scheme method deemed estimates. Notice that Italian TWC scheme values are likely to represent gross unitary energy saving underestimates because of the extra energy consumption due to fan coils that has been erroneously introduced in the calculation procedure developed by the AEEG. The default values for the heating and fan coil electric needs used in the calculation and reported in table 7 indicate that the energy savings are underestimated for a factor ranging between 3% and 4%.

Step 3

In principle multiplier effects may be relevant, although it has to be pointed out that only 28 energy efficiency projects addressing **** gas boilers were implemented under the Italian TWC scheme between May 2005 and May 2008³¹.

³¹ 5632 white certificates corresponding to about 65.49 GWh of final energy saved were issued because of these

Concerning free riders it is difficult to produce sufficiently accurate estimates related to Italy. However the persons interviewed indicated that the percentage of 20% reported in the EMEES case application report may be considered a good estimate of the amount of free-riders getting Italian white certificates because of condensing boiler installation.

Significant technical interactions with EEI actions addressing building insulation may exist. Unfortunately no estimates about such interactions have been produced for Italy.

Double counting may be in principle a major issue in Italy because a tax deduction amounting to 55% of condensing boiler sale price is granted by the budget law to each natural person installing condensing boilers. Presently no central database or registry allowing tracking which condensing boiler installations implemented under the TWC scheme have been also granted a tax deduction is in place in Italy. In case the EMEES method should be applied to estimate energy savings attributable to the TWC scheme only, this information would be necessary and its gathering would imply some costs for the governmental bodies in charge of granting the tax deduction and monitoring and verifying the energy savings yielded by the TWC scheme. However it is likely that in Italy the contribution of condensing boiler installations to the achievement of the ESD target will be estimated by calculating the impact of the whole package of EEI facilitating measures addressing this technology. If this will be the case double counting will not be an issue.

Step 4

A life time of 5 years is assumed for energy savings yielded by **** gas boiler installation under the Italian TWC scheme, such an assumption representing a marked underestimation of the real **** gas boiler average lifetime probably motivated by the reasons already expressed for the other case applications described so far.

The EMEES method recommends to consider a 17 year lifetime. Persons interviewed indicated this number might represent an overestimate of single family dwelling average lifetime. EEI actions implemented as of 2000 might be considered for the achievement of the 2016 ESD target in case the EMEES lifetime would be assumed (in this case condensing boiler performance degradation might represent an important factor to take into account while estimating the contribution of these actions to the achievement of the ESD target), whereas only EEI actions implemented as of 2012 might be counted for the achievement of such target in case the Italian TWC scheme would be assumed.

3.4 Methodology test on early actions and additionality issues

Additionality is likely to be an issue because of the tax deduction in place in Italy. However such issue may be solved by assessing the contribution to ESD target achievement by the whole policy package made of this EEI facilitating measure plus the white certificate scheme part addressing condensing boilers. Indeed the amount of energy savings generated by condensing boiler installations not caused by such facilitating measures is likely to be very low in Italy. Concerning early actions it was not possible to test how large the contribution to the 2016 ESD target by such actions might be. However, considering that only 5632 white certificates related to ****gas boiler installation (corresponding to

projects (see "Terzo rapporto annuale sul meccanismo dei titoli di efficienza energetica; situazione al 31 maggio 2008" published by the AEEG on October 2008). On the other hand the 2016 ESD target for Italy correspond to 118,464 GWh

65.49 GWh³² of final energy saved) were issued between May 2005 and May 2008, it is reasonable to assume that the contribution to the ESD target by early condensing boiler installations under the white certificate scheme would be negligible if the lifetime value proposed by the EMEEES case would be considered.

3.5 Method comparison and interactions with already existing evaluation methods

The comparison between the EMEEES case application on condensing boilers and the corresponding Italian TWC scheme method has been the subject of the previous report chapter sections. The pilot tests performed allowed identifying a probable mistake in the technical calculation sheet developed by the AEEG for **** gas boilers, indeed the calculation formula used to estimate the unitary energy savings strangely includes a negative addendum corresponding to a reduction of the energy savings attributable to the installation of fan coils, as if the installation of **** gas boilers were always accompanied by the installation of fan coils in Italy. The probable mistake noticed while performing the pilot tests has been signaled to the AEEG and will be hopefully corrected during the on-going consultation process that will lead to the production of the new version of the technical calculation sheet.

The comparison results indicate that the EMEEES unitary gross energy saving estimate for Italy (i.e. 6,9 KWh/year) is quite conservative (as it should be) with respect to the Italian TWC scheme method deemed estimates and also showed that, although the Italian TWC scheme method should be in principle applied only to centralized **** gas boilers, TWC scheme deemed estimates are not inconsistent with EMEEES method estimates that are supposed to refer both to centralized and single-family boilers.

However the Italian TWC scheme calculation method proves that the heating needs per dwelling may vary up to a factor 5 according to the various climatic zones in Italy. Such variations couldn't be taken into account in the proposed EMEEES level 1 default value for the heating need and the related adaptation factors based on Member States degree days and indicate that it is worth to go to level 2 or level 3 evaluation efforts while applying the EMEEES method rather than using EMEEES level 1 default values.

The comparison was performed by assuming that the efficiency of the replaced boiler is 82%. Nevertheless, whereas 82% is likely to represent both the boiler inefficient market and the boiler inefficient stock in Italy, in the EMEEES case application it is assumed that 82% represent the inefficient stock only, while the value of 89% is assumed for the inefficient market. The EMEEES case application do not provide information about how the 89% value recommended for the boiler inefficient market has been estimated.

Moreover the Italian TWC scheme method also provides deemed unitary energy saving estimates for domestic hot water (DHW) production by **** boilers that are of the same order if not higher than deemed unitary energy saving estimates for space heating, whereas the EMEEES case application does not address this important aspect. On the other hand the EMEEES case application provides elements to estimate the energy savings that could be generated by the installation of energy efficient heating system components other than condensing boilers, although the interactions between such

³² Notice that 65.59 GWh represent the *cumulated* final energy savings and not the annual final energy savings generated by ****gas boiler installations. On the other hand the 2016 ESD target for Italy correspond to 118,464 GWh.

components are not taken into account and the estimates provided are consequently very rough.

Finally lifetimes assumed under the methods compared are markedly different (a 5 year lifetime is assumed under the TWC scheme method, whereas a 17 year lifetime is assumed under the EMEEES case application). Nevertheless the number of early actions implemented under the Italian TWC scheme is negligible and also energy savings generated as of 2008 by **** gas boiler installation under such scheme are very few. In case condensing boiler installations will sensibly increase in the near future, lifetime will probably not any more represent a problem for the estimate of the contribution to 2016 ESD target achievement by condensing boiler installations.

3.6 Evaluation of costs related to method application

The same qualitative considerations made for the costs related to the application of the EMEEES methods described in the previous chapters (see section 1.6) can be referred to the EMEEES method on condensing boilers. In this case, however, the Italian TWC scheme method may be considered as equivalent to a level 2 and level 3 combined EMEEES evaluation effort as national default values are considered for the boiler efficiencies and the dwelling average area, whereas heating need estimates to be used are participant specific. It is reasonable to assume that the application of the level 2 and level 3 combined EMEEES method under the Italian TWC scheme would not produce significant changes with respect to the method presently used for **** gas boilers under this scheme. Therefore the costs due to EMEEES method application would be the same as determined by the Italian TWC scheme method application.

3.7 Target group perspective

As already mentioned (see section 3.1) the document illustrating the EMEEES case application has been submitted to Antonio Capozza and Umberto Ciarniello (CESI Ricerca), Emanuele Regalini (AEEG) and Claudio Palmieri (Hera Modena). A questionnaire addressing the aspects considered for the test has been prepared and submitted to these persons during phone interviews held once they had read the EMEEES case application report. Such persons have been selected and interviewed because CESI Ricerca has been involved together with the AEEG in the development of the technical sheets used under the Italian TWC scheme whereas Hera Modena had implemented EEI actions addressing condensing boilers and used the related TWC technical sheets to get the white certificates issued by the AEEG.

Some interviewees pointed out that using an EMEEES level 1 calculation formula that takes into account also possible energy efficiency improvements in other part of the heating system (distribution, emitters, control systems) would be too complicate considering that persons having to use the EMEEES method formulas will not be specialists. According to them it is better requiring operation standards ensuring that installed condensing boilers can achieve high energy performances than proposing too complicate formulas to estimate savings. For example they suggested that specifying in the EMEEES case application that only condensing boilers with modulated burners and operating with a return-water temperature not exceeding 60°C are addressed might serve to ensure that real savings are generated by the condensing boilers installed. According to

them energy savings of energy efficiency improvements due to heating system components other than condensing boilers should be considered only at the level 3 evaluation effort.

Other interviewees stressed that the energy savings due to DHW production are considerable and should be included in the calculation formula for the estimate of the unitary energy savings generated by condensing boiler installation.

No major objection has been raised with respect to the 17 years proposed for condensing boiler lifetime although an interviewee observed that single-family boilers might have a shorter lifetime.

Concerning EMEEES level 1 default values related to boiler efficiency it has been signaled that in Italy both the average seasonal efficiency of the boiler inefficient market and the boiler inefficient stock are likely to be at the level of 82%, whereas the EMEEES method proposes an 89% efficiency as EU default value for the inefficient boiler market. As far as the condensing boiler efficiency EMEEES default value of 94% is concerned, it has been observed that condensing boiler efficiency may be much higher.

The AEEG representative interviewed mentioned that in case of centralized multifamily condensing boilers a more accurate energy saving evaluation approach may be an ex-post evaluation approach based on the information about the amount of energy consumed annually. Such an approach may also easily take into account energy savings generated by heating system components other than the condensing boilers.

3.8 Specific conclusions

The pilot tests were mainly based on a confrontation on the paper between the EMEEES method and the corresponding deemed estimates of the unitary energy savings provided under the Italian TWC scheme for **** gas boilers as well as on interviews with stakeholders responsible for the development of the Italian TWC scheme methodologies or in charge of using such methodologies in order to submit to the Italian TWC scheme regulator the information necessary to get the number of certificates corresponding to the energy saving amount calculated.

The comparison performed during the pilot tests indicate that the EMEEES unitary gross energy saving estimate for Italy (i.e. 6,9 kWh/year) is quite conservative (as it should be) with respect to the Italian TWC scheme method deemed estimates. However the Italian TWC scheme calculation method proves that the heating needs per dwelling may vary up to a factor 5 according to the various climatic zones in Italy. Such variations couldn't be taken into account in the proposed EMEEES level 1 default value for the heating need and the related adaptation factors based on Member States degree days and indicate that it is worth to go to level 2 or level 3 evaluation efforts while applying the EMEEES method rather than using EMEEES level 1 default values.

Concerning assumptions about the baseline, whereas an 82% seasonal efficiency is likely to represent both the boiler inefficient market and the boiler inefficient stock in Italy, in the EMEEES case application it is assumed that 82% represent the inefficient stock only, while the value of 89% is assumed for the inefficient market. The EMEEES case application do not provide information about how the 89% value recommended for the inefficient boiler market has been estimated.

Lifetimes assumed under the two methods compared are markedly different (a 5 year lifetime is assumed under the TWC scheme method, whereas a 17 year lifetime is assumed under the EMEEES case application). Nevertheless the number of early actions implemented under the Italian TWC scheme is negligible and also energy savings generated as of 2008 by **** gas boiler installation under such scheme are very few. In case condensing boiler installations will sensibly increase in the near future, lifetime will probably not any more represent a problem for the estimate of the contribution to ESD target achievement by condensing boiler installations.

Additionality is likely to be an issue because of the tax deduction in place in Italy. However such issue may be solved by assessing the contribution to ESD target achievement by the whole policy package made of this EEI facilitating measure plus the white certificate scheme part addressing condensing boilers. Indeed the amount of energy savings generated by condensing boiler installations not caused by such facilitating measures is likely to be very low in Italy.

Concerning gross-to-net energy saving correction factors in principle multiplier effects may be relevant, although it has to be pointed out that only 28 energy efficiency projects addressing **** gas boilers were implemented under the Italian TWC scheme between May 2005 and May 2008. It is difficult to produced sufficiently accurate estimates of the free-riders in Italy. However the persons interviewed indicated that the percentage of 20% reported in the case application report may be considered a good estimate of the amount of free-riders getting Italian white certificates because of condensing boiler installation. Significant technical interactions with EEI actions addressing building insulation may exist. Unfortunately no estimates about such interactions have been produced for Italy. Double counting may be in principle a major issue in Italy because a tax deduction amounting to 55% of condensing boiler sale prize is granted by the budget law to each natural person installing condensing boilers.

3.9 General conclusions

Almost all the assumptions and hypotheses made in the EMEEES methodology are clearly justified and understandable. The EMEEES case application does not provide information about how the 89% average seasonal efficiency value recommended for the boiler inefficient market has been estimated.

Concerning EMEEES method usability employing the proposed EMEEES level 1 calculation formula that takes into account possible energy efficiency improvements in heating systems components other than condensing boilers (i.e. distribution, emitters, control systems) would be too complicated for the persons having to use the EMEEES method formulas who are typically not specialists. Evaluation of energy savings due to energy efficiency improvements of heating system components other than condensing boilers should be proposed only at the level 3 evaluation effort.

Concerning EMEEES method accuracy, energy savings due to DHW production are of the same order if not higher than energy saving due to space heating generation and should hence be included in the calculation formula for the estimate of the unitary energy savings caused by condensing boiler installation.

Concerning the consistency of the EMEEES method level 1 default values with the corresponding values estimated under the Italian TWC scheme, the results shown in the

table n. 8 indicate that the EMEEES unitary gross energy saving estimate for Italy (i.e. 6,9 KWh/year) is quite conservative (as it should be) with respect to the Italian TWC scheme method deemed estimates. However the Italian TWC scheme calculation method proves that the heating needs per dwelling may vary up to a factor 5 according to the various climatic zones in Italy. It is hence worth to go to level 2 or level 3 evaluation efforts while applying the EMEEES method rather than using EMEEES level 1 default values.

Concerning the costs implied by the application of the method tested it was not possible to perform quantitative estimates. It is reasonable to assume that the application of the EMEEES method under the Italian TWC scheme would not produce significant changes with respect to the method presently used for **** gas boilers under this scheme. Therefore the costs due to EMEEES method application would probably be the same as determined by the Italian TWC scheme method application.

3.10 Needs and potentials for improvement of the method tested

Needs and potentials for improvement of the method tested are listed hereunder.

- The EMEEES case application does not provide information about how the 89% value recommended for the average seasonal efficiency of the boiler inefficient market has been estimated. Some information might be provided in this respect.
- Using the proposed EMEEES level 1 calculation formula that takes into account possible energy efficiency improvements in heating systems components other than condensing boilers (i.e. distribution, emitters, control systems) would be too complicated for the persons having to use the EMEEES method formulas who are typically not specialists. Evaluation of energy savings due to energy efficiency improvements of heating system components other than condensing boilers should be proposed only at the level 3 evaluation effort.
- Requiring operation standards ensuring that installed condensing boilers can achieve high energy performances would be very useful and effective. For example specifying in the EMEEES case application that only condensing boilers with modulated burners and operating with a return-water temperature not exceeding 60°C are addressed might serve to ensure that real savings are generated by the condensing boilers installed and being evaluated.
- Energy savings due to DHW production are of the same order if not higher than energy saving due to space heating generation and should hence be included in the calculation formula for the estimate of the unitary energy savings caused by condensing boiler installation
- The case application report does not illustrate how to treat the uncertainties on the energy saving estimates resulting from the application of the EMEEES method.

4. EMEEES case application n. 5: Energy Efficient Cold Appliances and Washing machines

4.1 Testing activity description

As done with the previous case applications considered in this report, the EMEEES case application on energy efficient (EE) cold appliances and washing machines has been compared with the corresponding TWC evaluation method that the AEEG has developed after consultations with the main stakeholders involved in the implementation, monitoring and evaluation of EEI actions addressing this technology (see Delibera 111/04, scheda tecnica n. 12). General specifications and assumptions of the two methods have been compared and the EMEEES level 1 default values have been confronted with the deemed estimates provided by the calculation technical sheets developed by the AEEG for EE cold appliances and washing machines. It has to be pointed out that the AEEG revoked the existing TWC scheme method for washing machines on March 2008. This decision has been due to the fact that recent studies by CESI Ricerca³³ on the washing machine Italian market have shown that the percentage of not energy efficiency class A washing machines sold as of 2006 has been negligible whilst the existing TWC scheme method consisted in deemed estimates of the energy savings attributable to class A washing machines considering not class A washing machines sold on the market as the reference baseline. Moreover the Italian law 244/07³⁴ bans not class A washing machines from the market as of 2010. For these reasons and also because detailed information about Italian energy efficiency projects addressing washing machines are missing, the pilot tests on the EMEEES case application part related to EE washing machines could not be performed. Finally it has to be pointed out that the AEEG published on February 20, 2008³⁵ a document for consultation whereby new values for the deemed energy saving estimates related to energy efficient cold appliance installations reported in the calculation technical sheet n. 12 of the Delibera 111/04 were proposed. As it is likely that such new values will be soon adopted under the Italian TWC scheme, the pilot test comparison has been performed by referring to such new values that have been calculated by assuming class A cold appliances as reference baseline.

4.2 Main data sources used for the pilot test

Data used for the pilot test were those related to the assumptions and the default values considered for the deemed estimates of the energy savings yielded by energy efficient cold appliances as reported in the AEEG calculation technical sheets. Such information were found in the final versions of the consultation documents³⁶ which the deemed

³³ See CESI – Rapporto di Ricerca di Sistema (progetto NORME/REGOLE) “Titoli di efficienza energetica: potenziale e costi di attuazione degli interventi” prot. A5042404, dicembre 2005; <http://www.ricercadisistema.it/>

³⁴ See the article 2, comma 162 of such law

³⁵ See DCO 3/08 – “AGGIORNAMENTO DELLE SCHEDE TECNICHE PER PROGETTI DI RISPARMIO ENERGETICO RELATIVI ALL'INSTALLAZIONE IN AMBITO RESIDENZIALE DI LAMPADINE FLUORESCENTI COMPATTE CON ALIMENTATORE INCORPORATO, FRIGORIFERI, FRIGOCONGELATORI, CONGELATORI, LAVABIANCHERIA, LAVASTOVIGLIE AD ALTA EFFICIENZA, ROMPIGETTOAREATI PER RUBINETTI ED EROGATORI PER DOCCIA A BASSO FLUSSO” 20 February 2008, pagg. 21-30

³⁶ See in particular “Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli

estimates reported in the calculation technical sheets are based upon.

4.3 Test of methodology application step by step

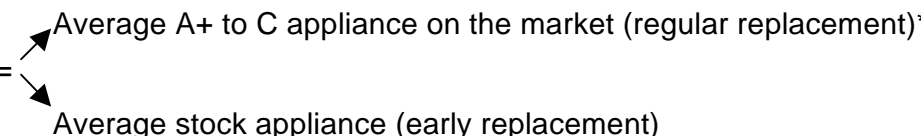
In the following the EMEEES case application is illustrated step by step and a comparison with the corresponding evaluation method developed under the Italian TWC scheme is presented.

Step 1 and step 2

The EMEEES formula proposed for the calculation unitary annual gross energy savings (step 1 and step 2 of the EMEEES methodology) is reported in the figure 9 below.

Unitary gross annual savings for A+ and A++ cold appliances:

$$([\text{annual energy consumption}]_{\text{BL}} - [\text{annual energy consumption}]_{\text{BAT}}) * F$$

Baseline (BL) = 

Best available technology (BAT) = A++ cold appliance

F = correction factor reflecting the ratio of the consumption under standard test conditions and the measured consumption in real life.

* Baseline for regular replacement should be adapted as soon as the EuP directive minimum energy performance standards will be introduced.

Figure 9: EMEEES formula for the calculation of unitary and gross annual energy savings in case of energy efficient cold appliance installation.

The formula reported in figure 9 above is supposedly proposed for EMEEES level 1, 2 and 3 evaluation efforts.

Based on the information reported in the French retailer catalogues and Eurotopten the EMEEES case application proposes a level 1 EU default annual unitary gain between A+ and A++ appliance of 61 kWh/year, whereas no EU default value is proposed for the coefficient F in the formula. Moreover the case application proposes to count the number of implemented actions directly in case of EEI facilitating measures consisting in financial

interventi di cui all'articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001" , January 16, 2003 and the document mentioned in the previous note.

incentives, through phone or internet surveys in case of EEI facilitating measures consisting in personal advices or through market surveys for all other types of facilitating measures.

Gross unitary energy saving deemed estimates for cold appliances proposed for the Italian TWC scheme method are calculated by assuming class A cold appliance as reference baseline and are summarized in the table 9 below.

Efficient cold appliance installed	Unitary annual energy savings attributed (kWh/year)
A+ refrigerator and fridge freezers	61.73
A++ refrigerator and fridge freezers	129.7
A+ freezer	20.65
A++ freezer	77.85

Table 9: proposed unitary energy saving deemed estimates for the Italian TWC scheme method.

From the data reported in the table above it may be noticed that the Italian TWC scheme provides gross unitary energy saving deemed estimates both for A+ and A++ cold appliances (by using equivalent class A cold appliances as baseline) and distinguishes between two cold appliance application types (i.e. freezers and refrigerators with or without freezers) whereas the EMEEES case applications provides a unique EU default unitary energy saving value for all class A++ cold appliance application types estimated by using class A+ cold appliances as baseline. Notice that the EMEEES level 1 default value of 61 KWh/year is not very conservative with respect to the corresponding Italian TWC scheme deemed estimates (e.g. the replacement of an A+ freezer with an A++ equivalent model would approximately yield $77.85 - 20.65 = 57.20$ KWh/year, whereas the replacement of an A+ refrigerator with an A++ equivalent model would approximately yield $129.7 - 61.73 = 67.97$ kWh/year in Italy).

AEEG documents do not provide information about how the Italian TWC scheme method default values above reported have been calculated. However it seems reasonable to assume that such values are derived from estimates of the average annual consumption of the class A, A+ and A++ cold appliance sold on the Italian market. Therefore the Italian TWC scheme method may be considered as corresponding to the EMEEES level 2 evaluation effort.

Step 3

In principle multiplier effects may be relevant. Nevertheless it has not been possible to perform any estimate of such effects during the pilot tests.

Also free riders are very difficult to be estimated. The additional incentive to buy energy efficient cold appliances provided by white certificates alone is generally quite low and the free-riders effect may hence be considered quite high. A survey performed on the Italian

market by GfK between January and April 2008 indicates that A+ cold appliance market share is around 39%. However part of such market share might be due to a tax deduction amounting to 20% of A+ and A++ cold appliance sale price that is granted by the Italian budget law to each natural person installing such appliances.

Double counting may be in principle a major issue in Italy because of the just mentioned tax deduction mechanism in place for A+ and A++ cold appliance installations. Presently no central database or registry allowing tracking which condensing boiler installations implemented under the TWC scheme have been also granted a tax deduction is in place in Italy. In case the EMEEES method should be applied to estimate energy savings attributable to the TWC scheme only, this information would be necessary and its gathering would imply some costs for the governmental bodies in charge of granting the tax deduction and monitoring and verifying the energy savings yielded by the TWC scheme. However it is likely that in Italy the contribution of energy efficient cold appliances installations to the achievement of the ESD target will be estimated by calculating the impact of the whole package of EEI facilitating measures addressing this technology. If this will be the case double counting will not be an issue.

Step 4

A life time of 5 years is assumed for energy savings yielded by energy efficient cold appliances under the Italian TWC scheme, such an assumption representing a marked underestimation of the real energy efficient cold appliance average lifetime probably motivated by the reasons already expressed for the other case applications described so far.

The EMEEES method recommends to consider a 15 year lifetime. EEI actions implemented as of 2002 might be considered for the achievement of the 2016 ESD target in case the EMEEES lifetime would be assumed, whereas only EEI actions implemented as of 2012 might be counted for the achievement of such target in case the Italian TWC scheme would be assumed.

4.4 Methodology test on early actions and additionality issues

Additionality is likely to be an issue because of the tax deduction in place in Italy and because of the high market share of class A+ cold appliances on the Italian market (see GfK estimate mentioned in section 4.3). In order to partially solve this issue the consultation document produced by the AEEG proposes to consider as eligible for certification only those energy efficiency projects providing a significant incentive to cold appliance purchasing (e.g. a purchase discount over 15% of the sale price) and creating a communication channel with energy efficient cold appliance purchasers in order to let them ask for information related to appliance use and to signal a possible appliance malfunctioning. Concerning early actions it was not possible to precisely test how large the contribution to the 2016 ESD target by such actions might be. However, considering that only 21190 white certificates³⁷ related to energy efficient white goods (i.e. energy efficient cold appliances, energy efficient dishwashers and energy efficient washing machines)³⁸

³⁷ See "Terzo rapporto annuale sul meccanismo dei titoli di efficienza energetica; situazione al 31 maggio 2008" published by the AEEG on October 2008.

³⁸ 21190 white certificates correspond to about 96.32 GWh of final energy saved. Notice that such amount represent the

were issued between May 2005 and May 2008, it is reasonable to assume that the contribution to the ESD target by early energy efficient cold appliance installations under the white certificate scheme would be negligible if the lifetime value proposed by the EMEEES case would be considered.

4.5 Method comparison and interactions with already existing evaluation methods

The Italian TWC scheme provides unitary energy saving deemed estimates both for A+ and A++ cold appliances by using equivalent class A cold appliances as baseline and distinguishes between two cold appliance application types (i.e. freezers and refrigerators with or without freezers) whereas the EMEEES case applications provides a unique EU default unitary energy saving value for all class A++ cold appliance application types estimated by using class A+ cold appliances as baseline. Notice that the EMEEES level 1 default value of 61 KWh/year is not conservative with respect to the corresponding Italian TWC scheme deemed estimates (see the calculation reported in section 4.3). Moreover the EMEEES case application assumes that the energy savings related to early replacements of inefficient appliances may be estimated whereas the Italian TWC scheme method deemed estimates only refer to regular replacements.

Finally lifetimes assumed under the methods compared are markedly different (a 5 year lifetime is assumed under the TWC scheme method, whereas a 15 year lifetime is assumed under the EMEEES case application).

4.6 Evaluation of costs related to method application

The same qualitative considerations made for the costs related to the application of the EMEEES methods described in the previous chapters (see e.g. section 1.6) can be referred to the EMEEES method on energy efficient cold appliances. In this case, however, the Italian TWC scheme method may be considered as the result of an EMEEES level 2 evaluation effort as deemed estimates are based on the average energy performances of the cold appliances on the Italian market. The estimate of the costs related to EMEEES method application should hence mainly focus on the costs related to the application of such evaluation effort that are likely not be very different from the costs of the Italian TWC scheme method presently used.

4.7 Target group perspective

No interviews have been realized for the pilot test of this EMEEES case application.

4.8 Specific conclusions

The pilot test on the EMEEES case application part related to energy efficient washing machines could not be performed for the reasons expressed in section 4.1. Therefore the specific conclusions below mentioned only concern the EMEEES case application part

cumulated final energy savings and not the annual final energy savings generated by ****gas boiler installations and includes energy savings generated by energy efficient dishwashers and washing machines. On the other hand the 2016 ESD target for Italy correspond to 118,464 GWh.

related to energy efficient cold appliances.

It is not clear why the EMEEES case application on energy efficient cold appliances assumes, at least for the level 1 evaluation effort, class A+ cold appliances as the reference baseline. It seems quite unlikely that some EU Member State where class A+ cold appliances are the average technology available on the market may exist. Moreover the EMEEES level 1 energy saving default value of 61 KWh/year provided is not very conservative with respect to the corresponding Italian TWC scheme deemed estimates (see the calculation reported in section 4.3).

No information are provided about how the correction factor F included in the formula reported in figure 9 might be estimated.

In principle multiplier effects may be relevant for this EMEEES case application. Nevertheless it has not been possible to perform any estimate of such effects during the pilot tests.

Also free riders are very difficult to be estimated. The additional incentive to buy energy efficient cold appliances provided by white certificates alone is generally quite low and the free-riders effect may hence be considered quite high. A survey performed on the Italian market by GfK between January and April 2008 indicates that A+ cold appliance market share is around 39%. However part of such market share might be due to the tax deduction in place in Italy for A+ and A++ cold appliances.

Double counting may be in principle a major issue in Italy because of the just mentioned tax deduction mechanism in place for A+ and A++ cold appliance installations. However it is likely that in Italy the contribution of energy efficient cold appliances installations to the achievement of the ESD target will be estimated by calculating the impact of the whole package of EEI facilitating measures addressing this technology. If this will be the case double counting will not be an issue.

The Italian TWC scheme performances as of 2008 indicate that it is reasonable to assume that the contribution to the ESD target by early energy efficient cold appliance installations under the white certificate scheme would be negligible if the lifetime value proposed by the EMEEES case would be considered.

4.9 General conclusions

Not all the assumptions and hypotheses made in this EMEEES methodology application are clearly justified and understandable. For example it is mentioned that the baseline to calculated additional energy savings should be the average of the A+ to C appliances on market offer, whereas the EU default values refers to a baseline represented by class A+ cold appliances only. Moreover, as already mentioned, it is not clear why the EMEEES method assumes, at least for the level 1 evaluation effort, class A+ cold appliances as the reference baseline. It seems quite unlikely that some EU Member State where class A+ cold appliances are the average technology available on the market may exist.

For the reasons just mentioned and because it is not always clearly explained what some of the default values proposed should represent and how they should be used (see for example the benchmarks values reported for some cold appliance typologies at pag. 18) the EMEEES method tested results quite difficult to be used.

Concerning the consistency of the EMEEES method level 1 default values with the

corresponding values estimated under the Italian TWC scheme, the 61 KWh/year estimated for the EU default energy savings is not very conservative with respect to the corresponding Italian TWC scheme deemed energy saving estimates (see the calculation reported in section 4.3).

Concerning the costs implied by the application of the method tested it was not possible to perform quantitative estimates. However it is reasonable to assume that the application of the EMEEES level 2 evaluation effort under the Italian TWC scheme would not produce significant changes with respect to the method presently used for energy efficient cold appliances under this scheme. Therefore the costs due to EMEEES method application would probably be the same as determined by the Italian TWC scheme method application.

4.10 Needs and potentials for improvement of the method tested

Needs and potentials for improvement of the method tested are listed hereunder.

- Not all the assumptions and hypotheses made in the EMEEES methodology are clearly justified and understandable. For example it is mentioned that the baseline to calculated additional energy savings should be the average of the A+ to C appliances on market offer, whereas the EU default values refers to a baseline represented by class A+ cold appliances only. Moreover it is not clear why the EMEEES method assumes, at least for the level 1 evaluation effort, class A+ cold appliances as the reference baseline. It seems quite unlikely that some EU Member State where class A+ cold appliances are the average technology available on the market may exist.
- It is not always clearly explained what should some of the default values proposed represent and how they should be used (see for example the benchmark values reported for some cold appliance typologies at pag. 18)
- White certificates are not mentioned in the list of EEI facilitating measures that may be covered by the EMEEES case application
- No information is provided about how the correction factor F included in the formula reported in figure 9 might be estimated.

References

- “Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all’articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001” January 16, 2003
- “Proposte di schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all’articolo 5, comma 1, dei decreti ministeriali del 24 aprile 2001” , October 27, 2004
- “Terzo rapporto annuale sul meccanismo dei titoli di efficienza energetica; situazione al 31 maggio 2008” published by the AEEG on October 2008
- “National report from the EMEEES pilot tests of Case application 2 -Residential building envelope improvement - and Case application 4 -Residential condensing boilers in space heating - performed under the French White Certificates Scheme” by Jean-Sébastien Broc, Dominique Osso, Luc Bodineau, Jérôme Adnot, Paul Baudry, Didier Bosseboeuf, Hervé Lefebvre
- “VSDs for Electric Motor Systems” , European Commission, DG TREN, SAVE II Programme, 2000 - ISR-University of Coimbra
- CESI – Rapporto di Ricerca di Sistema (progetto NORME/REGOLE) “Titoli di efficienza energetica: potenziale e costi di attuazione degli interventi” prot. A5042404, dicembre 2005; <http://www.ricercadisistema.it/>
- DCO 3/08 – “Aggiornamento delle Schede Tecniche per Progetti di Risparmio Energetico Relativi all’installazione in Ambito Residenziale di Lampade Fluorescenti Compatte con Alimentatore Incorporato, Frigoriferi, Frigocongelatori, Congelatori, Lavabiancheria, Lavastoviglie ad Alta Efficienza, Rompigettoareati per Rubinetti ed Erogatori per Doccia A Basso Flusso” 20 February 2008, pagg. 21-30
- Delibera 111/04 – “Approvazione di 9 schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all'articolo 5, comma 1, dei decreti ministeriali 24 aprile 2001 e sostituzione dell'allegato a alla deliberazione 27 dicembre 2002, n. 234/02“published on February 20, 2001 at www.autorita.energia.it
- Delibera 234/02 – “Approvazione di 8 schede tecniche per la quantificazione dei risparmi di energia primaria relativi agli interventi di cui all'articolo 5, comma 1, dei decreti ministeriali 24 aprile 2001” published on December 27, 2002 at www.autorita.energia.it
- M. Pavan, “Tradable energy efficiency certificates: the Italian experience”, Energy Efficiency Journal, Volume 01, Issue 04, November 2008; pagg. 257-266
- “Report on national workshops – Italy” produced by eERG in the framework of the EMEEES project, January 31, 2008

Appendix I: List of persons involved in the pilot tests

Marcella Pavan – Autorità per l'Energia Elettrica e il Gas

Emanuele Regalini - Autorità per l'Energia Elettrica e il Gas

Antonio Capozza – CESI Ricerca

Walter Grattieri – CESI Ricerca

Umberto Ciarniello – CESI Ricerca

Ilaria Bertini - ENEA

Claudio Palmieri – HERA Modena

Alessandro Pascucci – ESCO Italia