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Energy saving projects (EnSPs) — Guidelines for economic and financial evaluation

Projets d'économies d'énergie — Lignes directrices pour l'évaluation économique et financière

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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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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.

Introduction

A complete assessment of an investment in an energy saving project (EnSP) requires analysis of all costs and benefits over the lifetime of the investment. This assessment can be used to prioritize the EnSPs. However, it is important to consider the aim and scope at the outset because this will prescribe the course to be followed. The basic criterion for evaluating an investment decision in an EnSP is that the benefits resulting from the EnSP should be greater than the costs incurred within a defined time period for the return on the investment.

This document provides guidance on a methodological framework for the calculation, evaluation and reporting of economic status by defining economic indicators to facilitate the selection of energy performance improvement actions (EPIAs), EnSPs or opportunities. It provides examples and concepts to demonstrate the financial value of the activities related to energy savings to ensure the business connection to the organization.

This document is intended to help EnSP investment evaluators to determine an appropriate approach or type of analysis at an appropriate level of detail and to assist energy savings evaluators in completing consistent analyses using documented assumptions and reasoning. This document includes analytical techniques that are commonly required for an economic evaluation of an EnSP.

Where possible, the financial evaluation of an EnSP should follow the approved method of the organization making the investment, and the detailed approach outlined in this document should be adjusted based on guidance from the organization.

The aim of an economic and financial evaluation is to provide the information needed to make a judgement or a decision in relation to EnSPs.

The perspective of analysis is important, as it often dictates the approach to be used. Also, the ultimate use of the results of an analysis will influence the level of detail required. The decision-making criteria of the potential investor should also be considered.

This analysis approach provides a significantly better evaluation of the long-term implications of an investment than methods that focus on first cost or short-term results. In this document, evaluation methods can be applied to virtually any public or private business sector investment decision as well as EnSPs decisions. Such decisions include the evaluation of alternative solutions with different initial costs, operating and maintenance costs, and the evaluation of investments to improve energy performance.

The process approach and steps used for EnSPs economic and financial evaluation, which are used throughout this document, are illustrated in Figure 1.

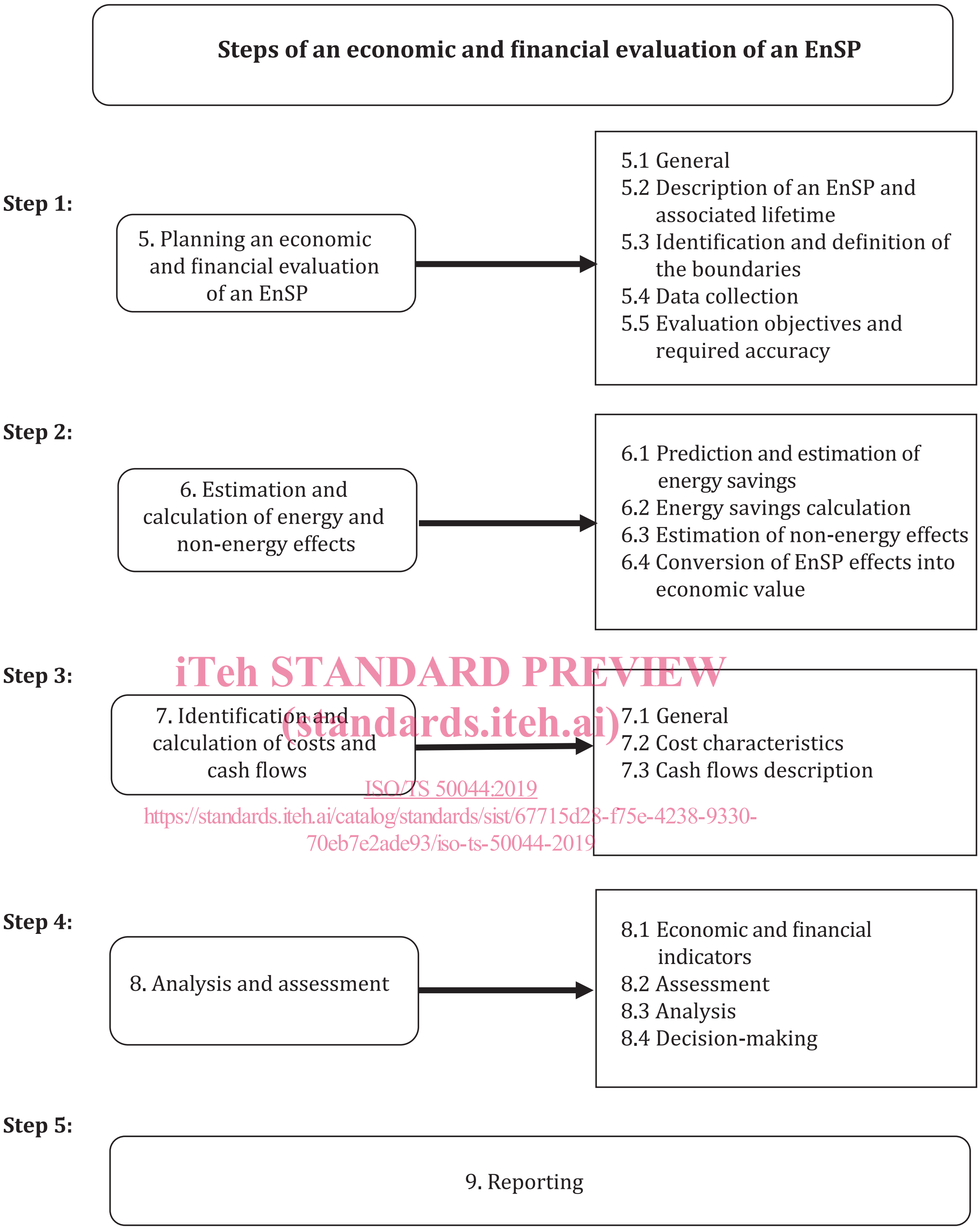

Figure 1 — Economic and financial evaluation approach

This document includes:

a) terms and definitions;

b) the types of costs that should be taken into account for the calculation of the economic and financial evaluation of EnSPs;

c) the data needed for the determination and calculation of costs related to the EnSP under consideration;

d) the calculation and assessment of economic and financial indicators (EFIs);

e) a general framework and rules for the economic priorities of EnSPs;

f) the principle of reporting and expression of results for the economic and financial evaluations of EnSPs.

This document provides indicators for the financial evaluation of all types of EnSPs. Those indicators include the internal rate of return (IRR), net present value (NPV), payback period (PP) and life cycle cost analysis (LCCA).

This document can be used by any organization during the important phases of an energy management system, such as energy review, design, procurement and management review, to prioritize and record energy performance opportunities accurately, consistent with ISO 50001.

This document also can be used by any stakeholder (e.g. policy makers, decision-makers, organizations, NGOs) that aims to quantify the cost of EnSPs over a specific period. Annex A provides guidance on the steps for an energy savings calculation. Annexes B to F provide an overview of the economic and financial evaluations with practical examples.

Energy saving projects (EnSPs) — Guidelines for economic and financial evaluation

1 Scope

This document gives guidelines for how to compare and prioritize energy saving projects (EnSPs) before implementation, using economic and financial evaluation. It includes a common set of principles.

This document is applicable to all EnSPs and energy performance improvement actions (EPIAs) that are developed by stakeholders and organizations for improving energy performance, irrespective of the type and size of an organization and its energy use and consumption.

The methodology for quantification methods for predicted energy savings and measurement and verification (M&V) of the energy savings are not in the scope of this document.

NOTE The methodology for the estimation of the energy savings is critical when determining cost savings.

The methodology of the scenario generation (building) for future energy saving measures and actions is not covered by this document.

General rules and methodologies within this document can be used either independently or in conjunction with other standards and protocols.

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
annual cost
sum of running costs and periodic costs or replacement costs paid on the year *n*

Note 1 to entry: The running cost is the money that needs to be spent regularly to run an *energy saving project* (3.11) or an *energy performance improvement action* (3.10), e.g. cost of maintenance, labour costs.

3.2
capital cost
initial construction costs and costs of initial adaptation where these are treated as capital *expenditure* (3.3)

[SOURCE: ISO 15686-5:2017, 3.1.2, modified — Note 1 to entry has been deleted.]

3.3
expenditure
money used to purchase, install and commission a capital asset

[SOURCE: ISO 15663-1:2000, 2.1.6, modified — “capital” has been deleted from the term.]

3.4
cash flow
CF
movement of money into (cash inflow) or out of (cash outflow) a business, *project* (3.24) or financial product

Note 1 to entry: Cash flow is usually measured for a specified period.

3.5
discount rate
factor or rate reflecting the time value of money that is used to convert *cash flows* (3.4) occurring at different times to a common time

[SOURCE: ISO 15686-5:2017, 3.3.1]

3.6
direct cost
expense that can be traced directly to an *energy saving project* (3.11)

3.7
energy
electricity, fuels, steam, heat, compressed air and other similar media

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

[SOURCE: ISO 50001:2018, 3.5.1]

3.8
energy consumption
quantity of *energy* (3.7) applied

[SOURCE: ISO 50001:2018, 3.5.2]

3.9
energy performance
measurable result(s) related to energy efficiency, energy use and *energy consumption* (3.8)

[SOURCE: ISO 50001:2018, 3.4.3, modified — Notes 1 and 2 have been deleted.]

3.10
energy performance improvement action
EPIA
action or measure or group of actions or measures implemented or planned within an organization intended to achieve *energy performance* (3.9) improvement through technological, managerial, behavioural, economical, or other changes

[SOURCE: ISO 50015:2014, 3.5, modified — "or operational" has been deleted.]

3.11
energy saving project
EnSP
activity that is intended to contribute to a measurable reduction in *energy consumption* (3.8)

Note 1 to entry: An EnSP can also be intended to contribute to a reduction in greenhouse gas emissions.

Note 2 to entry: An EnSP includes at least one *energy performance improvement action* (3.10).

3.12
energy savings
reduction of *energy consumption* (3.8) following the implementation of an *energy performance improvement action* (3.10)

[SOURCE: ISO/IEC 13273-1:2015, 3.3.9]

3.13
hurdle rate
minimum rate of return on a *project* (3.24) or investment required by a manager or investor

3.14
indirect cost
expense that cannot be traced directly to an *energy saving project* (3.11)

3.15
inflation
sustained increase in the general price level

Note 1 to entry: Inflation can be measured monthly, quarterly or annually against a known index.

[SOURCE: ISO 15686-5:2017, 3.3.3, modified — "deflation" has been deleted.]

3.16
internal rate of return
IRR
discount rate (3.5) that gives a *net present value* (3.22) equal to zero

Note 1 to entry: IRR is also known as the discounted *cash flow* (3.4) rate of return.

Note 2 to entry: In the context of savings and loans, IRR is also known as the economic rate of return.

[SOURCE: ISO 26382:2010, 3.8]

3.17
interactive effect
significant *energy* (3.7) result occurring beyond the project boundary as a consequence of action(s) within the project boundary

Note 1 to entry: Correctly identifying and accounting for consequential effects mitigates the *risk* (3.27) of double counting when the results of various *energy performance improvement actions* (3.10) are combined.

Note 2 to entry: The consequential effect is limited to the boundaries of the authority of the management of the energy-using system.

EXAMPLE Changing the lighting system to be more efficient will have a consequential effect on the HVAC system. If the measurement boundary is the lighting system only, the consequential effect on the HVAC system should be described.

[SOURCE: ISO 17741:2016, 3.13, modified — Notes 1 and 2 have been replaced and the example has been slightly amended.]

3.18
life cycle cost
LCC
discounted cumulative total of all costs incurred by an *energy performance improvement action (EPIA)* (3.10) over its life cycle

Note 1 to entry: For an *energy saving project* (3.11), the discounted life cycle cost is the sum of all discounted costs of the constituent EPIAs, taking into consideration their respective lifetimes.

[SOURCE: ISO 15663-3:2001, 2.1.9, modified — "an energy performance improvement action" has replaced "a specified function or item of equipment" and Note 1 to entry has been added.]

3.19
life cycle cost analysis
LCCA
methodology for the systematic economic evaluation of *life cycle costs* (3.18) over a period of analysis, as defined in the agreed scope

3.20
maintenance cost
total of necessarily incurred labour, material and other related costs incurred to retain equipment, a process or its parts in a state in which it can perform its required functions in an *energy saving project (EnSP)* (3.11)

Note 1 to entry: Maintenance includes conducting corrective, responsive and preventative maintenance on EnSPs, or their parts, and includes all associated management, cleaning, servicing, repairing and replacing of parts, where needed, to allow the EnSP and its parts to be used for its intended purposes.

[SOURCE: ISO 15686-5:2017, 3.1.9, modified — In the definition, “equipment, a process” has replaced “a building”. In the note, “ENSPs” has replaced “constructed assets” and “repainting” has been deleted.]

3.21
minimum attractive rate of return
MARR
hurdle rate (3.13) for a *project* (3.24) within an organization

Note 1 to entry: MARR is used to determine the *net present value* (3.22).

Note 2 to entry: In capital budgeting, the *discount rate* (3.5) used is known the hurdle rate and is usually equal to the incremental cost of capital.

3.22
net present value
NPV
sum of the discounted future *cash flows* (3.4)

Note 1 to entry: NPV converts future cash flows using a given *discount rate* (3.5).

[SOURCE: ISO 15686-5:2017, 3.2.2, modified — Notes 1 and 2 to entry have replaced the Note 1 to entry.]

3.23
new project
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

[SOURCE: ISO 17741:2016, 3.16, Note 4 to entry]

3.24
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 *energy performance improvement actions* (3.10).

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* (3.12) is the quantitative result as the project activities bring about reduction in the *energy consumption* (3.8) of energy-using systems within the project boundary.

Note 4 to entry: Retrofit project is a project conducted on an already existing energy-using system.

[SOURCE: ISO 17741:2016, 3.16, modified — Note 4 to entry has been deleted and Note 5 to entry renumbered accordingly.]

3.25
payback period
PP
period after which the initial capital invested has been paid back by the accumulated net revenue earned

[SOURCE: ISO 26382:2010, 3.13, modified — Note 1 to entry has been deleted.]

3.26
present value
PV
present worth
value of the *project* (3.24) *cash flow* (3.4) excluding the initial investment outlay

[SOURCE: ISO 15663-2:2001, 2.1.2, modified — “present worth” has been added as the admitted term.]

3.27
risk
effect of uncertainty on objectives

Note 1 to entry: An effect is a deviation from the expected. It can be positive, negative or both, and can address, create or result in opportunities and threats.

Note 2 to entry: Objectives can have different aspects and categories, and can be applied at different levels.

Note 3 to entry: Risk is usually expressed in terms of risk sources, potential events, their consequences and their likelihood.

[SOURCE: ISO 31000:2018, 3.1]

3.28
sensitivity analysis
test of the outcome of an analysis by altering one or more parameters from initial value(s)

[SOURCE: ISO 15686-5:2017, 3.2.5]

3.29
useful life
estimation of the median number of years of equipment life and accordingly the life of the *project* (3.24)

4 Symbols and abbreviated terms

For the purposes of this document, the following symbols, abbreviated terms and units apply.

Symbol/term	Description	Typical unit
A_n	annual investment (fixed and variable)	$
A_s	uniform annual saving	
A_t	net cash flow	$
$A_{t,i}$	annual costs, including variable and fixed annual costs and working capital cost	$
C_d	cost (or net proceeds) of disposal	$
C_e	cost of energy savings	$/kWh, $/MJ
C_i	initial cost of the system	$
C_m	cost of maintenance and repair	$

NOTE For simplicity, the financial unit of currency in this document is shown using a $ symbol. In practice, it will normally be in the local currency of the country where the EnSP is taking place.

Symbol/term	Description	Typical unit
C_t	cash outflow (at the beginning of and during the project; this can include an initial investment)	$
DPP	discounted payback period	years
E_c	annual energy consumption	kWh, MJ
E_p	energy price	$
i	interest rate	%
IRR	internal rate of return	%
LCC	life cycle cost	$
n	lifetime of the system	years
NPV	net present value	$
PI	profitability index	—
PP	payback period	years
PV	present value	$
r	discount rate	%
R_t	cash inflow	$
SPP	simple payback period	years
t	time	years
NOTE For simplicity, the financial unit of currency in this document is shown using a $ symbol. In practice, it will normally be in the local currency of the country where the EnSP is taking place.		

5 Planning an economic and financial evaluation of an EnSP

5.1 General

When planning and describing an EnSP, the costs and cash flows involved should be considered. As for any other investment, an EnSP should normally show a return on invested capital more than the hurdle rate.

NOTE The organization takes the decision as to whether the project return needs to exceed the hurdle rate. An EnSP can be done as part of the social licence to operate.

To be able to take a decision about the course of action on the recommendations of an energy audit, management needs to calculate all the costs associated with the project and determine the potential returns of the proposal.

This, however, is not quite as simple as it might first appear. Savings from EnSPs often decrease with time and EnSPs can require more maintenance, with higher associated costs, as they get older.

If an EnSP is self-financed or implemented using borrowed money, the opportunity cost of money or interest payments will apply. Both inflation and tax will influence the value of any future energy savings that can be achieved. It is therefore important that the economic and financial evaluation process allows for all these factors, with the aim of determining which EnSPs should be undertaken and of optimizing the benefits achieved. Consequently, a number of accounting and financial evaluation techniques have been developed to help decision-makers.

The detail of the financial evaluation should be proportionate to the size of the investment. Organizations may consider the level of detailed financial analysis in relation to the magnitude of the benefits and associated costs.

5.2 Description of an EnSP and associated lifetime

The following elements should be considered when carrying out an economic and financial evaluation of an EnSP:

- the aim of the evaluation;
- the required accuracy of the evaluation results;
- the availability of data related to energy consumption within the selected boundary;
- the capital budget for the implementation of the EnSP;
- the types of costs related to the EnSP, including non-energy costs;
- the current situation of energy consumption and relevant variables;
- the future situation of energy consumption and costs;
- uncertainty and risks associated with costs and savings from the EnSP;
- EFIs for the evaluation of the EnSP;
- whether a full financial evaluation is justified given the required investment in the project.

5.3 Identification and definition of the boundaries

5.3.1 General

An EnSP boundary should be selected to ensure that interactions and all activities related to an EnSP are included or calculated as interactive effects.

The EnSP boundary may include the facilities, systems, processes and equipment affected by the EnSP or EPIA(s) implemented within the project. The EnSP boundary should include measurements or calculations required to determine the interactive effects of the implementation of the project.

The project boundary can be drawn around an individual EPIA(s) or EnSP, if it is considered that there will be no interactive effects with other facilities, systems or equipment.

NOTE Examples of boundaries:

a) a university campus;

b) the engineering department within the university;

c) all the lighting systems in the university campus.

5.3.2 Examples of EnSP boundaries

According to the type of action, an EnSP or EPIA can take various forms, including:

a) organizational culture, e.g. changing the behaviour of staff in an organization by training;

b) replacement of old technologies with new technologies or adding a new part to improve the operation of equipment;

c) application of renewable energy resources, e.g. using a photovoltaic panel to reduce the fuel consumption of a generating system;

d) use of procured services for improving energy performance, e.g. personnel training, energy audits, consultants for repairing and maintaining facilities and equipment.

An EnSP can include one or more EPIAs, as shown in Figure 2 and Table 1.