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

EMEEES bottom-up case application 20: Voluntary agreements with individual companies - engineering method (industry and tertiary sectors)

Lars J. Nilsson
Christian Stenqvist
Contributions from: Carlos Lopes

Swedish Energy Agency
Lund University

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evaluate energy savings EU

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The Project in brief

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

Consortium

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

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

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

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Lars J. Nilsson
Christian Stenqvist

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1 Summary

1.1 Title of the method

Voluntary Agreements with Individual Companies - engineering method (industry and tertiary sectors)

In the following, energy efficiency improvement is abbreviated as EEI.

1.2 Type of EEI activities covered

End-use (EEI) action	
Sector	Industry, Tertiary
Energy end-use	All electricity end uses as ewll as end uses of fuels and heat
Efficient solution	Investments or changes in the operation and maintenance of pumping systems, air-handling, compressed air, lighting etc., as well specific industrial processes.
(EEI) Facilitating measure	
Types of (EEI) facilitating measures	Voluntary agreements at the industrial or tertiary company level

1.3 Detailed definition of EEI activities covered

The ESD contains no definition of voluntary agreements (VA) but refers in consideration 25 to an agreement “between stakeholders and public sector bodies appointed by the Member States”. Furthermore consideration 26 states that: ”the voluntary agreements which are covered by this Directive should be transparent and contain, where applicable, information on at least the following issues: quantified and staged objectives, monitoring and reporting.”

In this method, a VA is defined as a binding agreement that can apply sanctions if the contracted agreement is broken. An assessment of several VA’s has concluded that binding agreements are more effective in reaching targets (Price, 2005).

Voluntary agreements may be entered with stakeholder organisations, e.g., industrial subsector organisations, or as in this case with individual companies.

Voluntary agreements may include a variety of incentives and penalties and be more or less voluntary (Price, 2005). The method proposed here is developed based on a Swedish programme known as PFE, which is the acronym for

Programme for Energy Efficiency in Energy-intensive Industry. A major incentive is that PFE allows the participating companies to be exempted from the minimum taxation of electricity that was introduced by the Council Directive 2003/96/EC. In return the companies are required to:

- conduct an energy audit and report actions to be implemented
- implement an energy management system
- implement routines to ensure consideration of energy efficient options when purchasing electricity using equipment and when planning new projects

The Swedish voluntary agreement targets only electricity but the method proposed here is applicable also to other energy carriers. Energy auditing is an important component in many voluntary agreements but this method differs from Method 20 on Energy Audits in that it also needs to consider the savings resulting from an energy management system, routines for procurement, and possibly other soft measures such as education, training, information, etc. Such, as PFE exemplifies, are all possible components of a VA scheme.

1.4 General specifications

For energy savings to be eligible and counted towards the target they should result from the voluntary agreement scheme, possibly in combination with other EEI measures that the participants face. Savings can result from:

- Investments or changes in operation that are identified, and subsequently implemented, through an energy audit.
- Investments and changes in operation that are identified through the use of an energy management system.
- Savings that result from purchasing routines (for example with consistent use of life-cycle cost calculations) or new routines to consider energy efficiency when planning new projects.
- Savings that result from education, training, information, etc.

Energy audits generally facilitate level 2 or level 3 calculations since end-use actions and resulting energy savings are specified in the audit reports and, depending on reporting requirements, readily available to the evaluator. Participants to the Swedish PFE, e.g., have an obligation to implement energy saving investments that have a payback period less than 3 years. If an energy audit is an integral part of the VA scheme, the conservative default values established in the EMEEES case application 18 on energy audits can be used for level 1 calculation. There is however, a minimum requirement that end-use actions are at least known to exist on level 1. A list that specifies the number of actions and where these actions have been realised should be reported by the participant.

The savings that accrue from energy management systems and new routines are more difficult to quantify and are likely to differ considerably depending on how actively and consistently systems and routines are applied. Nevertheless attempts should be made to estimate them with conservative national level default values for level 2 calculations and with motivated estimates for level 3 calculations. The level 3 estimates can be motivated through reported savings by participants and the result of surveys and samples.

1.5 Formula for unitary gross annual energy savings

For this method, the unit used in the formula for the unitary gross annual energy savings is an industrial participant (a plant or several plants within a company). The definition (equation S1) is differentiated according to the level of evaluation effort (1, 2 or 3).

Unitary gross annual energy savings = Energy savings of one participant

(equation S1)

The total gross annual energy savings is then calculated as the sum of the savings for all N participants at all possible levels (1-3).

$$\text{Total gross annual energy savings} = \sum_{i=1}^{3} \sum_{j=1}^{N} (\text{savings of level i participant j})$$

Level 1 calculation

Only if an energy audit is an integral part of the VA scheme, the conservative default values established in the EMEEES case application 18 on energy audits can be used for level 1 calculation.

$$\text{Unitary gross annual energy savings} = (DV1_{h,f} * AC_{h,f}) + (DV1_{e} * AC_{e})$$

(equation S1a)

Where:

$DV1_{h,f}$ = default value for heat and fuel savings [%] from the energy audit case application

$AC_{h,f}$ = annual consumption of heat and fuel

$DV1_{e}$ = default value for electricity savings [%] from the energy audit case application

AC_{e} = annual consumption of electricity

Annual consumption values may be based on the average consumption over 3-5 years or estimated if there is no record due to e.g., major changes in production. Calculated electricity savings may be kept separate and converted to primary energy savings at different levels of aggregation.

Level 2 calculation

Unitary gross annual energy savings =
$RS_{h,f} + RS_e + (DV2_{h,f} * AC_{h,f}) + (DV2_e * AC_e)$

(equation S1b)

Where:
$RS_{h,f}$ = reported heat and fuel savings from actions identified in an energy audit and actually realised
RS_e = reported electricity savings from actions identified in an energy audit and actually realised
$DV2_{h,f}$ = default value for savings from changes in routines and O&M [%]
$DV2_e$ = default value for savings from changes in routines and O&M [%]

RS covers only reported savings that result from investments or actions that are clearly identifiable (e.g., retrofitting and reducing leakage in a compressed air system). Changes in Operation & Maintenance (O&M) result from the use of an energy management system which ensures, for example, continuous maintenance and adjustments in the operation of the compressed air system in order to maintain low leakage rates and identify additional savings. DV2 values can be EU country- and, or, subsector-specific. The member state needs to develop and motivate the default values through surveys and samples.

Level 3 calculation

Unitary gross annual energy savings =
$RS_{h,f} + RS_e + (RV3_{h,f} * AC_{h,f}) + (RV3_e * AC_e)$

(equation S1c)

Where:
$RS_{h,f}$ = reported heat and fuel savings from actions identified in an energy audit and actually realised
RS_e = reported electricity savings from actions identified in an energy audit and actually realised
$RV3_{h,f}$ = reported value for savings from changes in routines and O&M [%]
$RV3_e$ = reported value for savings from changes in routines and O&M [%]

RS covers only reported savings that result from investments or actions that are clearly identifiable (e.g., retrofitting and reducing leakage in a compressed air system). Changes in O&M result from the use of an energy management system which ensures high standards in the operation and maintenance of energy using equipment. RV3 values can be based on self-reported estimates but should be corroborated through surveys and samples, or verified by EMS auditors.

1.6 Indicative default value for unitary gross annual energy savings

The default values for unitary annual energy savings that are suggested below can only be accounted for once, i.e. when a participant enters a voluntary agreement. Energy savings are in this sense not cumulative.

Level 1 calculation default values

Only if an energy audit is an integral part of the VA scheme, the conservative default values established in the EMEEES case application 18 on energy audits can be used for level 1 calculation.

Table 1 –Proposed level 1 default values for average energy savings achieved by energy audits (% of the annual energy consumption covered by the audit), from EMEEES case application 18

Sector	Savings % of annual consumption	
	Electricity	**Heat and fuels**
Buildings in the municipal services sector (residential buildings not included)	2%	3%
Buildings in the private services sector (residential buildings not included)	1.5%	4%
Industry (energy-intensive process industry not included)	1%	2%

It is not possible to define clear cut default values with evidential support. Foremost, there are only a few examples of VA's targeting industrial companies. Those existing are characterized by heterogeneity, and there are also decisive variations in the evaluations practices aiming at assessing their impacts. Appendix II provides a compilation of electricity savings that has been reported by the companies participating in PFE. These figures are of course unfit as EU default values, but anyway give some indications on what various end-use EEI actions, within different industrial sectors, can achieve in terms of electricity savings.

Level 2 calculation default values

When developing national default values for $DV2_{h,f}$ and $DV2_e$, it is important that care is taken so that values are based on savings that are additional to the reported savings (RS) from specific actions. This can only be done at national level, as it also depends on the concrete national VA schemes and its role in the context of other measures targeting industrial energy consumers. It is important that national program administrators put an effort into developing country specific default values.

1.7 Formula for total ESD annual energy savings

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

Total ESD annual energy savings = total gross annual energy savings * (1 - free-rider coefficient + multiplier coefficient) * double-counting factor

(equation S2)

1.8 Indicative default value for energy savings lifetime

In the following (see Table 2) indicative default values for energy savings lifetimes are suggested.

Table 2: Proposed default values for energy savings lifetime.

Energy savings lifetime: **EU default values**	
EU default for technical actions	12 years
EU for organisational (EMS) actions	2-4 years

The default value for technical end-use actions is based on CEN CWA-27. Of course, if information on the technical actions implemented by end-use is available, end-use-specific CEN CWA-27 values can be used as well. For organisational actions the CWA-27 suggests a 2 year lifetime. It is suggested here that savings resulting from an energy management system should have a longer lifetime than 2 years. This would have to be proven by proving continuous operation of the energy management system.

1.9 Main data to collect

Table 3: Data needed for calculations on level 1, 2 and 3 respectively.

Data needed in calculation for EU values (level 1)	Corresponding data sources
Annual fuel, heat, and electricity consumption of each participant	Monitoring of participant data
Default values for energy savings (% of annual energy consumption)	Conservative default values, preferably the ones suggested in this report but only if an energy audit is part of the agreement
Free-rider and multiplier coefficient, double-counting factor	Surveys of participants and their end-use EEI actions taken; monitoring of end-use actions vs. facilitating measures to avoid double-counting the impacts of end-use actions

Data to be collected national values (level 2)	Corresponding data sources
Default values for savings resulting from the use of an energy management system, as well as procurement and planning routines	The literature appears to have very little information, anecdotal at best, on the savings that result from energy management in industry. Default values must be developed at national level. Savings may depend strongly on quality of the EMS, country, and industrial branch.
Reported savings from individual technical actions	It is assumed that participants are obliged to report both implemented investment options and saving actions with a payback period of less than 3 years as part of the voluntary agreement.
Annual fuel, heat, and electricity consumption of each participant	Monitoring of participant data
Free-rider and multiplier coefficient, double-counting factor	Surveys of participants and their end-use actions taken; monitoring of end-use actions vs. facilitating measures to avoid double-counting the impacts of end-use actions

Data to be collected participants-specific (level 3)	Corresponding data sources
Reported values for savings resulting from changes in routines, O&M, and energy management system	Self reported from participating companies corroborated by surveys and samples, or verified by EMS auditors
Reported savings from individual technical actions	It is assumed that participants are obliged to report as well as implement investment options and saving actions with a payback period of less than 3 years as part of the voluntary agreement.
Annual fuel, heat, and electricity consumption of each participant	Monitoring of participant data
Free-rider and multiplier coefficient, double-counting factor	Surveys of participants and their end-use actions taken; monitoring of end-use actions vs. facilitating measures to avoid double-counting the impacts of end-use actions

2 Introduction

2.1 Twenty bottom-up case applications of methods

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

This report deals with case application 20 “Voluntary agreements with individual companies – engineering method” developed by the Swedish Energy Agency (STEM).

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

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

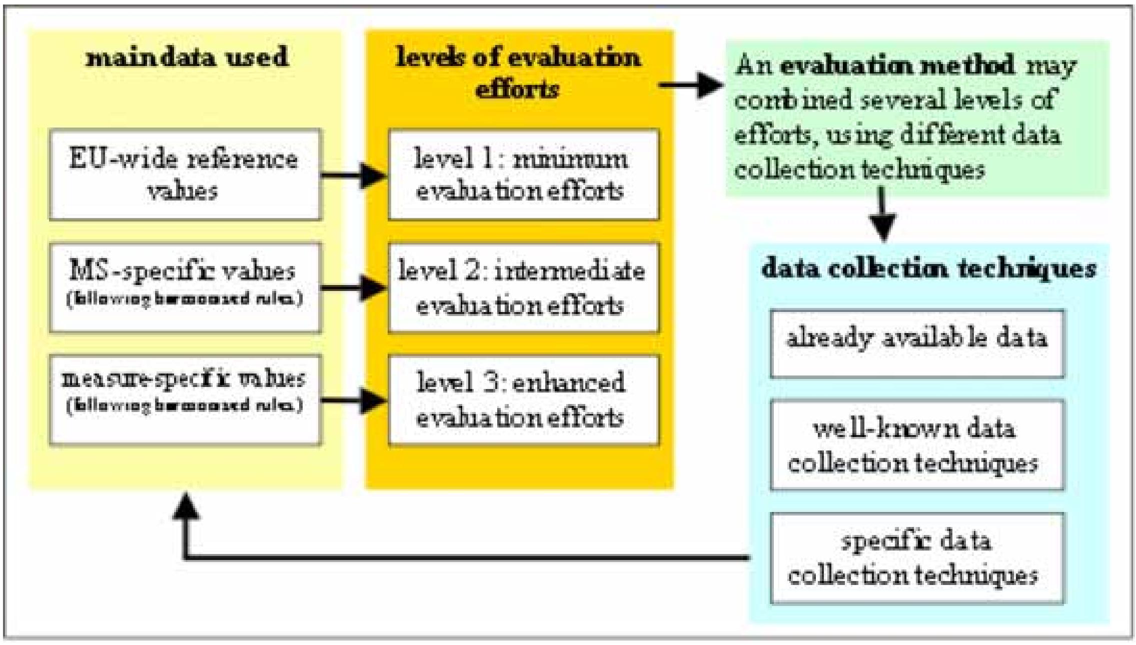
N°	End-use or end-use action, technology, or facilitating measure	Sector	Responsible organisation
1	Building regulations for new residential buildings	Residential	SenterNovem
2	Improvement of the building envelope of residential buildings	Residential	AEA
3	Biomass boilers	Residential	AGH-UST
4	Residential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

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

2.2 Three levels of harmonisation

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

Figure 1: Three levels of harmonisation



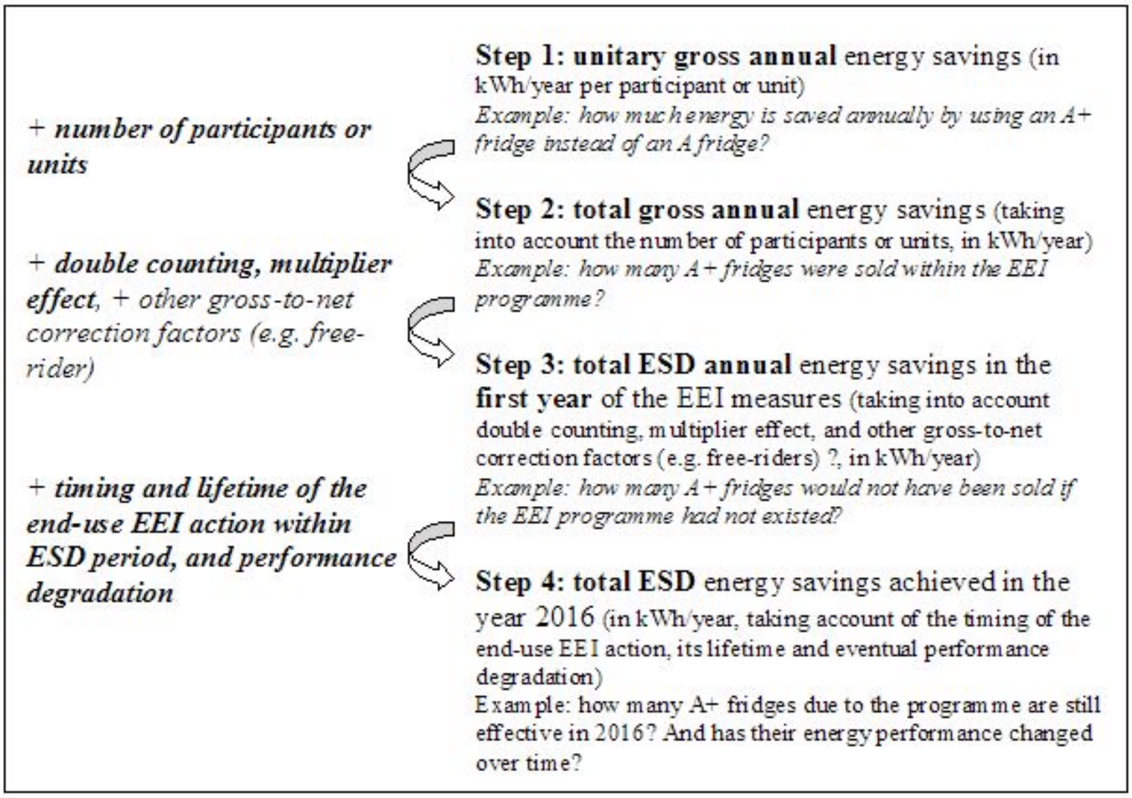
As a consequence, the EMEEES case applications for bottom-up evaluation methods present:

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

2.3 Four steps in the calculation process

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

Figure 2: Four steps in the calculation process



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

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

2.4 Pilot tests

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

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

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

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

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

3 Step 1: Unitary gross annual energy savings

3.1 Step 1.1: General formula and calculation model

The unit used in the formula for the unitary gross annual energy savings is one industrial participant (a plant or several plants within a company) as clarified by equation 1. Depending on the level of evaluation effort (1, 2 or 3) the equation have to be differentiated.

Unitary gross annual energy savings = Energy savings of one participant

(equation 1)

Level 1 calculation

Only if an energy audit is an integral part of the VA scheme, the conservative default values established in the EMEEES case application 18 on energy audits can be used for level 1 calculation.

Even on this level of calculation, the directive requires documentation. As a minimum requirement the end-use action has to be known, i.e. the participant of the VA will have to document and report where the action has been implemented. The type and quantity of the implemented end-use actions should also be clarified. The routines for documentation and reporting are suitably managed with an energy management system (EMS), but can be accomplished also without an EMS if the VA makes no such requirements. These minimum requirements on documentation give no or very weak understanding on the energy savings from the implemented actions. Therefore, conservative default values are used on this calculation level (see equation 1a).

Unitary gross annual energy savings = $(DV1_{h,f} * AC_{h,f}) + (DV1_{e} * AC_{e})$

(equation 1a)

Where:
DV1h,f = default value for heat and fuel savings [%] from the energy audit case application
ACh,f = annual consumption of heat and fuel
DV1e = default value for electricity savings [%] from the energy audit case application
ACe = annual consumption of electricity

The annual consumption values may be based on the average consumption over 3-5 years. If there is no such record estimations have to be made. Such estimations should consider factors that directly influences consumption levels e.g., major changes in production. Calculated electricity savings may be kept separate and converted to primary energy savings at different levels of aggregation.

Level 2 calculation

The level 2 calculation, given by equation 1b, make use of the reported energy savings from an energy audit. In addition the assumed savings due to the energy management system, i.e. changes in routines and O&M, are estimated with national default values.

Unitary gross annual energy savings =
$RS_{h,f} + RS_e + (DV2_{h,f} * AC_{h,f}) + (DV2_e * AC_e)$

(equation 1b)

Where:
$RS_{h,f}$ = reported heat and fuel savings from actions identified in an energy audit and actually realised
RS_e = reported electricity savings from actions identified in an energy audit and actually realised
$DV2_{h,f}$ = default value for savings from changes in routines and O&M
$DV2_e$ = default value for savings from changes in routines and O&M

RS covers only reported savings that result from investments or actions that are clearly identifiable (e.g., retrofitting and reducing leakage in a compressed air system). Changes in Operation & Maintenance (O&M) result from the use of an energy management system which ensures, for example, continuous maintenance and adjustments in the operation of the compressed air system in order to maintain low leakage rates and identify additional savings. DV2 values can be country- and, or, subsector-specific. The member state needs to develop and motivate the national default values through surveys and samples.

Level 3 calculation

At the level 3 calculation (see equation 1c) the reported energy savings from the energy audit as well as from the changes in routines and O&M are accounted for.

Unitary gross annual energy savings =
$RS_{h,f} + RS_e + (RV3_{h,f} * AC_{h,f}) + (RV3_e * AC_e)$

(equation 1c)

Where:
$RS_{h,f}$ = reported heat and fuel savings from actions identified in an energy audit and actually realised
RS_e = reported electricity savings from actions identified in an energy audit and actually realised

$RV3_{h,f}$ = reported value for savings from changes in routines and O&M
$RV3_e$ = reported value for savings from changes in routines and O&M

RS covers only reported savings that result from investments or actions that are clearly identifiable (e.g., retrofitting and reducing leakage in a compressed air system). Changes in O&M result from the use of an energy management system which ensures high standards in the operation and maintenance of energy using equipment. RV3 values can be based on self-reported estimates but should be corroborated through surveys and samples, or verified by EMS auditors.

3.2 Step 1.2: Baseline

The baseline should be the energy consumption at the participating company (or company unit/plant) "before the EEI facilitating measure is implemented". Correction for external conditions can be made according to the normalisation factors listed below. Especially relevant for an industrial company to correct for are factors like plant throughput, level of production, volume or added value, and changes in GDP level (see normalisation factor (e) below). Expressing the "before" energy consumption as an average consumption over a fixed base period, e.g. a few years before the EEI measure is initiated, is one way to deal with external conditions when establishing the baseline.

In this way, there is no distinction of the baseline, either if the objective of the evaluation is to calculate **all** energy savings, or to calculate **additional** energy savings. Additional energy savings are those that, as an effect of an EEI measure, come on top of those that energy consumers, investors, or other market actor would have done by themselves anyway (cf. EMEEES WP 4 summary report, Vreuls et al.) for more explanations).

Theoretically, if an end-use action concerns a replacement of existing equipment (e.g., appliances, boilers, cars; lighting system), one could use EMEEES or individual baseline values for new, inefficient equipment to calculate the additional energy savings. However, this will not be possible in practice. Member States wishing to know the extent of additional savings from a VA scheme might commission studies that analyse this issue for a sample of participants and actions. For the ESD energy savings, we propose not to require this but use the 'before' baseline that is usually also applied in energy audits.

An individual baseline at the company or plant level will always reflect the situation in the year the audit is made, or the end-use action implemented, and will therefore automatically be a '**dynamic'** baseline.

Baseline can only be formulated on the company or plant level, and therefore a baseline on each level, as suggested by Table 6 below will not be relevant in the case of a VA.

Table 6: Baselines on levels 1 and 2 are irrelevant in the VA case

level 1	EU default baseline: n/a
level 2	Member State-specific baseline: n/a
level 3	Participant-specific baseline: consumption before VA or end-use actions

3.3 Step 1.3: Requirements for normalisation factors

In the proposed calculation formulas no consideration has been taken to any of the external conditions that normally affect energy consumption. The ESD mentions the following conditions to be normalised:

(a) weather conditions, such as degree days
(b) occupancy levels
(c) opening hours for non-domestic buildings
(d) installed equipment intensity (plant throughput); product mix
(e) plant throughput, level of production, volume or added value, including changes in GDP level
(f) schedules for installation and vehicles
(g) relationship with other units

The relevance of each of the above factors depends on the type of companies targeted by the VA. For an industrial company at least (a), (d), (e) and (g) will be influential. All these factors can vary from year to year and thus cause actual energy saving to differ from the pre-estimate. Nevertheless, in the case of PFE and other similar EEI facilitating measures, normalisation factors are neglected by the engineering estimates.

It is recommended, in line with the ESD, that normalisation factors are to be considered. In the absence of default values the administrating agency should collect random samples for evaluation, and verification, of the actual importance of external conditions. Companies should also, within the framework of the energy management system, consider the impact of external condition and verify normalisation factors for compensation. For VA schemes, like PFE, that requires participating companies to implement an EMS, the reported estimated energy savings can very well be accompanied by normalisation factors.

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

Monitoring of the implemented end-use EEI actions is necessary to make feasible a quantified evaluation of energy savings accruing from a VA scheme. The level of monitoring that should be decided by the administrating agency is a question of available resources and dedication at the agency as well as at the participating companies. It can be expected that the degree of monitoring varies from inadequate to sophisticated for different EEI facilitating measures. For consideration of the different practices, the three levels of calculation have been developed.

Table 7: Efforts for data monitoring and the corresponding level of calculation.

Level 1	**Deemed savings** approach: Conservative EU default values are used for energy savings (only if energy audit ids part of the scheme, not recommended) Average annual consumption is monitored and reported by the participant The type of end-use EEI action and where it has been implemented is documented and reported, in order to prove its mere existence. Estimation of average energy consumption is needed if records are inadequate
Level 2	**Mixed deemed and ex-post** approach: Participants report the expected energy savings from the actions implemented after an energy audit (**enhanced engineering estimate**) National default value is used for savings from changes in routines and O&M (**deemed savings**) Average annual consumption is monitored and reported by the participant Participants monitor and report their achieved savings (**ex-post**) as far as possible Administrator controls quality and correctness of reports (e.g. through analysing figures, interviewing participants and conduct supervision at the facility)
Level 3	**Enhanced engineering estimate** and **direct measurement** approach: Participants report the expected energy savings from the actions implemented after an energy audit (**enhanced engineering estimate**) Participants also report estimated or measured savings from changes in routines and O&M Average annual consumption is monitored and reported by the participant Participants monitor and report their achieved savings (ex-post) as far as possible (**direct measurement**) Administrator controls quality and validity of reports (e.g. through analysing figures, interviewing participants and conduct supervision at the facility)

For clarification, it is the monitoring of data on savings from changes in routines and O&M that differentiates level 3 from level 2. It has been concluded that default values for this type of organisational savings are difficult to find. Consequently, it is recommended that the participants of a VA, instead of searching for unknown default values, try to estimate their deemed organisational savings and thereby strive for a level 3 calculation. The administrating agency will have to take charge in developing the guiding principle for such estimation. In return for stronger monitoring efforts default values will eventually be established.

The term reporting here refers to the act of a participating company to communicate its data of relevance according to the VA scheme requirements. A practical and effective reporting procedure is probably done through a standard template.

3.4.1 Conversion factors

A voluntary agreement scheme usually involves some kind of reporting that allows the administrating agency to review the potential and/or achieved energy savings of the participating company. The level of detail in this reporting may of course vary, but usually total fuel consumption and fuel savings may be aggregated based on some Member States specific (or even company specific) conversion factors. In such cases, the reporting will not distinguish the consumption and savings, between different fuel types. Thereby it will not be feasible to make ex-post conversions according to the conversion table in Annex II of the ESD. For the sake of an EU harmonisation in this matter it is recommended that Annex II conversion factors are used. Therefore, existing schemes should be amended to ensure reporting by fuel type.

When looking at energy efficiency from a system perspective, it becomes clear that savings in terms of primary energy use rather than end use better reflects the actual energy savings. In this method energy savings are defined as savings occurring at the end user. Conversion factors, i.e. weighting factors converting these figures to primary energy may be used. Therefore the calculated electricity savings should be kept separate and converted to primary energy savings depending on the different levels of aggregation. According to Annex II of the ESD, MS can use national conversion factors or conversion factors listed in the Annex. The ESD suggest that a default co-efficient of 2,5 for savings in electricity may be applied, which reflects the average 40 percent EU generation efficiency.

3.4.2 Considering the direct rebound effect

End-use actions leading to increased energy efficiency will reduce the per unit price of energy services. If a direct rebound effect exists this cost reduction will influence the consumption of energy in an upward direction and, therefore, to some extent counteract the initial reduction in energy use.

The direct rebound effect is not explicitly mentioned in the ESD. It has not yet been decided by the European Commission and the ESD committee, whether this effect shall be included in the total ESD annual energy savings or eliminated from them. In the latter case, the following requirements apply.

At an industrial plant it is not likely that a direct rebound effect would occur. It is the production volume that controls the manufacturing process. Hence EEI actions in industrial equipment like pumping systems, motors, compressed air etc., will not lead to longer periods of operation than the actual manufacturing process requires.

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

What decides the level of calculation is the availability of data. Level 1 is the option for the VA scheme that lacks a proper monitoring system but requires an energy audit. When data has been made available the evaluation should be done at level 2 or 3. What differentiates the two is whether the energy savings from changes in routines and O&M is monitored (level 3) or not (level 2).

Primarily, to be eligible to account for organisational actions the VA scheme must include policy instruments that target: energy management, implementation of routines for procurement of energy efficient equipment, education, training, information etc. Without such measures to promote organisational actions the related parameters ($DV2_e$, $DV2_{h,f}$, $RV3_e$, $RV3_{h,f}$) will have to be left out (i.e. set to zero) in the calculation of unitary gross annual energy savings.

When the VA scheme does include organisational facilitating measures but the effects of these have not been monitored, national default values will have to be applied. Just like it is difficult to quantify the environmental improvement from adopting an environmental management system (e.g. ISO 14001), it is difficult to quantify the effects in terms of energy savings from using an energy management system. Evidence for an energy saving effect will have to be collected through sampling. At level 3 the VA participating companies contribute to increasing this knowledge on EMS, through their efforts on monitoring and reporting.

4 Step 2: Total gross annual energy savings

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

The total gross annual energy savings is the sum of all unitary gross annual energy savings. The unit is one industrial participant (including one or several plants within a company) and hence the calculation is done by summing up the energy savings occurring at all possible levels (1-3) for all industrial participants.

$$\text{Total gross annual energy savings} = \sum_{i=1}^{3} \sum_{j=1}^{N} (\text{energy savings of level i participant j})$$

(equation 2)

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

In this case the number of actions equals the number of industrial participants that have entered the voluntary agreement in question. The administrator of a VA might be a public sector body or another institution appointed by the public sector body. In either way a voluntary agreement calls for a systematic documentation. The ESD consideration 26 states that: ”The voluntary agreements which are covered by this Directive should be transparent and contain, where applicable, information on at least the following issues: quantified and staged objectives, monitoring and reporting.”

Since a VA includes commitments between the individual company and the public sector body, these have to be clarified in a contract. The contract will clarify important matters such as targets, time schedules, documentation and reporting practices etc. Through the signing of an agreement the number of contracted participants will be recorded. This and further documentation regarding the voluntary agreement should be made accessible by the programme administrator or the appointed operating agent.

5 Step 3: Total ESD annual energy savings

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

5.1 Step 3.1: Formula for ESD annual savings

If all correction factors are included, the formula for the total ESD (net) annual energy savings is given by equation 2 below.

Total ESD annual energy savings = total gross annual energy savings * (1 - free-rider coefficient + multiplier coefficient) * double-counting factor

(equation 3)

The correction factors can be explained as follows, according to definitions from ESD and by proposal from the EMEEES project:

The free-rider coefficient: Quantifies the energy savings attributable to actors, who would have implemented an end-use EEI action anyway, but make use of facilities or support provided by an EEI measure. This coefficient has a range of [0, 1]

The multiplier coefficient: Quantifies how the initial energy-saving effect of an EEI measure is enhanced due to a market transformation, i.e. “meaning that the market will implement a measure automatically without any further involvement from the authorities or agencies referred to in Article 4(4) or any private-sector energy services provider.” (ESD Annex IV 5) This coefficient has a range from 0 to, in principle, very large numbers.

The double-counting factor: The combined effect of the overlapping EEI measures may be smaller or larger than the sum of the separate effects. This factor has a range of [0, 1].

Technical interactions: Regards an overlap of the energy-saving effects of two or more end-use EEI actions targeting the same end-use or system (e.g., the simultaneous installation of a new motor, pump and frequency converter in a pumping system where the sum of the individual component saving is greater than the combined total). We propose that this effect is covered in the reported gross annual savings from end-use EEI actions and does not get covered through a correction factor at this level.

As will be discussed below, it is difficult to determine appropriate values for these correction factors. Free-rider and multiplier effects may cancel each other. The attribution of savings to specific policy measures may be difficult to make (consider for example a mix of an EE-motor programme, a voluntary agreement, and increased energy taxes).

5.2 Step 3.2: Requirements for avoiding double counting

Depending on the policy programs that operate in a Member State, industrial companies can be affected by a number of (EEI) facilitating measures alongside with an existing voluntary agreement. Investment subsidies, free or subsidized energy audits and white certificates programmes provide a few examples on policies that may overlap with a VA. In such a situation, i.e. when different facilitating measures are addressed at the same industrial company, the risk for double counting has to be acknowledged. In more detail, the following policy instruments can be part of the package linked to a VA with an individual company:

Economic incentive: Is considered to be the most important driver for change. E.g., the Swedish PFE offers the participating companies an exemption from the minimum tax on electricity (0,5 Euros/MWh). In some circumstances, a tax reduction may instead have a contradictory effect by decreasing the electricity price and thereby creating disincentives for implementing end-use actions. This should not be the case when the tax exemption is kept at a low level, i.e. about 1 percent of the electricity price (for an industrial user), and is offered only in accordance with the VA that make demands for end-use actions. In this case, a tax exemption will become an attractive incentive for a company to join the program. The main cost saving potential however will be found in the reduced energy costs following the implementation of end-use actions. A tax exemption is not the only option for economic incentive. Free or subsidised energy audits, financial support for purchase of energy efficient equipment are other options that have been practised by VA schemes in different Member States.

Energy audit: An energy audit raises awareness about energy saving potentials and thereby increases the probability that end-use actions are implemented.

Binding agreement: A VA includes commitments between the individual company and the public sector body, which have to be clarified in a contract. This contract will have to clarify important matters such as targets, time schedules, documentation and reporting practices etc. Whether the program is a non-binding or a binding agreement should also be clarified. In either case it should be specified what the consequences are for failing fulfilment. In this method a VA is defined as a binding agreement that can apply sanctions if the contracted agreement is broken. An assessment of several VA’s has concluded that binding agreements are more effective in reaching targets (Price, 2005).

Energy management system: What is here referred to is the use of a standardized EMS, based on the “plan-do-check-act” approach. The PFE participants have implemented and attained certification according to the Swedish standard SS 62 77 50. Currently the European Committee for

Standardization (CEN) develops a standard for EMS. This project, going under the title CEN/CLC BT/TF 189, is planned to be finished by the end of 2009. Also an ISO energy management standard (ISO 50001) is expected by the end of 2010. All mentioned standards have in common, a close relation to the structure of ISO 14001 on environmental management system.

Routines for procurement and planning: Routines for considering energy efficient options in procurement and planning procedures could be included in an existing energy management system. Like any management system the scope of an EMS depend on the company's own ambitions. If, for a company the use of such routines is considered to be a significant energy aspect it may very well be incorporated in the EMS.

Procurement based on life cycle cost assessment (LCC) is one example of a routine. The PFE participants are required to adopt LCC-routines for procurement of all electric equipment using more than 30 MWh annually.

The possible range of the double counting factor is [0,1]. A coefficient of 1 represents a situation where no overlapping exists between the VA and other EEI measures. 0 represents a situation with a complete overlap in such a way that no energy savings are attributable to the VA.

Double counting should primarily be avoided. This is done either by evaluating only the combined effects of the whole package of policies and energy services addressed to the companies concerned or by allocation so that each quantified energy saving relates to its specific facilitating measure. Priority rules need to be defined in case that one end-use action was influenced by more than one facilitating measure. The allocation procedure will be straightforward if the administrator of the VA uses a monitoring system that documents the reported end-use actions. Preferably the system should exchange information with monitoring systems that document energy savings with origin from other policy instruments.

With poor, or nonexistent, monitoring systems it will not only be far fetched to estimate a double counting factor. Also the fundamental estimation of the unitary gross annual energy savings will be difficult to secure. Of this reason it is a minimum requirement, even on level 1, that end-use actions are documented and reported by the participating company.

The difficulty of attributing savings to specific programs supports the idea that it may be better to focus on assessing the combined effects of the package of EEI measures on savings in plants, branches, or other appropriate level of analysis. This would not complicate the calculation with a double-counting factor. The double-counting factors could still be considered qualitatively and discussed in the reporting.

5.3 Step 3.3: Requirements for taking account of technical interactions

A technical interaction refers to when several end-use actions have an energy saving impact on the same technical system. The situation may arise that the actual energy saving is different from the sum of the individual actions.

In the context of a VA with energy audits we propose that technical interactions are already handled when ex-ante savings estimates for planned or implemented saving actions are reported. Adding a factor at the aggregate level of calculating total annual savings would only introduce uncertainty.

5.4 Step 3.4: Requirements for multiplier energy savings

In terms of a VA there can be many examples of a multiplier effect leading to spill-over in energy savings.

One example is that a participating company implements more end-use actions than what is being reported to the administrator. Possibly the action does not correspond with the criteria for an end-use action according to the VA scheme. Nevertheless additional energy savings are created upon implementation.

Another possibility is that the experience from energy management learned in one unit/plant within a company is transferred to other parts of the organisation. In this way additional energy savings can be implemented in units/plants that are kept outside the VA.

The VA can also be noticed by non-participating companies that upon recognition will become influenced to implement energy saving actions. There may also be market transformation effects in that more energy efficient technologies become the standard choice in various applications.

It is reasonable to believe that a participating company, often being an energy intensive and important actor in the Member State economy, may lead other companies to also implement energy management system. E.g., through the Swedish PFE a number of guide books on energy management have been prepared for the participating companies, and this information material is accessible also for non- participating companies. With this guidance and upon recognition of energy saving potential it is possible that also companies outside PFE will implement cost efficient end-use actions. This chain of cause and impact might appear somewhat far fetched. Increased awareness for energy issues leading to energy savings within a non-participating company cannot be attributable to one policy measure exclusively.

To assign a credible value for the multiplier effect in relation to an already hard to establish baseline would require rather extensive surveys and research. It may still be commented on in qualitative terms in the reporting.

5.5 Step 3.5: Requirements for the free-rider effect

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

The possible range of the free rider coefficient is [0, 1]. 1 represents a 100 percent free rider effect meaning that all end-use EEI actions reported to the administrator would have been implemented irrespective of the VA. A coefficient of 0 represents the opposite, i.e. all end-use EEI actions are attributable to the VA. There can be numerous factors influencing the degree of free ridership. An estimation of the free rider effect associated with a VA could consider the particular design of the agreement. Respect could be taken of the incentives and/or penalties involved for participating companies to cope, or not cope, with the agreement. Differences among the participating companies in terms of: turnover, profit/loss, energy costs as a share of total production costs etc., will further complicate the estimation.

Monitoring the achieved energy savings of the participants and relating the result to a control group of non-participants that represents a baseline is one way to estimate the free rider effect. If the identification of a relevant control group is unfeasible, a survey directed only to the participants could be conducted. A suggestion of a straightforward questionnaire design is given in the box (figure 3) below.

Q1: Which of the reported end-use actions would have been implemented irrespective of the VA?

Q2: Which of the reported end-use actions were identified and planned to be implemented before entering VA?

Q3: Which of the reported end-use actions were identified as potential actions to implement before entering the VA?

Figure 3: An example of a questionnaire for targeting the free-rider effect

Based on the end-use EEI actions received the corresponding energy savings on each level Q1 to Q3 are summed up, cleared for double-counting, and multiplied with a “reasonable” coefficient (a, b, c) that states the likelihood that the action actually is being implemented. The sum of all levels is thereafter divided by the total gross annual energy savings, i.e. the energy savings of all participants (see figure 4).

$$\text{Free rider coefficient} = \frac{Q1 * a + Q2 * b + Q3 * c}{\text{Total gross annual energy savings}}$$

The coefficients could for example be defined as: a=1, b=0,5 and c=0,25.

Figure 4: Calculation of free-rider coefficient based on questionnaire response.

However, it should be noted that even a simple decision about, for example, replacing a pump is based on a number of considerations including reliability, price expectations, remaining technical lifetime, etc., and it is very difficult to single out the effect of a specific program. The answer to Q1 may well be: - We do not know.

Alternatively, it could be decided that all investments with a pay-back time of less than one or two years should be considered free-rider savings since it could be argued that they should be implemented anyway.

For the purpose of reporting the ESD energy savings, as said above, the free-rider effect will only need to be considered if the aim is to calculate additional energy savings. Even in this case, in light of the difficulties of determining the free-rider effect in the context of industry and voluntary agreement we propose that it should only be attempted to quantify it for VA schemes that deliver more than 50 million kWh of annual energy savings or, if that is not the case, more than 10 % of the national ESD target (cf. Vreuls et al, 2009). However, it should in any case be commented on in qualitative terms in the reporting, and is certainly an effect to be taken into consideration by a MS when evaluating the VA as a policy program.

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

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

6.1 Requirements for the energy saving lifetime

The following values are suggested as default values:

Energy savings lifetime: **EU default values**	
EU default for technical actions	12 years
EU for organisational (EMS) actions	2-4 years

The default value for technical end-use actions is based on CEN CWA-27 that states the following energy saving lifetimes for end-use EEI actions in the industrial sector; pumping systems 15 years, compressed air systems 15 years, waste heat recovery 15 years, motors/variable speed drives 10 years and combined heat and power 8 years. A reasonable default value will therefore be in the domain 10-15 years, and here 12 years is proposed. Of course, if information on the technical actions implemented by end-use is available, end-use-specific CEN CWA-27 values can be used as well.

For organisational actions the CEN CWA-27 suggests a 2 year lifetime. It is suggested here that savings resulting from an energy management system should have a longer lifetime than 2 years. This would have to be proven by proving continuous operation of the energy management system.

6.2 Special requirements for early actions

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

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

OR

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

If the latter interpretation is confirmed, a Member State can include in its ESD savings the energy savings that accrue from early end-use actions initiated between 1995 and 2008, if there is a lasting effect in 2016 (or 2010 for the intermediate target). This, of course, can only be done under the condition that:

Energy saving lifetime ≥ 8 years + 2008 – year of installation

For the inclusion of early actions this will have to be demonstrated. Acknowledging the proposed default value for energy saving lifetime for technical actions (i.e. 12 years), there will not be many pre 2004 actions that will last until 2016, unless longer lifetimes are proven.

6.3 How to treat uncertainties

Uncertainties have been identified throughout this report and will certainly have to be treated at each level of calculation. Some uncertainties are general in the sense that they arise from the functioning of the VA scheme. The table below aims to exemplify by presenting some important components of the Swedish PFE (see table 8). The related uncertainties will have relevance also to other VA schemes given that they include the same or similar components. For a thorough discussion on uncertainties related to energy audits, which is considered a central component of a VA scheme, it is recommended to read EMEEES case application #18 on Energy Audits (Suomi U., Gynther L. 2007).

Table 8: Uncertainties related to procedures of the policy program with PFE as an example

VA scheme component	Related uncertainties and possible countermeasures
Conduct energy audit	The quality of the energy audit depends on e.g.: the auditing scheme, quality of input data (e.g. measurements), the competence of the auditor. These factors will eventually influence the reported potential and deemed energy savings. The VA administrator must clearly define the audit scheme (i.e. comprehensive or system specific EA), and set appropriate standards for its implementation. Auditors can gain competence through training and certification.
Audit report of identified end-use actions	The quality of the audit report depends on e.g.: the assumptions made (i.e. choice of parameter) in energy savings calculations, the carefulness when fill in the form/report. By using a standard template for reporting misunderstandings can be avoided. Handbooks for reporting in accordance to the template will ease the work. The quality of the reports should be controlled by the administrator.
Implement and certify EMS. Apply routines for procurement and planning.	Difficult (or impossible) to judge whether the EMS and related routines are implemented to a sufficient or satisfying degree. It is a subjective statement that must be defined by the individual company and thus it can only reflect its level of ambition, in the work with energy management. Accreditation of certification institutes can at least give status to an EMS

	certificate. Administrator should practise supervision to make sure that EMS and routines are taken serious among the participants, but also to collect experiences from the implementation of organisational measures for energy saving.
Reported realized end-use actions	Sources for uncertainties are e.g.: the risk that companies deliberately over- or understate realized savings (for reasons unknown), the criteria (set by the administrator) for when to implement an action can be indistinct, the carefulness when filling the form/report. Savings effects from EMS and routines are difficult to quantify and large uncertainties can be suspected. Quality control and supervision to verify results is important. Otherwise the VA will have to build simply on trust. Especially when economic incentives are involved this can be regarded doubtful.

Appendix I: Justifications and sources

CWA 27 2007. *Lifetimes in Energy Efficiency Calculations*. CEN Workshop Agreement 27. CWA 15693:2007. CEN, Paris, France.

Nuijen, W. and Booij, M., 2002. *Experiences with Long-Term Agreements on Energy Efficiency and An Outlook to Policy for the Next 10 Years*. Utrecht, The Netherlands: NOVEM. Pdf available online: http://www.senternovem.nl/mmfiles/lta_experiences_report_tcm24-171835.pdf

Price L. 2005. *Voluntary Agreements for Energy Efficiency or GHG emissions Reduction in Industry: An Assessment of Programs Around the World.* Proceedings of the 2005 ACEEE Summer Study on Energy Efficiency in Industry.

STEM 2007. *Två år med PFE – De första redovisade resultaten*. Swedish Energy Agency, Eskilstuna. Pdf available online: http://www.swedishenergyagency.se/web/biblshop.nsf/frameset.main?ReadForm&Doc=1902

Suomi U., Gynther L. 2007. *Task 4.2: harmonised bottom-up evaluation methods; Method 20, Energy Audits*. Pdf available online: http://www.evaluate-energy-savings.eu/emeees/downloads/EMEEES_Method_20_Energy_Audits_Final_draft_071130.pdf

Vreuls, H., Thomas, S., Broc, J.-S., 2009. *General bottom-up data collection, monitoring, and calculation methods, Summary report.* SenterNovem, Sittard, Wuppertal Institute, Wuppertal, ARMINES, Nantes

Appendix II: List of reported electricity savings from PFE

Industrial sector / elec. savings of total sector	Type of end-use EEI action[i]	No. of end-use EEI actions[ii]	Average elec. savings (of total elec. use)[iii]	Average elec. savings (MWh/a)[iv]
Pulp and paper manufacturing / 2,10 %	Pumping systems	169	0,15 %	755
	Motors	42	0,20 %	575
	Fan systems	22	0,10 %	435
	Lighting systems	17	0,06 %	170
	Compressed air syst.	13	0,09 %	515
Manufacturing of chemicals, chemical products and plastic goods / 2,2 %	Pumping systems	16	0,57 %	440
	Compressors	12	0,46 %	875
	Motors	11	0,37 %	40
	Fan systems	10	0,33 %	140
	Cooling systems	8	0,49 %	435
	Compressed air systems	5	1,18 %	970
Sawmills wood product manufacturing / 3,5 %	Lighting systems	11	0,59 %	75
	Motors	5	0,88 %	150
Food and beverage production / 6,2 %	Ventilation- and heating systems	11	0,3 %	230
	Pumping systems	11	0,24 %	150
	Lighting systems	8	0,14 %	115
	Fan systems	6	0,43 %	335
Steel and metal production / 2 %	Motors	23	0,12 %	200
	Fan systems	7	0,14 %	470
	Ventilation- and heating systems	7	0,13 %	290
Mines, Ore refining / 3,5 %	Ventilation- and heating systems	13	0,14 %	710
	Pumping systems	10	0,03 %	380

[i] The participants have reported their end-use EEI action according to a categorization into type made by the PFE administrator. Listed here are only the more frequently occurring types of actions.
[ii] An end-use EEI action can include one or several components, e.g. a pumping system can consist of one single pump but usually refers to improvements in several pumps.
[iii] The average electricity saving for a type of end-use EEI actions is the percentage of the total electricity use reported by the participating company. The total elec. use can include one or several plants within a company.
[iv] The average electricity saving in MWh per year is the average of the reported end-use EEI actions. MWh/a refers to the first year saving which, when neglecting normalisation factors, is assumed to be sustained over the consecutive years during the energy saving lifetime.