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General technical rules for measurement, calculation and verification of energy savings of projects

Règles techniques générales pour la mesure, le calcul et la vérification des économies d'énergie dans les projets

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 257, *Evaluation of energy savings*.

Introduction

The purpose of this International Standard is to establish a set of general rules for measurement, calculation and verification of energy savings of projects. These general rules are considered universal and are applicable irrespective of the measurement and verification (M&V) methodology used. This International Standard is designed to be used by all the project stakeholders that aim to quantify the energy savings over a specific period in the new projects or retrofit projects. It could reduce the technical and financial barriers in the measurement, calculation and verification for energy saving projects.

This International Standard specifies the basic procedure of M&V of energy savings of M&V plan. A common understanding of M&V on project level is established by outlining how calculation methods for M&V could be selected under different project scenarios. It is intended as a set of principles, guidance and methods for M&V of energy savings that can be applied to a broad variety of projects.

There are numerous calculation methods and M&V methodologies available to quantify energy savings but credible determination of energy savings is considered essential for all the project stakeholders to have a clear and correct understanding of the energy performance of project.

In this International Standard, energy savings are determined by comparing measured, calculated or simulated energy consumption before and after and/or with and without implementation of a project and making suitable adjustments for changes in relevant variables (routine adjustment) or suitable adjustments for changes in static factors (non-routine adjustment) and therefore energy savings are the difference between the adjusted energy baseline and the reporting period energy consumption.

This International Standard can be used by any interested party in order to apply M&V to the reporting of energy savings results.

General technical rules for measurement, calculation and verification of energy savings of projects

1 Scope

This International Standard specifies the general technical rules for measurement, calculation and verification of energy savings in retrofits projects or new projects.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EVO 10000-1:2014, *International Performance Measurement and Verification Protocol, Core Concepts*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
baseline period
specific period of time before the implementation of *energy performance improvement action* (3.8) selected for the comparison with the *reporting period* (3.19) and the calculation of *energy savings* (3.9)

[SOURCE: ISO/IEC 13273-1:2015, 3.3.1, modified — "energy performance" replaced by "energy savings" and deleted "and of energy performance improvement action"]

3.2
boundary
physical or virtual limit around *energy using systems* (3.11) or facilities which are related to (an) *energy performance improvement action(s)* (3.8)

Note 1 to entry: Project boundary is a boundary around (an) *energy performance improvement action(s)* (3.8).

Note 2 to entry: M&V boundary is a boundary which is affected by (an) *energy performance improvement action(s)* (3.8).

3.3
energy
capacity of a system to produce external activity or to perform work

Note 1 to entry: Commonly the term energy is used for electricity, fuel, steam, heat, compressed air and other like media.

Note 2 to entry: Energy is commonly expressed as a scalar quantity.

Note 3 to entry: Work as used in this definition means external supplied or extracted energy to a system. In mechanical systems, forces in or against direction of movement; in thermal systems, heat supply or heat removal.

[SOURCE: ISO/IEC 13273-1:2015, 3.1.1]

3.4
energy baseline
quantitative reference(s) providing a basis for comparison of *energy performance* (3.7)

Note 1 to entry: An energy baseline reflects a specified period of time.

Note 2 to entry: An energy baseline can be normalized using variables which affect *energy use* (3.10) and/or *consumption* (3.5) e.g. production level, degree days (outdoor temperature), etc.

Note 3 to entry: Energy baseline is also used for calculation of *energy savings* (3.9), as a reference before and after implementation of *energy performance improvement actions* (3.8).

[SOURCE: ISO 50001:2011, 3.6]

3.5
energy consumption
quantity of *energy* (3.3) applied

Note 1 to entry: Energy consumption can be quantified before/after or/and with/without any *energy performance improvement action* (3.8).

[SOURCE: ISO/IEC 13273-1:2015, 3.1.13, modified — the original Note 1 replaced by a new Note 1]

3.6
energy efficiency
ratio or other quantitative relationship between an output of performance, service, goods or *energy* (3.3) and an input of energy

EXAMPLE Conversion efficiency; energy required/energy used; output/input; theoretical energy used to operate/energy used to operate.

Note 1 to entry: Both input and output need to be clearly specified in quantity and quality, and be measurable.

[SOURCE: ISO/IEC 13273-1:2015, 3.4.1]

3.7
energy performance
measurable results related to *energy efficiency* (3.6), *energy use* (3.10) and *energy consumption* (3.5)

Note 1 to entry: In this International Standard, *energy performance* (3.7) is only for *energy consumption* (3.5).

[SOURCE: ISO/IEC 13273-1:2015, 3.3.1, modified — added Note 1 to entry]

3.8
energy performance improvement action
EPIA
action or measure (or group of actions or measures) implemented or planned within a project intended to achieve *energy performance* (3.7) improvement through technological, management, behavioural, economic, or other changes

[SOURCE: ISO 50015:2014, 3.5, modified — “an organization” replaced by “a project”]

3.9
energy savings
reduction of energy consumption (3.5) compared to an adjusted *energy baseline* (3.4)

Note 1 to entry: Energy savings may be the result of implementation of an action(s).

Note 2 to entry: The energy baseline can be adjusted with routine adjustment (3.20) and/or *non-routine adjustment* (3.15).

[SOURCE: ISO 17742:2015, 2.19, modified — added ”adjusted” before “energy baseline”, notes 1 and 2 rewritten]

3.10
energy use
manner or kind of application of *energy* (3.3)

EXAMPLE Ventilation; lighting; heating; cooling; transportation; processes; production lines.

Note 1 to entry: Characteristics of energy use include, but are not limited to, the purpose of the use, source(s) choice and application.

[SOURCE: ISO/IEC 13273-1:2015, 3.1.12]

3.11
energy using system
physical items with defined *boundaries* (3.2), using *energy* (3.3)

EXAMPLE Facility, building, part of a building, machine, equipment, product, etc.

[SOURCE: ISO/IEC 13273-1:2015, 3.1.9, "system" deleted]

3.12
installation and commissioning period
specific period of time during which the *EPIA* (3.8) is put in place and inspection has been done on the equipment that is installed, including the operation procedures, to ensure that they conform to the design intent of the EPIA

3.13
interactive effect

significant energy result occurring beyond the *project* (3.16) *boundary* (3.2) as a consequence of action(s) within the project boundary

Note 1 to entry: When implementing multiple *EPIAs* (3.8) within one project boundary, correctly identifying and accounting for additive savings is important.

Note 2 to entry: "significant" is decided by the stakeholder.

EXAMPLE Changing the lighting system to be more efficient type will have an interactive effect on the HVAC system. If the project boundary is the lighting system only, the interactive effect on the HVAC system should be considered by choosing M&V boundary around the lighting and HVAC system.

3.14
measurement and verification
M&V
process of planning, measuring, collecting data, analysing, verifying, and reporting *energy performance* (3.7) or energy performance improvement for defined M&V *boundaries* (3.2)

[SOURCE: ISO 50015:2014, 3.13]

3.15
non-routine adjustment
adjustment made to the energy baseline to account for non-typical or non-predetermined changes in *relevant variables* (3.17) or *static factors* (3.21), outside the changes accounted for by *routine adjustment* (3.20)

Note 1 to entry: Non-routine adjustments may apply where the energy baseline no longer reflects current *energy use* (3.10) or *energy consumption* (3.5) patterns, or there have been major changes to the process, operational patterns, or energy systems.

[SOURCE: ISO 50015:2014, 3.16, modified — "unusual changes" replaced by "non-typical or non-predetermined changes"]

3.16
project
unique process consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements including constraints of time, cost and resources

Note 1 to entry: An individual project may form part of a larger project structure and may consist of two or more EPIAs.

Note 2 to entry: The complexity of the interactions among project activities is not necessarily related to the project size.

Note 3 to entry: *Energy savings* (3.9) is the quantitative result as the project activities bring about reduction in the *energy consumption* (3.5) of *energy using systems* (3.11) within the *project* (3.16) *boundary* (3.2).

Note 4 to entry: New project is a project involving an energy using system that has not been installed or commissioned, such that the project cannot be considered and treated as a retrofit.

Note 5 to entry: Retrofit project is a project conducted on an already existing energy using system.

[SOURCE: ISO 10006:2003, 3.5, modified — added "and may consist of two or more EPIAs." at the end of Note 1 to entry, removed NOTE 2, NOTE 3 and NOTE 4, made NOTE 5 the new Note 2 to entry, added new Note 3 to entry, Note 4 to entry and Note 5 to entry]

3.17
relevant variable
quantifiable factor that impacts *energy performance* (3.7) and routinely changes

EXAMPLE Production parameters (production volume, production rate); weather conditions (outdoor temperature, degree days); operating hours, operating parameters (operational temperature, light level).

[SOURCE: ISO 50015:2014, 3.18, modified — EXAMPLE rewritten]

3.18
reported energy savings
energy savings (3.9) reported as a result of the *M&V* (3.14) process

3.19
reporting period
defined period of time selected for the determination and reporting of energy savings.

[SOURCE: ISO 50006:2014, 3.15, modified — "calculation" replaced by "determination" and "energy performance" replaced by "energy savings"]

3.20
routine adjustment
adjustment made to the *energy baseline* (3.4) to account for changes in *relevant variables* (3.17) according to a predetermined method

Note 1 to entry: The predetermined method could be based on *reporting period* (3.19) conditions or any other referenced conditions.

Note 2 to entry: The term "normalization" is used in ISO 50006:2014 to refer to this concept; see Reference [4].

[SOURCE: ISO 50015:2014, 3.20, modified — note 1 deleted and new notes 1 and 2 added]

3.21
static factors
identified factor that impacts *energy performance* (3.7) and does not routinely change

EXAMPLE 1 Facility size; design of installed equipment; the number of weekly production shifts; the number or type of occupants, range of products.

EXAMPLE 2 A change in a static factor could be a change in a manufacturing process, raw material from aluminium to plastic, and can lead to a *non-routine adjustment* (3.15).

[SOURCE: ISO 50015:2014, 3.22]

4 Concept of energy savings of a project

Energy savings are the difference between the energy consumption during the baseline period adjusted with routine adjustments and/or non-routine adjustments (adjusted energy baseline) and the energy consumption during the reporting period.

The energy savings are expressed by Formula (1).

$$E_s = E_a - E_r \tag{1}$$

where

E_s is the energy savings;

E_a is the adjusted energy baseline;

E_r is the energy consumption during the reporting period.

Figure 1 shows the energy savings as hatched area between the adjusted energy baseline and the energy consumption during the reporting period.

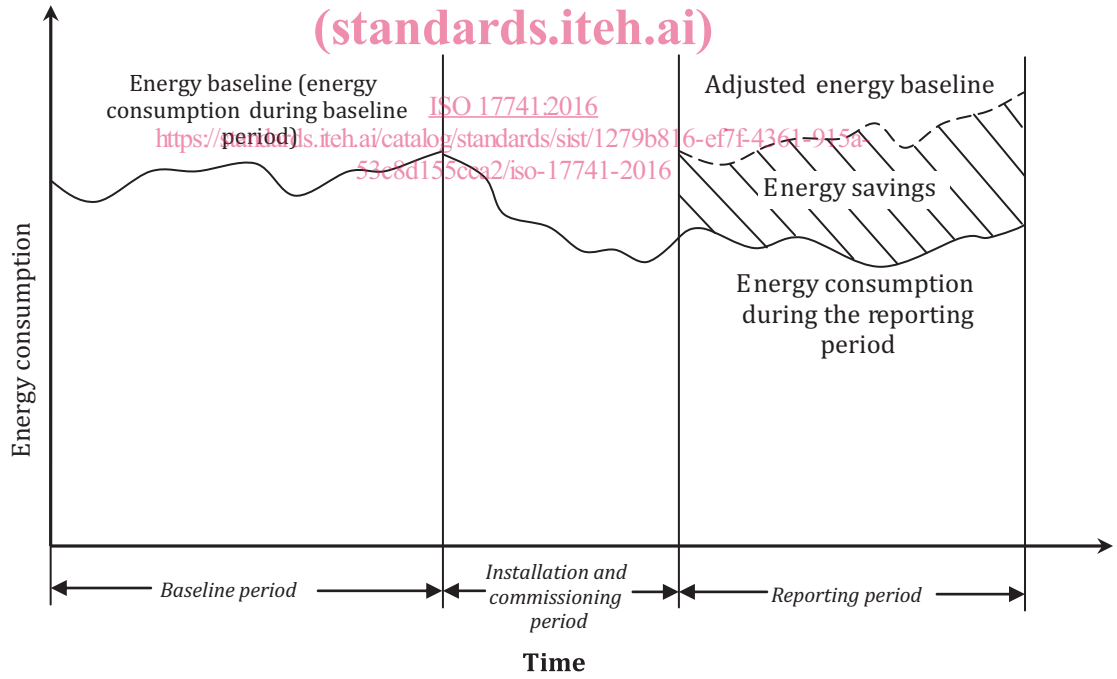

Figure 1 — Demonstration of energy savings of projects