NL Agency
Ministry of Economic Affairs, Agriculture and Innovation

A new tool for evaluators: the European standard on energy savings calculations

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Introduction

- The development of a Standard on Energy Efficiency and Savings Calculation European

- Main elements for a calculation model

- Four step calculation model

- Example: boiler exchange

- Conclusions

Standard on Energy Efficiency and Savings Calculation, a five year process

- March 2007 a kick off meeting: two Working Groups: one for Top-Down calculations and one for Bottom-Up calculations
- June 2010: A draft document to create a standard
- In 2011 revised drafts
- April 2012 the final draft published for formal voting by the members of CEN.
- Expected publication by December 2012: “Introductory element, Energy Efficiency and Savings Calculation, Top-down and Bottom-up Methods Complementary element” as standard **EN16212:2012**.

Discussions during development of the Standard, example baselines

	Baseline; final draft	Baseline; one of the provisional drafts
Definition	energy consumption calculated or measured, possibly normalised, in the situation without an end-use action	energy consumption calculated or measured, normalised by adjustment factors, as a reference before any energy efficiency improvement action
Notes	NOTE 1: The baseline provides a reference against which measurements can be taken or compared. NOTE 2: The baseline can contain other actions but not the action under consideration	NOTE The definition is a combination of the definition of energy baseline (energy consumption calculated or measured over a period of time normalised by adjustment factors) and the note (baseline may be used for calculation of energy savings, as a reference before energy efficiency improvement action) in the technical report on terminology.

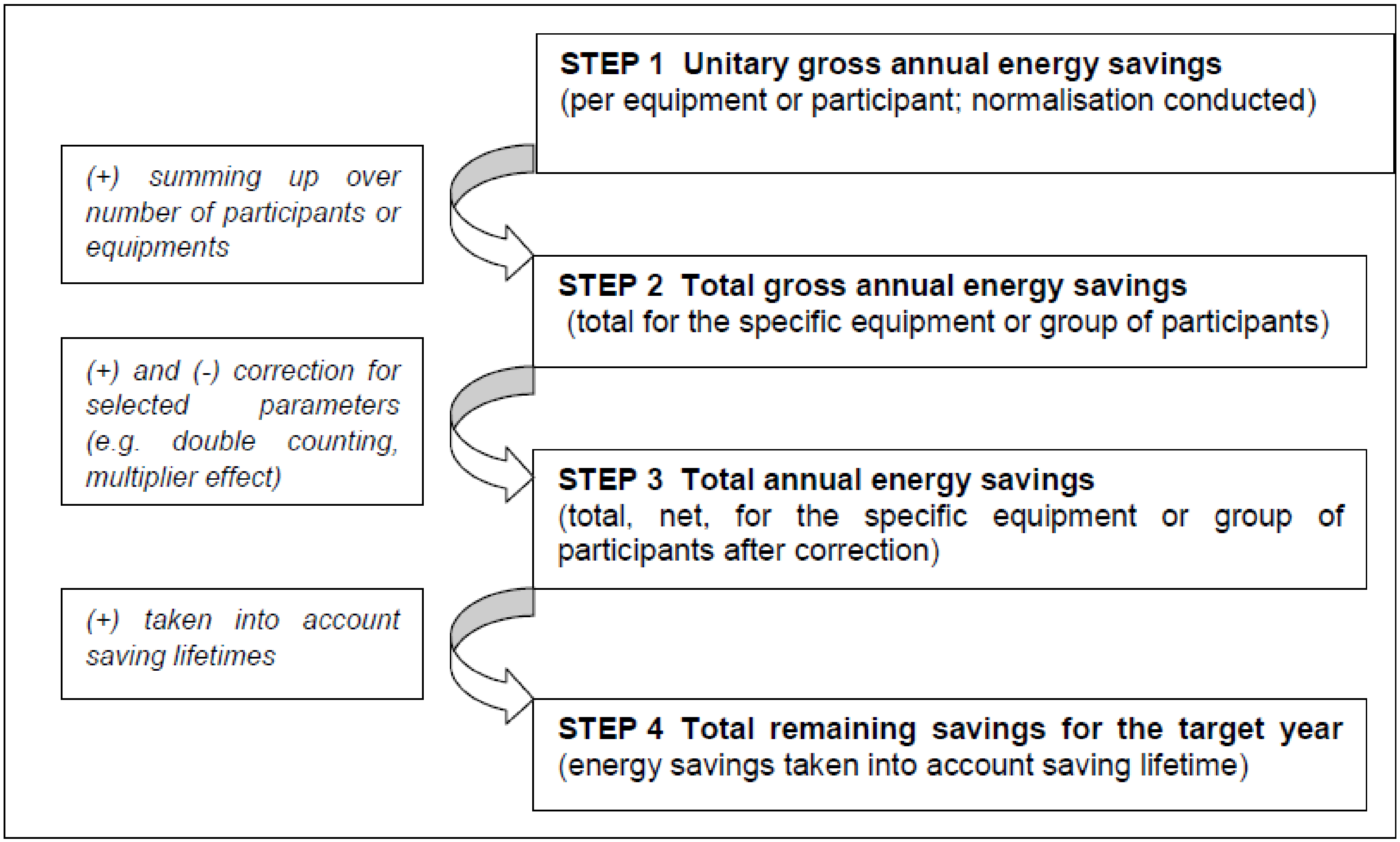
Main elements for the calculation method

1.A calculation model or formula including baselines and normalisation;

2.Data collection techniques, for data needed to feed the calculation model;

3. A set of reference or default values.

The Calculation Model



NOTE Based on Vreuls et al 2008 [6]; figure 1: a four steps calculation process

A Four step Calculation Process

Step 1: Calculation of unitary gross annual energy savings

Step 1.a:	Definition of elementary unit
Step 1.b:	General formula / calculation model
Step 1.c:	Baselines and specific formulas
Step 1.d:	Normalisation of energy consumption
Step 1.e:	Technical interaction
Step 1.f:	Application of conversion factors (when relevant)

Step 2: Calculation of total gross annual energy savings

Step 2.a:	Calculating the number of elementary units of action
Step 2.b:	Summing up the unitary gross annual energy savings

Step 3: Calculation of total annual energy savings

Step 3.a:	calculation of total annual energy savings
Step 3.b:	correction for double counting
Step 3.c:	correction for multiplier effect
Step 3.d:	correction for free-rider effect
Step 3.e:	correction for rebound effect

Step 4: Calculation of remaining energy savings for target year

Baselines

two general approaches for selecting the baseline situation:

a. a reference situation; the two most used ones are:

1. the stock situation; based on a the existing overall situation for the product or systems;
2. the market situation; based on those products or systems currently available in the market;

This approach is applicable to add-ons, replacements and new systems;

For new systems, a virtual baseline situation has to be defined/created

b. the “before” situation.

This approach is applicable to add-ons and replacement cases

Data Collection Techniques

The standard refers to the **three** levels of evaluation efforts related to details in data handling in order to an optimal trade-off between evaluation costs and accuracy:

1. a minimum level of efforts: using already available data often in combination with existing (international) default values;
2. an intermediate level of efforts: using well know techniques for data collection additional to already available data and national default values or deemed savings (available and/or adjusted);
3. a level of enhanced efforts: using data collections best fitted for the specific calculations/evaluation and action specific values for the parameters and additional some default values

Step 1 in the Calculation Process; the boiler example

Step 1.b: General formula

Unitary gross annual energy savings =

$(1/N_0 - 1/N_1)*SHD*A$ [kWh/unit*yr]

Where:

N_0 is mean annual Energy efficiency of the heating supply equipment before the replacement action (seasonal)

N_1 is mean annual Energy efficiency of the new heating supply equipment (seasonal)

SHD is specific Heating Demand [kWh/unit*yr]

A is average area of the space heated by the heating supply equipment (household, office, etc.) *[m^2]*

0 is situation without action [baseline];

1 is situation with action.

Step 1 in the Calculation Process; the boiler example

step 1.b: General formula

Unitary gross annual energy savings =

$(1/N_0 - 1/N_1)*SHD*A$ [kWh/unit*yr]

For the EU average of 86kWh/m² Specific Heating Demand (*SHD*) and an EU average area of the space heated of 90 m² the formula will be:

$(1/N_0 - 1/N_1)* 86* 90\ kWh$

Step 1 in the Calculation Process; the boiler example

Step 1.c: Baseline

Option A1a: N_0 is mean annual energy efficiency of the average non-condensing boiler on the *market,* having a mean efficiency of 89%. Assuming that the new boiler has an efficiency of 96%, then

UGAES = (1/0.89 –1/ 0.96)* *86* 90= 634 kWh*

Option A1b: N_0 is mean annual energy efficiency of the average condensing boiler on the *market,* having a mean efficiency of 94%. Assuming that the new boiler has an efficiency of 96%, then

UGAES = (1/0.94 –1/ 0.96)* *86* 90= 172 kWh*

Step 1 in the Calculation Process; the boiler example

Step 1.d: Normalisation

There is no need for normalisation as the specific heating demand (*SHD*), is calculated according to ISO 13790, and already normalised.

Step 1.e: Technical Interaction

Technical interaction is applicable in case the building code holds standards for *separate* efficiency measures.

The EU Energy Performance of Building Directive (EPBD) methodological framework deals with this technical interaction

Step 1 in the Calculation Process; the boiler example

Step 1.f: Application of conversion factors (when relevant)

The conversion factor is relevant in situations where the replacement of the boiler is combined with a change in energy carrier (fuel).

For example the old boiler might have used oil, while the new boiler is fired by gas or by wood, the litre oils, m^3 gas and m^3 wood have to be converted into an equivalent in Joule.

Step 2 in the Calculation Process; the boiler example

Total gross annual energy savings

The result of adding up the gross unitary energy savings for the individual boilers.

E.g. for the example below dealing with an EU stock for non-condensing boiler baseline (option A2a), where the unitary gross annual energy savings is 1377 kWh, and a number of 20000 boiler replacements, the total gross annual energy savings will be

*TGAES = 20 000 * 1 377 = 27540 kWh*

Step 3 in the Calculation Process; the boiler example

Step 3: Total annual energy savings

Step 3.a: Formula for total annual energy savings

Total annual energy savings are calculated according to the formula:

*f(DC) * f(MP) * f(FR) * (RE)* total gross annual energy savings*

Where:

f *(DC)* is double counting;

f (MP) is the multiplier effect;

f (FR) is the free rider effect;

f (RE) is the rebound effect.

Step 3 in the Calculation Process; the boiler example

Step 3.b: Correction for double counting

Example: A facilitating measure is stimulating the replacement of the boiler, e.g. a local energy plan and a national subsidy scheme both promoting replacement by high efficient boilers.

Step 3.c: Correction for multiplier effect

Example: The promotion of the boiler may be so successful that after the facilitating period, the less efficient one will no longer be on the market and a market transformation is realised. This can be added to the direct energy savings due to the promotion measure.

Step 3 in the Calculation Process; the boiler example

Step 3.d: Correction for free-rider effect

Example: Some research estimating an EU average of 20% of purchasers that would have selected a condensing boiler without facilitating measures as subsidies

Step 3.e: Correction for rebound effect

Example: part of the initial gain is offset by behaviour that increases energy use. It could happen that the occupants set the thermostat at a higher temperature because heating proves to be less costly than before

Step 4 in the Calculation Process; the boiler example

Step 4: total remaining energy savings for target year (optional)

Only those end-use actions that have not reached the end of their energy saving lifetime in the target year will be counted.

Example: the EU default/harmonised energy saving lifetime for small boilers in the CWA-15693:2007 holds: 17 years.

So the maximum number of annual savings to be accounted for in the target year is 17

Conclusions

- The (draft) European standard prEN 16212 provides evaluators with a tool
  - to make the calculations more transparent and
  - helps other evaluators to get a quick overview on the choice made during the calculation process.

- It can make future evaluations more efficient, as experiences from conducted calculations will be better documented and easier to be (re)used.

- As the standard provides the evaluator with a structure to highlight the choices for baselines and for the use of default values and/or parameter values from program specific data collections, it will stimulate future development of more and improved accurate deemed savings. This will result in more cost-efficient evaluations

Thanks for your attention

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