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GUIDE

colour inside

Inclusion of energy efficiency aspects in electrotechnical publications

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Inclusion of energy efficiency aspects in electrotechnical publications

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ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INCLUSION OF ENERGY EFFICIENCY ASPECTS IN ELECTROTECHNICAL PUBLICATIONS

FOREWORD

This first edition of IEC Guide 118 has been prepared, in accordance with ISO/IEC Directives, Part 1, Annex A, by the IEC Advisory Committee on Energy Efficiency (ACEE). This is a non-mandatory guide in accordance with SMB Decision 136/8.

The text of this IEC Guide is based on the following documents:

Four months' vote	Report on voting
C/1979A/DV	C/2002/RV

Full information on the voting for the approval of this IEC Guide can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Energy efficiency is key to addressing the challenge to support energy policies while preserving the environment.

Many energy efficient technologies and solutions are already available and cost-effective; nevertheless, a variety of barriers inhibits the deployment of these technologies and impedes harvesting their energy efficiency potential.

Standardization can play an important role to help overcome these barriers and to disseminate and promote energy efficient technologies, solutions and services.

This Guide aims to give advice to technical committees on the way energy efficiency should be considered and included in IEC publications.

IEC publications may deal exclusively with energy efficiency or may include clauses specific to energy efficiency; however technical committees are encouraged to:

- consider energy efficiency in their standardization work;
- identify which aspects of energy efficiency are relevant for their standardization;
- use a structured approach when addressing energy efficiency;
- use a systems approach when addressing energy efficiency.

This Guide helps to fulfil IEC Energy Efficiency Policy[1] by indicating how energy efficiency can be included in electrotechnical publications.

In this Guide, the term “technical committees” also includes subcommittees and system committees. The term “publication” includes “International Standard”, “Technical Report”, “Technical Specification” and “Guide”. In addition, the term “product” includes “process”, “service” and combinations thereof, commonly known as “systems”.

Technical committees dealing with subjects relating to energy efficiency for the whole, or for a specific part of their activities, are invited by SMB Decision 136/8 to follow the provisions of this Guide.

1 White Paper: Coping with the Energy Challenge. The IEC’s role from 2010 to 2030. Smart electrification – The key to energy efficiency.

INCLUSION OF ENERGY EFFICIENCY ASPECTS IN ELECTROTECHNICAL PUBLICATIONS

1 Scope

This Guide is intended for technical committees and gives guidance on how to consider energy efficiency aspects when preparing IEC publications.

Its purpose is:

- to describe the contributions of IEC publications to energy efficiency;
- to describe the concept of an energy efficiency aspect;
- to provide categories of energy efficiency aspects and a list of energy efficiency aspects to be considered by technical committees.

This Guide:

- helps in harmonizing the approach to energy efficiency;
- raises awareness that provisions in IEC publications can affect the energy performance of the product itself (taken individually) and of the entire application (embedding the product), in both negative and positive ways;
- helps technical committees to identify energy efficiency aspects that contribute to energy efficiency improvement of the product itself and of the entire application;
- promotes the use of a systematic approach when addressing energy efficiency in the context of standardization;
- promotes the use of a systems approach when addressing energy efficiency aspects in the context of standardization.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 13273-1:2015, *Energy efficiency and renewable energy sources – Common international terminology – Part 1: Energy efficiency*

IEC Guide 119, *Preparation of energy efficiency publications and use of basic energy efficiency publications and group energy efficiency publications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 13273-1 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
energy efficiency
ratio or other quantitative relationship between an output of performance, service, goods or energy, 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]

3.2
energy performance
measurable results related to energy efficiency, energy use and energy consumption

[SOURCE: ISO/IEC 13273-1:2015, 3.3.1]

3.3
energy efficiency improvement
increase in energy efficiency as a result of technological, design, behavioural or economic changes

[SOURCE: ISO/IEC 13273-1:2015, 3.4.3]

3.4
relevant variable
quantifiable factor that impacts energy performance 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]

3.5
static factor
identified factor that impacts energy performance 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 (e.g. office workers); range of products.

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

[SOURCE: ISO 50006:2014, 3.17]

4 Standardization and energy efficiency

4.1 General considerations

Standardization plays a key role in promoting energy efficiency as it:

- supports the dissemination of energy efficient technologies;
- accelerates the uptake of the next generation of energy efficient technologies;

- creates the prerequisites for energy efficiency through enabling technologies;
- enables conformity assessment;
- helps overcome market barriers to energy efficiency.

Energy efficiency is a horizontal topic spanning the IEC domain and may be dealt with in IEC publications in various forms across a wide range of technologies and for different products, processes and services.

The horizontal nature of the topic and increasing integration of products, processes and services entering the market requires that technical committees identify which aspects of energy efficiency are relevant for standardization and when doing that:

- use a structured approach;
- adopt a systems approach (see 4.3 and IEC Guide 119).

4.2 The concept of energy efficiency

Energy efficiency relates the output of an activity to its energy input, for a given service. The input can be expressed in various energy units (kilowatt-hours, joules, tonnes of oil equivalent, etc.). In contrast, the output may not necessarily be expressed in energy units and covers a wide range of activities and services – production of cement, floor area, passenger-kilometres, employees, etc. – expressed in many units (tonnes, square metres, kilometres, number of employees, etc.).

It is key for energy efficiency to not reduce the given service but to optimize the energy input for a given service.

NOTE 1 Examples of an activity include processes, services, etc.

NOTE 2 Energy performance and energy efficiency are different concepts. The concept of energy performance includes energy use and energy consumption; energy performance, for instance, can be improved without necessarily affecting energy efficiency. Energy efficiency is one aspect of energy performance and is a frequently used metric for measuring energy performance.

NOTE 3 Implementation of energy efficiency measures can be based on energy price consideration.

Evaluation of energy efficiency should consider several important factors. Crucial are boundaries which define the scope for energy efficiency improvement.

The description of the boundaries may be conceptual or physical.

In evaluating energy efficiency, all relevant energy inputs and outputs across the boundaries need to be identified as well as the key performance indicators (KPIs) used to measure it. For the complete definition of the context necessary for energy efficiency assessment, driving parameters should also be defined (see Figure 1).

NOTE 4 Driving parameters, other than internal process parameters, are all factors that affect energy efficiency and include weather, operating parameters (indoor temperature, lighting levels, etc.), production volume, range of products, etc.; this concept includes the concept of relevant variable and static factors as defined by ISO 50006.

The definition of energy efficiency may vary when boundaries change.

EXAMPLE The energy efficiency of an electric motor, the energy efficiency of that motor driving a pump, the energy efficiency of the pumping system made of that motor and pump.

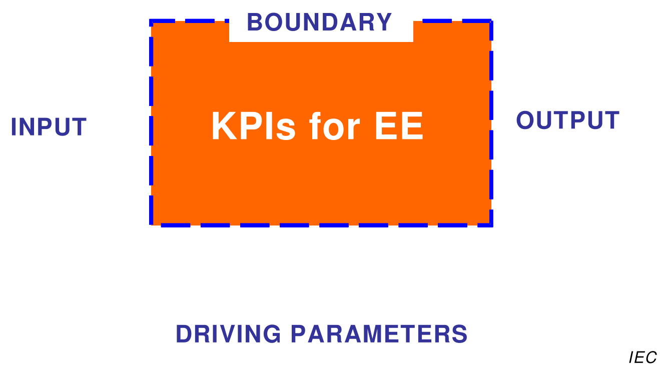

Figure 1 – Key elements in energy efficiency definition

For more details on boundary definition, see Clause B.2 and refer to IEC Guide 119.

Energy efficiency may vary and degrade over time.

4.3 Systems approach

Energy efficiency of a system needs to be analysed using a systems approach.

A systems approach to energy efficiency does not only consider the energy performance of the single components, but, and essentially, how efficiently these components are used within the application and boundary.

A systems approach to energy efficiency implies that the energy efficiency of one or more components may be de-optimized in order to achieve the maximum efficiency in the considered application and boundary.

A systems approach to energy efficiency is likely to optimize energy efficiency improvements as:

- the components and the application are considered together;
- the gains in energy efficiency of an optimized system may be much higher than the gains of an optimized individual component;
- an energy efficiency improvement at component level can be totally spoiled if this high efficiency component is used in poor operating conditions.

4.4 Contribution of standardization to energy efficiency

Standardization can play a role in overcoming some of the barriers to the implementation of energy efficient technologies and solutions. Examples include:

- common measurement and test methods to assess the use of energy and reductions attained through new technologies and processes;
- calculation methods so that sound comparisons of alternatives can be made in specific situations and can help with adaptation of infrastructure to integrate new technologies and interoperability;
- means to codify best practices and management processes for efficient energy use and energy conservation;
- design checklists and guides that can be applied to both the design of new systems as well as the retrofit of existing systems;

- common efficiency classifications, tolerances and minimum energy performance standards;
- the definition of possible energy efficiency metrics.

When developing IEC publications, barriers to energy efficiency should be considered, with the goal to contribute in overcoming such barriers through standardization activity. Annex A provides examples.

5 Energy efficiency aspects in IEC publications

5.1 General

This Guide proposes a systematic procedure for the identification of energy efficiency aspects to be considered for inclusion in IEC publications, when this is relevant for the technical committees.

This procedure is based on a general description of the energy efficiency improvement process. In this context, energy efficiency aspects are elements that are necessary to support this process. Energy efficiency aspects include tools, methods, activities, measures, checklists or guides.

Although this Guide is intended for use by technical committees, the principles of this procedure are general and may be used whenever improving energy efficiency is being considered during the life cycle.

5.2 Energy efficiency improvement process

A process to achieving energy efficiency improvements is shown in Figure 2.

In this energy efficiency improvement process as well as in the whole document the term "loss" is not to be interpreted solely in strict physical terms nor with a negative connotation only. The term "loss" includes also any kind of opportunity for energy efficiency improvement which is currently not implemented.

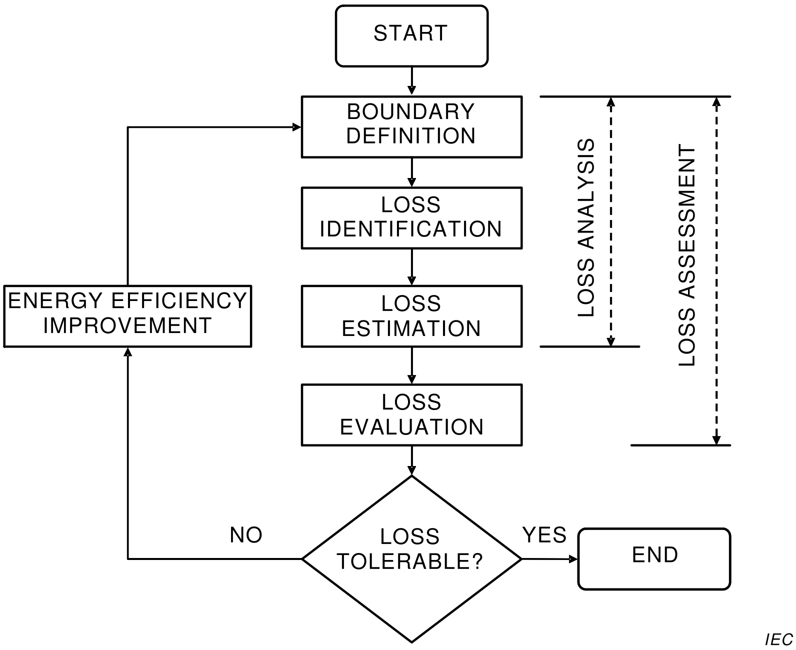

Figure 2 – Iterative process of energy efficiency improvement

Starting with the boundary description, current energy efficiency can be determined and potential improvements identified.

Once sources of losses are identified and their level determined (loss analysis), this can be compared against a limit in order to determine whether such a level of losses is tolerable. If they are not tolerable (e.g. according to classification level), energy efficiency improvement should be implemented. Otherwise the process requires no further action. If the boundary or the major parameters change, the process should be repeated.

The criteria for deciding whether the current level of losses is tolerable or not may be found in many different sources such as national regulations, societal decisions or standards.

Annex B provides additional information.

5.3 Inclusion of energy efficiency aspects in IEC publications

Energy efficiency aspects are all elements that are necessary for the energy efficiency improvement process described in 5.2.

It is the task of technical committees to identify and support all necessary energy efficiency aspects in their publications.

Every proposal for preparing or revising a publication should identify which aspects of energy efficiency are to be included.

The following categories of energy efficiency aspects should be considered (not all of these may be relevant to a given publication):

- define energy efficiency;
- measure energy efficiency;
- assess energy efficiency;
- improve energy efficiency;
- enable energy efficiency.

Examples of energy efficiency aspects and energy efficiency aspect categories are presented in Table 1. Annex C provides additional information on the inclusion of energy efficiency aspects in IEC publications.

Table 1 – Energy efficiency aspect categories and examples

Energy efficiency aspect categories	Energy efficiency aspect
Define energy efficiency	Define terminology
	Define system boundaries (including the scope for energy efficiency)
	Define EE KPIs (energy efficiency key performance indicators)
	Define energy baseline
	Define driving parameters (adjustment factors, static factors)
	Define reference applications
	Define reference load profiles
	Define reference control strategies
Measure energy efficiency	Define test methods
	Define measurement methods
	Define measurement plans
	Define calculation methods
	Define classes
Assess energy efficiency	Energy audits
	Benchmarking methods
	Energy efficiency investment evaluation
Improve energy efficiency	Energy management system
	Design criteria guidelines
	Application guidelines
	Best practices
	Loss reduction
	(Standby losses)
Enable energy efficiency	Interoperability
	Communication
	Standardized data format
	Qualification of energy efficiency services
	Measurement infrastructure

Energy efficiency aspects (EEAs) related to definition, measurement and assessment of energy efficiency are typical domains of standardization. EEAs related to energy efficiency improvement should not be specified in IEC publications when they involve technological solutions and matters of design.

Minimum energy efficiency values should not be defined in IEC publications; however, IEC publications may consider providing support for conformity assessment (testing, labelling, energy efficiency classes or classifications, etc.).

EEAs can be a property of the product and its way of use, which can be used to influence the product energy efficiency.

There is only a limited number of generic services that can be provided by a single publication. The technical committees should consider for themselves which of these services will be made available through their publications (e.g. a committee might consider to provide energy efficiency classification for their product, but refrain from making any statement about labelling).

Technical committees are invited to consider not only services that can be provided by their product scope, but should also consider interactions with applications of which the product is a part.

Implementation of energy efficiency measures should not impair safety.

NOTE For example, these interactions may result in a wider set of KPIs or measurements necessary to assess energy efficiency than restricting the assessment only to the individual product. Typically this will be a joint effort to determine the relevant load profiles and duty cycles and to make available the necessary product data in order to make such system considerations possible.

It is beyond the scope of this Guide to cover or list all possible aspects relevant for all possible products within the scope of IEC.

5.4 Energy efficiency publications

Coordination between technical committees is necessary to achieve a coherent approach to energy efficiency. A structured approach is recommended as it ensures that each publication is restricted to its scope.

IEC Guide 119 defines the following energy efficiency publications:

- basic energy efficiency publication;
- group energy efficiency publication;
- product publication.

More detail on the structured approach to be adopted within IEC, on the type of publications and on the procedures for their preparation is given in IEC Guide 119.

Annex A
(informative)

Market barriers to energy efficiency

There is an established literature concerning what has become known as the “market barriers to energy efficiency”. Market barriers to energy efficiency are those barriers that should justify the so called “efficiency gap”. The efficiency gap refers to the difference between levels of investment in energy efficiency that appear to be cost effective based on engineering-economic analysis and the (lower) levels actually occurring.

NOTE For a review of the literature concerning the concept of a barrier to energy efficiency, refer to, for example, UNIDO, *Barriers to industrial energy efficiency: A literature review*.

The following barriers are seen to contribute to this efficiency gap:

- lack of awareness of the savings potential;
- inadequate information about performance efficiency;
- lack of widely used metrics for performance efficiency;
- the tendency to focus on the performance of individual components rather than the energy yield or consumption of complete systems;
- split incentives;
- tendency to focus on lowest initial cost rather than life cycle cost;
- low rate of return on investment.

Standardization can play a role in overcoming some of these barriers. Examples of generic market barriers to energy efficiency and possible measures to overcome them from a standardization point of view are given in Table A.1.

Table A.1 – Examples of generic market barriers to energy efficiency and possible measures to overcome them from a standardization point of view

Generic barrier	Potential measures to remove barriers	Standardization role in support
Lack of information	Information centres and services; Appliance labelling; Consumer information	Develop common measurement and test methods in order for energy efficiency to be measurable, comparable and reportable on a common basis Develop standards for customer information about energy consumption, use, trends, etc.
Lack of trained personnel or technical or managerial expertise	Training programmes (e.g. integrated resource planning; analysing non-traditional projects)	Develop design checklists and guides providing state-of-the-art knowledge formalized by recognized experts in the field, based on international consensus from a balance of interests
Below long-run marginal cost pricing and other price distortions	Instituting supportive legal, regulatory and policy changes	International Standards can be helpful in supporting cooperation and potential harmonization of public policies in the fields concerned
Regulatory biases or absence	Standards	Provide a level playing field for all market actors and eliminate unnecessary barriers to trade
High transaction costs	Market development and commercialization; Demand-side management programmes; Energy service companies	Disseminate energy efficient technology Qualification requirements for energy service and energy service companies
High initial capital costs or lack of access to credit	Innovative financing mechanisms	Reduce uncertainty for all the economic players providing calculation and saving verification methods Qualification requirements for EPC (energy performance contracts)
High user discount rates	Energy service companies	Qualification requirements for energy services, energy service companies (ESCOs) and energy performance contracting (EPC)
Mismatch of the incidence of investment costs and energy savings	Institutional matching of costs and benefits; Energy service companies	Life cycle costing (purchase and operational costs) Qualification requirements for energy service companies (ESCOs)
Higher perceived risks of the more efficient technology	Technology research, adaptation, and demonstration; and/or performance contracting	Disseminate energy efficient technology Provide a consistent and clear framework describing technologies and good practices in the fields concerned, including, inter alia, terminology, classifications, test methods, performances (along with the modalities of the presentation of test results and performance levels)

Annex B
(informative)

Engineering approach to energy efficiency improvement

B.1 General

Annex B provides a general description of a systematic, engineering approach to energy efficiency improvement.

The key steps of such process are:

- boundary definition;
- identification of sources of losses (loss identification);
- estimation of losses (loss estimation);
- evaluation of losses (loss evaluation);
- energy efficiency improvement.

A more detailed description of each step is given in Clauses B.2 to B.6.

B.2 Boundary definition

B.2.1 Principle

The boundary used for energy efficiency considerations has to be clearly identified and defined.

B.2.2 Explanation

In order to assess and improve energy efficiency, the context should be clearly defined. Defining the context includes setting the scope of the analysis, establishing its metric and identifying all the relevant variables.

Boundary should be defined in terms of:

- intended use (relevant applications and services);
- energy inputs;
- outputs;
- operational status;
- driving parameters other than internal process parameters (relevant variables, static factors);
- KPIs for energy efficiency;
- interactions between components of the system;
- (possible) interactions with other systems.

The description of the boundary may be conceptual or physical. Within the boundary there can be a device, a product or a system depending on the application considered.

A physical description of the boundary includes:

- the physical limits of the product,

- power inlets or outlets,
- communication interfaces,
- media inlets or media outlets.

A conceptual description of a boundary includes:

- a list of provided services,
- a process description,
- etc.

B.3 Loss identification

B.3.1 Principle

The elements that have an impact (positive or negative) on energy efficiency should be identified.

The process should take into consideration the use of the product, process or service, including installation and maintenance, when applicable.

B.3.2 Explanation

The first step in understanding and assessing the opportunities for improving energy efficiency is to identify where and how much is used and lost.

The aim of loss identification is to identify the elements that influence the energy efficiency (sources of losses) together with the nature of this impact (cause-effect relationship). Sources of losses include the elements that might facilitate or hamper energy efficiency improvement.

Loss identification is based on the energy modelling of the system under consideration.

NOTE In the case of technical systems, energy modelling includes:

- a breakdown of the energy consumption by use and source;
- energy flows and balances;
- pattern of energy inputs through time;
- system use;
- relationships between energy input and driving parameters;
- one or more key performance indicators suitable to evaluate energy efficiency of the system.

For certain domains lists of typical and recurrent sources of losses may be available.

B.4 Loss estimation

B.4.1 Principle

The severity of the impact (positive or negative) on energy efficiency of each source of losses identified in the previous step should be estimated.

B.4.2 Explanation

After having identified the elements that influence energy efficiency (sources of losses) together with the nature of this impact, quantification is necessary in order to estimate the relevance of each source of losses. This can be done by investigating the magnitude of their impact on energy efficiency.

Loss estimation should determine the current level of losses by using the same KPIs for energy efficiency defined in the “boundary definition” step.

Loss estimation should ultimately be quantitative; at the beginning of the iterative process loss estimation may also be semiquantitative or qualitative. The most recommended tool for quantification is an entropy or exergy analysis.

Loss estimation should take into account the driving parameters other than internal process parameters (relevant variables, static factors).

B.5 Loss evaluation

B.5.1 Principle

The severity of the impact (positive or negative) of losses on energy efficiency should be measured against a criterion to determine whether it is acceptable or tolerable.

Loss evaluation includes setting the scale and defining the tolerable level.

B.5.2 Explanation

The purpose of loss evaluation is to put the current level of losses into context and to assist in making decisions about which losses need treatment and the priority for their reduction, based on the outcomes of loss analysis. Loss evaluation focuses on the following question: Are the losses above an acceptable level?

In order to put the current level of losses into context, the severity of the impact (positive or negative) on energy efficiency is grouped into a number of classes/levels. This classification is domain specific and serves the judgment of the tolerability of such identified losses.

Judging whether losses are tolerable or not involves comparing the level of losses found during the analysis process with established loss criteria (tolerable level). Based on this comparison, the need for improvement is decided.

The amount of effort used for improving energy efficiency should be proportionate to the significance of losses. Decision makers might use different processes, including cost-benefit analysis, for understanding the optimal level of energy efficiency improvement.

Decisions should take into account the wider context including consideration of the tolerance of the losses borne by other parties.

The criteria that set the tolerable level may derive from different levels including:

- market (e.g. benchmarking average efficiency, top runner criteria);
- environmental (e.g. sustainability);
- legal, regulatory and other requirements (e.g. Minimum Energy Performance Standards (MEPS) from regulatory authorities).

B.6 Energy efficiency improvement

B.6.1 Principle

If the current energy efficiency level is judged to be unsatisfactory, one or more options to improve its energy efficiency should be selected and implemented.

NOTE Energy efficiency improvement measures are normally not specified in IEC publications, because they involve technological solutions and matters of design, which are to be left to market decisions.

B.6.2 Explanation

Energy efficiency improvement involves selecting one or more options for improving energy efficiency and implementing or enabling the implementation of these options.

Options to improve energy efficiency should be balanced against other factors, such as product function, performance, cost, marketability and quality, and legal, regulatory and safety requirements. Options should not impair safety requirements.

Strategies and techniques for energy efficiency improvement may be represented by:

- obtaining an unchanged output value at a reduced energy input level;
- obtaining an increased output value with unchanged energy input level;
- obtaining an output value that surpasses the increase in energy input level in relative terms.

Measures can concentrate on the specific system and try to decrease losses in the given boundary.

In most cases, however, the most significant energy efficiency improvements are achieved by considering the entire application, i.e. performing a system level optimization. Technical committees are encouraged, for this reason, to adopt a systems approach when addressing energy efficiency in the context of standardization.

Energy efficiency improvement includes the possibility for energy recovery. The beneficiary of the energy recovered may be a different system than that under consideration.

NOTE In this case boundary should be changed.

Energy efficiency improvement includes also energy efficiency enabling products and technologies (e.g. process optimization through automation and control).

Annex C
(informative)

Inclusion of energy efficiency aspects in IEC publications

Annex C complements 5.3 by giving some examples of energy efficiency aspects inclusion in publications. For this reason, Table 1 in 5.3 is reproduced below as Table C.1; a third column has been added, listing examples of publications that address one or more energy efficiency aspects presented in 5.3.

Table C.1 – Energy efficiency aspects and examples of their inclusion in publications

Energy efficiency aspect categories	Energy efficiency aspect	Examples of inclusion in publications
Define energy efficiency	Define terminology	• ISO/IEC 13273-1, *Energy efficiency and renewable energy sources – Common international terminology – Part 1: Energy efficiency*
	Define system boundaries	• IEC 61800-9-1, *Adjustable speed electrical power drive systems – Part 9-1: Ecodesign of power drive systems, motor starters, power electronics and their driven applications – General requirements for setting energy efficiency standards for power driven equipment using the extended product approach (EPA) and semi analytic model (SAM)* • IEC TR 62837, *Energy efficiency through automation systems*
	Define EE KPIs (energy efficiency key performance indicators)	• IEC 60364-8-1, Low-voltage electrical installations – Part 8-1: Energy efficiency • IEC 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE-code)* • IEC TS 60034-30-2, *Rotating electrical machines – Part 30-2: Efficiency classes of variable speed AC motors (IE-code)* • IEC TS 60076-20, *Power transformers – Part 20: Energy efficiency* • ISO/IEC 30134 (all parts), *Information technology – Data centres – Key performance indicators* • IEC 61800-9-2, *Adjustable speed electrical power drive systems – Part 9-2: Ecodesign for power drive systems, motor starters, power electronics & their driven applications – Energy efficiency indicators for power drive systems and motor starters* • IEC TR 62837, *Energy efficiency through automation systems* • ISO 22400-2, *Automation systems and integration – Key performance indicators (KPIs) for manufacturing operations management – Part 2: Definitions and descriptions*
	Define energy baseline	• ISO 50006:2014, *Energy management systems – Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) – General principles and guidance*

Energy efficiency aspect categories	Energy efficiency aspect	Examples of inclusion in publications
	Define driving parameters (adjustment factors, static factors)	• (to be completed)
	Define reference applications	• IEC 60456, *Clothes washing machines for household use – Methods for measuring the performance*
	Define reference load profiles	• (to be completed)
	Define reference control strategies	• EN 15232, *Energy performance of buildings – Impact of Building Automation, Controls and Building Management* • IEC TR 62837, *Energy efficiency through automation systems*
Measure energy efficiency	Define test methods	• IEC 60034-2-1, *Rotating electrical machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*
	Define measurement methods	• IEC 62442-1, *Energy performance of lamp controlgear – Part 1: Controlgear for fluorescent lamps – Method of measurement to determine the total input power of controlgear circuits and the efficiency of the controlgear* • IEC 62301, *Household electrical appliances – Measurement of standby power* • IEC 62018, *Power consumption of information technology equipment – Measurement methods* • IEC 60034-2-1, *Rotating electrical machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*
	Define measurement plans	• IEC 62888 (all parts), *Railway applications – Energy measurement on board trains*
	Define calculation methods	• EN 15193, *Energy performance of buildings – Energy requirements for lighting*
	Define classes	• IEC 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE-code)* • IEC 60034-30-2, *Rotating electrical machines – Part 30-2: Efficiency classes of variable speed AC motors (IE-code)* • IEC 61800-9-2, *Adjustable speed electrical power drive systems – Part 9-2: Ecodesign for power drive systems, motor starters, power electronics & their driven applications – Energy efficiency indicators for power drive systems and motor starters* • IEC TS 60076-20, *Power transformers – Part 20: Energy efficiency*
Assess energy efficiency	Energy audits	• ISO 50002:2014, *Energy audits – Requirements with guidance for use* • ISO 11011:2013, *Compressed air – Energy efficiency – Assessment* • EN 16247-5:2015, *Energy audits – Part 5: Competence of energy auditors*
	Benchmarking methods	• EN 16231:2012, *Energy efficiency benchmarking methodology*

Energy efficiency aspect categories	Energy efficiency aspect	Examples of inclusion in publications
	Energy efficiency evaluation	• ISO 20140-1:2013, *Automation systems and integration – Evaluating energy efficiency and other factors of manufacturing systems that influence the environment – Part 1: Overview and general principles*
	Energy efficiency investment evaluation	• ISO 50044, *Energy Savings Evaluation – Economics and financial evaluation of energy saving projects*
Improve energy efficiency	Energy management system	• ISO 50001:2011, *Energy management systems – Requirements with guidance for use* • ISO 50004:2014, *Energy management systems – Guidance for the implementation, maintenance and improvement of an energy management system*
	Design criteria guidelines	• IEC TS 60034-31 – *Rotating electrical machines – Part 31: Selection of energy-efficient motors including variable speed applications – Application guide*
	Application guidelines	• ISO 50004:2014, *Energy management systems – Guidance for the implementation, maintenance and improvement of an energy management system* • IEC 60364-8-1, *Low-voltage electrical installations – Part 8-1: Energy efficiency* • IEC TR 62837, *Energy efficiency through automation systems*
	Best practices	• IS 399, *Energy Efficient Design Management* • CLC/TR 50600-99-1, *Information technology – Data centre facilities and infrastructures – Part 99-1: Recommended practices for energy management*
	Losses reduction	• CLC/TR 50600-99-1, *Information technology – Data centre facilities and infrastructures – Part 99-1: Recommended practices for energy management*
	(Standby losses)	• (to be completed)
Enable energy efficiency	Interoperability	• (to be completed)
	Communication	• ISO/IEC 15067-3, *Information technology – Home electronic system (HES) application model – Part 3: Model of a demand-response energy management system for HES*
	Standardized data format	• (to be completed)
	Qualification of energy efficiency services	• EN 15900:2010, *Energy efficiency services – Definitions and requirements*
	Measurement infrastructure	• IEC 62974-1, *Monitoring and measuring systems used for data collection, gathering and analysis – Part 1: Device requirements*
NOTE 1 A single publication could address more than one energy efficiency aspect. NOTE 2 Not all energy efficiency aspects eventually addressed by cited publications have been highlighted.		

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IEC 60034-2-1, *Rotating electrical machines – Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)*

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IEC 60034-30-2, *Rotating electrical machines – Part 30-2: Efficiency classes of variable speed AC motors (IE-code)*

IEC TS 60034-31, *Rotating electrical machines – Part 31: Selection of energy-efficient motors including variable speed applications – Application guide*

IEC TS 60076-20, *Power transformers – Part 20: Energy efficiency*

IEC 60364-8-1, *Low-voltage electrical installations – Part 8-1: Energy efficiency*

IEC 60456, *Clothes washing machines for household use – Methods for measuring the performance*

IEC 61800-9-1, *Adjustable speed electrical power drive systems – Part 9-1: Ecodesign for power drive systems, motor starters, power electronics and their driven applications – General requirements for setting energy efficiency standards for power driven equipment using the extended product approach (EPA) and semi analytic model (SAM)*

IEC 61800-9-2, *Adjustable speed electrical power drive systems – Part 9-2: Ecodesign for power drive systems, motor starters, power electronics & their driven applications – Energy efficiency indicators for power drive systems and motor starters*

IEC 62018, *Power consumption of information technology equipment – Measurement methods*

IEC 62301, *Household electrical appliances – Measurement of standby power*

IEC 62442-1, *Energy performance of lamp controlgear – Part 1: Controlgear for fluorescent lamps – Method of measurement to determine the total input power of controlgear circuits and the efficiency of the controlgear*

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[2] Under preparation. Stage at the time of publication: IEC FDIS 62974-1:2017.

[3] Under preparation. Stage at the time of publication: ISO/CD 50044:2017.

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CLC/TR 50600-99-1, *Information technology – Data centre facilities and infrastructures – Part 99-1: Recommended practices for energy management*

IS 399, *Energy Efficient Design Management*

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