Osso paper 3163

Compatibility of the French white certificate program to fulfil the objective of energy savings claimed by the Energy Service Directive

Dominique Osso, Paul Baudry
Electricité de France - R&D
Ecuelles, France
dominique.osso@edf.fr, paul.baudry@edf.fr

Jean-Sébastien Broc
Ecole des Mines de Nantes
Nantes, France
Jean-Sebastien.Broc@emn.fr

Jérôme Adnot
Ecole des Mines de Paris
Paris, France
jerome.adnot@mines-paristech.fr

Luc Bodineau, Hervé Lefebvre
ADEME
Paris France
luc.bodineau@ademe.fr, Herve.lefebvre@ademe.fr

Keywords

Energy Savings (or White) Certificates, Bottom-Up Evaluation, Building Retrofitting, Energy Services Directive, National Energy Efficiency Action Plans

Abstract

The Commission has proposed a Directive on the promotion of end-use efficiency and energy services (ESD) to enhance the cost-effective and efficient end-use of energy in Member States. According to the Directive, the Member States shall adopt and aim to achieve an overall national indicative energy savings target of 9% (or beyond) in 2016. This target is to be reached by way of energy services and other energy efficiency measures.

The French National Energy Efficiency Action Plan to comply with the ESD includes a White Certificates scheme (or FWC) as one of the important measures to fulfil the target.

As the accountings of energy savings in the FWC scheme and in the ESD are different (e.g. lifetime-cumulated and discounted kWh for FWC and annual kWh for ESD), an analysis of the compliance of both methodologies and a comparison of the assessed savings are necessary.

In this paper, we evaluate the compliance with the ESD requirements of two different end-use actions (insulation, heating boiler) included in the FWC scheme. This is done through the concrete case of certificates filed by EDF. The main objective of this evaluation is to assess the contribution of the savings of these FWC actions to the target of the ESD. Finally, general conclusions are drawn about the use of a White Certificates scheme as a monitoring and evaluation tool for the ESD purpose.

Introduction

Two main targets of European and French energy policies are the security of energy supply and greenhouse gas mitigation. Energy conservation is unavoidable in order to reach both goals. In this frame, the European Commission has produced several directives and in particular a directive on the promotion of end-use efficiency and energy services (ESD, 2006). The objective of this directive is to enhance the cost-effective and efficient end-use of energy in Member States. According to the Directive, the Member States (MS) shall adopt and aim to achieve an overall national indicative energy savings target of 9% (or beyond) in 2016.

The French White Certificates (FWC) scheme comes under the umbrella of this directive as it is one of the components of the French strategy for energy efficiency. In this context, the FWC savings will have to be reported for ESD purposes. Nevertheless, the saving accounting methods of the ESD and the FWC are different and require a study to assess the FWC contribution to the objective of the ESD.

In this paper, we firstly present both the ESD and FWC schemes. After a general comparison between ESD and FWC accounting systems, we then analyse two case studies performed within the EMEEES project and based on FWC end-use actions: thermal insulation, condensing boilers. The main questions were to determine if the FWC scheme is an efficient monitoring tool for the ESD purpose and if both accounting systems were compatible. Finally, general conclusions are drawn about the use of a White Certificates scheme as a monitoring and evaluation tool for the ESD purpose.

The ESD

According to the Directive, MS shall submit periodically their National Energy Efficiency Action Plan (NEEAP) to the Commission showing how they intend to reach the 9% indicative energy savings target by 2016. NEEAP shall describe the measures already in force or planned (in 2007) and then the progress towards the national targets together with an update on the portfolio of measures (in 2011 and 2014).

The ESD is the first European Directive for which MS will have to report the achieved savings. These savings will be calculated as the sum of the measured or estimated reductions in final energy consumption in the year 2016 attributable to the reported services, programmes and measures. This raised concerns about how to monitor and verify energy savings from the reported measures in a harmonised way, i.e. taking account of the different level of knowledge and experiences among the 27 MS. The EU-funded project EMEEES (Evaluation and Monitoring for the EU directive on Energy End-Use Efficiency and Energy Services)(EMEEES, 2008) aims at assisting the European Commission in developing harmonised evaluation methods[1]. In this paper, we use as reference for the ESD methodology the proposals made by the EMEEES project.

The French White Certificates scheme

The French law No 2005-781, of 31 July 2005, establishing energy policy guidelines, holds demand side management as the first part of this policy and creates a new market-based instrument to support this policy: French White Certificates (FWC). As presented in the French NEEAP (French Authorities, 2008), the FWC system is dependent on:

- demand for certificates: energy savings obligations are imposed on energy suppliers in the residential and service sectors. They comply with these obligations by returning an equivalent number of certificates;
- supply of certificates: end-use actions are rewarded with certificates (under certain eligibility requirements).

End-use actions are eligible for all energy carriers and all sectors except for the installations already covered by the European Emission Trading Scheme (ETS). So far 139 types of standardized actions were defined and validated covering all sectors (industry, residential, transport and tertiary) and many end-uses or technologies (insulation, efficient boilers, etc.). For more details about White Certificates and evaluation systems, see e.g. Bertoldi and Rezessy (2007) and DGEC (2009). First results on the FWC scheme are also presented in (3274 Bodineau).

Comparison of the two accounting methods for the ESD and the FWC

FWC energy saving accounting method

To facilitate implementation of the FWC system, especially the registering and crediting of reported actions, standardised end-use actions have been defined according to a standardised form including the following details:

- scope of the defined action (name, targeted sector and energy end-use, energy efficiency technology or service implemented);
- quality requirements (minimum energy performance level, other norms to comply with, other requirements such as installation by a professional, etc.);
- data, formula and baseline used to calculate the standardised unitary energy savings.

[1] For more details on the project, see (Thomas et al., 2007; Vreuls et al., 2008) and www.evaluate-energy-savings.eu.

The FWC energy savings deal with final energy saved and are expressed in kWh cumac, meaning cumulated and discounted (in French, ***cum**ulés **ac**tualisés*). This value of energy savings corresponds to the standardised annual energy savings (in kWh/year) summed over the action lifetime and discounted at a 4% rate (Ministry of Economics, 2006).

EMEEES accounting method for ESD

A general guideline for the bottom-up methods for the ESD reporting was defined in the EMEEES project based on a four step calculation and three levels of evaluations (for more details see Broc et al. (2007)). The four steps for the calculation process in ESD bottom-up evaluation are:

1. Step 1: **unitary gross annual** energy savings (in kWh/year per participant or unit),
2. Step 2: **total gross annual** energy savings (taking into account the number of participants or units, in kWh/year),
3. Step 3: **total ESD annual** energy savings in the **first year** of the actions (taking into account double counting, multiplier effect, and other gross-to-net correction factors), in kWh/year,
4. Step 4: **total ESD** energy savings achieved in the year 2016 (in kWh/year, taking account of the timing of the action, and its lifetime).

Furthermore, three levels of evaluation efforts are proposed in the EMEEES methodology.

Table 1. Three levels of evaluation efforts.

	Data scale	Main data sources	Data processing and documenting
Level **1**	**European default values**	**existing/available** European regulation, studies and statistics	**reliability coefficient** according to the level of **reliability** of the default value
Level **2**	**National** representative **values**	**up-to-date** national statistics, surveys, samples, registries	requirements = **minimum set of information and justifications** to be reported
Level **3**	**Programme- or Participant-specific values**	**specific** monitoring systems, registries, surveys, measurements	requirements to report on the specific data and justifications **in detail** (standard report at least available)

Case study

The general approach of the pilot test presented here is to compare the monitoring and evaluation system used for the FWC scheme with the EMEEES principles, and to assess the contribution of the FWC savings to the ESD objective. The case study is based on a programme delivered by EDF and credited by FWC savings, accounting for a total amount of 1.16 TWh cumac. This sample represents 3.2% of the 36 TWh cumac of certificates already credited at the end of year 2008 (Ministry of Ecology, 2009). It contains actions implemented in the residential sector, as 88.1% of the actions reported so far for the whole FWC scheme.

We use here the EMEEES framework (four calculation steps and three evaluation levels) to compare both methodologies at the general level. At last, even if the consistency between FWC and EMEEES methods should be checked for each calculation step (e.g. checking consistency in the baseline definition), the main remaining difference between both methodologies is related to step 4. Indeed, when assessing the contribution from the FWC scheme to the ESD target, the task is to translate the FWC savings expressed in kWh cumac into kWh saved in 2016. This step is mainly done by dividing the kWh cumac by the discounting coefficient to get annual savings (kWh/year). This discounting coefficient represents the action lifetime discounted at a yearly rate of 4%.

We detail hereafter the calculations used for the two main categories of end-use actions included in this sample (i.e. insulation and condensing boilers). For each one, we first compare the calculation models of the FWC and EMEEES methods, before performing different calculation scenarios according to the three levels of evaluation efforts defined in the EMEEES methodology. Finally, conclusions are drawn about the compatibility of the FWC accounting system with the ESD reporting, and whether it is worth it to use participants' data (level 3 evaluations) compared to national reference data (level 2 evaluations).

Thermal insulation of buildings

FWC calculation model

Most of the values used in the FWC calculations are average values based on national statistics or past studies. In the case of insulation actions, the calculation also takes account of the following parameters registered for each participant: climate zone (called: H1, H2, H3) depending on the location of the dwelling (postcode registered for each participant) and energy carrier for space heating (electricity or fossil).

The formula used to calculate the annual unitary energy savings is based on the reduction of heating needs calculated by the decrease of thermal losses (ΔU in W/m².K of insulated area) multiplied by normalized heating degree days and correcting climate zone factor[2]. The resulting energy savings are then calculated by dividing the space heating needs by the average heating system efficiency of the French building stock[3] (ATEE, 2005).

It should be noticed here that the unit of action is the m² of installed insulating material (or insulated surface), and not the m² of net floor area of the dwelling. The assessed lifetime of the insulation actions in the FWC scheme is 35 years, giving a discounting coefficient of 19.411.

Comparison of both calculation models

For **step 1** (unitary savings), both formulae are based on the heating demand, even if they use distinct parameters to express it: thermal transmission combined with the heating degree days and the climate zone for the FWC, and directly the specific heating demand according to a given dwelling typology (e.g. building ages, classes, etc.) for EMEEES[4]. Both methods used thus consistent physics considerations. Both models also use the same definition for the reference situation or baseline, i.e. the level of heating demand before implementing the insulation actions. But a difference remains when dealing with the rebound effect[5]: it is neglected in the FWC calculation, when the EMEEES method proposes a default value of 20% (based on existing literature).

Besides, for the unitary savings result, the EMEEES method considered that it was not possible to define European default values (for level 1 evaluation). So savings should be evaluated at least at level 2, i.e. based on national statistics or other national reference values. For the level 3 (participant-specific values) the EMEEES method proposes to use the Energy Performance Certificates (EPC) for buildings (as defined in the EPBD directive (EPBD, 2002)) as data sources for the energy demand before and after refurbishment. The method used for FWC corresponds to an EMEEES level 2 evaluation, as the baseline is based on average national values for the French building stock.

The main difference between both calculation models relies therefore on the two distinct approaches in the analysis of insulation actions: in the EMEEES method, the dwelling is considered as a whole (i.e. system approach), whereas the FWC scheme deals with dwelling components (e.g. roof, windows, etc.). This difference is due to the data registered to account for the actions (i.e. for **step 2**): bills of insulation works for FWC vs. EPC for EMEEES. This means also two different units of action: m² of insulating material for FWC vs. m² of net floor area for EMEEES. In France, EPC are not required in case of refurbishment and are not centralised in a database as proposed in the EMEEES method. Finally, even if the EMEEES method recommends using a system rather than a component approach, the latter option is also presented as possible in the ESD context. Therefore, although they are different, FWC and EMEEES methods are compatible for ESD reporting.

Other differences between FWC and EMEEES methods appear when considering **step 3** (i.e. total ESD savings). Multiplier and free-rider effects are not directly taken into account in the FWC calculations. However they could be evaluated ex-post through a monitoring of the insulation market. Likewise, double counting is to be considered for the ESD reporting, as other facilitating measures overlap with the FWC scheme, such as tax credits. The remaining difference between FWC and EMEEES calculations is related to **step 4** (lifetime cumulated and discounted savings vs. annual savings in 2016). In case of insulation actions, the translation of kWh cumac for FWC into kWh saved in 2016 for the ESD is direct by applying the discounting coefficient (19.411) the reverse way as presented before.

Possible calculation scenarios

Each distinct type of insulating actions (roof, windows, wall and floor) was studied one by one. For the pilot test, we calculated the energy savings according to three levels of possible desegregation[6] (Table 2) from the detailed to simple one:

- Full desegregation: corresponding to a mix of level 2 and level 3 data (cf. EMEEES methodology).
- Medium desegregation[7]: only taking account of the climate zone as level 3 data.
- No desegregation: meaning a “national representative” level; this would correspond to the level 2 result.

[2] H=1.1, H2=0.9, H3=0.6.
[3] 0.95 for direct electric heating, 0.6 for fossil fuel boilers.
[4] For more details about the EMEEES method see Amman et al. (2008).
[5] E.g. part of the energy efficiency improvement will be used to increase the inner temperature, and not to decrease the energy consumption.
[6] Taking account of what data is registered for each participant.
[7] In the medium desegregation approach we consider that the most accessible information is the climate zone (only related to the postcode) which is written on the invoice.

Table 2. Calculation scenarios for insulation actions.

Level of desegregation	Data for climate zone	Data for fuel type
Full	Participants' data Possible values: H1; H2; H3	Participants' data Possible values: electric ; fossil fuel
Medium	Participants' data Possible values: H1; H2; H3	Weighted average, based on the distribution of the national building stock
No desegregation	Weighted average, based on the distribution of the national building stock	

Table 3. Assessment of total gross annual energy savings depending of the calculation scenarios.

Type of insulation action	Default value (level 1)	No desegregation (level 2)	Medium desegregation	Full desegregation (mix of level 2 and level 3)	Maximal difference
roof	Unavailable	8,58 GWh.	8,27 GWh	7,93 GWh	8%
Wall	unavailable	1.011 GWh	0.992 GWh	0.965 GWh	5%
Windows	unavailable	10.935 GWh.	10.795 GWh,	10.991 GWh	<2%
floors	unavailable	0.423 GWh/y.	0.427 GWh/y	0.421 GWh/y	<2%

The results (Table 3) show that, in the specific case of this sample of insulation actions, the maximal difference between the different scenarios is always below 10% without specific tendency. This tends to show that the possible deviations between the national building stock and the participants compensate. Consequently it could be assumed that for a sufficiently large number of actions, the level 2 result is not significantly different from the level 3 results. This means that for reporting savings for the ESD, level 2 data could be sufficient.

Condensing boilers

FWC calculation model

In the FWC model, the energy savings for a condensing boiler is calculated as a set percentage (40%) of final energy consumption (defined from national statistics on energy bills) differentiated by climate zone, dwelling type, age and size (ATEE, 2006). The 40% gain is based on the difference of efficiency between a condensing boiler and an old boiler representing the stock average. Average annual savings are then cumulated and discounted over the action lifetime (16 years, meaning a discounting coefficient of 12.118)(Ministry of Economics, 2006).

Comparison of both calculation methods

For **step 1** (unitary savings), FWC formula is based on final energy consumption (from energy bills), whereas EMEEES formula[8] is based on heating needs (calculated from the building characteristics). But as the values used for boiler efficiencies are known, it is easy to switch from one approach to the other. A more significant difference lies in the definition of the reference situation or baseline. In the FWC model, the baseline is an old fossil fuel boiler, assumed to be representative of old buildings stock. In the EMEEES method, two baselines are proposed to calculate either "all" or "additional" savings[9]. EMEEES baseline for "all" savings is similar to the FWC one: either the average efficiency of boilers in the building stock (conservative European average for level 1 evaluation, and national average for level 2) or the registered efficiency of the participants' boilers (for level 3). For "additional" savings, EMEEES baseline is the average efficiency of the "non-efficient" boilers sold on the market, assuming that without the facilitating measure, the participants would have bought a new boiler anyway, but a "non-efficient" one. Therefore, the FWC values correspond to level 2 "all" savings.

For condensing boilers, the EMEEES method proposed a conservative European default value (level 1 evaluation) for unitary savings, based on the EcoBoiler study (Kemma et al., 2007) and experts judgement. It is then possible to compare FWC values with this conservative benchmark (see scenarios below).

For **step 2** (total savings), the unit of action is an installed boiler for FWC and m² of heated net floor area for EMEEES. This is again due to the type of data registered (boilers' bills for FWC). However the dwelling size is also taken into account in the FWC model through the building typology, and the number of rooms or the net floor area registered for each FWC participant. So both approaches (FWC and EMEEES) are consistent for step 2. For **step 3** (total ESD savings), similar comments regarding insulation actions apply (see above). Likewise for **step 4**, the FWC savings should be translated into ESD savings by applying the discounting coefficient (12.118) the reverse way.

[8] For more details about the EMEEES method see Adnot et al. (2008).
[9] "All" savings means evaluating what would have happened if all equipment had stayed at the same energy efficiency level as before ("before-after" situation). Whereas "additional" savings means evaluating what would have happened in the absence of the evaluated facilitating measure ("with and without" situation).

Possible calculation scenarios

This section presents a comparison of results calculated for a sample including 68 condensing boilers. Based on the available data, different scenarios were used to analyse to what extent increasing the evaluation level would enable the reporting of more accurate (and higher) results:

- scenario [level 1 “stock”]: calculations using the EMEEES default values (level 1) for the energy consumption and the efficiency gain (taking the boilers’ stock as baseline); the only level 3 data used (i.e. specific to the EDF sample) is the number of implemented actions.
- scenario [level 1 “market”]: same as scenario [level 1 “stock”], except that for the efficiency gain, the baseline is the average efficiency from the boilers’ “inefficient” market.
- scenario [level 2]: calculations using national average (i.e. level 2) values for the energy consumption and the efficiency gain ; the only level 3 (i.e. specific to the EDF sample) data used is the number of implemented actions.
- scenario [level 3]: calculations using as far as possible level 3 data (i.e. specific to the EDF sample), meaning using all the data registered for each participant in the FWC scheme (number of actions, climatic zone, dwelling type, age, size) combined with the corresponding level 2 (national) data, i.e. energy consumption according to dwelling type and age, and correction factors for dwelling size and climatic zone.

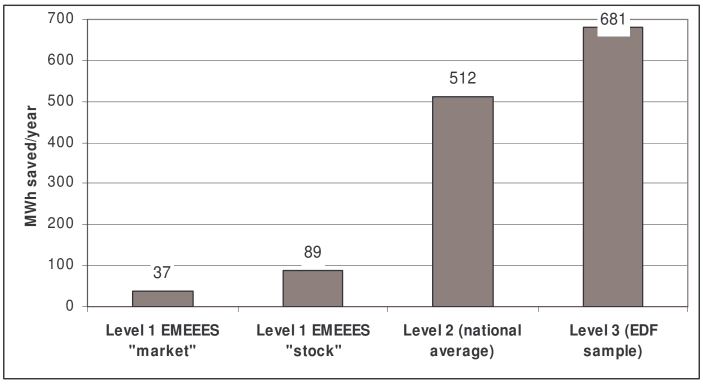

Figure 1. Total gross annual energy savings from the calculation scenarios for condensing boilers.

The first conclusion from these results is that there is a very significant gap between both level 1 (“market” and “stock”) and other results (levels 2 and 3). This highlights that either the EMEEES default values may be too conservative, or the national values used for the FWC scheme overestimate the savings (for the case of condensing boilers), especially due to the very low boiler efficiency used for the baseline. For the ESD reporting, such a difference (between national and benchmark values) should be justified, for harmonisation purpose.

The second conclusion is that the calculated savings are higher, when more participants’ data are used (i.e. level 3 savings > level 2 savings). For such a small sample (68 boilers analysed here), the possible variations due to the different parameters taken into account do not compensate statistically (contrary to the previous case of insulation actions). Another reason may be that actions were implemented in situations of higher unitary savings (e.g. in the coldest climate zone). In these conditions (small sample, targeting specific situations), a level 3 evaluation (i.e. registering more participants’ data) appear to be worthwhile.

Conclusion

The EMEEES methodology (4 steps and 3 levels) and the FWC methods appear to be consistent. Nevertheless, looking into details, some differences may occur, mainly due to the type of available data. But this does not affect the consistency of the distinct options, as long as they are well-documented.

This test is a case example where the Member-State (France) can not directly use the EMEEES method (due to data availability), but may take advantage of the EMEEES method to better use its own existing evaluation method. This is in accordance with the harmonisation objective of the ESD: Member-States remain free, in a certain extent, to use their own evaluation system, but they should use harmonised reporting principles. Therefore, based on this test, this approach appears to be a good way to support a learning and improvement process.

The results from the calculation scenarios emphasise the importance of the nature of the evaluated sample. In the case of large enough samples (here for insulation actions), the results do not differ significantly between level 2 (using national average) and level 3 (using participants’ data) values. This supports the assumption that for large enough samples, possible deviations from national averages statistically compensate. But this is not valid anymore for a small sample (here for condensing boilers). So choosing between a level 2 and a level 3 evaluation can depend on the number of actions, and also whether the actors focused their efforts on specific targets.

Another conclusion from the calculation scenarios is that the difference between a level 1 (using European default values) and a level 2 (using national values) evaluation may be very significant. This confirms that defining conservative default values would induce Member States to assess their own national values (which seems necessary for defining effective energy efficiency policies). At the same time, the comparison between default and national values enables to detect too high differences, which may be due to either a too strong conservativeness for the default values, or to particular national values which would need to be justified (or both).

Finally, the FWC scheme appears to provide a good monitoring system for energy savings, in line with ESD expectations. The comparison with the EMEEES methodology raised some issues, but none would make FWC inconsistent with the ESD requirements. However, it enabled to detect some routines which would be necessary to translate FWC results (as they are accounted so far) into results for the ESD purpose.

References

Adnot, J., Bory, D., Bourges, B., Broc, J.-S. (2008), *Method 7: Residential condensing boilers for space heating*, report for the task 4.2 of the EMEEES project, May 2008, 24p, http://www.evaluate-energy-savings.eu/

Amman, C., Geissler, S., Barreto, L. (2008), *Method 2: improvement of the building envelope of residential buildings*, report for the task 4.2 of the EMEEES project, March 2008, 55p, http://www.evaluate-energy-savings.eu/

ATEE (2006), Technical Association on Energy and Environment, Energy saving certificate, calculation sheet, *individual condensing boilers,* BR85, rev. 9, January 2006

ATEE (2005), Technical Association on Energy and Environment, Energy saving certificate, calculation sheet, *insulation of walls,* BR93, rev. 7, December 2005

Bertoldi, P., Rezessy, S. (2007), *Assessment of White Certificate Schemes and their Energy Savings Evaluation Methods*, Proceedings of the 2007 International Energy Program Evaluation Conference, Reliable Program Results? You Betcha! pp.342-353, 13-16 August 2007, Chicago, IL.

Broc, J.-S., Thomas, S., Adnot, J., Bourges, B., Vreuls, H. (2007), *The developing process for harmonised bottom-up methods*, report D4 of the EMEEES project, Revised version of 20 April 2007, 119p.

DGEC (2009), general directorate for energy and raw materials, http://www.industrie.gouv.fr/

EMEEES (2008), EMEEES - EU funded Project, http://www.evaluate-energy-savings.eu/

Thomas S. et al., *How much energy saving is 1% per year?*, ECEEE 2007 summer Study - Saving Energy – Just Do It!, June 2007, La Colle sur Loup - France, 571-582

EPBD (2002), Directive 2002/91/EC on the energy performance of buildings –EPBD

ESD (2006), European Parliament and council, Directive 2006/32/EC on energy end-use efficiency and energy services of 5/04/2006

French Authorities (2008) Note from The French Authorities, *Subject: Energy efficiency action plan for France*, 27 February 2008, 37p

Kemma, R., van Elburg, M., Li, W., van Holsteijn, R. (2007) *Task 2 Report: Market Analysis, Preparatory Study on Eco-design of Boilers*, VHK, September 2007, 78p. (www.ecoboiler.org)

Ministry of Ecology (2009), Ministry of Ecology, Energy, Sustainable Development, and Town and country Planning, *Energy savings certificate information letter*, January 2009, 2p.

Ministry of Economics (2006), Ministry of Economic, Finances and Industry, *Decree of 19/06/2006 defining standardized energy savings actions*, NOR INDI0607665A

Vreuls, H., Thomas, S., Broc, J.-S. (2008), *General bottom-up data collection, monitoring, and calculation methods*, Deliverable 6 of the EMEEES project, 30 September 2008, 55p.

Acknowledgments

This paper was built on the work carried out under the EMEEES project. Financial support from Intelligent Energy Europe (EIE) program of the European Community is gratefully acknowledged.