CEN WORKSHOP AGREEMENT xxxxx

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English version

Saving lifetimes of Energy Efficiency Improvement Measures in bottom-up calculations

Final CWA draft (CEN WS 27)

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Foreword

This CEN/CENELEC Workshop Agreement 27 lays down values of average saving lifetimes for different energy efficiency improvement (EEI) measures, and/or an agreed methodology to establish these average saving lifetimes, in bottom-up calculations of energy savings.

As the energy saving effect of some EEI measures last for decades, while other measures last for a much shorter period of time, saving lifetimes per EEI measure type are a must when calculating total energy savings (to be) realized at any point in time.

In this edition of the CWA xxxxx the values of average saving lifetimes, and/or an agreed methodology to establish these average saving lifetimes, are specified for different EEI measure types for bottom-up calculations.

This CEN/CENELEC Workshop Agreement has been prepared by a Workshop, the Secretariat of which is held by the Netherlands Standardization Institute (NEN). The document has been developed through the collaboration of a number of contributing partners, representing a wide mix of interests.

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This Workshop Agreement has been prepared in close cooperation with the European Commission (DG TREN and DG JRC), and is intended to support the bottom-up calculations of (to be) realized energy savings in relation to the Directive on energy end-use efficiency and energy services of the EU [1], further referred to as Energy Service Directive (ESD).

This CWA xxxxxx results in a list of saving lifetimes of EEI-measures that covers most of the ESD Annex III exemplary measures, and is the proposal for the Commission to replace the example list of lifetimes in ESD Annex IV item 4 (Harmonised lifetimes of energy improvement measures in bottom-up calculations). One has to keep in mind that this is a preliminary list, based on current knowledge at the time of publishing. A more comprehensive list of EEI measures and harmonised saving lifetimes is needed by Member States for the EEAP's reporting 2011.

The lifetimes resulting from this CWA xxxxxx constitute an input to the calculation of bottom-up energy savings. An overall calculation method will be development, e.g. by the CEN/BT TF 190 and in the IEE project "Evaluation and Monitoring of the EU Directive on Energy End-use Efficiency and Energy Services (EMEEES)".

The formal process followed by the Workshop in the development of this CEN Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN Management Centre can be held accountable for the technical content of this CEN Workshop Agreement or possible conflict with standards or legislation. This CEN Workshop Agreement can in no way be held as being an official standard developed by CEN and its members.

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Comments or suggestions from the users of the CEN Workshop Agreement are welcome and should be addressed to the CEN Management Centre.

1 Scope

This CEN Workshop Agreement specifies a list of values of average saving lifetimes, and/or an agreed methodology to establish these saving lifetimes, for commonly implemented types of energy efficiency improvement (EEI) measures in end-use. These saving lifetimes can be used in bottom-up calculations of energy savings, (to be) realized as result of policies and actions, as part of Directive 2006/32/EC on energy end-use efficiency and energy services (Energy Service Directive, ESD).

This Workshop Agreement provides saving lifetimes in relation to the ESD, and does not supersede saving lifetimes used in Member States for other purposes. The CEN Workshop Agreement recognizes that there is variation in the saving lifetimes of EEI measures across Member States.

NOTE The term 'saving lifetime' is used in this CWA, as to avoid confusion with the lifetime of products, used by manufacturers in e.g. a guaranty on duration of the product.

2 Normative references

There are no normative references.

3 Terms and Definitions

For the purposes of this CEN Workshop Agreement the following terms and definitions shall apply (for end-use that is subject to the Energy Service Directive).

3.1 Energy efficiency (improvement)
energy efficiency is the ratio between an output of performance, service, goods or energy, and an input of energy. An improvement in energy efficiency means an increase in energy efficiency as a result of technological, behavioural and/or economic changes

NOTE It regards both reductions in energy demand (e.g. insulation) as well as higher conversion efficiencies in end-use (e.g. boiler).

3.2 Energy efficiency improvement (EEI) measures
all actions in end-use of energy that normally lead to verifiable and measurable or estimable energy efficiency improvement

NOTE This regards technical measures, organisational measures and behavioural measures in specific parts of end-use.

3.3 EEI measure type
a category of EEI measures with similar characteristics as to energy efficiency

3.4 Energy savings
the amount of saved energy determined by measuring and/or estimating energy consumption before and after implementation of one or more EEI measures, whilst ensuring normalisation for external conditions that affect energy consumption

NOTE For technical systems it regards the difference in energy use between the new energy efficient system and the old replaced system.

3.5 Saving period
number of years after implementation of the measure, for which the measure is performing and there is a verifiable effect on energy consumption

3.6 Saving lifetime

number of years actually used in calculations of bottom-up energy efficiency improvement. The saving lifetime can take into account, explicitly or implicitly, factors that influence the energy savings during the saving period of EEI measures or measure types

NOTE The saving lifetime can diverge from the saving period due to correction factors.

3.7 Harmonised saving lifetime

saving lifetime, agreed on in this CWA for specified EEI measures, used throughout the EU in bottom-up calculations of energy savings for the ESD

NOTE This harmonised saving lifetime constitutes an average value for all EEI measures to be classified under a defined measure type. It does not supersede EEI measure lifetimes used in Member States for other purposes.

3.8 Default saving lifetime

conservative (lowest) estimate of a saving lifetime, valid throughout the EU for those EEI measure types where no harmonised saving lifetime is available

NOTE 1 Member States can choose to determine the saving lifetime instead of using the default value.

NOTE 2 This default lifetime does not supersede lifetimes used in Member States for other purposes.

3.9 Initial savings

energy savings in the first year of the implementation of the EEI measures

NOTE In practice, and under normal conditions, this regards the energy savings in the first calendar year of regular operation of the EEI measure.

3.10 Yearly savings

the energy savings of implemented EEI measures in each year of the saving period

NOTE In practice, yearly savings often are equal or lower than the initial savings in the course of time.

3.11 Cumulative savings

sum of yearly energy savings over the saving period

NOTE Cumulative savings are also referred to as lifetime savings.

3.12 Design lifetime

intended lifespan, in terms of functioning time, number of functioning cycles, etc., foreseen by the manufacturer when he designs the product, provided that it is used and maintained by the user as intended by the manufacturer

NOTE 1 This definition regards technical EEI measures where lifetime is defined by technical properties of the system. E.g. for boilers the period without non-incidental failure.

NOTE 2 The design lifetime must not be confused with the guarantee period of products, which is a commercial and marketing aspect.

3.13 Economic lifetime

period during which the EEI measure (well maintained) is sufficiently economically attractive as to keep the saving measure in service

NOTE In many cases economic lifetime regards measures where the functioning can be stopped if wanted, e.g. smaller cogeneration units in case of an unfavourable ratio of fuel and electricity prices.

3.14 Behavioural/Social lifetime
number of years until the device, with improved energy efficiency, is replaced for other reasons than technical failure or economic unattractiveness

NOTE This generally regards consumer goods where replacement is not related to the design lifetime of the good but to social and consumption trends.

3.15 Technical measures
deployment of physical devices, either replacing an energy using system or additional to such a system, that save energy

NOTE The definition of energy efficiency implies that the activity, performance, service, output, etc. realized with the efficient device is at least the same as for the replaced device.

3.16 Organisational measures
change in the management of energy systems, working schedules and/or procedures as to decrease energy consumption

NOTE The definition of energy efficiency implies that the activity, performance, service, output, etc. is not influenced by the organisational measure. Usually organisational measures exploit the potential of already installed technology in a better way or avoid unnecessary energy consumption by better monitoring of energy use.

3.17 Behavioural measures
change in daily behaviour of persons as to energy using systems, leading to lower energy use

NOTE The definition of energy efficiency implies that the activity, performance, service, output, etc. is not influenced by the behavioural measure. In case of reduction of unnecessary energy use this is true; however, lower thermostat setting than experienced as comfortable constitutes a lower level of service.

3.18 Deterioration
change in the performance of the EEI measure after implementation, leading to a decrease in yearly energy savings

NOTE For technical measures it regards deterioration in system characteristics; for behavioural measures it regards people reverting back to their old habits/behaviour on energy use.

3.19 Non-retention
non-retention is the inverse of retention, being the degree to which the EEI measure remains in place/operation after implementation, as a result of developments not related to the characteristics of the measure itself but to the superior system

NOTE 1 The term retention should preferably be used as the term “obsolescence” has another meaning, e.g. when a component cannot be found on the market (for technical or economic reasons) as spare part of a product that shall be maintained or repaired.

NOTE 2 Examples are EEI measures in office buildings, where the saving effect disappears when offices face vacancy due to changing market conditions.

3.20 Ex-post evaluation
backward looking studies aimed at determining the realized energy savings, and the effects of policy measures or programmes, based on observed developments in preceding years

3.21 Ex-ante evaluation
forward looking studies aimed at determining the anticipated energy savings and the effects of policy measures and programmes, based on expected developments, e.g. according to energy scenarios or other forecasting activities

3.22 Maintenance regime
change in lifetime and/or performance after implementation of the EEI measure due to (lack of) maintenance

NOTE 1 In defining the design lifetime the maintenance regime corresponds to the normal maintenance advised by the manufacturer in the context of the design of its products, e.g. for cars, to change oil every 30000km, to change brake pads when they are worn out. In practice insufficient maintenance can lead to a shorter lifetime.

NOTE 2 Lack of maintenance can also lead to lower yearly energy savings. Regular maintenance can restore this downward trend. However, this effect is not taken into account in this CWA document..

4 Symbols and abbreviated terms

4.1 Symbols

No symbols to be specified.

4.2 Abbreviations

EEI Energy Efficiency Improvement

ESD Directive on Energy End-use Efficiency and Energy Services

SP Saving Period

DLT Design Lifetime

ELT Economic Lifetime

BLT Behavioural/Social Lifetime

SLT Saving Lifetime

CFnr Correction factor for non-retention

CFm Correction factor for maintenance regime

EEAP Energy Efficiency Action Plan

5 Determination of saving lifetime figures

5.1 General approach

The bottom-up calculation of energy efficiency improvements for the Energy Service Directive (ESD) demands saving lifetimes per type of EEI measure. The ESD stated that an agreed preliminary list of the average lifetime of different EEI measure types must be available by November 2006. Annex A shows a list of commonly (to be) applied measure types for energy end-use in sectors inside the scope of ESD (households, services, transport and part of industry). These EEI measure types have been split into technical, organizational and behavioural measures.

The ESD expresses a strong preference for harmonised saving lifetimes, valid for all Member States. These are most convenient in calculations of bottom-up energy savings and facilitate comparison of the results across Member States. In practice, however, there exist several barriers for defining harmonised lifetimes:

- For many EEI measure types there exists only poor empirical evidence on the actual duration of energy saving effects. Figures used for saving lifetimes in national energy efficiency programmes are prevailingly based on expert estimates only.
- In several cases there exist real differences between Member States with regard to the saving lifetime of the same EEI measure type. These differences may be due to climate, building practices and energy use patterns in general.
- For behavioural and organizational saving measures the saving lifetime depends to a great extent on the way these measures are stimulated. Policies and programmes to support these type of measures widely differ across Member States.

If harmonised saving lifetimes are not attainable, saving lifetimes need to be determined, in principle, for each single EEI measure type separately. However, this is not possible in many cases due to lack of data and/or resources. Then a default saving lifetime value can be a practical solution.

In consequence this leads to the following approaches:

- Harmonised saving lifetime figures for all EU-countries.
- Saving lifetime figures, calculated according to a prescribed methodology (or derived from surveys or measurements).
- Default saving lifetime values, based on a conservative estimate of actual lifetimes.

In all cases the saving lifetime may be dependent on a number of factors. In the following these factors are described and it is decided which factors should be taken into account, whether implicitly in harmonised saving lifetimes or explicitly in calculated saving lifetimes.

In practice the lifetimes of individual EEI measures of the same type will show a (wide) range of values. However, in this CWA it has been assumed that average values can be used for the large number of EEI measures in the bottom-up calculation of total energy savings.

5.2 Factors in calculating energy savings and saving lifetimes

The use of saving lifetimes in bottom-up calculations for the Energy Service Directive should enable a reasonable accurate picture of total energy savings, to be expected or realized, in the years between 2008 and 2016. The total savings are the sum of yearly savings over all EEI measures, applied from 1995 on (in some cases 1991) and still contributing in the chosen year. All factors that define the yearly savings of the EEI measures should be taken into account as to meet ESD demands.

Figure 1 shows the possible development of energy savings over time for a specific EEI measure. Energy savings accumulate from implementation until the moment when the EEI measure stops performing. The cumulative savings are defined by three elements:

- the initial energy savings
- the saving period
- the divergence from initial energy savings during this period.

The yearly savings are the product of initial savings and relative change in savings.

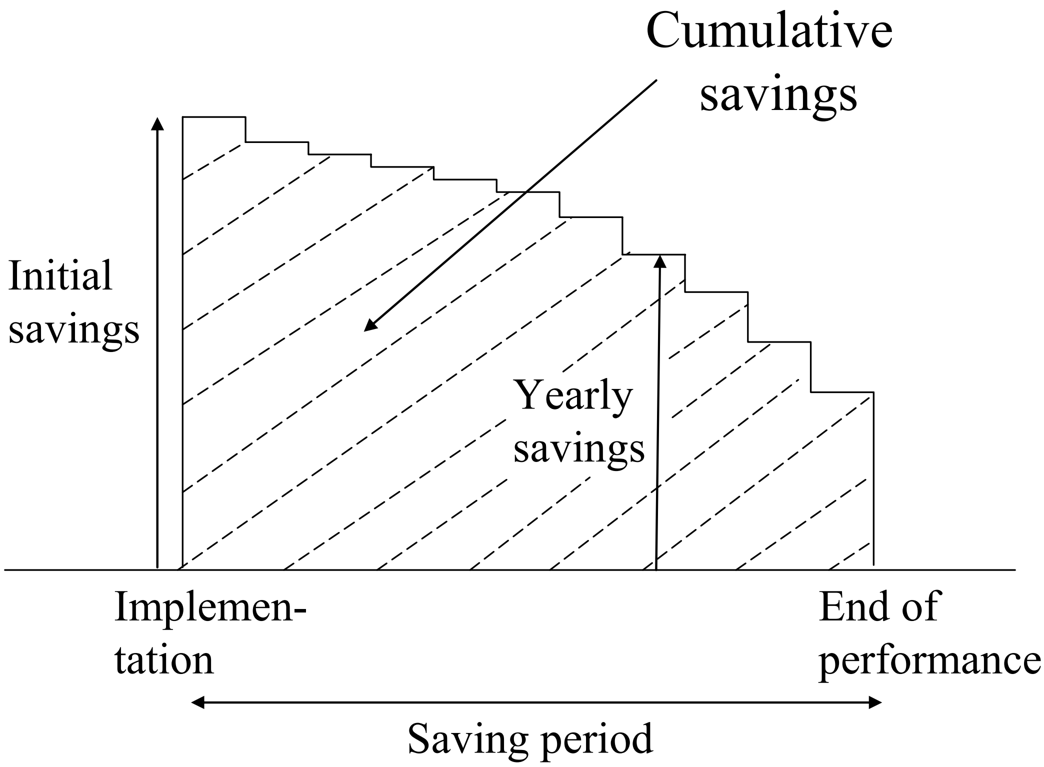

Figure 1 — Development of energy savings for a specific EEI measure

The amount of cumulative savings is dependent on a number of influencing factors (see e.g. [3] and [4]). On the one hand they can influence the saving period (x-axis in Figure 1) and on the other hand the level of yearly energy savings (y-axis in Figure 1). In the following these factors will be described in more detail. Further on, it has to be decided which factors should be taken into account when determining saving lifetimes.

Factors influencing the saving period (SP)

The saving period during which an EEI measure performs will depend on factors that define the end-of-performance moment.

Design lifetime
The design lifetime defines the intended lifetime of a technical EEI measure, provided that it is used and maintained as foreseen by the manufacturer. Replacement by a new system is mostly due to increased malfunction of the system. The design lifetime will normally define the maximum length of the saving period (see Figure 2).

For behavioural and organisational EEI measures, focusing on the efficient use of existing energy using systems, no “design” lifetime can be defined.

Economic lifetime
In some cases technical system are replaced earlier or switched off for economic reasons, although from the technical point of view they are still functioning well. For example, smaller CHP units are sometimes switched off because the ratio between fuel prices (costs) and electricity prices (benefits) has become too unfavourable. This economic lifetime will be shorter than the design lifetime (see Figure 2).

Behavioural/social lifetime
Consumer electronic appliances are frequently replaced before the end of their technical lifetime due to behavioural or social reasons, e.g. because audio- or video systems with new features enter the market. The behavioural/social lifetime will be shorter than the design lifetime, and often shorter than the economic lifetime (see Figure 2).

For behavioural and organisational EEI measures no "design" lifetime can be defined; the behavioural/social lifetime is the only lifetime to be used.

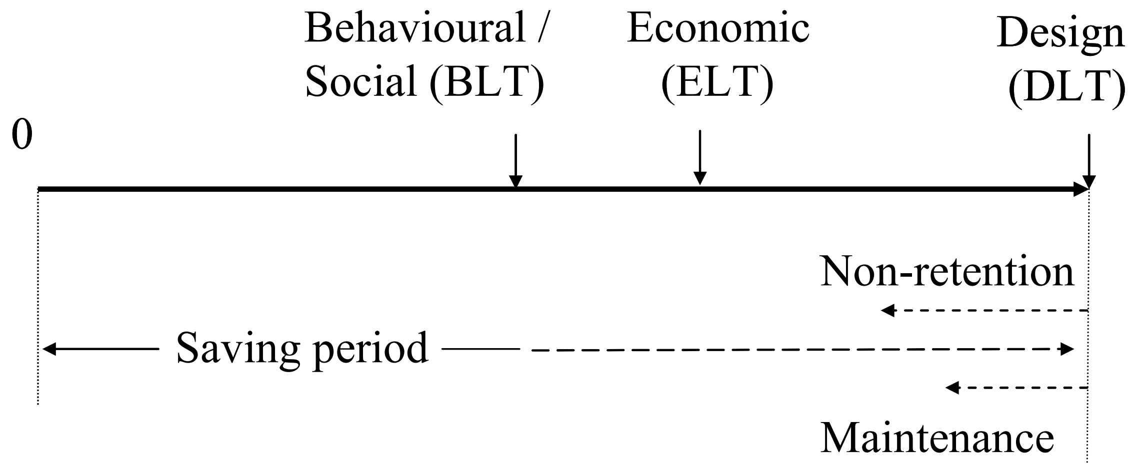

Figure 2 — Saving period as result of design-, economic- and behavioural/social lifetime

Non-retention
EEI measures are often part of a superior system, e.g. insulation is part of a dwelling and an efficient engine is part of a car. Non-retention (see definition in section 3.19) of an EEI measure means that the measure is not saving any more because the superior system stops operating. For instance, the often occurring vacancy in older office buildings limits or ends the saving effect of EEI measures in the building. Non-retention thus may shorten the saving lifetime of EEI measures even if the measure itself is able to function (see Figure 2).

Maintenance regime
For some technical EEI measures the quality of maintenance influences the saving period (see Figure 3). Due to lack of maintenance the actual saving period can be lower than the design lifetime which is based on a prescribed amount of maintenance.

Factors influencing the yearly savings

After implementation of the EEI measure the initial savings can change due to the following factors.

Deterioration
For technical systems deterioration of the saving effect means that the initial saving effect erodes due to aging, e.g. by fouling of the heat exchanger in the boiler. In other publications [3] the term "performance degradation" is used. For behavioural EEI measures the factor deterioration represents a change (mostly a loss) in saving performance for the group of participants. For instance, after stopping a campaign to turn off unused lights people will "forget" to turn off the lights more and more and revert back to old habits.

Maintenance regime
For many technical EEI measures the quality of maintenance influences the level of yearly energy savings achieved (see Figure 3). The maximum influence on the level of savings is equal to the

difference in savings for no maintenance or optimal maintenance. Maintenance could compensate to a certain extent for the loss in yearly energy savings due to other factors.

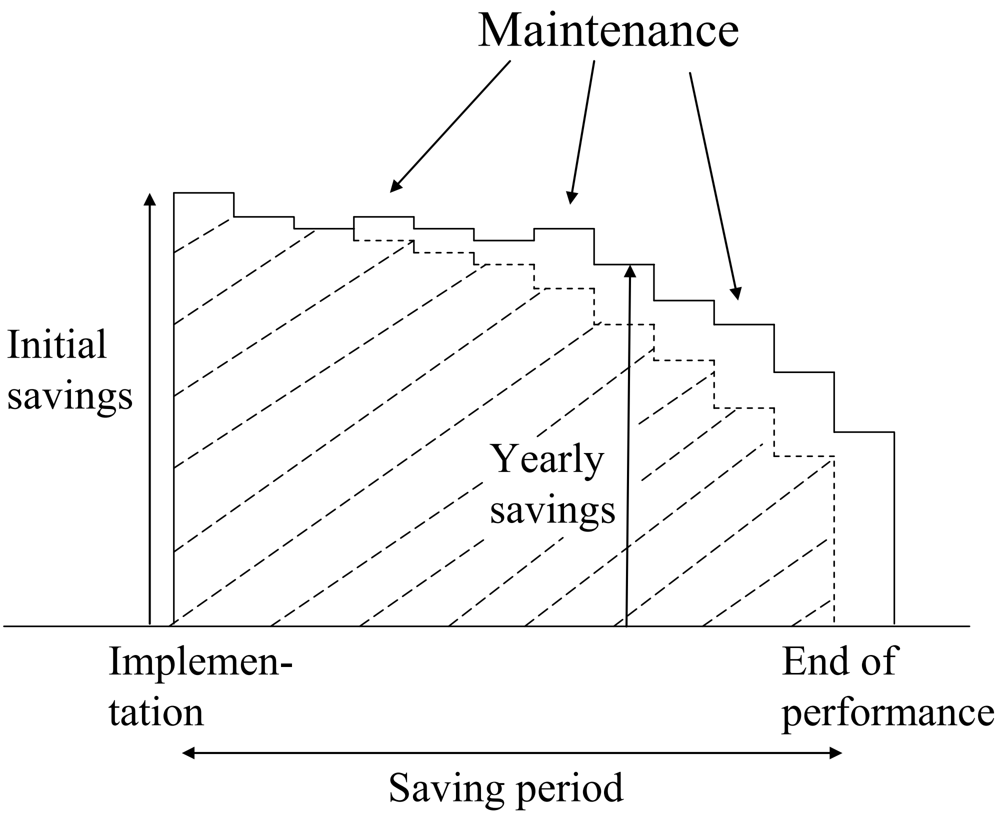

Figure 3 — Development of energy savings for a specific EEI measure with maintenance effect

Usage pattern
Another factor that could influence yearly savings is a change in the pattern of use of the energy saving systems that changes the intensity of use and subsequently the yearly savings. For instance, retirement of household members influences occupation rates and space heating demand, and thus the savings of energy efficient boilers. Expansion of activities in companies could increase the savings due to an energy management program. And (policy induced) mitigation of car use decreases the savings of fuel efficient motors.

Climate change
Climate change will presumably lead to warmer winters and hotter summers in Europe. The first effect lowers heat demand for space heating, the latter raises demand for space cooling, refrigerators, etc. In this way climate change will influence cumulative energy savings from implementing EEI measures. Contrary to the preceding "usage" factor this effect is not the result of decisions of individuals but of global long-term trends.

The factors described could lead to a yearly energy savings of EEI measures that is lower than the initial value (see Figure 1). Total bottom-up savings decrease as well, as these are the sum of yearly energy savings over all EEI measures. To take account of these lower energy savings the initial savings can be corrected. However, this would fall outside the scope of this CWA (see next section).

Instead of initial savings the lifetime can be corrected for lower yearly savings. Actually this means that the EEI measure is assumed to perform at the level of initial savings, but for a shorter period than the actual saving period SP. This method will overestimate the energy savings in earlier years but underestimate the contribution of an EEI measure at the end of the saving period. However, this

method can be acceptable when many different EEI measures, implemented in various years, are present. The effects of overestimation and underestimation will level out and calculated total bottom-up savings will give a reasonable picture of actual total energy savings.
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Factors inside and outside the scope of this CWA

In the CWA it has been agreed to incorporate in the saving lifetime the factors (if relevant) that can influence the saving period:

- design lifetime;
- economic lifetime;
- behavioural/social lifetime;
- non-retention;
- maintenance affecting the saving period.

Not dealt with in this CWA are the factors that can influence the yearly savings:

- deterioration;
- maintenance affecting yearly savings;
- usage patterns;
- climate change.

As to deterioration and maintenance it has been agreed that they have to be taken into account elsewhere, e.g. the EMEEES project, due to their relevance for the calculation of bottom-up energy savings for the ESD. Yearly savings should be calculated using the initial energy savings and these correction factors. In this way the lifetimes determined according to this CWA will lead to consistently calculated ESD energy savings.

Relevance of factors for different EEI measure categories

The lasting saving effect of EEI measures is dependent on the possibilities for change in performance. In this respect the EEI measure can be divided into the following categories:

- not removable, e.g. cavity wall insulation;
- easily removed, e.g. draught strips;
- reversible, e.g. smaller CHP-units turned on or off;
- behavioural and organisational actions, e.g. switching off unused lights.

Next to the design lifetime the following factors must be taken into account per category of EEI measures (see Table 1).

Table 1 — Relevant factors per category of EEI measure type

EEI measure category	Economic lifetime	Behavioural/ social	Non-retention	Maintenance regime
Not removable	No	No	Yes	Yes
Easily removed	Yes	Yes	Yes	(Yes)
Reversible	Yes	No	(Yes)	(Yes)
Behavioural/ organizational	No	Yes	(Yes)	No

In case of not removable EEI measures the saving lifetime cannot be shortened for economic of behavioural/social reasons. However, non-retention and maintenance (affecting the saving period) can play a role and need to be taken into account. In case of easily removable EEI measures the saving lifetime can be shortened for economic and behavioural/social reasons. For reversible EEI measures the economic lifetime of implemented efficient systems will be the deciding factor. If this is the case, non-retention and maintenance will be of less importance. For behavioural EEI measures it is assumed that behaviour/social reasons will be decisive for the saving lifetime. Maintenance is not relevant and non-retention will be of less importance.

5.3 Harmonised saving lifetimes

Harmonised saving lifetime figures constitute an average saving lifetime for a given EEI measure type across all EU Member States, to be used in the context of the ESD after acceptance by the European Commission. For part of commonly applied EEI measure types a harmonised saving lifetime has been defined (see Table A.1). To this end a survey of presently applied lifetimes in different countries was executed. This survey generally offered up to five figures per EEI measure type. These results have been discussed at the CWA meetings and complemented with saving lifetime values supplied by experts. For EEI measure types with sufficient matching between the available values an average saving lifetime value was agreed.

For EEI measure types with relatively long saving lifetimes harmonised saving lifetimes are the standard (see section 5.6).

In defining the harmonised saving lifetimes all factors directly influencing the saving period (see section 5.2) have been (implicitly) taken into account. The factors that influence the yearly savings of EEI measures are accounted for elsewhere in energy saving calculations.

It has to be stressed that only limited evidence on actual saving lifetimes is available. Therefore, with increasing evidence over time, the list of EEI measure types with harmonised saving lifetimes in Annex A and the values of saving lifetimes, to be adopted by the Commission, can be adapted and revised in the future.

5.4 Calculated saving lifetimes

Calculated saving lifetime figures result from a prescribed process taking into account all relevant factors that might influence saving lifetimes of specific EEI measure types. The saving lifetime is calculated according to the following procedure:

— For technical EEI measures the design lifetime is identified, whether by means of technical standards or based on information of manufacturers.

— An analysis is made of the possible influence of economic lifetime, behavioural/social lifetimes, maintenance regime and non-retention.

— If economic and/or behavioural/social lifetimes are relevant the design lifetime is corrected, resulting in a shorter saving period than the design lifetime.

— If the factors non-retention and/or maintenance are relevant the saving period is corrected, resulting in a calculated saving lifetime shorter than the saving period.

— The size of the correction is calculated based on the influence on cumulative energy savings. This average correction does not account for differences over the saving period.

Finally the saving lifetime SLT of a certain EEI measure type is calculated as follows:

SLT = MIN {DLT*CFnr* CFm, ELT, BLT}

where:

SLT	is the saving lifetime;
DLT	is the design lifetime;
ELT	is the economic lifetime;
BLT	is the behavioural/social lifetime;
CFnr	is the correction factor for non-retention;
CFm	is the correction factor for lack of maintenance at the cost of the saving period.

For technical EEI measures all factors can be relevant. For behavioural measures only the BLT factor counts. The inputs for the calculated saving lifetimes will be country specific. To assure reliable and transparent results the determination method has to fulfil certain quality demands. The following aspects need to be dealt with:

— information sources;

— method: engineering estimates, measurements, etc.;

— level of reliability;

— check with other Member-States if available;

— last update of the value.

For behavioural (and some organisational) EEI measures there is no installed device that fixes efficient energy use for a number of years. Therefore the saving lifetime can be dependent on the duration of policy measures to stimulate implementation of these measures. E.g. turning off unused energy using systems due to an information campaign will often erode after ending the campaign. In these cases the calculated saving lifetime can be linked to the duration of the policy measure.

In some cases there are alternative methods to determine the saving lifetime for EEI measures in specific countries, e.g. measurements or a survey. Measurements may provide lifetime values including correction factors (see reference [12]). If factors have influenced the saving period, their effect will be visible in the results of a survey on EEI measures that are still present in the year of monitoring, e.g. less old boilers than could be expected according to the design lifetime only. Such a survey may replace the calculation method, especially in ex-post evaluations where actual developments can be observed.

5.5 Default values for saving lifetimes

Default saving lifetime values, based on a conservative estimate of actual lifetimes, are used in those cases where neither a harmonised lifetime nor a determined saving lifetime is available. Because it is not known beforehand for which cases lifetimes are determined, this CWA specifies default saving lifetimes for all EEI measure types in Annex A where no harmonised saving lifetime is given. In this way Member States can always choose to either determine (by calculation or survey) saving lifetimes or rely on default saving lifetimes.

For reasons of simplicity default values for a specific EEI measure type are valid for all Member States. Default values are conservative expert estimates of saving lifetimes. This approach is intended to prevent too optimistic bottom-up saving figures and induce Member States to perform calculations or surveys on actual saving lifetimes and correction factors, at least for EEI measures with a large contribution to total ESD-savings. Especially in the case of organisational and behavioural EEI measure types with a high contribution to the total ESD-target preference should be given to the calculation method or alternatives, such as surveys.

In Annex A preliminary default values are given for all commonly applied EEI measure types in EU-countries that have no harmonised lifetime.

The default values are partly based on available lifetime figures that diverged too much between the countries as to have harmonised lifetimes (see section 5.3). If no such data was available the default values have been based on expert opinions.

5.6 Choice of method in determining saving lifetimes

General approach

Given the demands specified in the ESD, preference is given to the use of harmonised saving lifetimes by all Member States. If no harmonization is possible for specific EEI measure types the next choice is determination (by calculation or survey) of the saving lifetimes by each MS. If no data are available or the effort is too large, MS may choose to use default values.

The choices with respect to the defining saving lifetimes will also depend on the lifetime compared to the length of the ESD-period and on the application of the saving lifetime figures (ex-ante or ex-post).

Choice dependent on saving lifetimes versus ESD-period

The Energy Service Directive regards EEI measures that will be implemented from 2008 on (new measures) and so-called “early action” measures from 1995 on (sometimes from 1991 on). These measures should contribute to the 9% total energy savings target by the end of 2016. EEI measures with a long saving lifetime will always contribute to the ESD-target, but for short saving lifetimes the contribution will depend on the exact lifetime.

With regard to the consequences of saving lifetimes for ESD-evaluation methods three groups are distinguished: shorter than 10 years, from 10 to 25 years and longer than 25 years (see Table 2). With regard to the contribution to the ESD-target a distinction is made between new measures and early action measures.

Table 2 — Contribution of lifetime groups to ESD-savings in 2016 and method to define saving lifetimes

Lifetime group	Contribution EEI measure category		Method to be applied
	Early action	New measures	
< 10 years	No	Part	All methods
10-25 years	Part	Full	Harmonised (new measure)
> 25 years	Full	Full	Harmonised

Measures in the group “< 10 years” will not always contribute to the ESD-target in 2016. For instance a measure implemented in 2010 with a saving lifetime of 5 years will have disappeared by 2016. Earlier implemented measures with a short lifetime will have disappeared anyway in 2016. All new measures with a saving lifetime equal or greater than 10 years, and all earlier measures with a saving lifetime > 25 years, will always contribute to the ESD target. For earlier implemented measures with a saving lifetime of 10-25 years this will depend on the year of implementation and the exact saving lifetime.

Differences between countries with respect to saving lifetimes > 25 years are of no importance for the ESD-evaluation. Therefore, saving lifetimes of EEI measures that are sufficiently long can be harmonised in all cases. If only new EEI measures are regarded, the same is true for saving lifetimes > 10 years. In Annex A it is shown that all EEI measure types with very long saving lifetimes (more than 25 years) are harmonised.

The choice of method depending on the lifetime described above can change if the ESD period is extended. However, this is outside the scope of this CWA document.

Choice in ex-ante and ex-post evaluations

Saving lifetimes can be used in ex-ante as well as ex-post evaluations. In ex-ante evaluations made beforehand there are by nature less (reliable) data available on lifetimes and on correction factors than in ex-post evaluations, where there is an opportunity to gather data on actual developments. Also, the ESD demands will be more stringent for ex-post evaluations, asking for sufficient quality of inputs, such as saving lifetimes.

In ex-ante evaluations for the Energy Service Directive there is a choice between harmonised saving lifetimes, use of (conservative) default values or determined (calculation or survey) saving lifetimes. The ex-ante evaluation will be followed by an ex-post evaluation that should check the saving lifetimes anticipated beforehand. This is especially important for EEI measures where the anticipated lifetime coincides with the year 2016. The choice of method in the ex-post evaluation can differ from that in the ex-ante evaluation, because more information has become available and/or because more certainty on actual saving lifetimes is needed. In Table 3 the ex-post alternatives are shown for each choice in the ex-ante evaluation.

Normally harmonised saving lifetimes will be used both ex-ante and ex-post. However, it is possible that for specific EEI measures the actual saving lifetime diverges from the harmonised values for many countries. In these cases, Member States should deliver their newly gained evidence on actual lifetimes for a revision of the harmonised lifetime. A method change from harmonised to calculation/survey must be restricted as far as possible, as to prevent a selective choice (e.g. only when it leads to a more favourable lifetime figure). A method change should be limited to cases where it could have a substantial effect on total ESD-savings for a country.

Table 3 — Choices as to methods applied in ex-ante and ex-post evaluations

Ex-ante choice	Possible ex-post choices		
Harmonised	Harmonised	Revised harmonised	(Calculation/survey)
Calculation	Calculation/survey	(Harmonised)	
Default	Calculation/survey	Default	Harmonised

The calculation method might be replaced by an alternative method, such as a survey on actual lifetimes. Theoretically it is possible that calculated saving lifetimes are replaced by harmonised saving lifetimes. However, if the differences that prevented harmonization do not disappear, this will not be the case and the calculation/survey method is to be applied ex-post.

Default values will often be chosen in ex-ante evaluations because information on actual saving lifetimes is lacking in a Member State. This information can become available later, providing the opportunity to determine a more realistic saving lifetime value. A change from default values to harmonised saving lifetimes is also possible, e.g. in case of a new saving technology applied EU-wide, for which lifetime data is yet to become available.

5.7 Application of CWA-results

Ex-ante and ex-post

The CWA-approach is formulated in such a way that it is suitable for both ex-ante and ex-post evaluations. The ex-ante evaluation is part of formulating Energy Efficiency Action Plans, to be submitted by Member States to the European Commission in 2007. In 2011 and 2014 EEAP's must be submitted which include ex-post evaluations on intermediate realised savings.

It has to be stressed that on the moment only very limited evidence on actual saving lifetimes is available. A more comprehensive list of measures and (harmonised) saving lifetimes is needed by the Member States for the EEAP reporting in 2011. If such a list will not become available the present CWA figures are to be used.

While monitoring in coming years, increasing evidence on actual lifetimes can be gathered. On the one hand the list of EEI measure types with harmonised saving lifetimes in Annex A can be enlarged, and on the other hand the saving lifetimes can be adapted. The revised figures can be used for the ex-post evaluations. Given the main application of this CWA, the way to attain more reliable saving lifetime figures (calculation, survey or measurements) is not dealt with here.

Checklist for determination of saving lifetimes

In the table in Annex A the factors influencing lifetime (economic and behavioural/social lifetimes, non-retention and maintenance) are highlighted for non-harmonised EEI measures when relevant. This information should be used as a checklist when determining the saving lifetimes for EEI measure types (see section 5.4).

For proven EEI measures there is already information available in literature on the factors that define the saving lifetime of the measure. However, in many cases introduction is too recent or too limited to gather reliable information. In some cases the measure is yet to be introduced at a substantial scale. In these cases the information on factors has to be based on comparable EEI measure types or general mechanisms. For instance, behavioural/social lifetimes will be a factor for most EEI measures that depend on changes in daily energy use habits. Economic lifetimes will be a factor for EEI measures which are comparable with smaller CHP units. Non-retention will be a factor for all EEI measures that are applied in office buildings (where vacancy can occur due to changing market conditions for rented space).

Different fields of application of an EEI measure

Technical EEI measures sometimes differ as to saving lifetime because of diverging fields of application. In Annex A this aspect is covered by including the same EEI measure type several times for different sectors, partly also with differing saving lifetime values. In some cases, however, there could be a need for a further disaggregation of sectors in order to be able to define realistic saving lifetimes for specific sub-segments (e.g. a specific industrial branch). For the moment, the Annex A proposes default saving lifetimes for those EEI measures where saving lifetimes strongly depend on the field of application. With a revision of the list of measures and saving lifetime figures a further disaggregation into specific sub-segments further harmonised saving lifetimes could be defined (e.g. a harmonised saving lifetime for the use of efficient motors in a specific industrial application).

Differences in intensity of use

Differences in the intensity of use can influence the saving lifetimes – if expresses in years – considerably. For instance, a "heavy-duty" CFL with many burning hours per year will perform during less years than a CFL that is used less intensely. The use of an average saving lifetime figure puts energy savings at zero after this average number of years. In reality the CFL’s with fewer burning hours, and thus a longer saving lifetime, will still contribute to total savings. To take account of this effect, the lifetime of EEI measures with large differences in the intensity of use is expressed in other units than years (e.g. lifetime running hours or km driven).

EEI measure types not mentioned in the table

The list of EEI measure types in Annex A is a compromise between the large number of actual measures with very specific properties and a small set of measures with such general properties that it is difficult to specify lifetime values. The list of measures is meant to cover most of the bottom-up monitored energy efficiency improvements for the Energy Service Directive.

If applied measure types are not mentioned in Annex A the saving lifetime can be determined by calculating it according to the rules described in section 5.4 or by using a default value of the most comparable EEI measure type. However, if these measures provide a substantial contribution to the ESD-target, they should be made part of the list in a future revision of the list, preferably with a harmonised lifetime.

Uncertainty in results

Article 14 of the ESD asks Member States to provide a thorough analysis and evaluation of the three-yearly EEAP’s which contain the actions to be undertaken.

According to Annex IV of the ESD Member States, when reporting on attaining the ESD-target, may choose to use the method of quantified uncertainty, e.g. an error margin of 20% for a 90% confidence interval. To calculate this error margin for total bottom-up energy savings, margins have to be specified for initial savings, saving period and correction factors for all EEI measure types. Due to the so-called law of great numbers the uncertainty margin in total savings will be much lower than the margins for the input data of different EEI measure types. A good example of requirements can be found in [2], pp.105-130. However, the method or protocol for defining the uncertainty margins in saving lifetimes is not part of this CWA.

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Annex A
Preliminary list of saving lifetimes for commonly applied EEI measure types

Table A.1 — Information on saving lifetimes for commonly applied EEI measures

	EEI measure	Factors				Saving lifetime (*)	
		Economic lifetime	Behavior /Social	Non-retention	Mainte-nance	Harmonised	Default
	Households						
	Technical						
1	Insulation: building envelope					>25	
2	Draught proofing		X				5
3	Windows/glazing					24	
4	Replace hot water storage tank					15	
5	Insulation of hot water pipes					>25	
6	Heat reflecting radiator panels					18	
7	Small boilers					17	
8	Large boilers				X		17
9	Heating control		X		X		5
10	Heat recovery systems					17	
11	Hot water saving faucets					15	
12	Heat pump (household)					17	
13	Efficient chiller or room air conditioner					10	
14	New/upgraded district heating					20	
15	Solar water heating					19	
16	Efficient cold appliances					15	
17	Efficient wet appliances					12	
18	Consumer electronic goods		X	X			3
19	Efficient bulbs CFL		X	X			(6000 h)
20	Luminaire with ballast systems					15	
21	Energy efficient architecture					>25	
22	Micro-CHP	X			X		8
23	PV-panels					23	
	Organisational						
24	Hydraulic balancing of heating					10	

	EEI measure	Factors				Saving lifetime (*)	
		Economic lifetime	Behavior /Social	Non-retention	Mainte-nance	Harmonised	Default
	Behavioural						
25	Electricity saving		X				2
26	Heat saving		X				2
27	Feedback on use from smart meters		X				2
	Commercial / Public sector						
	Technical						
28	Windows/glazing					24	
29	Insulation: building envelope					>25	
30	Heat recovery systems					17	
31	Energy efficient architecture					>25	
32	Heat pumps (commercial sector)					20	
33	Efficient chillers in AC					17	
34	Efficient ventilation systems					15	
35	Commercial refrigeration		X	X			8
36	Energy efficient office appliances	X		X			3
37	Combined heat and power	X					8
38	Motion detection light controls					10	
39	New/renovated office lighting					12	
40	Public lighting systems					13	
	Organisational						
41	EMS (monitoring, ISO)	X					2
	Transport						
	Technical						
42	Efficient vehicles						(100000 km)
43	Low resistance tyres for cars		X				(50000 km)
44	Low resistance tyres for trucks	X					(100000 km)
45	Side boards on trucks						(500000 km)
46	Tyre pressure control on trucks						(500000 km)
47	Fuel additives	X	X				2
	Organisational						
48	Modal shift		X				2
	Behavioural						

	EEI measure	Factors				Saving lifetime (*)	
		Economic lifetime	Behavior /Social	Non-retention	Mainte-nance	Harmonised	Default
49	Econometer		X				2
50	Optimal tyre pressure		X				1
51	Efficient driving style		X				2
	Industry (not part of emission trading)						
	Technical						
52	Combined heat and power	X					8
53	Waste heat recovery						8
54	Efficient compressed air systems	X					8
55	Efficient electric motors/variable speed drives						8
56	Efficient pumping systems			X			8
	Organisational						
57	Good energy man. & mon.	X			X		2

(*) Sometimes expressed in km and hours that are used to determine the saving lifetime, sources [5], [6], [7], [8], [9], [10], [11]

Explanation values

- Lifetime value agreed: 99
- Lifetime in hours of km driven: (9999)

Descriptions EI measures:

1. Insulation: building envelope: Insulating material within the building envelope (e.g. cavity wall insulation, solid wall insulation or roof insulation).
2. Draught proofing: Material that fills gaps around doors, windows etc. to increase the air-tightness of buildings.
3. Windows/glazing: Glazing with good thermal properties.
4. Replace hot water tank: Installation of a new hot water storage tank with foam insulation.
5. Insulation of hot water pipes: Installation of insulating material on unexposed hot water pipes.
6. Heat reflecting radiator panels: Insulation material installed between radiators and the wall to reflect heat back into the room.
7. Small boilers: Individual boilers of no larger than 30 kW output.
8. Large boilers: Individual or communal boilers larger than 30 kW output.

9. Heating controls: Timing devices, thermostats and radiator valve thermostatic controls.
10. Heat recovery systems: Installation of systems to recover and recirculate heat .
11. Hot water saving faucets: Faucets with flow restrictors.
12. Heat pump (household): Ground source or air to air heat pumps for internal heating.
13. Efficient chiller or room air conditioner: Energy efficient air conditioning units for homes.
14. New/upgraded district heating: Heating supplied from a centralised heat source.
15. Solar water heating: Solar thermal collectors for hot water supply.
16. Efficient cold appliances: Refrigerators, freezers for household use that have a good energy efficiency rating e.
17. Efficient wet appliances: Dish washers, washing machines and tumble driers for household use that have a good energy efficiency rating.
18. Consumer electronic goods: Household electronic products (e.g. TV, DVD player, set-top box, home computer).
19. Efficient bulbs CFL: Compact fluorescent lamps for household use.
20. Luminaire with ballast system: Lighting units with dedicated efficient lamp fittings.
21. Energy efficient architecture: Dwelling design that optimises thermal properties of building materials, orientation of building to natural light and heat sources and the use of natural ventilation
22. Micro-CHP: Individual combined heat and power units for households.
23. PV-panels: Photovoltaic solar panels.
24. Hydraulic balancing of heating: Adjusting household heating system so that hot water for heat is distributed between rooms in an optimal balance.
25. Electricity saving: Behaviours that lead to the saving of electricity (e.g. switching off lights in empty rooms, turning electronic goods off).
26. Heat saving: Behaviours that lead to the saving of heat (e.g. turning heating off when rooms not in use).
27. Smart meters: A class of electricity or gas meters that provides the user with enough information to allow them to moderate their consumption.
28. Windows/glazing : See (4) above.
29. Insulation: building envelope: See (1) above.
30. Heat recovery systems: See (11) above.
31. Energy efficient architecture: Building design that optimises thermal properties of building materials, orientation of building to natural light and heat sources and the use of natural ventilation.
32. Heat pumps (commercial sector).

33. Efficient chillers in AC: Efficient chilling systems for use in building air conditioning.
34. Efficient ventilation systems: System mechanically controlled which extracts the foul air with in an appropriate amount as to ventilate, and supplies new preheated air in the principal parts by the means of blowing inlets.
35. Commercial refrigeration: refrigeration units.
36. Energy efficient office appliances: Office electronic products (e.g. desktop or laptop computers, printers, photocopiers, fax machines).
37. Combined heat and power: Combined heat and power units for commercial sector.
38. Motion detection light controls: Detectors that switch off lights when nobody is present.
39. New/renovated office lighting: Efficient lighting systems for offices.
40. Public lighting systems: Outside lighting for public spaces.
41. EMS (monitoring, ISO): Use of Energy Management System such as monitoring and improvement or ISO14000.
42. Efficient vehicles: Vehicles that consume a low amount of primary energy (e.g. petrol or diesel) for distance travelled.
43. Low resistance tyres for cars: Tyres that have a low rolling resistance.
44. Low resistance tyres for trucks: See (44) above.
45. Side boards on trucks: Aerodynamic additions for heavy goods vehicles.
46. Tyre pressure control on trucks: Automatic tyre pressure monitoring device for heavy goods vehicles.
47. Fuel additives: Additives that increase the combustion efficiency of fuels.
48. Modal shift: Change of mode of transport to a more energy efficient form (e.g. cars to bikes, or trucks to freight trains).
49. Econometer: Fuel consumption feedback device for cars and trucks designed to increase fuel efficient driving style.
50. Optimal tyre pressure: Maintenance of optimal tyre pressure.
51. Efficient driving style: Adoption of driving style designed to increase fuel efficiency.
52. Combined heat and power: Combined heat and power units for the industrial sector.
53. Waste heat recovery: Use of heat generated as a by-product of industrial processes or other sources.
54. Efficient compressed air systems: Use of efficient air compressors, or efficient use of existing air compressors.
55. Efficient electric motors and variable speed drives: Use of efficient electric motors/drives or motors/drives that provide smooth changes in drive.
56. Efficient pumping systems: Use of efficient pumps in industrial processes.
57. Good energy management and monitoring