ANNEX IV

General framework for measurement and verification of energy savings

1. Energy savings measurements and calculations and their normalisation

1.1. Measuring energy savings

General

In measuring the realised energy savings as set out in Article 4 with a view to capturing the overall improvement in energy efficiency and to ascertaining the impact of individual measures, a harmonised calculation model which uses a combination of top-down and bottom-up calculation methods shall be used to measure the annual improvements in energy efficiency for the EEAPs referred to in Article 14.

In developing the harmonised calculation model in accordance with Article 15(2), the Committee shall aim to use, to the extent possible, data which are already routinely provided by Eurostat and/or the national statistical agencies.

Top-down calculations

A top-down calculation method means that the amount of energy savings is calculated using the national or larger-scale aggregated sectoral levels of energy savings as the starting point. Adjustments of the annual data are then made for extraneous factors such as degree days, structural changes, product mix, etc. to derive a measure that gives a fair indication of total energy efficiency improvement, as described in point 1.2. This method does not provide exact measurements at a detailed level nor does it show cause and effect relationships between measures and their resulting energy savings. However, it is usually simpler and less costly and is often referred to as ‘energy efficiency indicators’ because it gives an indication of developments.

In developing the top-down calculation method used in this harmonised calculation model, the Committee shall base its work, to the extent possible, on existing methodologies such as the ODEX model[(1)].

Bottom-up calculations

A bottom-up calculation method means that energy savings obtained through the implementation of a specific energy efficiency improvement measure are measured in kilowatt-hours (kWh), in Joules (J) or in kilogram oil equivalent (kgoe) and added to energy savings results from other specific energy efficiency improvement measures. The authorities or agencies referred to in Article 4(4) will ensure that double counting of energy savings, which results from a combination of energy efficiency improvement measures (including mechanisms), is avoided. For the bottom-up calculation method, data and methods referred to in points 2.1 and 2.2 may be used.

Before 1 January 2008, the Commission shall develop a harmonised bottom-up model. This model shall cover a level between 20 and 30 % of the annual final inland energy consumption for sectors falling within the scope of this Directive, subject to due consideration of the factors referred to in points (a), (b) and (c) below.

Until 1 January 2012, the Commission shall continue to develop this harmonised bottom-up model, which shall cover a significantly higher level of the annual final inland energy consumption for sectors falling within the scope of this Directive, subject to due consideration of the factors referred to in points (a), (b) and (c) below.

In the development of the harmonised bottom-up model, the Commission shall take the following factors into account and justify its decision accordingly:

(a) experience with the harmonised calculation model during its first years of application;

(b) expected potential increase in accuracy as a result of a larger share of bottom-up calculations;

(c) estimated potential added cost and/or administrative burden.

In developing this harmonised bottom-up model in accordance with Article 15(2), the Committee shall aim to use standardised methods which entail a minimum of administrative burden and cost, notably by using the measurement methods referred to in points 2.1 and 2.2 and by focusing on those sectors where the harmonised bottom-up model can be most cost efficiently applied.

Member States that so wish may use further bottom-up measurements in addition to the part prescribed by the harmonised bottom-up model subject to the agreement of the Commission, in accordance with the procedure referred to in Article 16(2), on the basis of a description of the methodology presented by the Member State concerned.

If bottom-up calculations are not available for certain sectors, top-down indicators or mixtures of top-down and bottom-up calculations shall be used in the reports to the Commission, subject to the agreement of the Commission, in accordance with the procedure referred to in Article 16(2). In particular, when assessing requests to this effect within the context of the first EEAP described in Article 14(2), the Commission shall demonstrate the appropriate flexibility. Some top-down calculations will be necessary to measure the impact of measures implemented after 1995 (and in certain cases as early as 1991) that continue to have impact.

1.2. How energy savings measurements should be normalised

Energy savings shall be determined by measuring and/or estimating consumption, before and after the implementation of the measure, while ensuring adjustment and normalisation for external conditions commonly affecting energy use. Conditions commonly affecting energy use may also differ over time. Such conditions may be the likely impact of one or several plausible factors, such as:

(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.

2. Data and methods that may be used (measurability)

Several methods for collecting data to measure and/or estimate energy savings exist. At the time of the evaluation of an energy service or energy efficiency improvement measure, it will often be impossible to rely only on measurements. A distinction is therefore made between methods measuring energy savings and methods estimating energy savings, where the latter is the more common practice.

2.1. Data and methods based on measurements

Bills from distribution companies or retailers

Metered energy bills may form the basis for measurement for a representative period before the introduction of the energy efficiency improvement measure. These may then be compared to metered bills for the period after the introduction and use of the measure, also for a representative period of time. The findings should be compared to a control group (non-participation group) if possible or, alternatively, normalised as described in point 1.2.

Energy sales data

The consumption of different types of energy (e.g. electricity, gas, heating oil) may be measured by comparing the sales data from the retailer or distributor obtained before the introduction of the energy efficiency improvement measures with the sales data from the time after the measure. A control group may be used or the data normalised.

Equipment and appliance sales data

Performance of equipment and appliances may be calculated on the basis of information obtained directly from the manufacturer. Data on equipment and appliance sales can generally be obtained from the retailers. Special surveys and measurements may also be carried out. The accessible data can be checked against sales figures to determine the size of energy savings. When using this method, adjustment should be made for changes in the use of the equipment or appliance.

End-use load data

Energy use of a building or facility can be fully monitored to record energy demand before and after the introduction of an energy efficiency improvement measure. Important relevant factors (e.g. production process, special equipment, heating installations) may be metered more closely.

2.2. Data and methods based on estimates

Simple engineering estimated data: Non-inspection

Simple engineering estimated data calculation without on-site inspection is the most common method for obtaining data for measuring deemed energy savings. Data may be estimated using engineering principles, without using on-site data, but with assumptions based on equipment specifications, performance characteristics, operation profiles of measures installed and statistics, etc.

Enhanced engineering estimated data: Inspection

Energy data may be calculated on the basis of information obtained by an external expert during an audit of, or other type of visit to, one or several targeted sites. On this basis, more sophisticated algorithms/simulation models could be developed and be applied to a larger population of sites (e.g. buildings, facilities, vehicles). This type of measurement can often be used to complement and calibrate simple engineering estimated data.

3. How to deal with uncertainty

All the methods listed in point 2 may entail some degree of uncertainty. Uncertainty may derive from[(2)]:

(a) instrumentation errors: these typically occur because of errors in specifications given by the product manufacturer;

(b) modelling errors: these typically refer to errors in the model used to estimate parameters for the data collected;

(c) sampling errors: these typically refer to errors resulting from the fact that a sample of units was observed rather than the entire set of units under study.

Uncertainty may also derive from planned and unplanned assumptions; these are typically associated with estimates, stipulations and/or the use of engineering data. The occurrence of errors is also related to the chosen system of data collection that is outlined in points 2.1 and 2.2. A further specification of uncertainty is advised.

Member States may choose to use the method of quantified uncertainty when reporting on the targets set out in this Directive. Quantified uncertainty shall then be expressed in a statistically meaningful way, declaring both accuracy and confidence level. For example, 'the quantifiable error is found with 90 % confidence to be ± 20 %'.

If the method of quantified uncertainty is used, Member States are also to take into account that the acceptable level of uncertainty required in energy savings calculations is a function of the level of savings and the cost-effectiveness of decreasing uncertainty.

4. Harmonised lifetimes of energy efficiency improvement measures in bottom-up calculations

Some energy efficiency improvement measures last for decades while other measures last for a shorter period of time. The list below gives some examples of the average lifetime of energy efficiency improvement measures:

Loft insulation of private dwellings	30 years
Cavity wall insulation of private dwellings	40 years
Glazing E to C rated (in m^2)	20 years
Boilers B to A rated	15 years
Heating controls — upgrade with boiler replacement	15 years
CFLs — retail	16 years

Source: Energy Efficiency Commitment 2005 — 2008, UK

To ensure that all Member States apply the same lifetimes for similar measures, these lifetimes will be harmonised on a European level. The Commission, assisted by the Committee established under Article 16, shall therefore replace the above list with an agreed preliminary list of the average lifetime of different energy efficiency improvement measures not later than 17 November 2006.

5. How to deal with multiplier effects of energy savings and how to avoid double counting in mixed top-down and bottom-up calculation methods

The implementation of one energy efficiency improvement measure, e.g. hot water tank and pipe insulation in a building, or another measure with equivalent effect, may have future multiplier effects in the market, 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. A measure with multiplier potential would in most cases be more cost-effective than measures that need to be repeated on a regular basis. Member States

shall estimate the energy savings potential of such measures including their multiplier effects and verify the total effects in an ex-post evaluation using indicators when appropriate.

With regard to the evaluation of horizontal measures, energy efficiency indicators may be used, provided that the way in which they would have developed without the horizontal measures can be determined. However, it must be possible to rule out, as far as possible, double counting with savings achieved through targeted energy efficiency programmes, energy services and other policy instruments. This applies particularly to energy or CO_2 taxes and information campaigns.

Corrections shall be made for double counting of energy savings. The use of matrices that enable the summation of impacts of measures is encouraged.

Potential energy savings resulting after the target period shall not be taken into account when Member States report on the overall target set out in Article 4. Measures that promote long-term market effects should in any case be encouraged and measures that have already resulted in multiplier energy savings effects should be taken into account when reporting on the targets set out in Article 4, provided they can be measured and verified using the guidance given in this Annex.

6. How to verify energy savings

If deemed cost-effective and necessary, the energy savings obtained through a specific energy service or other energy efficiency improvement measure shall be verified by a third party. This may be done by independent consultants, ESCOs or other market actors. The appropriate Member State authorities or agencies referred to in Article 4(4) may provide further instructions on this matter.

Sources: A European Ex-post Evaluation Guidebook for DSM and EE Service Programmes; IEA, INDEEP database; IPMVP, Volume 1 (Version March 2002).

(**1**) ODYSSEE-MURE Project, SAVE Programme. Commission 2005.

(**2**) A model for establishing a level of quantifiable uncertainty based on these three errors is given in Appendix B in the International Performance Measurement & Verification Protocol (IPMVP).