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**Energy management systems —  
Measurement and verification of  
energy performance of organizations  
— General principles and guidance**

*Systèmes de management de l'énergie — Mesure et Vérification de la  
performance énergétique des organismes — Principes généraux et  
recommandations*

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Published in Switzerland

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 Technical Committee ISO/TC 242, *Energy management*.

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## Introduction

The purpose of this International Standard is to establish a common set of principles and guidelines to be used for measurement and verification (M&V) of energy performance and energy performance improvement of the organization. M&V adds value by increasing the credibility of energy performance and energy performance improvement results. Credible results can contribute to the pursuit of energy performance improvement.

This International Standard can be used irrespective of the type of energy used.

This International Standard can be used in several organizational contexts:

- by organizations with or without existing energy management systems, such as ISO 50001;
- for the M&V of energy performance or energy performance improvement;
- for all or part of an organization.

This International Standard can be used by organizations of any size, M&V practitioners, or any interested parties, in order to apply M&V to the reporting of energy performance results. The principles and guidance in this International Standard can be used independently or in conjunction with other standards and protocols. The principles and guidance in this International Standard are not required by ISO 50001, but can be applied by organizations using ISO 50001.

This International Standard does not specify calculation methods; rather, it establishes a common understanding of M&V and how M&V could be applied to different calculation methods. These principles and guidelines are applicable irrespective of the M&V method used.

[Annex A](#) provides an overview of the M&V flow that is used throughout this International Standard.

This International Standard is one of a family of International Standards developed by ISO/TC 242 and ISO/TC 257, on energy management and on the evaluation of energy savings related to regions and projects. Both ISO/TC 242 and ISO/TC 257 address organizational energy management and energy savings.

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# Energy management systems — Measurement and verification of energy performance of organizations — General principles and guidance

## 1 Scope

This International Standard establishes general principles and guidelines for the process of measurement and verification (M&V) of energy performance of an organization or its components. This International Standard can be used independently, or in conjunction with other standards or protocols, and can be applied to all types of energy.

## 2 Normative references

There are no normative references.

## 3 Terms and definitions

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

### 3.1

#### **baseline period**

specific period of time used as the reference for comparing with the *reporting period* (3.19)

Note 1 to entry: Use for comparing energy performance and the calculation of the *energy performance* (3.9) and of the *energy performance improvement action* (3.5).

### 3.2

#### **consequential effect**

*indirect energy effect* (3.3) or *non-energy effect* (3.4)

### 3.3

#### **indirect energy effect**

effect on organizational *energy performance* (3.9) beyond the direct effect of the *energy performance improvement action* (3.5)

EXAMPLE The reduced load on the cooling system due to the improved efficiency of the lighting system resulting in an indirect energy effect.

### 3.4

#### **non-energy effect**

effect of implementing *energy performance improvement actions* (3.5) that is additional to the energy impact

EXAMPLE As a result of the installation of a more efficient washer, less water is needed resulting in a water non-energy effect.

Note 1 to entry: The M&V objective defines to what extent non-energy items that result from energy performance improvement actions are considered.

### 3.5

#### **energy performance improvement action**

#### **EPIA**

action or measure or group of action or measures implemented or planned within an *organization* (3.17) intended to achieve *energy performance improvement* (3.10) through technological, managerial or operational, behavioural, economical, or other changes

3.6

**energy**

electricity, fuels, steam, heat, compressed air, and other like media

Note 1 to entry: For the purposes of this International Standard, energy refers to the various forms of energy, including renewable, which can be purchased, stored, treated, used in equipment or in a process, or recovered.

Note 2 to entry: Energy can be defined as the capacity of a system to produce external activity or perform work.

[SOURCE: ISO 50001:2011, 3.5]

3.7

**energy baseline**

quantitative reference(s) providing a basis for comparison of *energy performance* (3.9)

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

Note 2 to entry: An energy baseline can be normalized for *relevant variables* (3.18) which affect *energy use* (3.12) and/or *energy consumption* (3.8), e.g. production level, degree days (outdoor temperature), etc.

Note 3 to entry: The energy baseline is also used for calculation of energy savings, as a reference before and after implementation of *energy performance improvement actions* (3.5).

[SOURCE: ISO 50001:2011, 3.6]

3.8

**energy consumption**

quantity of *energy* (3.6) applied

[SOURCE: ISO 50001:2011, 3.7]

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3.9

**energy performance**

measureable results related to energy efficiency, *energy use* (3.12) and *energy consumption* (3.8)

Note 1 to entry: In the context of energy management systems, results can be measured against the *organization's* (3.17) energy policy, objectives, targets and other energy performance requirements.

Note 2 to entry: Energy performance is one component of the performance of the energy management system.

[SOURCE: ISO 50001:2011, 3.12]

3.10

**energy performance improvement**

improvement in measurable results related to energy efficiency, *energy use* (3.12) or *energy consumption* (3.8) compared to the *energy baseline* (3.7)

3.11

**energy performance indicator**

**EnPI**

quantitative value or measure of *energy performance* (3.9), as defined by the *organization* (3.17)

Note 1 to entry: *EnPIs* (3.11) could be expressed as a simple metric, ratio or a more complex model.

Note 2 to entry: For the purposes of this International Standard, a quantitative value or measure of energy performance developed by the *M&V practitioner* (3.15) is referred to as an energy performance metric.

[SOURCE: ISO 50001:2011, 3.13, modified – Added Note 2 to entry.]

3.12

**energy use**

manner or kind of application of *energy* (3.6)

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



[SOURCE: ISO 50001:2011, 3.18]

### 3.13

#### **measurement and verification**

##### **M&V**

process of planning, measuring, collecting data, analysing, verifying, and reporting *energy performance* (3.9) or *energy performance improvement* (3.10) for defined *M&V boundaries* (3.14)

### 3.14

#### **M&V boundary**

organizational, physical, site, facility, equipment, systems, process or activity limits within which *energy performance* (3.9) or *energy performance improvement* (3.10) is measured and verified

### 3.15

#### **M&V practitioner**

individual or team that performs *measurement and verification* (3.13)

Note 1 to entry: The Spanish equivalent is “profesional en M&V” or “experto en M&V”.

### 3.16

#### **non-routine adjustment**

adjustment made to the *energy baseline* (3.7) to account for unusual changes in *relevant variables* (3.18) or *static factors* (3.22), 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* (3.12) or *energy consumption* (3.8) patterns, or there have been major changes to the process, operational patterns, or energy systems.

### 3.17

#### **organization**

company, corporation, firm enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration and that has the authority to control its *energy use* (3.12) and *energy consumption* (3.8)

Note 1 to entry: An organization can be a person or a group of people.

[SOURCE: ISO 50001:2011, 3.22]

### 3.18

#### **relevant variable**

quantifiable factor that impacts *energy performance* (3.8) and routinely changes

EXAMPLE Weather conditions; operating conditions (indoor temperature, light level); working hours; production throughput.

### 3.19

#### **reporting period**

##### **report period**

defined period of time selected for calculation and reporting of *energy performance* (3.9)

### 3.20

#### **routine adjustment**

adjustment made to the *energy baseline* (3.7) to account for changes in *relevant variables* (3.18) according to a predetermined method

Note 1 to entry: ISO 50001 uses the term “predetermined method” to refer to this concept.

### 3.21

#### **significant energy use**

*energy use* (3.12) accounting for substantial *energy consumption* (3.8) and/or offering considerable potential for *energy performance improvement* (3.10)

Note 1 to entry: Significance criteria are determined by the *organization* (3.17) or the *M&V practitioner* (3.15).

[SOURCE: ISO 50001:2011, 3.27, modified — Added “or the M&V practitioner” to Note 1 to entry.]

### 3.22

#### **static factor**

identified factor that impacts *energy performance* (3.9) 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* (3.16).

## 4 Measurement and verification principles

### 4.1 General principles

These principles are the basis for the subsequent guidance on the M&V of organizational energy performance and energy performance improvement. Principles are not requirements rather, these principles should guide decisions made in both planned and unanticipated situations.

The purpose of M&V is to provide confidence to interested parties that reported results are credible.

The following principles (described in detail in 4.2 to 4.8) should be addressed:

- appropriate accuracy and management of uncertainty;
- transparency and reproducibility of M&V process(es);
- data management and measurement planning;
- competence of the M&V practitioner;
- impartiality;
- confidentiality; and
- use of appropriate methods.

### 4.2 Appropriate accuracy and management of uncertainty

Uncertainty of results, including measurement accuracy, needs to be managed to an appropriate level for the purpose of the M&V. A clear statement regarding the accuracy of results and steps taken to mitigate uncertainty should be included in the reported results.

### 4.3 Transparency and reproducibility of M&V process(es)

An M&V process should be documented to ensure transparency and traceability of the process. The entire M&V should be documented in a manner that ensures reproducibility, which contributes to confidence in the M&V result.

NOTE When the data are confidential, transparency can be limited for some interested parties.

#### 4.4 Data management and measurement planning

The M&V process should include information on how the data will be managed during the M&V activities. Data management includes (but is not limited to) the means to store, backup, maintain and secure the data. The M&V process should also include information on measurement planning such as location, frequency, and installation of meters or sensors. These issues need to be included in the documentation.

#### 4.5 Competence of the M&V practitioner

Competence of the M&V practitioner contributes to confidence in the results reported. The M&V practitioner will meet relevant legal, regulatory, certification or other requirements for the M&V process. The organization requesting the M&V may define competency requirements. In all cases, the M&V practitioner should declare their competence with regards to the provided M&V services. M&V practitioners should work within their field of expertise and comply with appropriate codes of ethics.

#### 4.6 Impartiality

Impartiality contributes to confidence in the reported results. Impartiality does not require third party independence. The M&V plan as well as the M&V reports should contain a statement outlining the impartiality of the M&V practitioner. The interested parties should formally disclose any conflict of interest before starting activities or as they arise during the M&V process.

#### 4.7 Confidentiality

Any confidential information necessary to perform the M&V should be made accessible to the M&V practitioner. If information necessary to perform the M&V cannot be made available to the M&V practitioner due to confidentiality requirements, the M&V practitioner should highlight this in the M&V plan and details of any restrictions that may affect the M&V result. The M&V practitioner should ensure that confidentiality is maintained.

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#### 4.8 Use of appropriate methods

The M&V method as well as the calculation methods selected should follow established good practices. The reasons for selecting the M&V method and calculation methods should be clearly described in the M&V plan.

### 5 Measurement and verification plan

#### 5.1 General

There are six fundamental steps in the M&V process which are specified in the M&V plan:

- 1. Establish and document an M&V plan (see 5.2 to 5.13): the M&V plan is the document that describes how each phase of the M&V should be performed.
- 2. Data-gathering (see 6.1).
- 3. Verify the implementation of EPIA(s) if any (see 6.2).
- 4. Conduct M&V analysis (see 6.4).
- 5. Report M&V results and issue documentation (see 6.5).
- 6. Review the need to repeat the process, as necessary (see 6.6).

Repeat the steps 1 to 5 of the M&V process, as determined in step 6. The sequence of these six basic steps is illustrated in Figure 1. The M&V plan is outlined in 5.2 to 5.13.