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Technical energy systems — Structure for analysis — Energyware supply and demand sectors

Systèmes d'énergie technique — Structure d'analyse — Secteurs de fourniture d'énergie et de demande en énergie

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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.

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.

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International Standard ISO 13601 was prepared by Technical Committee ISO/TC 203, *Technical energy systems*.

Annex A forms an integral part of ISO 13601. Annexes B and C are for information only.

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Introduction

The International Standards of the 13600 series are intended to be used as tools to define, describe, analyse and compare technical energy systems at the micro and macro levels. The use of these tools provides an objective basis for discussion on energy options in the technical, environmental and social contexts and thus help consensus-building and decision-making.

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Technical energy systems — Structure for analysis — Energyware supply and demand sectors

1 Scope

This International Standard specifies a structure that shall be used to describe and analyse technical energy systems. It defines subsectors of the energyware supply and demand sectors, and furthermore defines a model structure for each subsector. This provides a set of standardized modules, according to which all data shall be organized and presented. The structure serves the same purpose in studies of technical energy systems as an accounting code plan does in bookkeeping. It is principally aligned with the structure of official international statistics (ISIC) in order to facilitate data aquisition.

The use of this structure facilitates the comparison betweeen different studies of technical energy systems and permits partial results of one study to be used in other studies.

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2 Normative reference

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The following standard contains provisions which, through reference in this text, constitute provisions of the standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on ISO 13601 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

3 Structure of energyware supply and demand sectors

3.1 General

According to ISO 13600, the technosphere is divided in two sectors: the energyware supply sector and the energyware demand sector. Further division into subsectors is shown in Figure 1. See also Annex A.

A technical energy system can cut across many subsectors (see Annex B). When describing such systems, they shall be subdivided according to subsectors. Each part of such a technical energy system, falling in a particular subsector, shall be consolidated and presented separately before proceeding to a final total consolidation.

A technical energy system normally contains a large number of interacting components, as outlined in Figure 2.

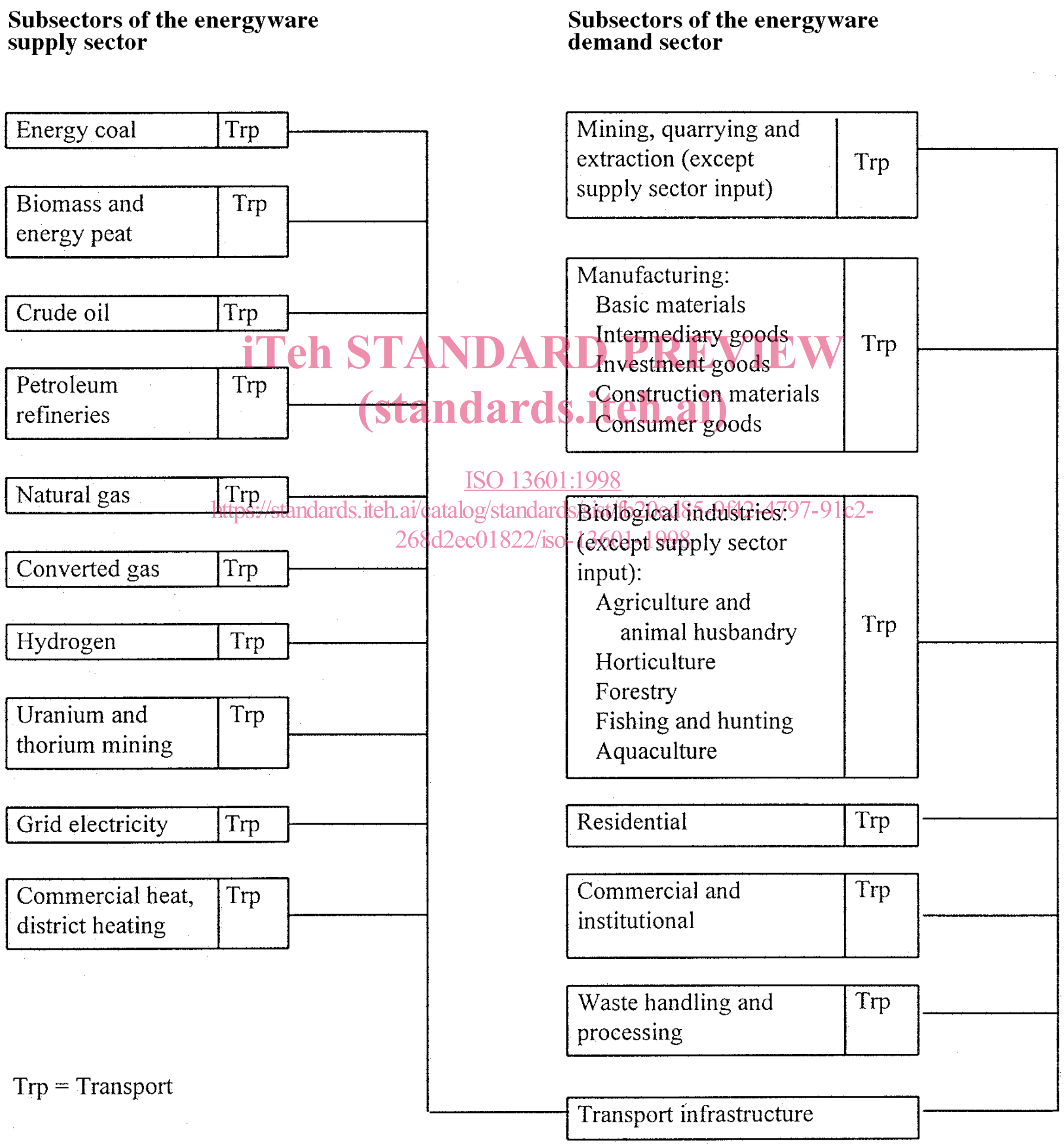
The actual structure of interacting components shall be simplified by successive consolidation into standardized model boxes, which together define the model structure of the subsector. Further consolidation of these model boxes results in the subsector consolidated box.

The main input to one model box is either a natural resource or the output from the preceding model box. Each model box also has inputs of ancillary materials, including energyware and services. Other inputs are capital goods, e.g. construction materials and investment goods, labour and land.

Land surfaces which are occupied by buildings or covered by pavement, asphalt or similar surface hardeners shall be considered to have been incorporated in the technosphere. Other land surfaces shall be considered as parts of nature. In many cases, such land is affected by exploitative impacts and releases. Examples are gardens, parks and agricultural land.

In addition to the main output, there are by-products both from normal operation and from decommissioning of the technical energy systems themselves. Some by-products, referred to as waste, are inputs to the waste handling and processing subsector, which produces reclaimable resources and release.

Transportation shall be dealt with separately, and related to the actual flow. Inputs to this activity are energywares for the propulsion, ancillary materials of different kinds, including services from the transport infrastructure subsector, and capital goods represented by vehicles and craft.


Subsectors of the energyware supply sector
Subsectors of the energyware demand sector
Energy coal
Trp
Biomass and energy peat
Trp
Crude oil
Trp
Petroleum refineries
Trp
Natural gas
Trp
Converted gas
Trp
Hydrogen
Trp
Uranium and thorium mining
Trp
Grid electricity
Trp
Commercial heat, district heating
Trp
Mining, quarrying and extraction (except supply sector input)
Trp
Manufacturing: Basic materials Intermediary goods Investment goods Construction materials Consumer goods
Trp
Biological industries: (except supply sector input): Agriculture and animal husbandry Horticulture Forestry Fishing and hunting Aquaculture
Trp
Residential
Trp
Commercial and institutional
Trp
Waste handling and processing
Trp
Transport infrastructure
Trp = Transport

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NOTE The lines from the transport infrastructure subsector to the other subsectors symbolize the resources expended in the transport infrastructure subsector and shall be accounted for as overhead in each of the other subsectors.

Figure 1 — Subsectors of the energyware supply and demand sectors divided according to economic activity

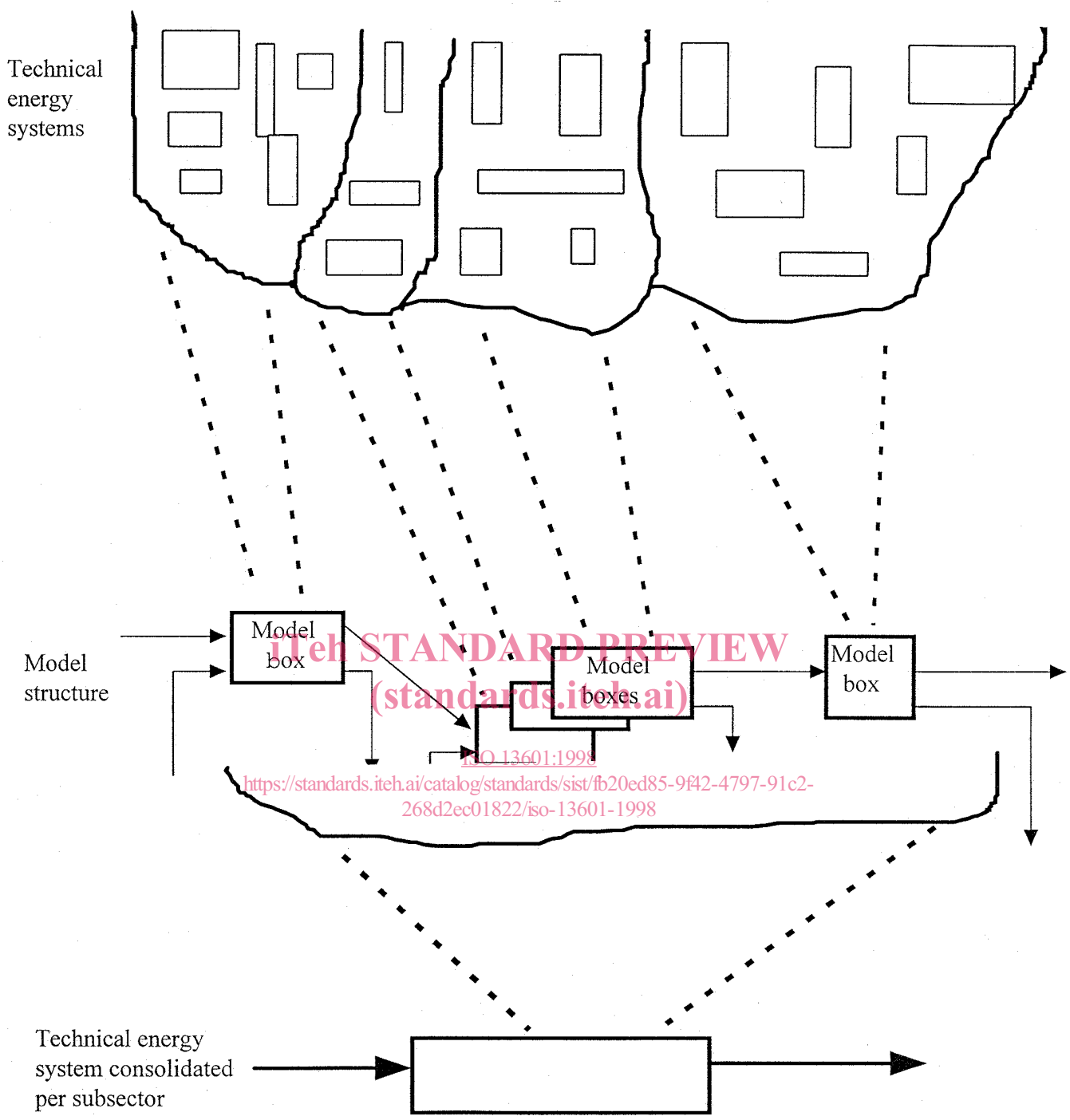

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Figure 2 — Relationship between technical energy systems, model structure and consolidated subsectors — Successive consolidation

Dedicated transport systems, such as pipelines, and transmission and distribution networks, shall be included in their respective subsectors.

Transport between two subsectors, including empty trips, shall be accounted for in the sending subsector.

Services given by the transport infrastructure subsector shall be accounted for as overhead to identified transport.

Resources expended in exploration, which precedes investment in mining, quarrying and extraction facilities, whether producing useful results or not, shall be accounted for as an overhead.

Construction activity connected to investment shall be included in the relevant model box.

3.2 Simplified presentation of model boxes

The model structure of technical energy systems shall be described by the formalized input-output model given in ISO 13600. For simplicity, however, two of the three inputs; ancillary inputs and other production factors, are in the following presentation combined into one, denoted with an asterisk (*). In the energyware demand sector, energyware normally appears among the ancillary inputs. See Figure 3.

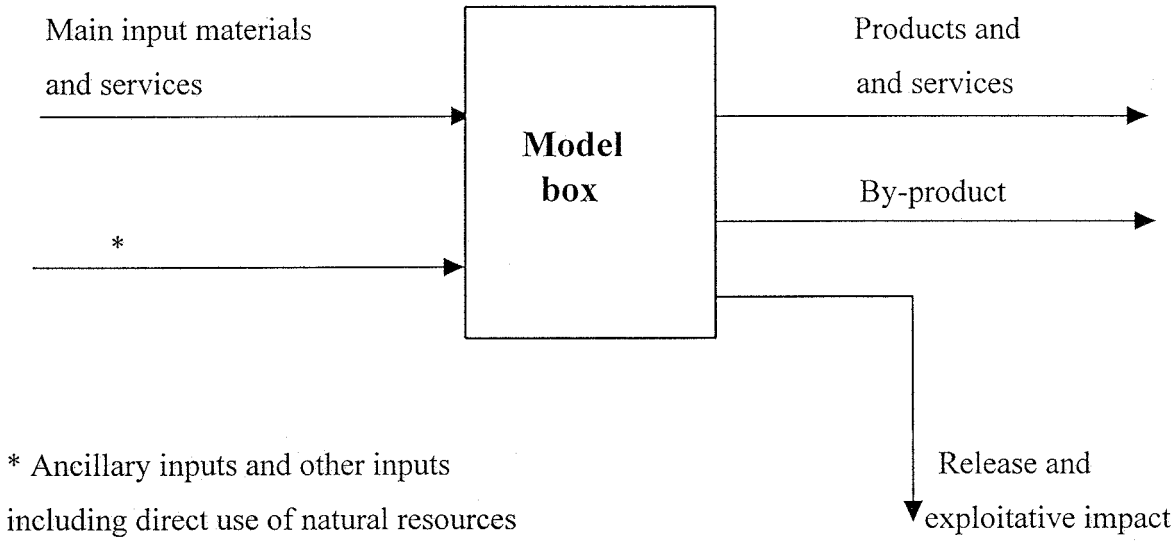

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Figure 3 — Simplified presentation of model boxes

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3.3 Energyware supply sector (see also Annex C)

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3.3.1 Energy coal subsector

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3.3.1.1 General

The model structure that shall be used to describe technical energy systems in the energy coal subsector, which includes lignite, consists of three model boxes: mining, processing and transportation (see Figure 4).

The processing stage includes production of coal briquettes.

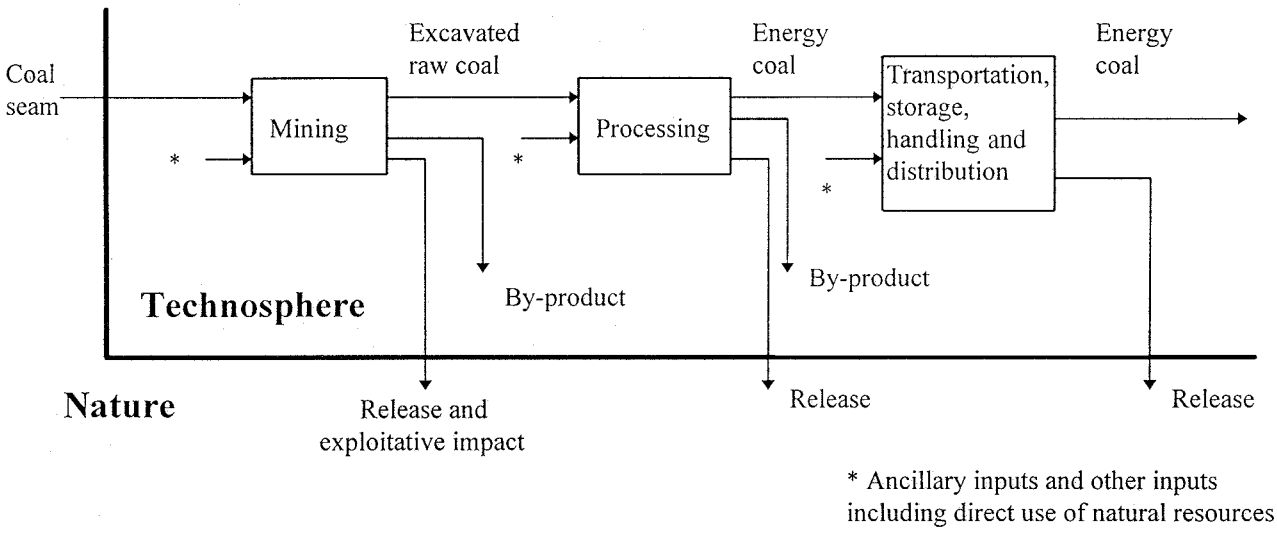

Figure 4 — Model structure of technical energy systems in the energy coal subsector

3.3.1.2 Inputs

Coal in the seam shall be regarded as a natural resource, but once excavated as an energyware.

The main input materials to the different model boxes are:

— coal seam to mining

— excavated raw coal to processing (mainly sorting and washing)

— energy coal to transportation.

3.3.1.3 Outputs

The main output from one model box is the main input to the next. The consolidated main output from this subsector is energy coal, in some cases in the form of briquettes, delivered to receivers in other subsectors.

By-products may be created during coal mining and processing.

A release formed in this subsector is the contaminant of water used in washing the excavated raw coal.

3.3.2 Biomass and energy peat subsector

3.3.2.1 General

This subsector comprises of harvesting or production of:

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— energy peat;

— commercial firewood;

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— other biomass as defined in ISO 13600;

— charcoal;

— motor alcohols derived from biomass;

— fuels derived from vegetable and animal oils.

The model structure that shall be used to describe technical energy systems in the biomass and energy peat subsector consists of four model boxes: cultivation and harvesting; transportation; processing; and transportation, storage and distribution (see Figure 5).

On-site processing takes place in the cultivation and harvesting model box.

Drying of biomass and energy peat may take place in the cultivation and harvesting box and in the processing box.

3.3.2.2 Inputs

Trees, bushes, sticklings and peat, before harvesting and processing, shall be regarded as natural resources, but after that as energywares.

The main input materials to the different model boxes are:

— growing biomass or peat to cultivation and harvesting;

— harvested biomass or peat to transportation and processing;

— processed and dried biomass or peat to transportation, storage, handling and distribution.

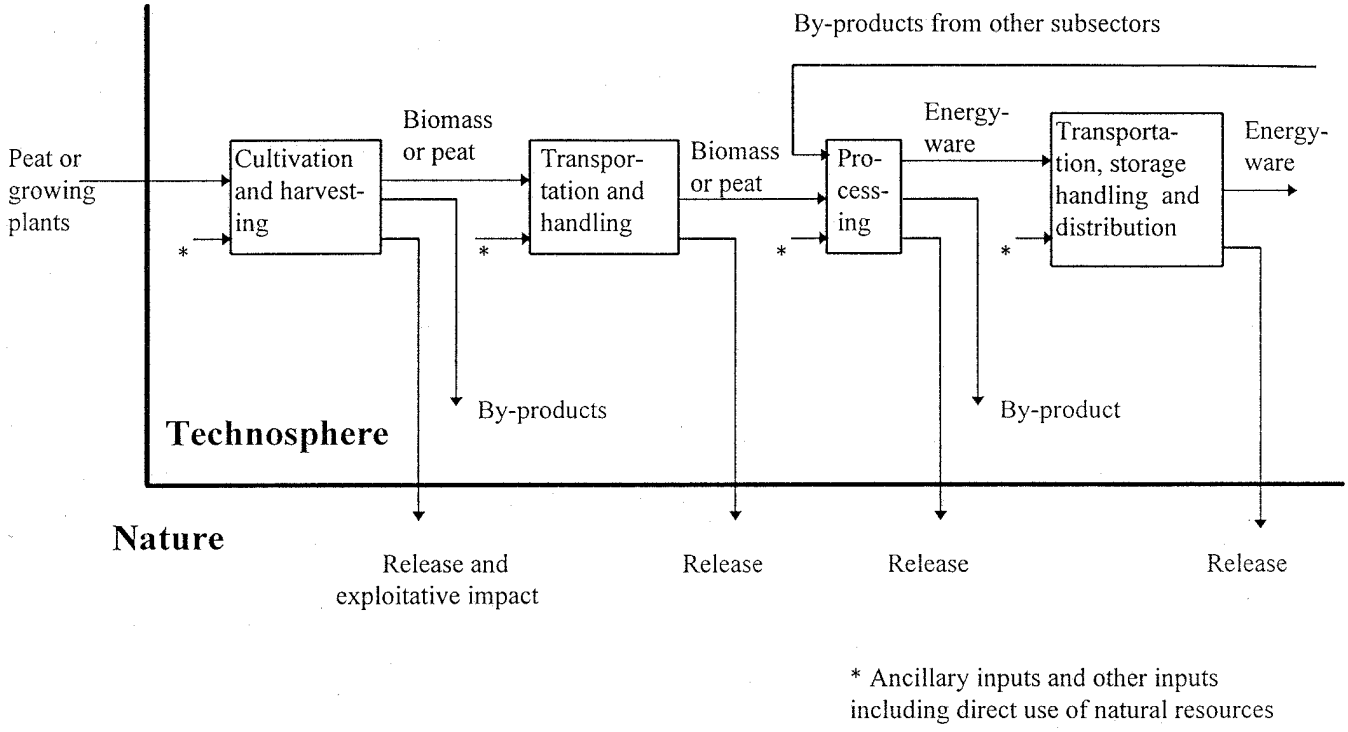

Figure 5 — Model structure of technical energy systems in the biomass and energy peat subsector

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3.3.2.3 Outputs

The consolidated main output from this subsector is processed and often partly dried biomass delivered to receivers in other subsectors.

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By-products may be created during cultivation and harvesting and processing.

Cultivation and harvesting comprise intended releases such as fertilizers and pesticides and intended exploitative impacts such as draining.

Releases to note in this subsector are the contaminants of soil, surface and ground water; and pollutants such as air dust.

3.3. Crude oil subsector

3.3.3.1 General

The model structure that shall be used to describe technical energy systems in the oil extraction subsector consists of two model boxes: production, including crude oil pumping and separation of gases and water, and transportation, storage and handling (see Figure 6).

3.3.3.2 Inputs

Oil in the ground, unextracted, shall be regarded as a natural resource, and is main input material to the production model box.

The main input material to the transportation, storage and handling model box is crude oil.

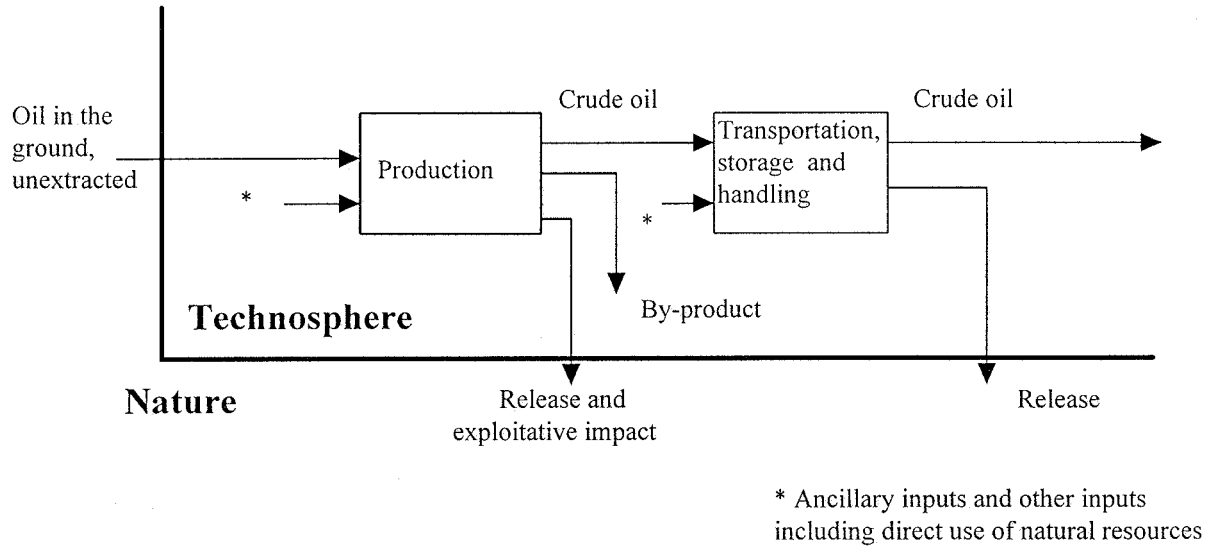

Figure 6 — Model structure of technical energy systems in the crude oil subsector

3.3..3 Outputs

The consolidated main output from this subsector is crude oil, delivered to receivers in other subsectors, mostly oil refineries.

By-products, mainly hydrocarbon gases, may be obtained from the oil extraction subsector.

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The environmental load comprises:

— depletion: ultimately restricted resource base;

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— exploitative impact: normally of relatively limited significance;

— release: oil spill and gaseous emissions.

3.3.4 Petroleum refineries subsector

3.3.4.1 General

The model structure that shall be used to describe technical energy systems in the petroleum refineries subsector consists of two model boxes: processing (refining) including storage of crude oil and oil products; and transportation, storage, handling and distribution (see Figure 7).

3.3.4.2 Inputs

The main input to the different model boxes are:

— crude oil to processing (refining) and

— oil products to transportation, storage, handling, and distribution.

3.3.4.3 Outputs

The consolidated main output from this subsector are petroleum products delivered to receivers in other subsectors.

By-products, for example petroleum coke, refinery gases and district heat, are obtained during oil refineries processing.

Examples of releases are oil spills and gaseous emissions.

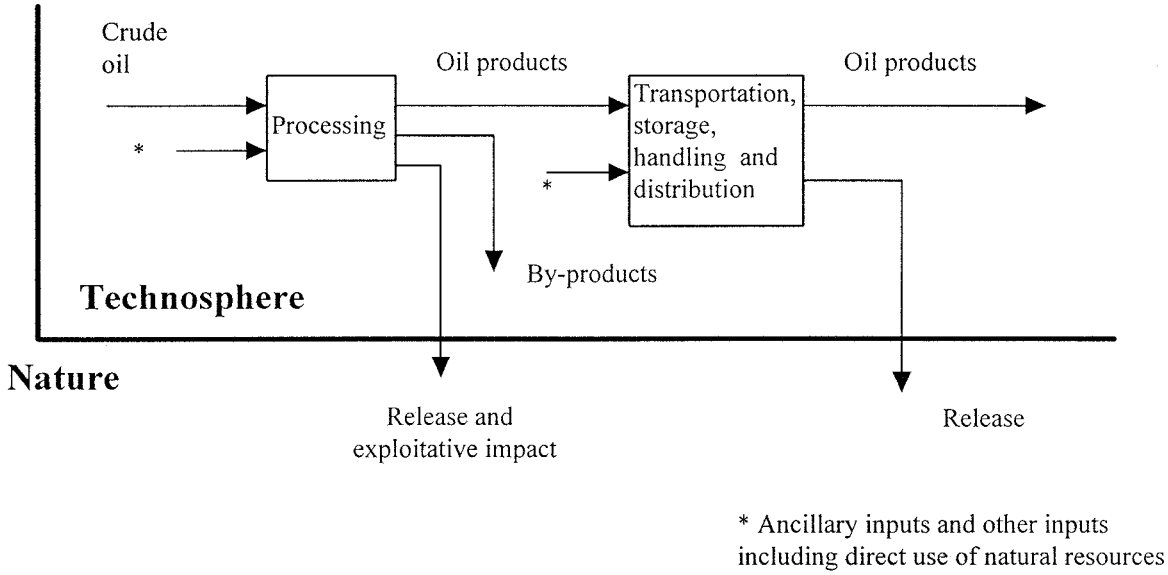

Figure 7 — Model structure of technical energy systems in the petroleum refineries subsector

3.3.5 Natural gas subsector

3.3.5.1 General

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The model structure that shall be used to describe technical energy systems in the natural gas subsector consists of four model boxes: production; transportation, storage and handling; preparation; and distribution (see Figure 8).

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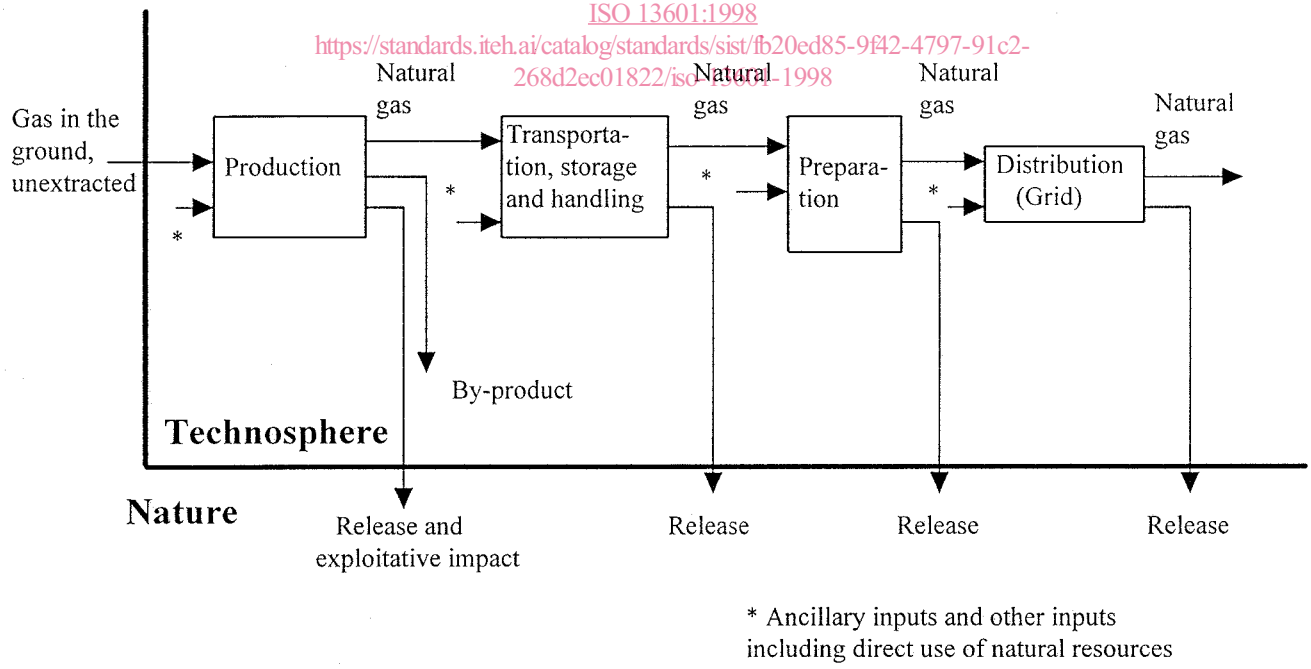

Figure 8 — Model structure of technical energy systems in the natural gas subsector

3.3.5.2 Inputs

Natural gas in the ground, unextracted, shall be regarded as a natural resource.

The main input material to the different model boxes are:

— natural gas to production;

— liquefied or compressed natural gas to transportation, storage and handling and to preparation;

— compressed, and sometimes odorized, natural gas to the distribution gas grid.

3.3.5.3 Outputs

The main output from the preparation model box is natural gas, which may be odorized.

The consolidated main output from this subsector is compressed natural gas, delivered to receivers in other subsectors.

By-products, mainly helium and liquefied petroleum gases (LPG), may be obtained from the natural gas production. The low temperature of liquified natural gas (LNG) may be used to produce by-products such as oxygen, nitrogen or even grid electricity.

One exploitative impact can be a change in the geological structure.

The main release is methane leaked into the atmosphere. The quantity of this release depends on the integrity of the pipeline system.

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Another release may be carbon dioxide or other gases emitted during production.

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3.3.6 Converted gas subsector

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3.3.6.1 General

The model structure that shall be used to describe technical energy systems in the converted gas subsector consists of four model boxes: transformation; transportation, storage and handling; preparation; and distribution (see Figure 9).

3.3.6.2 Inputs

The main input materials to the transformation model box are:

— oil products from the petroleum refineries subsector;

— energy coal from the energy coal subsector. Gas from integrated coking plants in the iron and steel industry shall be accounted for in the energyware demand sector;

— biomass from the biomass subsector or reclaimable resources from the energyware demand sector;

— natural gas.

The main input to the transportation, storage and handling, the preparation, and the distribution model boxes is the converted gas produced in the transformation model box.

One input to the preparation model box may consist of products and by-products from other energyware subsectors, mainly from the crude oil or petroleum refineries subsectors, but also from the biomass subsector.