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Energy savings — Determination of energy savings in organizations

Économies d'énergie — Détermination des économies d'énergie dans les organismes

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Foreword

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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is Technical Committee ISO/TC 301, *Energy management and energy savings*.

Introduction

This International Standard describes approaches for determining energy savings based on one of the following two approaches:

a) an organization-based approach, i.e. a change in the amount of energy consumed by the organization, as measured within the organizational boundaries;

b) an EPIA-based approach, i.e. aggregating energy savings from energy performance improvement actions (EPIAs) measured within the organizational boundaries.

Both approaches compare energy consumption for a defined period of time, the energy consumption in a baseline period and a reporting period of equivalent length. Guidance is given on reconciliation between the two approaches.

This International Standard also considers the following in the context of energy savings:

— the use of primary and delivered energy;

— methods for normalizing energy consumption;

— methods for aggregating energy savings from different types of energy.

The flowchart in Annex A shows the process for determining energy savings using this International Standard.

This International Standard is designed to be broadly consistent with the overall framework for the determination and reporting of energy savings in projects, organizations and regions set out in ISO 17743, as well as with the principles and guidelines given in ISO 50015 on the measurement and verification of energy performance of organizations.

Energy savings — Determination of energy savings in organizations

1 Scope

This International Standard describes approaches for the determination of energy savings in organizations. It can be used by all organizations, whether or not they have an energy management system, such as ISO 50001.

This International Standard addresses the following topics in the context of energy savings:

— establishing the purpose of determining energy savings;

— determining boundaries;

— energy accounting, including primary and delivered energy and the use of common energy units;

— selecting an approach for the determination of energy savings;

— establishing an energy baseline;

— normalization of energy consumption;

— determination of energy savings;

— reporting and other matters.

Specific methods for the measurement and verification of energy performance and its improvement are outside the scope of this International Standard.

NOTE ISO 50015 establishes general principles and guidelines for the process of measurement and verification of energy performance of an organization or its components.

2 Normative references

There are no normative references.

3 Terms and definitions

3.1
baseline period
defined period of time selected as the reference for the determination of energy savings

3.2
boundary
physical or site limit and/or organizational limit as defined by the *organization* (3.16)

Note 1 to entry: The boundaries of the organization could be different from the boundaries used for the determination of energy savings.

Note 2 to entry: The determination of energy savings can include one or more boundaries, e.g. of one or more *energy performance improvement actions* (3.10), or of parts of the organization.

EXAMPLE Equipment; a system; a process; a group of processes; a room; a building; a site; an entire organization; multiple sites under the control of an organization.

[SOURCE: ISO 50001:2011, 3.1, modified — The term has been changed from the plural ("boundaries") to the singular ("boundary") and the definition has been modified accordingly; Notes 1 and 2 to entry have been added and additional examples have been included.]

3.3
delivered energy
energy (3.5) arriving at the *boundaries* (3.2) of an *organization* (3.16)

Note 1 to entry: Delivered energy includes *primary energy* (3.17) produced (e.g. oil from a well) or renewable energy generated onsite (e.g. electricity from photovoltaic panels).

3.4
double counting
summing the individual energy savings from two or more *energy performance improvement actions* (3.10) when they influence the *energy consumption* (3.8) of each other either positively or negatively

Note 1 to entry: In cases where there are interactive effects between the energy performance improvement actions (EPIAs), the energy savings due to the combined effect of these EPIAs may be different from the sum of the energy savings from the individual EPIAs.

3.5
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 types of energy, including renewable, which can be purchased, stored, treated, used in equipment or in a process, or recovered.

Note 2 to entry: In other contexts, energy can be defined as the capacity of a system to produce external activity or perform work.

Note 3 to entry: Examples of other like media include hot water, and intermediate products or by-products, such as biogas or coke oven gas.

[SOURCE: ISO 50001:2011, 3.5, modified — Notes 1 and 2 to entry have been modified and Note 3 to entry has been added.]

3.6
energy accounting
system of rules, methods, techniques and conventions used to measure, analyse and report *energy consumption* (3.8)

3.7
energy baseline
quantitative reference(s) providing a basis for comparison of *energy performance* (3.9)

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

Note 2 to entry: An energy baseline can be normalized using *relevant variables* (3.18) impacting *energy use* (3.11) and/or *energy consumption* (3.8), e.g. production level, degree days (outdoor temperature).

[SOURCE: ISO 50001:2011, 3.6, modified — Note 2 to entry has been modified and the original Note 3 to entry has been deleted.]

3.8
energy consumption
quantity of *energy* (3.5) applied

[SOURCE: ISO 50001:2011, 3.7]

3.9
energy performance
measurable results related to energy efficiency, *energy use* (3.11) and *energy consumption* (3.8)

Note 1 to entry: In this International Standard, energy performance generally refers to energy consumption only.

[SOURCE: ISO 50001:2011, 3.12, modified — The original Notes 1 and 2 to entry have been deleted because they were specific to energy management, and a new Note 1 entry has been added.]

3.10
energy performance improvement action
EPIA
action or measure or group of actions or measures implemented or planned within an *organization* (3.16) intended to achieve energy performance improvement through technological, managerial or operational, behavioural, economic, or other changes

[SOURCE: ISO 50015:2014, 3.5, modified — The word "economical" has been replaced by "economic".]

3.11
energy use
manner or kind of application of *energy* (3.5)

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

[SOURCE: ISO 50001:2011, 3.18]

3.12
energy using system
physical items with defined *boundaries* (3.2) using *energy* (3.5)

EXAMPLE Facility; building; part of a building; machine; equipment; product.

[SOURCE: ISO/IEC 13273-1:2015, 3.1.9, modified — The word "system" has been deleted from "system boundaries".]

3.13
indirect energy effect
effect on organizational *energy performance* (3.9) beyond the direct effect of an individual *energy performance improvement action* (3.10)

[SOURCE: ISO 50015:2014, 3.3, modified — The words "the energy performance improvement action" have been replaced by "an individual energy performance improvement action" and the original example has been deleted.]

3.14
non-routine adjustment
adjustment made to the *energy baseline* (3.7) to account for unusual changes in *relevant variables* (3.18) or *static factors* (3.20), outside the changes accounted for by *normalization* (3.15)

Note 1 to entry: Non-routine adjustments may apply where the energy baseline no longer reflects *energy use* (3.11) or *energy consumption* (3.8) patterns, or there have been major changes to the process, operational patterns, or *energy using systems* (3.12).

Note 2 to entry: For routine adjustments, normalization is used.

Note 3 to entry: Non-routine adjustments are needed when a change in static factors occurs after the *baseline period* (3.1).

[SOURCE: ISO 50015:2014, 3.16 modified — The words "routine adjustment" have been replaced by "normalization" in the definition and Notes 2 and 3 to entry have been added.]

3.15
normalization
process of routinely modifying energy data in order to account for changes in *relevant variables* (3.18) to compare *energy performance* (3.9) under equivalent conditions

[SOURCE: ISO 50006:2014, 3.13, modified — Note 1 to entry has been deleted.]

3.16
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* (3.11) 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, modified — The word "energy" has been added before "consumption".]

3.17
primary energy
energy (3.5) that has not been subjected to any conversion or transformation process

Note 1 to entry: Primary energy can be either a non-renewable or a renewable energy, or a combination of both.

[SOURCE: ISO/IEC 13273-1:2015, 3.1.6, modified — The words "energy conversion" have been replaced by "any conversion or transformation process".]

3.18
relevant variable
quantifiable factor that impacts *energy performance* (3.9) 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 50006:2014, 3.14]

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

3.20
static factor
identified factor that impacts *energy performance* (3.9) and does not routinely change

EXAMPLE 1 A static factor can be a change in *energy using systems* (3.12) (design of installed equipment, range of products, building), or a change in organization (e.g. outsourcing or insourcing of activities, sale of subsidiary companies) or a change in the number or type of building occupants (e.g. office workers).

EXAMPLE 2 A change of a static factor could be a change in a manufacturing process raw material, from aluminium to plastic.

EXAMPLE 3 Changes to operational patterns, such as the number of weekly production shifts, or the number of working days in a supermarket chain.

[SOURCE: ISO 50006:2014, 3.17, modified — Example 1 has been modified and Example 3 has been added.]

4 Preliminary considerations and boundaries

4.1 Preliminary considerations

Before determining energy savings, the organization should establish:

— the objective of determining energy savings, e.g.

  — for compliance purposes;

  — for use in annual reporting;

  — to form part of an energy management system, such as ISO 50001;

  — to calculate the financial return of energy performance improvement actions (EPIAs);

— the organization for which energy savings are being determined;

— the parties responsible for the determination of energy savings, their roles and their relationship with the organization;

— the parties who will receive the results;

— a summary of the type of data to be used, including their periodicity and the intervals for which they are to be collected and analysed.

4.2 Approaches to determining energy savings

4.2.1 Two approaches to determining energy savings

There are two approaches to determining energy savings:

a) an organization-based approach: the change in the total energy consumption of the organization or its constituent parts (a form of “top down” approach);

b) an EPIA-based approach: aggregating energy savings from identified EPIAs (sometimes referred to as being a “bottom up” approach).

The choice between these two approaches may depend on the objective of determining energy savings, or how the boundaries are identified.

4.2.2 Organization-based approach

The organization-based approach is commonly used in the following cases:

— for periodic reporting of the energy savings of an organization within its boundaries with respect to legal or other requirements;

— for assessing the energy savings of an organization as a part of an energy management system.

Dividing an organization into constituent parts may be a useful tool in the organization-based approach if the energy consumption of each can be analysed separately.

EXAMPLE 1 An organization consists of three departments: manufacturing, transportation and sales. It determines the energy savings of each individual department and then sums the energy savings from those parts, i.e. by using an organization-based approach. However, if the three departments cooperate by introducing EPIAs to reduce empty return trips, waiting times, total annual drive mileage, etc. by optimizing manufacturing schedule, sales planning, vehicle routeing, etc., it might also be possible to determine energy savings by summing the individual EPIAs (an EPIA-based approach).

The division of an organization into its constituent parts may be based on the following considerations:

a) based on physical items: the division is based on energy using systems whose performance is separately analysed and for each of which separate energy savings targets are set;

EXAMPLE 2 An integrated consumer products manufacturer might divide the organization into each of its manufacturing facilities and a building in which the corporate office is located.

EXAMPLE 3 An organization which manufactures washing machines in one plant or plants and semiconductors in another plant or plants might be divided on the basis of product types.

NOTE An organization can use a single facility to make multiple products or multiple facilities to make different products.

b) based on organizational requirements: the division is based on business units whose performance is separately analysed and for each of which separate energy savings targets are set;

c) based on sites: the division is based on geographical locations for each of which performance is analysed and separate energy savings targets are set.

EXAMPLE 4 An organization which makes fertilizers might be divided on the basis of its manufacturing sites.

If an organization is divided into its constituent parts in order to determine energy savings, the reasons for the division should be documented.

4.2.3 EPIA-based approach

An EPIA-based approach is commonly used to determine the effect of one or more EPIAs on the energy savings of the organization. The organization should include all EPIAs that positively or negatively impact energy performance within the organizational boundaries. EPIAs may include operational and capital improvement actions. The organization may seek to identify all actions that impact energy performance, whether or not they were initially intended to be an EPIA.

It is not always cost effective to measure energy savings from each individual EPIA. In such cases, energy savings from a representative sample may be used. The organization should document:

— the reasons why the sampling method is used;

— the reasons why the sample is representative of the variation in energy consumption;

— the method used to extrapolate results from the sample EPIAs to all EPIAs.

Sampling may be carried out by the following methods:

a) in a temporal sense (time), e.g. metering occurring for part of the time;

b) in a physical sense (see example 2 below).

EXAMPLE 1 In an organization with many employees, an effective approach to measuring the energy savings from behavioural measures (such as campaigns designed to get employees to switch off lights or computers when not in use) might be to use a sample of employees.

EXAMPLE 2 It might not be cost effective to monitor energy savings (e.g. by installing additional metering) from all machines when a substantial number of similar machines are upgraded. In this case, a sample of a smaller number of machines might be taken. If the data from the sample are found to be representative, the energy savings can be extrapolated to arrive at the total energy savings.

NOTE The determination of energy savings through projects within an organization is addressed by other standards.

More information about how to reconcile between the two approaches is included in Annex B.

4.3 Determining the boundaries

The organization should select boundaries appropriate to the purpose of determining energy savings. The boundaries can be for the entire organization or some of its constituent parts.

EXAMPLE 1 A single building; a university campus or shopping centre; all the operations within a single manufacturing plant or process; all buildings owned by a public authority within an administrative district; all the buses operated by a transit authority.

However, the boundaries of the energy savings determination can be different from those of the organization, e.g. in the following cases:

— where energy is stored within the organization boundaries;

— where energy is exported across the organization boundaries;

— where primary energy is generated on site;

— where goods or people are transported by or on behalf of the organization;

— where transportation energy is used by employees when undertaking work for the organization (e.g. salesmen or consultants travelling to customers' premises);

— where suppliers manufacture components or provide services, and inclusion is mandated externally.

It may be necessary to establish multiple boundaries if they can be well-defined. For example, where an organization wishes to determine energy savings from operations in several locations, each of which manufactures components of a single final product or service and the components are transported between the plants.

EXAMPLE 2 Company level energy used by a car manufacturer where the cars are assembled in one country, but the engines and transmission units are manufactured in another country. In this case, the total company energy consumption will exceed the sum of the energy consumed by the factories in the two countries due to the energy consumed in transportation.

Specifying the boundaries in an organization-based approach can sometimes be easier than in an EPIA-based approach.

Organizations often seek to determine total energy savings across the organization by using an EPIA-based approach. In this case, it may be useful to define boundaries which are specific for each EPIA. The boundary of one EPIA may overlap with that of another EPIA.

Figure 1 illustrates an organization which consists of three divisions: production (manufacturing), distribution and sales, and a head office.

— Figure 1 a) shows the physical boundaries of the organization. There are three factory buildings, an office building and a utility building containing a combined heat and power (CHP) plant. Each physical building could also be used as boundaries for determining energy savings, an organization-based approach.

— Figure 1 b) shows boundaries of the organization based on business units: the head office, with separate sales, distribution and production divisions. It determines the energy savings of each individual business unit and then sums the energy savings from those constituent parts, which is also an organization-based approach.

— Figure 1 c) shows boundaries based on EPIAs undertaken by the organization:

  — EPIA 1 reduces the energy consumption in the three production plants and consequently reduces steam load on the CHP plant;

  — EPIA 2 increases the power generation from the CHP plant, leading to lower purchase of electricity imported from the grid;