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Technical energy systems — Methods for analysis —

Part 1: General

Systèmes d'énergie technique — Méthodes d'analyse —
Partie 1: Généralités

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 13602 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13602-1 was prepared by Technical Committee ISO/TC 203, *Technical energy systems*.

ISO 13602 consists of the following parts, under the general title *Technical energy systems — Methods for analysis*:

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— *Part 1: General*

Other parts are under preparation.

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Annexes A, B and C of this part of ISO 13602 are for information only.

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Introduction

International Standards ISO 13600, ISO 13601 and ISO 13602 (all parts) are intended to be used as tools to define, describe, analyse and compare technical energy systems (TESs) at micro and macro levels. These tools enable the user to make objective choices of TESs in their total technical, economic, environmental and social contexts and thus to help consensus-building and decision-making.

ISO 13600 covers basic definitions and terms needed to define and describe TESs in general and TESs of energyware supply and demand sectors in particular. ISO 13601 covers structures that can be used to describe and analyse subsectors at the macro level of energyware supply and demand, while ISO 13602 (all parts) facilitates the description and analysis of any technical energy systems with an emphasis on systems at the microlevel.

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Technical energy systems — Methods for analysis —

Part 1:
General

1 Scope

This part of ISO 13602 provides methods to analyse, characterize and compare technical energy systems (TESs) with all their inputs, outputs and risk factors. It contains rules and guidelines for the methodology for such analyses.

This part of ISO 13602 is intended to establish relations between inputs and outputs and thus to facilitate certification, marking and labelling.

2 Normative references

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The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 13602. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 13602 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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ISO 13600:1997, *Technical energy systems — Basic concepts*

ISO 14040:1997, *Environmental management — Life cycle assessment — Principles and framework*

3 Terms and definitions

For the purposes of this part of ISO 13602, the following terms and definitions apply.

3.1
embedded energy
total amount of energy directly used to produce or process inputs to make a TES

NOTE Upon decommissioning and in recycling the materials, some of the embedded energy can sometimes be reclaimed.

3.2
technical energy system
TES
combination of equipment and plant interacting with each other to produce, consume, or in many cases transform, store, transport or handle energyware and other energy resources

NOTE TESs also include other resources, expanding the definition given in ISO 13600:1997, item 2.24.

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3.3
energy resource
any matter or phenomenon that can be converted into energyware or directly into energy services, which can be classified as a renewable, non-renewable or reclaimable resource

NOTE See Table 4 for examples of energy resources.

3.4
energy service
useful, measurable output of any energy-use system

NOTE See Table 5 for examples of energy services for defined functional units.

3.5
energy-use system
part of a technical energy system converting energyware or other energy sources into energy services

3.6
functional unit
quantified performance of a technical energy system for use as a reference unit

3.7
renewable resource
natural resource for which the ratio of the creation of the natural resource to the output of that resource from nature to the technosphere is equal to or greater than one

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3.8
capital goods
input to a technical energy system composed of investment goods and construction materials

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3.9
capital investment
capital goods and construction or installation activities composing a technical energy system

4 Methods of analysis of TES

4.1 General

The methods for the analysis of TESs have two distinctly different but complementary purposes.

a) Combined TESs (macro level)

Chains combining TESs using energyware or direct energy sources may be compared and optimized from different viewpoints:

- technical (safety, feasibility, reliability);
- economic (competitiveness, availability);
- ecological (emissions, climate, biosphere).

This method of analysis enables the deduction of social impacts such as health, well-being and social costs. Strategic decisions about matters such as conservation of resources, saving foreign exchange, national security and traffic congestion may be made. Overall comparisons among coal, oil, gas, hydro, wind, bio, solar and hydrogen TESs constitute examples of this method of analysis.

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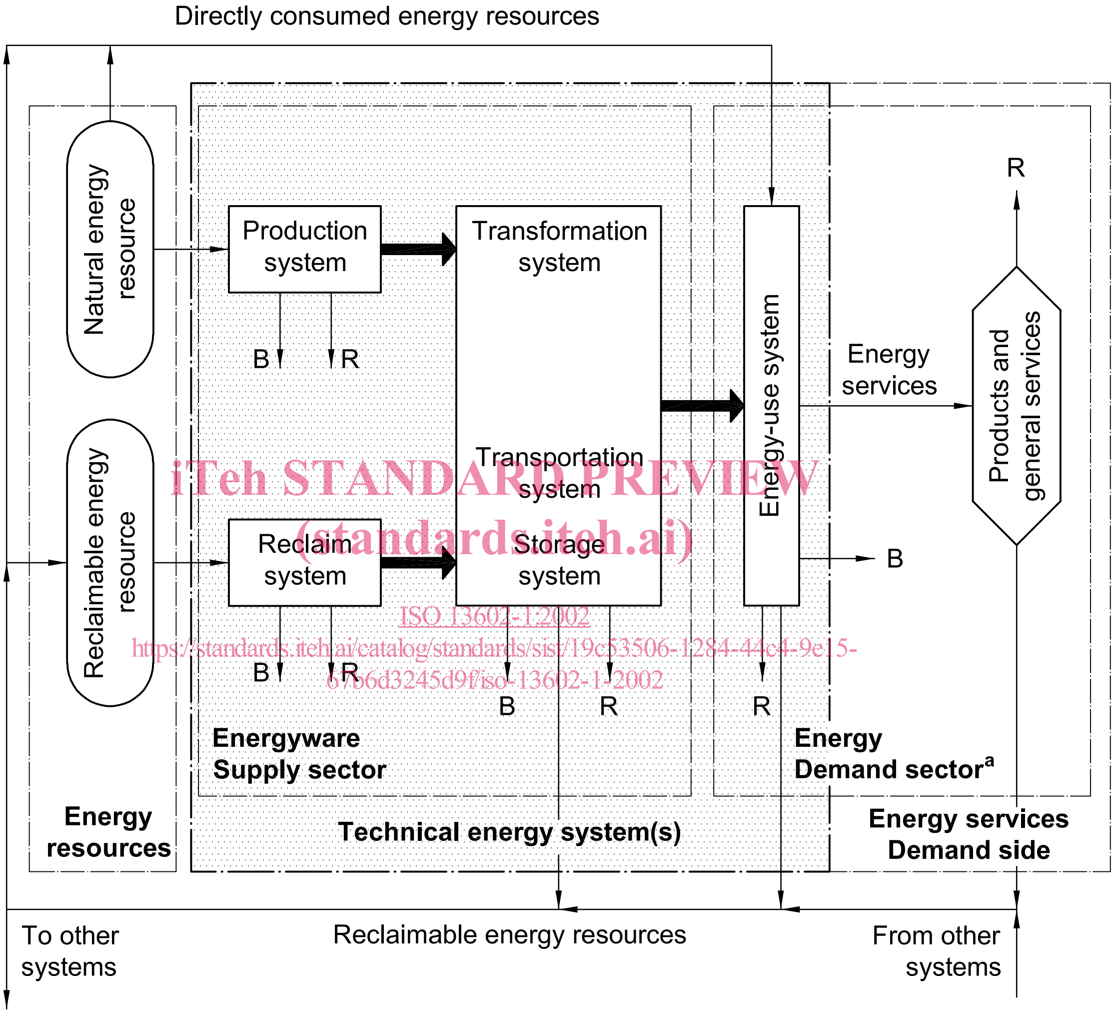
b) Alternative systems within combined TESs (micro level)

A TES can be composed of one or several subsystems, which may be combined, analysed or compared with an alternative TES at various stages. These alternative combinations may concern energyware production, conversion, refining, transformation, transport, handling or storage methods, or energy-use processes.

Energy flows within a generalized TES ranging from the energy resource inputs to the final energy service outputs, which are needed to manufacture products or render services of a general nature such as telecommunications or medical services, are shown in Figure 1.



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Key

R = Release
B = By-products

Energyware

Energy resources used for TES

TES or process units

Products and general services using energy services

[a] This term includes both energyware demand, in accordance with clause 7 and Figure 6, as per ISO 13600:1997, and direct energy resource demand.

Figure 1 — Energy flows within a generalized TES

4.2 TESs yielding comparable energy services

Examples of simplified alternative TESs are given in Table 1.

Table 1 — Simplified alternatives

Example	Energy resource	Transport/Conversion/Distribution	Energy-use system	Energy service
4.3.1	Beeswax	Horse cart — Candle maker — Truck	Candle	Light
4.3.2	Sunlight	Light duct		Light
4.3.3	Natural gas	Pipeline — Power station — Cable — Transformer	Light bulb	Light
4.3.4	Wind	Propeller — Generator — Transformer — Cable	Fluorescent lamp	Light

A possible combination of TESs in a factory with their various energy inputs and energy service outputs is shown in Figure 2, whereby each energy-use system can be analysed and alternatives compared.

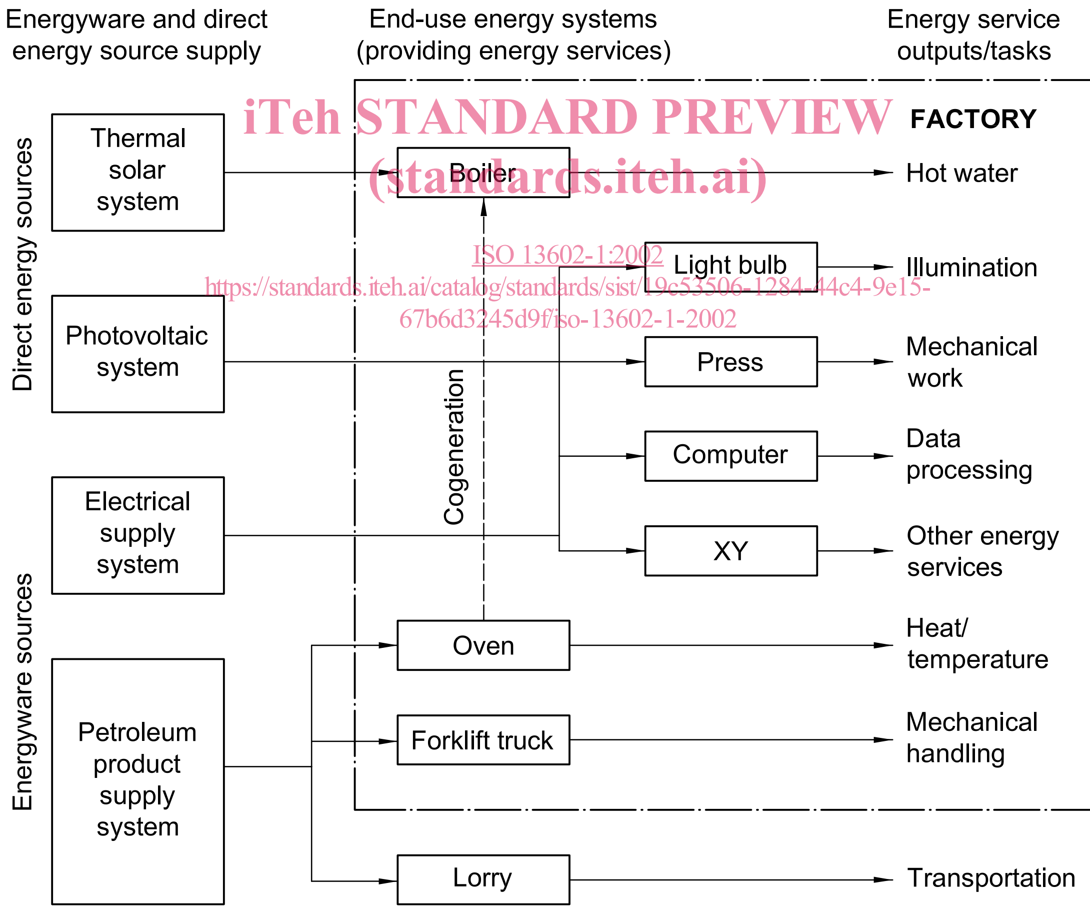

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Figure 2 — Examples of possible combination of TESs in a factory

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5 I-O (input-output) analysis of TES

5.1 Elementary I-O model

TESs shall be analysed by means of standardized I-O models which allow systematic quantitative and qualitative comparisons. An elementary model is described in Figure 3. This I-O model describes any TES, including all factors in the determination of internal and external costs and impacts. It mainly distinguishes two different I-O categories, shown on the vertical (A) and horizontal (B) axes.

Practical examples of applied and combined I-O models of an energy-saving lamp, a refrigerator and a co-generation unit are shown in annexes A, B and C, respectively.

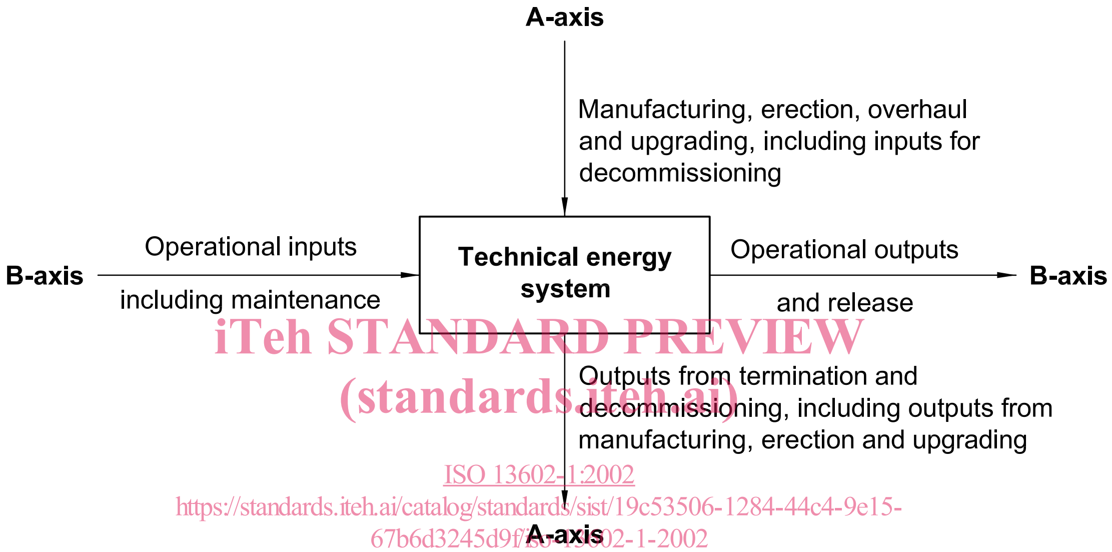

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Figure 3 — Elementary I-O model

5.2 Life cycle and operational I-O categories

5.2.1 Capital goods and related service inputs needed to set up a TES, such as construction materials and labour, hardware and software, space and predefined information, enter the I-O model on top, on the A-axis (see column 2 in Table 2). Residues, recyclable or waste and possible after-effects, including releases and environmental impacts of the terminated and decommissioned system, leave the box at the bottom on the A-axis (see column 2 in Table 3).

5.2.2 Operational inputs, such as energy resources or energyware, operational manpower, operational information and auxiliary materials such as lubricants, pass through the I-O model horizontally on the B-axis. Inputs such as energy resources (see Table 4) and inputs related to the maintenance of energy systems (see Table 2) enter from the left of the I-O box, and outputs such as energyware, energy services, releases and by-products including emissions or waste, exit to the right on the B-axis (Operational outputs in Table 3).

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