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Calculation methods for energy efficiency and energy consumption variations at country, region and city levels

Méthode de calcul pour l'efficacité énergétique et les variations de consommation d'énergie aux niveaux national, régional et urbain

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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).

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).

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

For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 301, *Energy management and energy savings*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Due to the increasing role of energy efficiency improvements and of controlling the energy consumption growth in international climate and energy policies, there is a need for harmonization of methods to evaluate the impact of these policies at the international level.

This document is concerned with the evaluation of energy consumption and energy intensity changes through explanatory factors, as well as the calculation of an energy efficiency index, at national and regional levels. The practical application can be different due to specific restrictions, such as methodologies, availability of data at lower levels of disaggregation, or difficulty in understanding and communicating.

The methods presented here can provide valuable insights into trends in energy use and factors linked to those trends. Still, not all aspects of the phenomena that affect energy use are accounted for by the methods in this document, as these methods are primarily descriptive. While the analysis presented here can reveal patterns or shifts in patterns of energy use, they do not necessarily reveal causality, an aspect that can also require additional analysis.

The user should be aware of some issues associated with the methods presented in this document. Some of these arise from analytic issues. For example, whether to combine all fuels in a sector into a single energy variable or to treat them separately is a question best addressed by clear reference to the purpose of the analysis using the methods presented here. Other aspects are phenomena not explicitly included in the methods presented here. An example is the role of the prices of energy or other goods, which can require additional methods.

This document is composed of three different calculation methods:

— evaluation of structure effects in the variation of energy intensity;

— calculation of energy efficiency indices;

— decomposition analysis of energy consumption variation.

Energy intensity is often considered as an indicator of energy efficiency at aggregate level when limited data are available. Their use as a proxy for energy efficiency can be improved by removing from their variations changes in economic structures: this is the objective of the first part of this document.

With more detailed data on energy consumption available by subsectors or energy uses (e.g. space heating) or by modes of transport (e.g. cars), it is possible to assess energy efficiency trends through a more accurate indicator than energy intensity, called “energy efficiency indices”: this is the objective of the second method of calculation presented in this document.

The variation of energy consumption can be related to change in economic activity, to energy savings as well as to other explanatory factors: the purpose of the third method of calculation described in this document is to present the method of decomposition of changes in energy consumption. It makes use of indicator-based savings, i.e. energy savings calculated according to the indicator-based method, as described in ISO 17742.

This document considers all end-use sectors, such as industry, transport, households, services (also known as the “tertiary sector”) and agriculture. It does not generally incorporate the energy supply sectors, such as power plants, refineries or coal mines. However, the integration of the power sector can be considered in the decomposition of the primary energy consumption to account for the effect of variations in energy efficiency and energy mix in the power sector.

Energy consumption considered in this document excludes feedstock energy, such as oil feedstock used to produce plastics or natural gas used as a feedstock for the production of fertilisers, as they are not affected by energy efficiency policies.

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This document can be used by any interested parties (decision-makers, companies, researchers, NGOs, etc.) that want to understand changes in the energy intensity or the energy consumption, as well as to assess energy efficiency by sector over a specific period.

This document is part of a set of documents developed by TC 301 (see Figure 1) and builds on the general principles outlined in ISO 17743, including reporting and system boundaries, and on the energy savings calculations presented in ISO 17742.

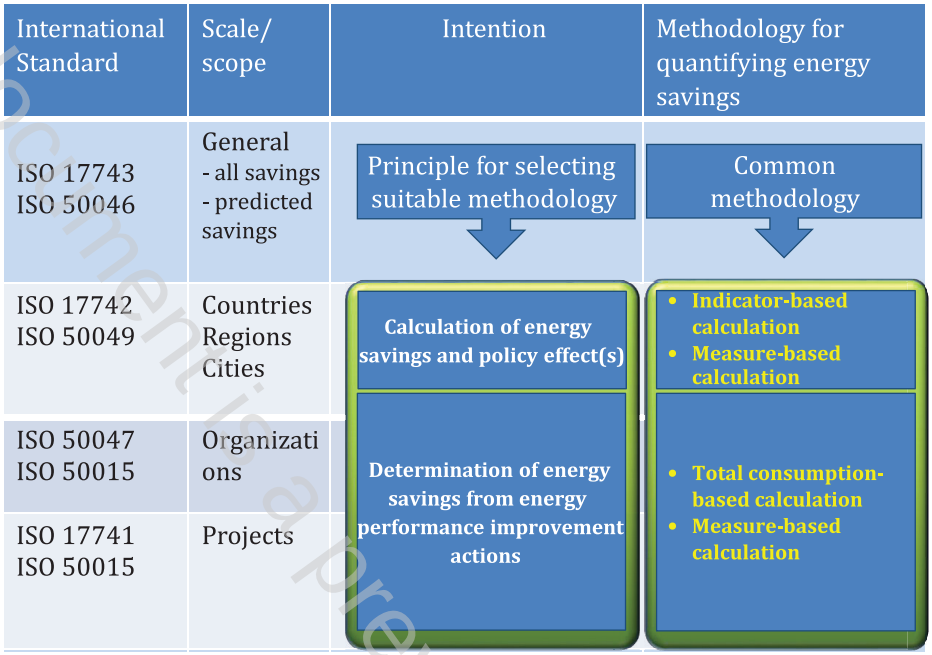

Figure 1 — Relationship between documents

The document covers more precisely three types of calculation methods based on energy efficiency indicators. Compared to ISO 17742, it details more advanced methodologies that facilitate a more comprehensive understanding of changes in: a) energy intensity, b) energy efficiency and, finally, c) energy consumption. The evaluation of energy efficiency trends relies on the calculation of energy efficiency indices. Variations in energy consumption are explained from a decomposition into different explanatory factors, one of which being energy savings. Therefore, this document complements ISO 17742 on energy savings calculation methods. More specifically, it complements how ISO 17742 deals with indicator-based methods. For each calculation method, examples of specific calculations are presented separately in Annexes A to C.

When applying this document, the user can choose between different options of the methods proposed. In order to be transparent in the way results have been obtained, the user of this document should specify the methodology used when presenting the results.

The general methodologies to evaluate trends in energy intensity, energy efficiency and energy consumption and its link to energy savings are presented in Clause 4. The calculation of the influence of structural changes in the energy intensity variation is described in Clause 5. The calculation method for the energy efficiency index is described in Clause 6. Finally, the method of decomposition of the energy consumption is given in Clause 7. Annexes A to C provide examples to illustrate various types of calculations. Annex D presents the methodology of climatic corrections, as most of these calculations should be done with energy efficiency indicators adjusted to a normal climate.

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Calculation methods for energy efficiency and energy consumption variations at country, region and city levels

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1 Scope

This document gives guidelines for methods for analysing changes in energy efficiency and energy consumption, and for measuring energy efficiency progress, for countries, regions and cities. It is composed of three different calculation methods:

— evaluation of structure effects in the variation of energy intensity;

— calculation of energy efficiency indices;

— decomposition analysis of energy consumption variation.

This document is applicable to providing an aggregated statistical evaluation for a country, region or city. It does not apply to calculating changes in the energy consumption or in energy efficiency at the individual consumer's level (e.g. households, organizations, companies).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
activity factor
variation in the energy consumption levels of a sector or subsector due to the variation of the activity of the sector for a given period

Note 1 to entry: The quantification of this factor depends on the driver used to measure the activity.

3.2
apparent energy efficiency improvement
increase in *energy efficiency* (3.5) without correction or adjustment (i.e. gross value resulting from a calculation)

3.3
base year
reference year in the calculation

Note 1 to entry: It is usually the first year of calculation.

Note 2 to entry: The year can be calendar or fiscal. All data should have the same definition of year, whether calendar or fiscal.

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