
**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

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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.

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 acquisition.

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

2 Normative reference

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

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

Trp = Transport

Subsectors of the energyware demand sector

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	

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

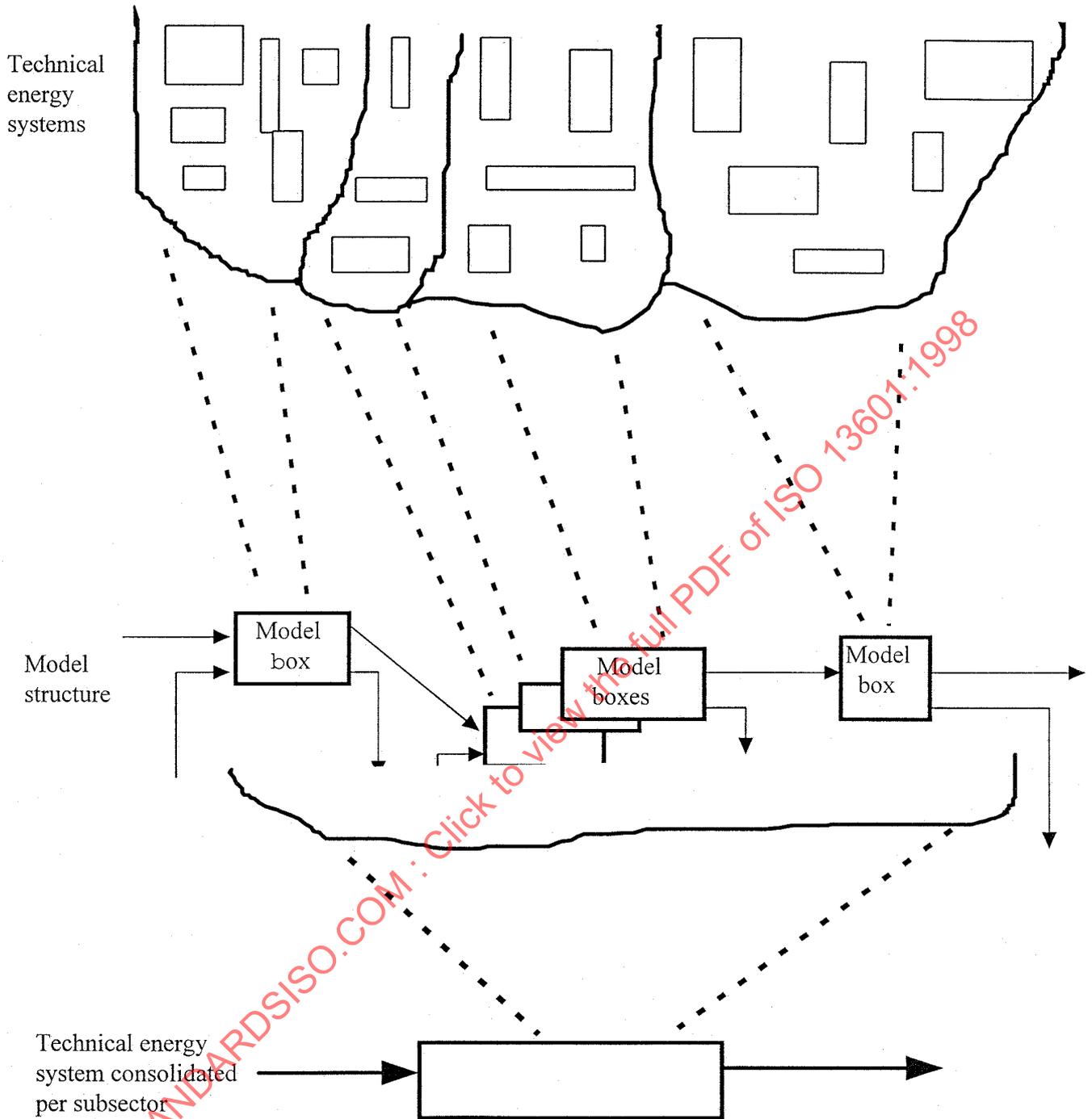


Figure 2 — Relationship between technical energy systems, model structure and consolidated subsystems — Successive consolidation

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

Transport between two subsystems, including empty trips, shall be accounted for in the sending subsystem.

Services given by the transport infrastructure subsystem 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.

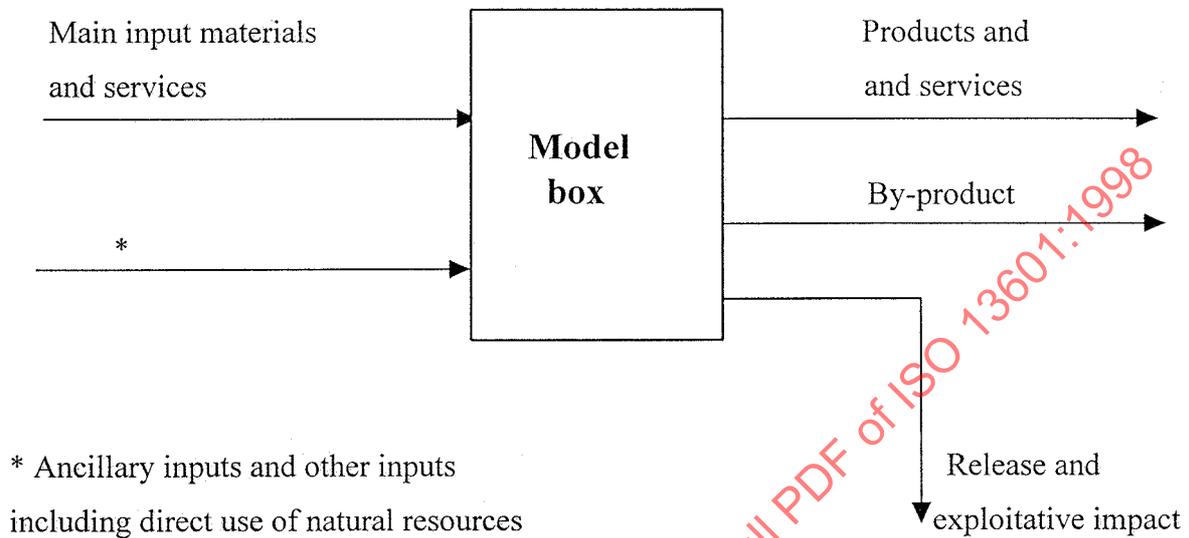


Figure 3 — Simplified presentation of model boxes

3.3 Energyware supply sector (see also Annex C)

3.3.1 Energy coal subsector

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.

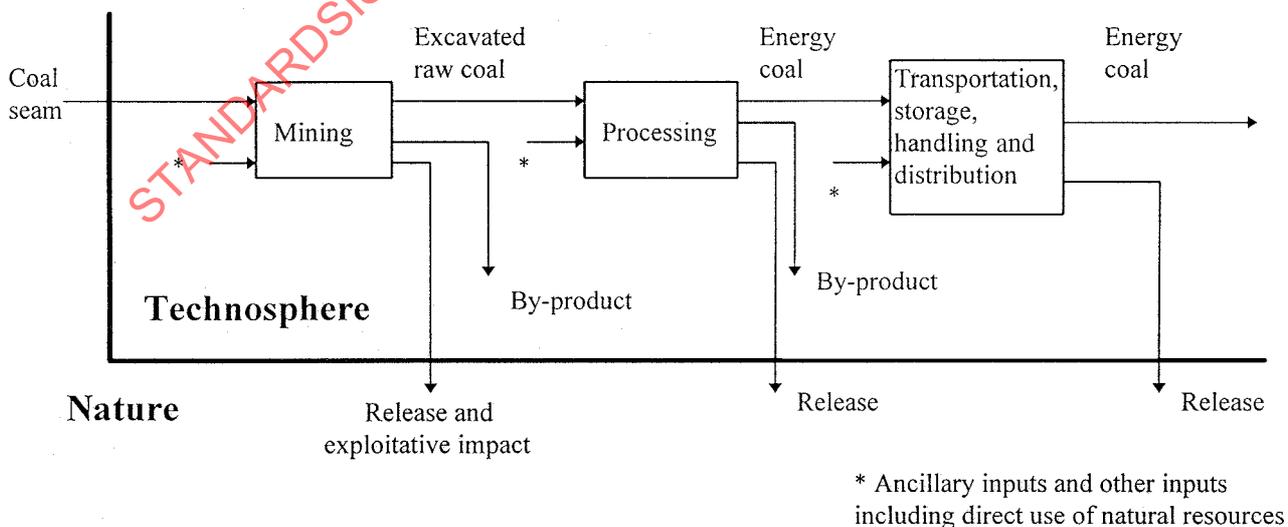


Figure 4 — Model structure of technical energy systems in the energy coal subsector

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:

- energy peat;
- commercial firewood;
- 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.

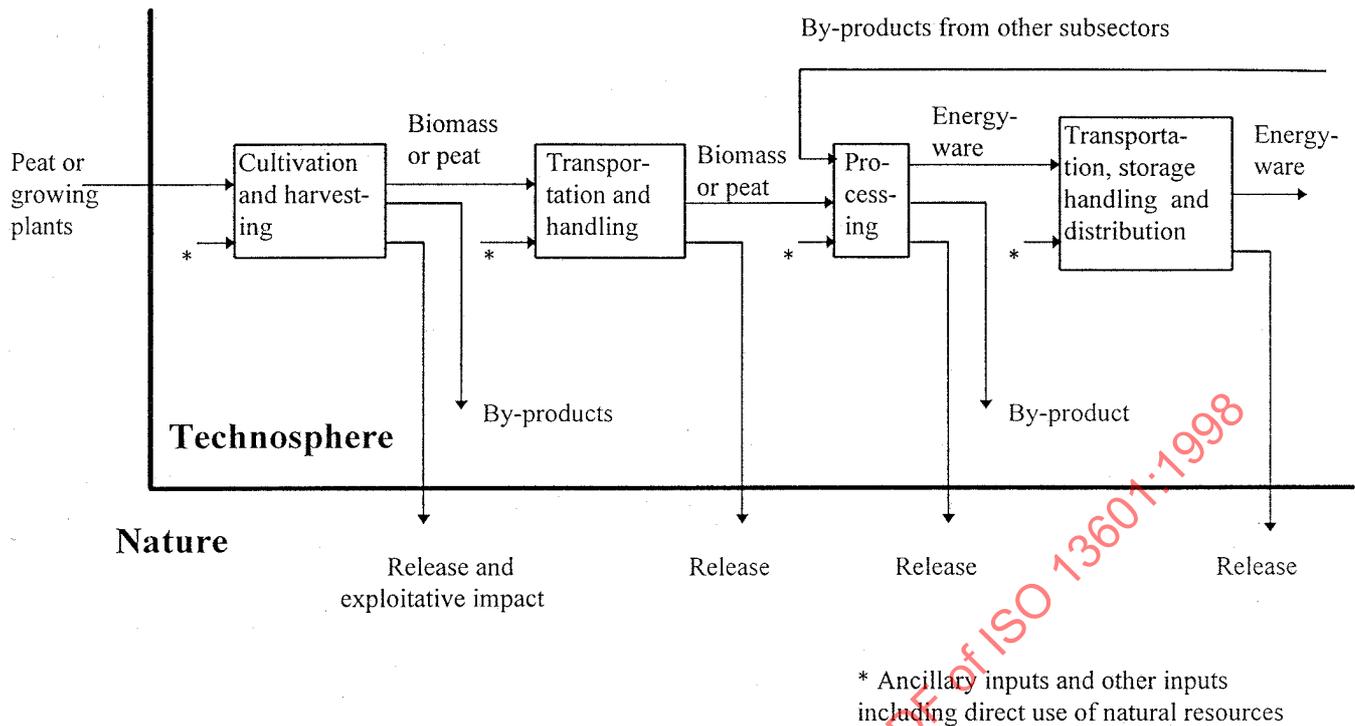


Figure 5 — Model structure of technical energy systems in the biomass and energy peat subsector

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.

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.

3.3.3 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.

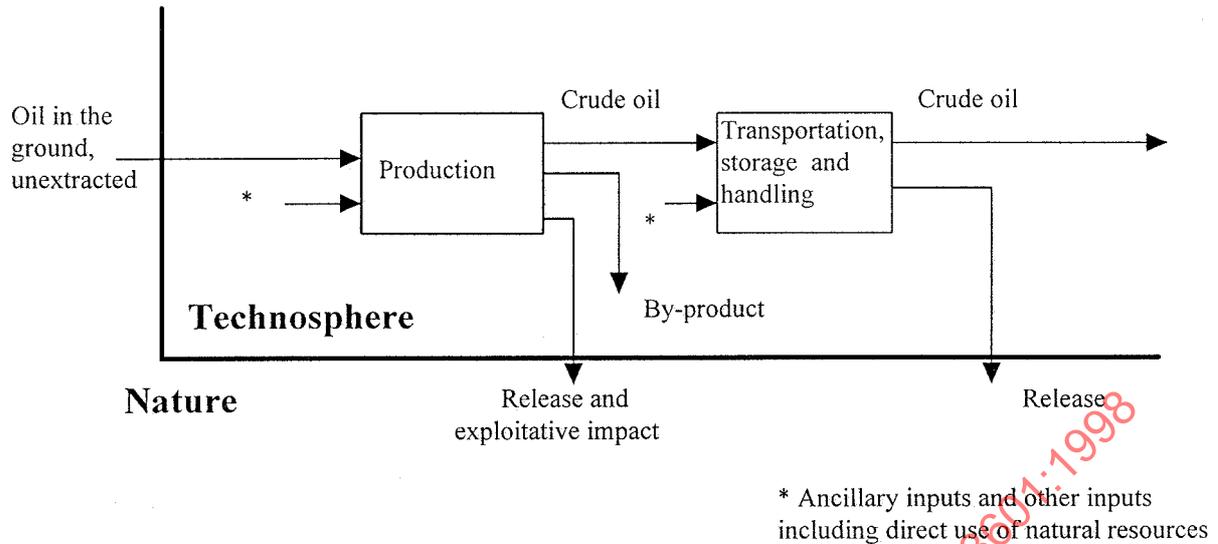


Figure 6 — Model structure of technical energy systems in the crude oil subsector

3.3.3.3 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.

The environmental load comprises:

- depletion: ultimately restricted resource base;
- 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.

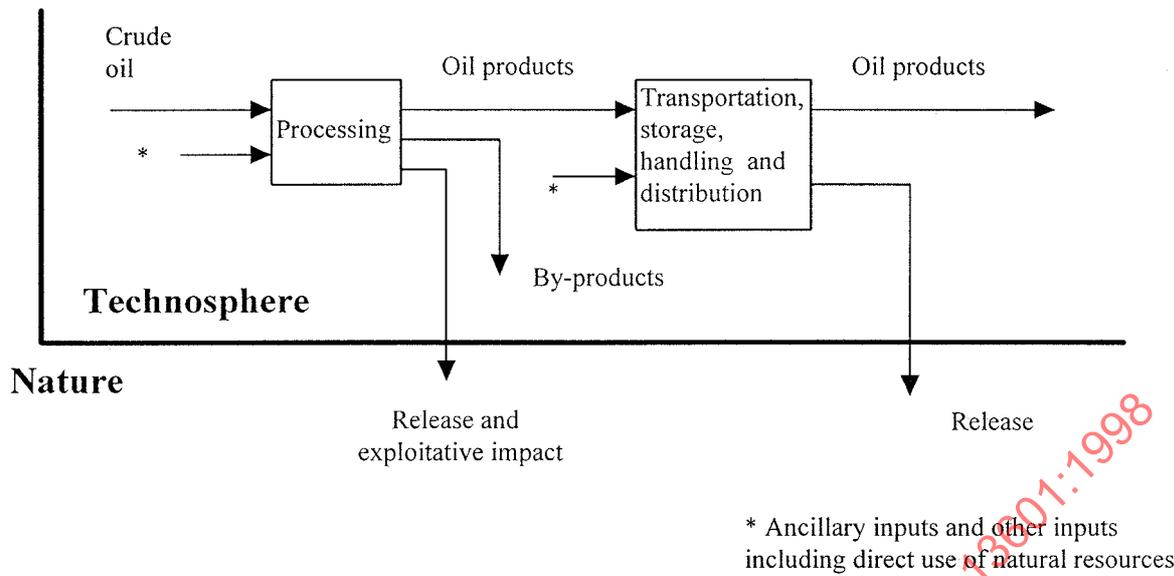


Figure 7 — Model structure of technical energy systems in the petroleum refineries subsector

3.3.5 Natural gas subsector

3.3.5.1 General

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).

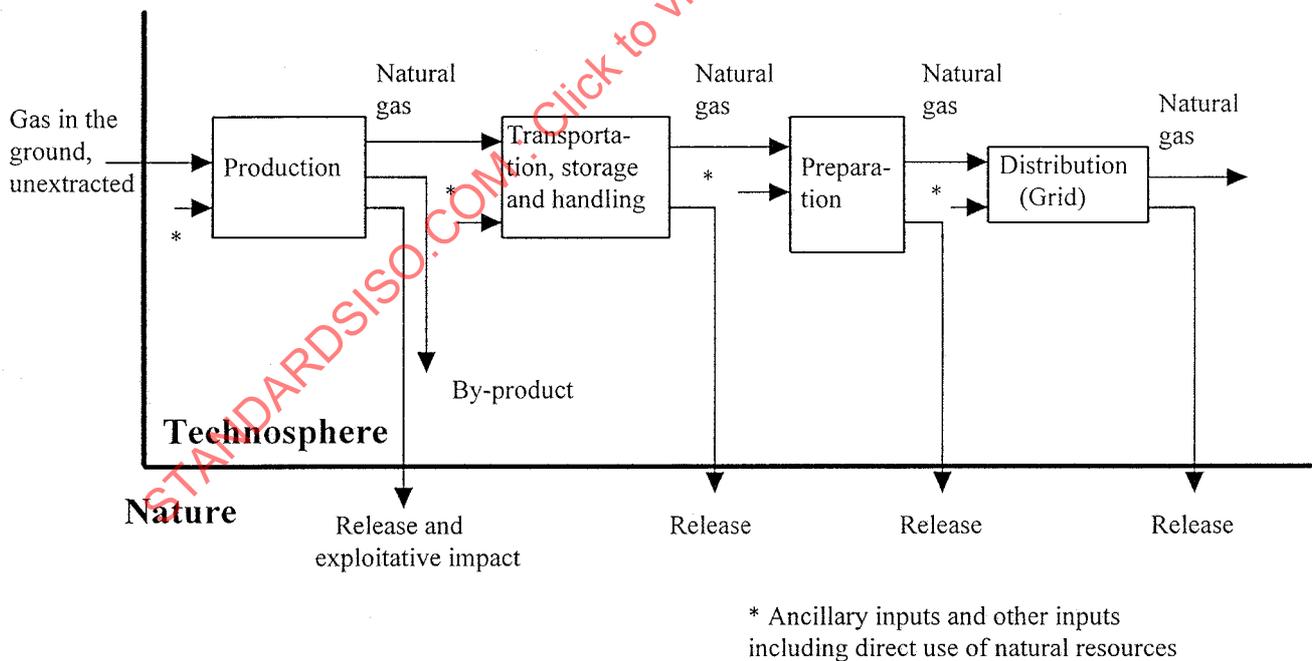


Figure 8 — Model structure of technical energy systems in the natural gas subsector

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.

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

3.3.6 Converted gas subsector

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.

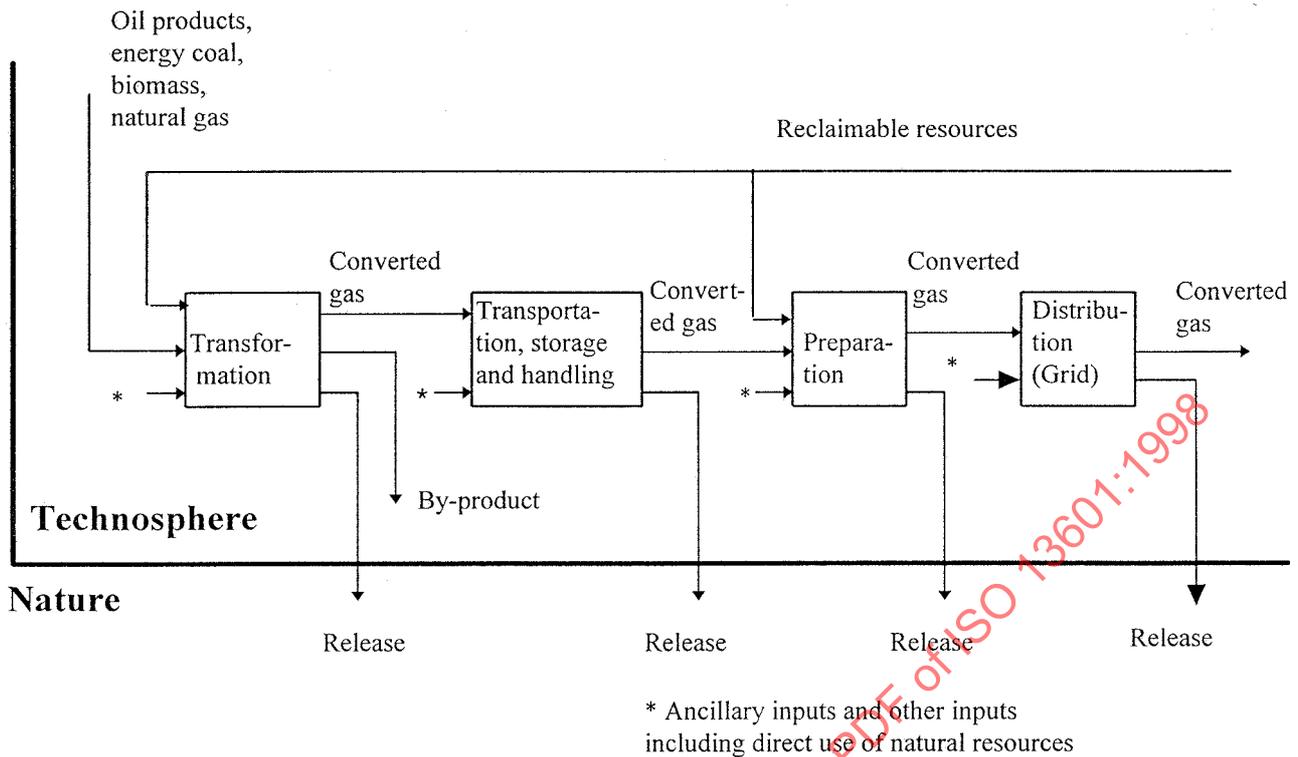


Figure 9 — Model structure of technical energy systems in the converted gas subsector

3.3.6.3 Outputs

The consolidated main output from this subsector is converted gas, normally a mixture of methane, carbon oxides and hydrogen, and delivered to receivers in other subsectors.

By-products may be obtained from the transformation model box, for example coke, tar and charcoal.

The main release is gas leaked into the atmosphere.

3.3.7 Hydrogen subsector

3.3.7.1 General

Hydrogen is typically produced via two routes:

- energyware transformation from various petroleum fractions and natural gas by reforming;
- electrolysis of water using either grid electricity or direct input, e. g. photovoltaic cells.

The model structure that shall be used to describe technical energy systems in the hydrogen sub-sector consists of three model boxes: energyware transformation or production; transportation, storage and handling; and distribution (see Figure 10).

3.3.7.2 Inputs

The main input to the hydrogen transformation or production model box is water coming from nature and petroleum fractions or natural gas.

The main input to the transportation, storage and handling, and distribution subsectors is liquified or compressed hydrogen.

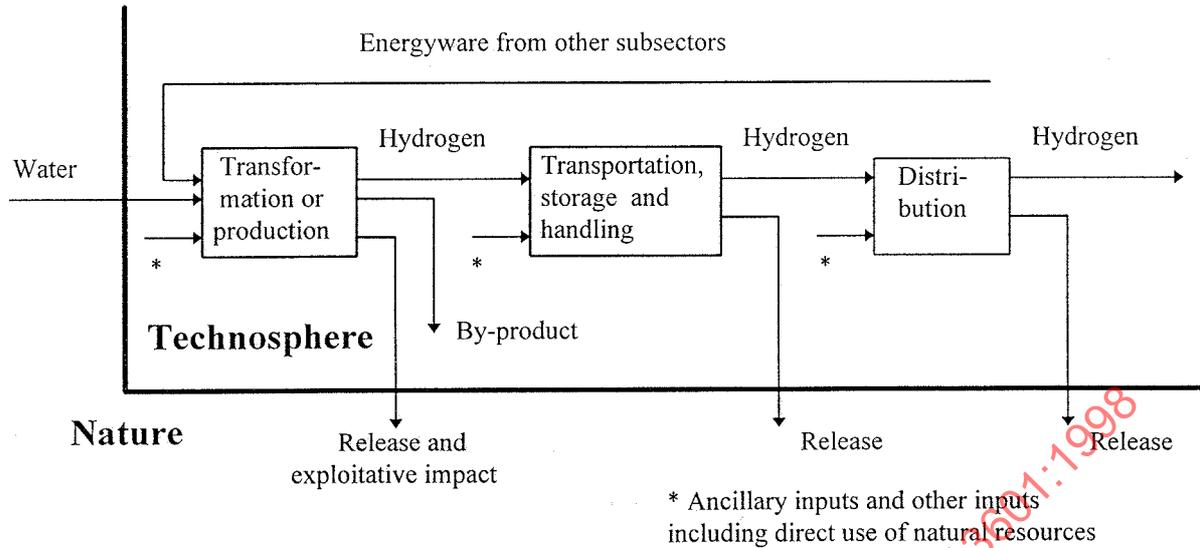


Figure 10 — Model structure of technical energy systems in the hydrogen subsector

3.3.7.3 Outputs

The main output from one model box is the main input to the next. The main output from the transformation or production, and the transportation, storage, and handling model boxes is liquified or compressed hydrogen.

By-products from the transformation model box are oxygen and/or carbon monoxide.

3.3.8 Uranium and thorium mining subsector

3.3.8.1 General

The model structure that shall be used to describe technical energy systems in the uranium and thorium mining subsector consists of three model boxes: mining; processing and conversion; and transportation, storage and handling (see Figure 11).

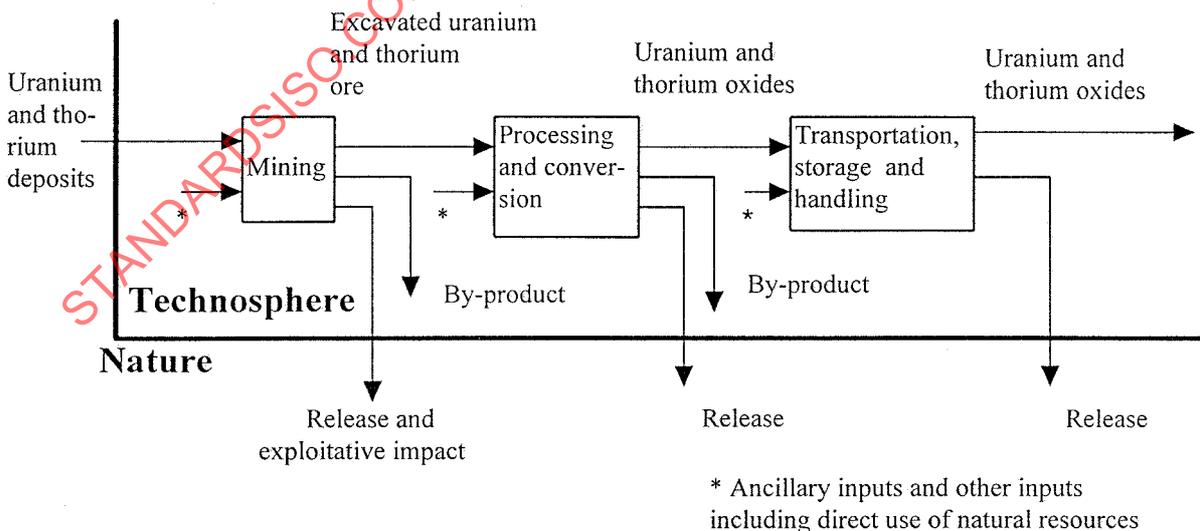


Figure 11 — Model structure of technical energy systems in the uranium and thorium mining subsector

3.3.8.2 Inputs

Uranium and thorium in the mine deposit shall be regarded as natural resources.

The main input materials to the different model boxes are:

- uranium and thorium deposits to mining;
- excavated uranium and thorium ores to processing and conversion;
- uranium and thorium oxides to transportation, storage and handling.

3.3.8.3 Outputs

The consolidated main output from this subsector is uranium and thorium oxides delivered to receivers in other subsectors.

A release to note in this subsector is the contaminant of water and soil, and large volumes of sludge in the mining areas.

3.3.9 Grid electricity subsector

3.3.9.1 General

Grid electricity is generated via two routes:

- a) transformation from energyware or reclaimable resources in thermal and nuclear power plants;

The model structure that shall be used to describe technical energy systems according to this route consists of the following three model boxes:

- preparation, processing and storage;
- transformation or production;
- spent nuclear fuel storage and processing.

- b) production directly from natural non-depletable resources such as hydro, solar, tidal, wind, geothermal, ocean-thermal and salt gradients.

The model structure that shall be used to describe technical energy systems according to this route consists of the following model box:

- energyware production.

The model structure that shall be used to describe technical energy systems in the distribution of grid electricity consists of the following three model boxes:

- electricity grid;
- electricity storage;
- electricity distribution.

See figure 12.

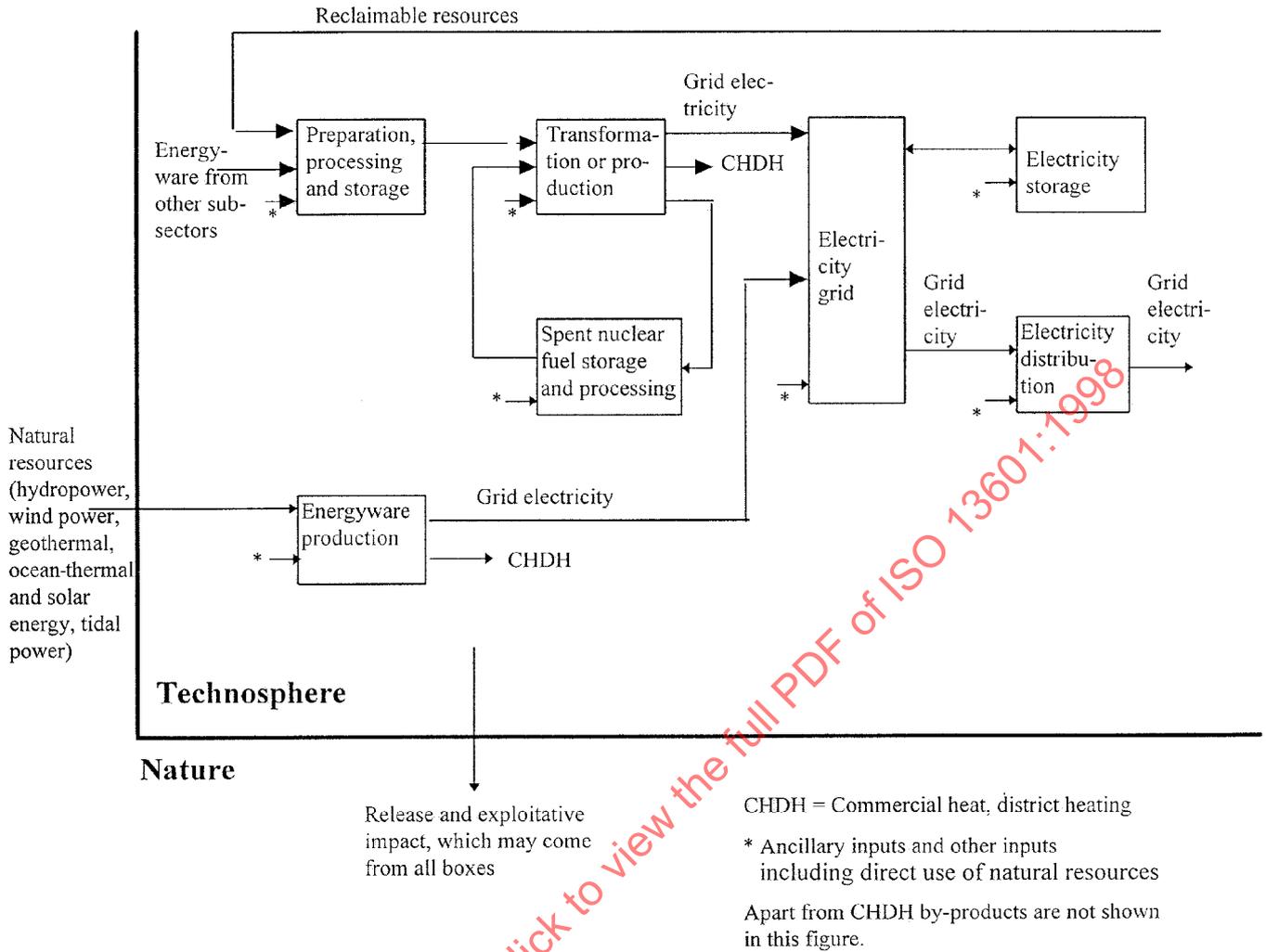


Figure 12 — Model structure of technical energy systems in the grid electricity subsector

3.3.9.2 Inputs

The main input materials to the different model boxes are:

- energyware from other subsectors or reclaimable resources to the preparation, processing and storage model box;
- natural non-depletable resources to the energyware production model box;
- prepared and processed energyware to the energyware transformation or production model box;
- nuclear fuel elements used in the nuclear power plants to the spent nuclear fuel storage and processing model box;
- electricity to the electricity grid, to electricity storage, and to electricity distribution model boxes.

3.3.9.3 Outputs

The consolidated main output from this subsector is grid electricity delivered to receivers in other subsectors.

By-products may appear from the preparation, processing and storage, energyware transformation and production, and spent nuclear fuel storage and processing model boxes.

From thermal power plants the most significant releases are gaseous emissions, fly ash and heat.

The nuclear fuel cycle produces radioactive substances which in principle are stored in the technosphere for a certain time for radioactivity to decay. These substances shall be considered to be released to nature when permanent storage sites are finally sealed. Releases of radioactive substances occur during normal operations mainly from reactors and reprocessing plants.

Exploitative impacts are important, especially water level changes for hydroelectric and tidal plants and cooling water requirements for thermal plants.

3.3.10 Commercial heat, district heating subsector

3.3.10.1 General

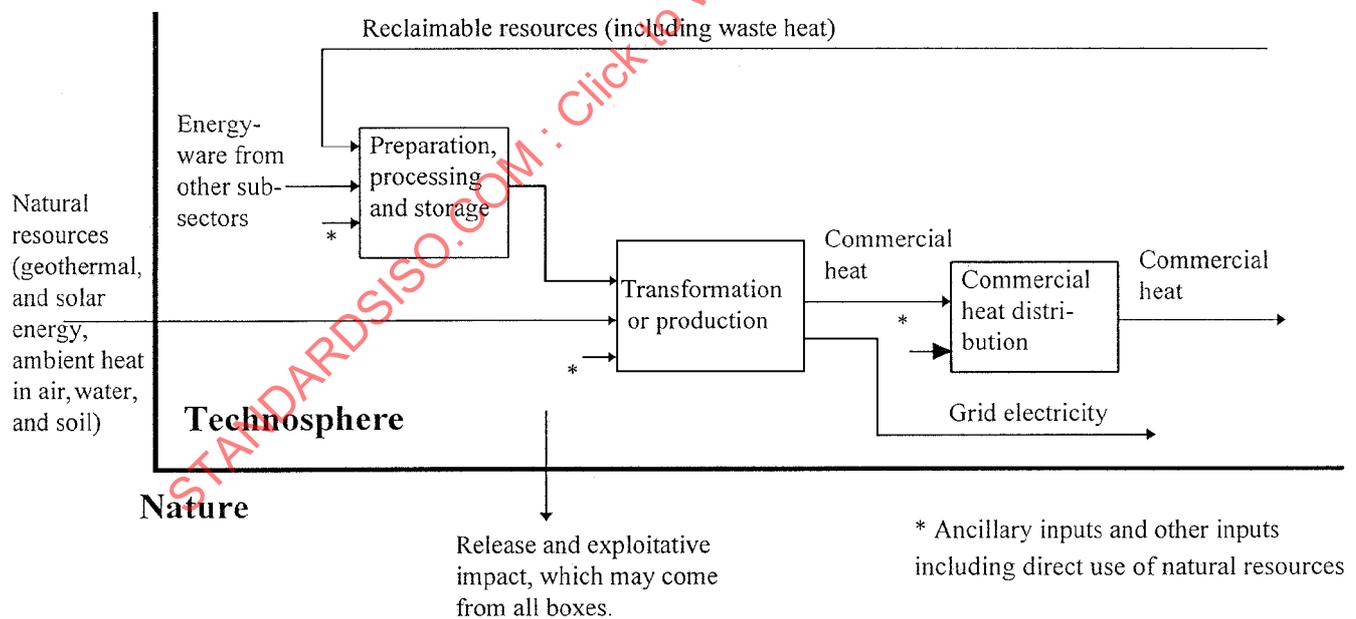
Similar to the case of the grid electricity subsector, district heat is generated by transformation of energyware or reclaimable resources in conventional thermal and nuclear power plants, or by production directly from natural non-depletable resources such as solar, geothermal, ambient heat in air, water and soil.

The model structure that shall be used to describe technical energy systems in the district heat subsector consists of three model boxes: preparation, processing and storage; energyware transformation or production; and distribution (see Figure 13).

3.3.10.2 Inputs

The main inputs are:

- energyware from other subsectors to the preparation, processing and storage model box;
- prepared and processed energyware or natural resources to the energyware transformation or production model box;
- commercial heat to the distribution model box.



NOTE Apart from grid electricity, by-products are not shown in this figure.

Figure 13 — Model structure of technical energy systems in the commercial heat, district heating subsector

3.3.10.3 Outputs

The consolidated main output from this subsector is commercial heat, district heating delivered to receivers in other subsectors.

By-products may appear from the preparation, processing and storage and energyware transformation or production model boxes, in the latter case sometimes in the form of grid electricity.

The most important releases are gaseous emissions and fly ash.

3.4 Energyware demand sector

3.4.1 Mining, quarrying and extraction (except coal, oil, gas, energy peat, uranium, thorium)

3.4.1.1 General

The model structure that shall be used to describe technical energy systems in each of the mining, quarrying and extraction subsectors consists of three model boxes: mining, quarrying and extraction; processing; and transportation, storage and handling (see Figure 14).

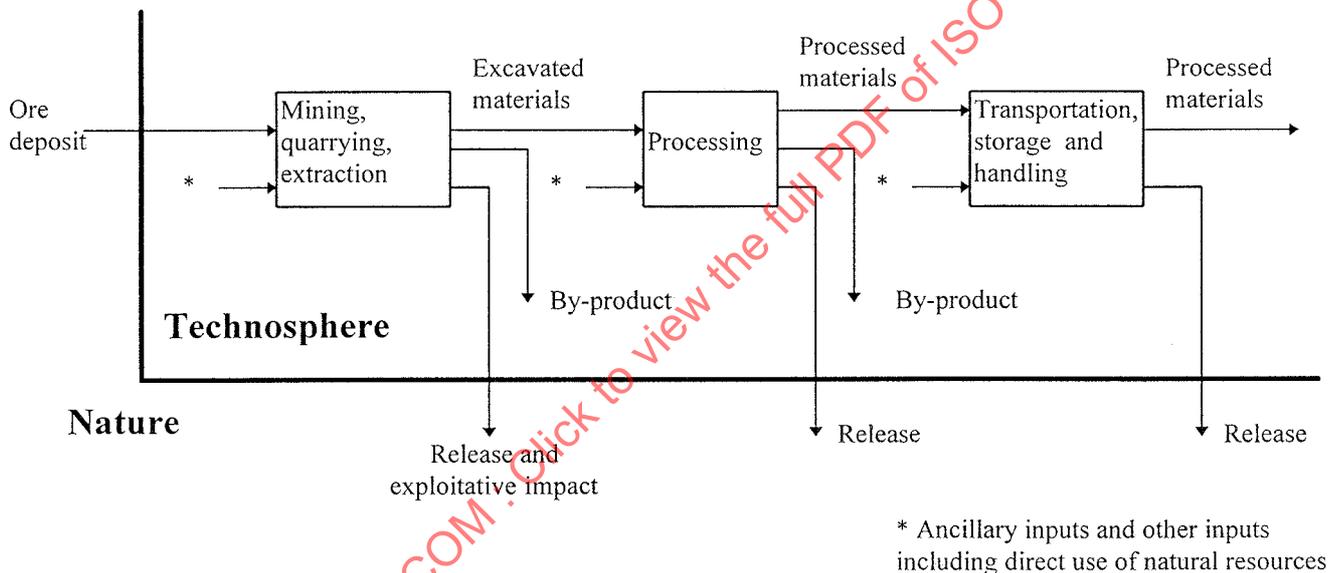


Figure 14 Model structure of technical energy systems in the mining, quarrying and extraction industries subsector

3.4.1.2 Inputs

The main input materials to the different model boxes are:

- ore to mining, quarrying or extraction, which implies a corresponding depletion of the resource;
- excavated materials to processing;
- processed materials to transportation, storage and handling.

3.4.1.3 Outputs

The consolidated main output from this subsector is processed materials delivered to receivers in other subsectors.

By-products may be obtained during mining, quarrying or extraction, and processing.

A release to note in this subsector is the contaminant of water used in washing the excavated ore.

Environmental impacts include holes in the ground, slag heaps and hydrology changes.

3.4.2 Manufacturing subsectors

3.4.2.1 General

These subsectors are (see Annex A):

- Basic materials industry
- Intermediary goods industry
- Investment goods industry
- Construction materials industry
- Consumer goods industry

The model structure of the manufacturing industry subsectors that shall be used to describe technical energy systems in the manufacturing subsectors consists of two model boxes: processing; and transportation, storage and handling. See Figure 15.

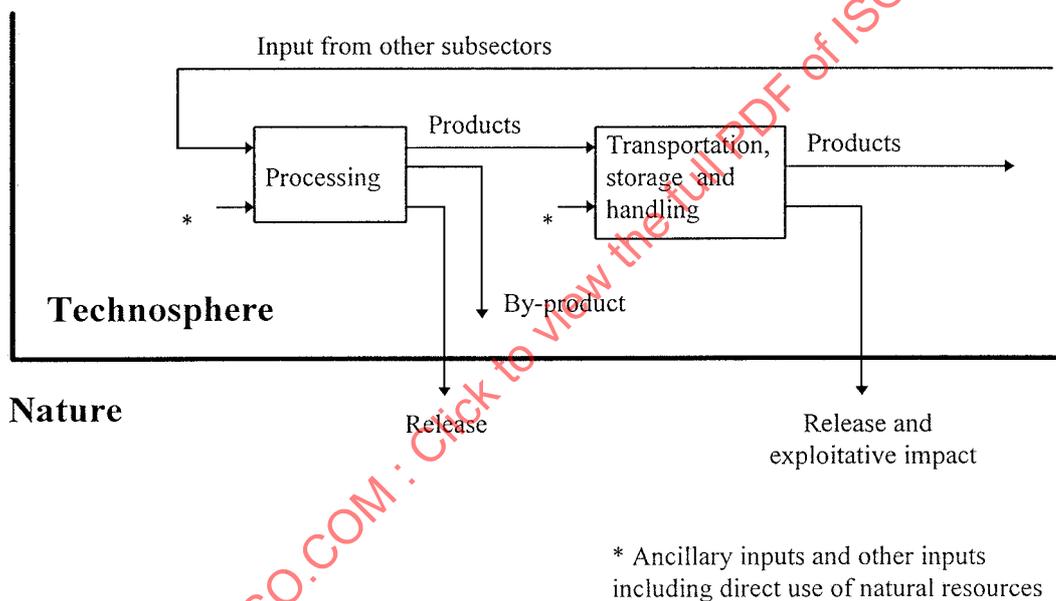


Figure 15 — Model structure of technical energy systems in the manufacturing subsector

3.4.2.2 Inputs

The main input materials to the different model boxes are:

- products and services from other subsectors, such as processed materials, intermediary goods, reclaimable resources and industrial products, to processing;
- products to transportation, storage and handling.

3.4.2.3 Outputs

The consolidated main outputs from these subsectors are industrial products delivered to receivers in other subsectors.

By-products are obtained in many processing activities.

Examples of releases are gaseous emissions and liquid effluents.

3.4.3 Biological industries subsector

3.4.3.1 General

This subsector includes:

- agriculture and animal husbandry (except energy crops);
- horticulture;
- forestry (except energy forest);
- fishing and hunting;
- aquaculture.

The model structure that shall be used to describe technical energy systems in the biological industries subsector consists of the following four model boxes:

- keeping, hunting or catching of animals or cultivation and harvesting of plants;
- transportation, storage and handling of unprocessed biological products;
- processing;
- transportation, storage and handling of processed biological products.

See Figure 16.

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

Drying may take place both in the cultivation and harvesting model box and in the processing model box.

Packaging may take place in any one or more of the model boxes.

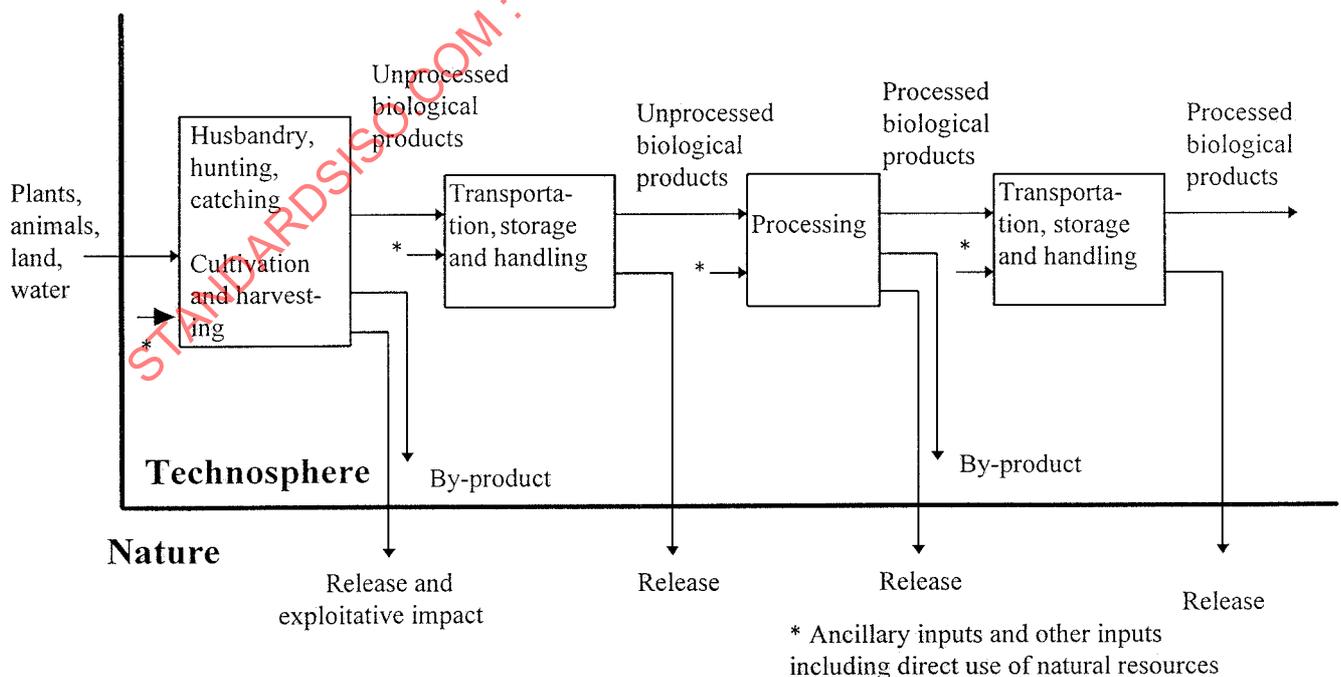


Figure 16 — Model structure of technical energy systems in the biological industries subsector

3.4.3.2 Inputs

The main inputs to the different model boxes are:

- plants, animals, land and water to husbandry, hunting, catching, cultivation or harvesting;
- unprocessed biological products to transportation, storage and handling, and to processing;
- processed biological products to transportation, storage and handling.

3.4.3.3 Outputs

The consolidated main output from this subsector is processed biological products to receivers in other subsectors.

By-products may be obtained during husbandry, hunting, catching, cultivation or harvesting and processing.

In this subsector there are intended releases, such as fertilizers and pesticides, and intended exploitative impact, such as draining.

Another exploitative impact is the change in composition of the biosphere.

3.4.4 Residential subsector

3.4.4.1 General

The residential subsector provides accommodation and transportation services and covers every activity in the household, including those related to buildings and private transportation equipment.

The model structure that shall be used to describe technical energy systems in the residential subsector consists of three model boxes: residential buildings; private transportation; and transport of by-products. See Figure 17.

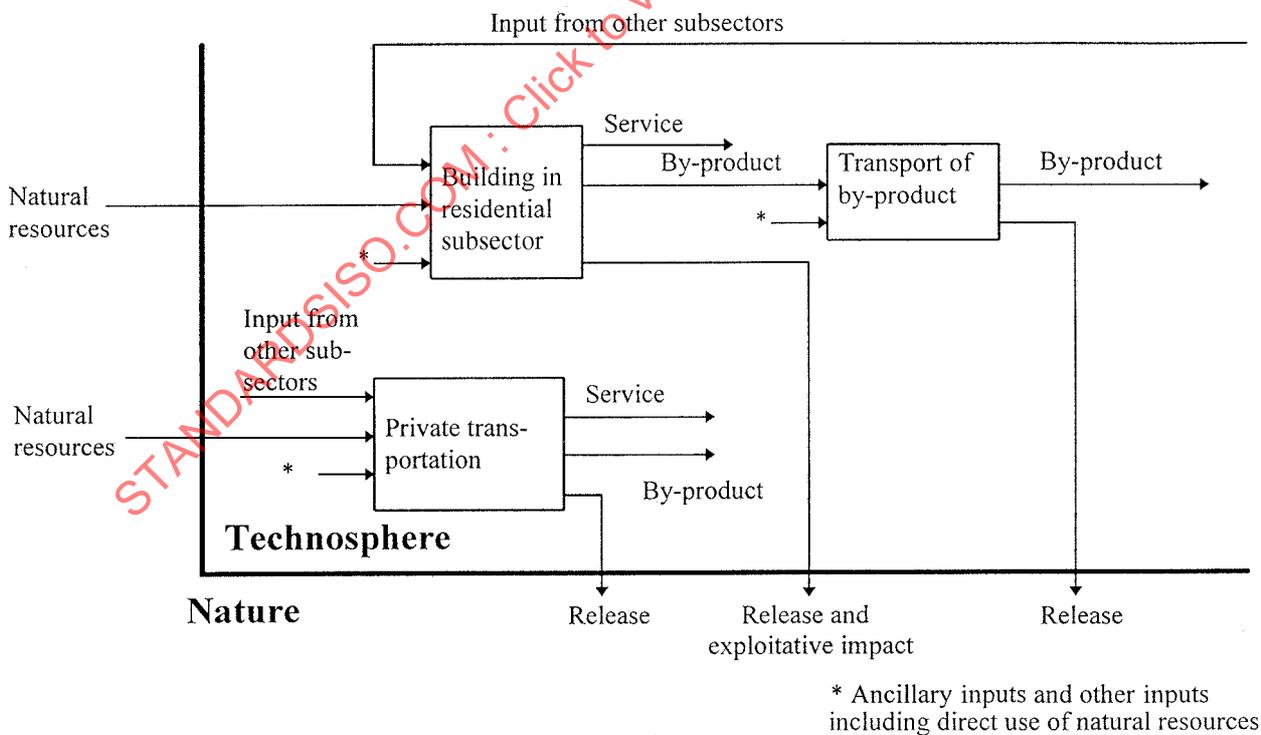


Figure 17 — Model structure of technical energy systems in the residential subsector

3.4.4.2 Inputs

The main inputs to the different model boxes are:

- inputs from other subsectors to buildings in residential use and to private transportation;
- natural resources, e.g. solar radiation, private firewood, mushrooms, wild berries, locally grown garden products;
- by-products, mostly waste, to transport of by-product.

3.4.4.3 Outputs

The consolidated main output from this subsector is services in the form of benefits to the users.

In this subsector there are intended releases, mainly food consumed by the users, and fertilizers and pesticides for gardening.

3.4.5 Commercial and institutional subsector

3.4.5.1 General

The model structure that shall be used to describe technical energy systems in the commercial and institutional subsector consists of two model boxes: commercial and institutional activities, and transportation and handling. See Figure 18.

3.4.5.2 Inputs

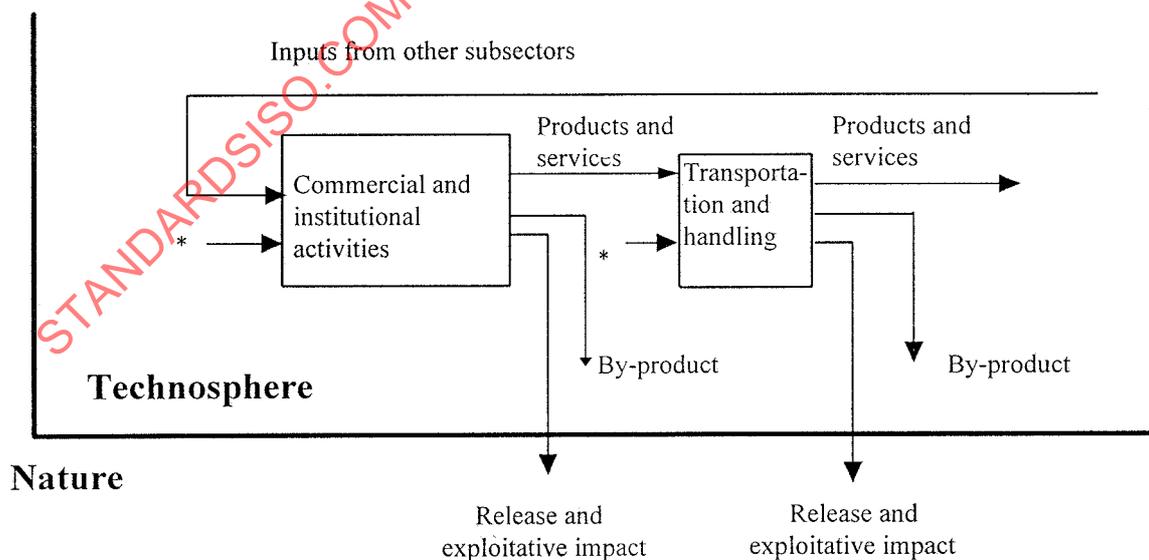
The main inputs to the different model boxes are:

- products and services from other subsectors to commercial and institutional activities;
- products and services to transportation and handling.

3.4.5.3 Outputs

The consolidated main output from this subsector is products and services.

By-products from this subsector are mostly waste.



* Ancillary inputs and other inputs including direct use of natural resources

Figure 18 — Model structure of technical energy systems in the commercial and institutional subsector

3.4.6 Waste handling and processing subsector

3.4.6.1 General

The model structure that shall be used to describe technical energy systems in the waste handling and processing subsector consists of three model boxes: waste processing, transportation and storage, and landfill and protective storage. See Figure 19.

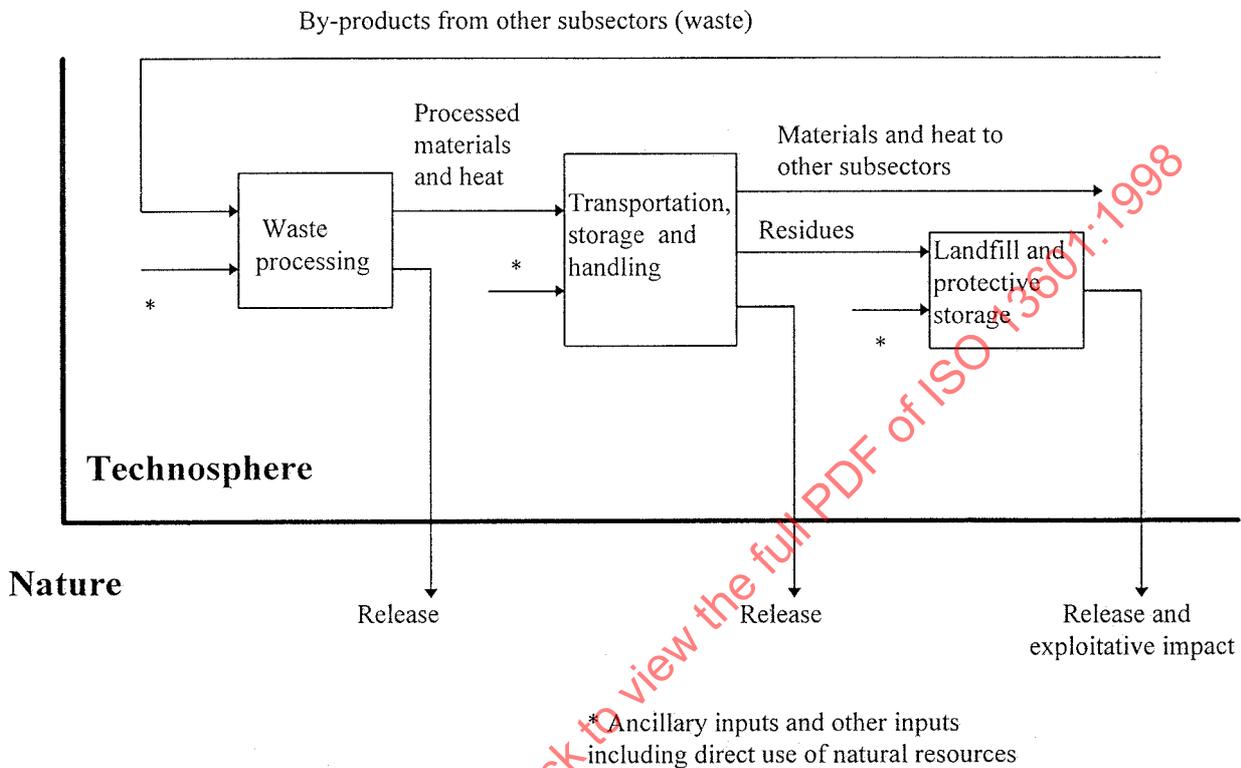


Figure 19 — Model structure of technical energy systems in the waste handling and processing subsector

3.4.6.2 Inputs

The main input materials to the different model boxes are:

- by-products from other subsectors to waste processing;
- processed materials and heat to transportation and storage ;
- residues to landfill and protective storage.

3.4.6.3 Outputs

The consolidated main output from this subsector is processed materials and heat from incineration.

A significant release is the substances disposed of by controlled depositing in the high seas. Other releases are gaseous emissions from incineration and leakage from controlled landfills.

The controlled landfill shall be considered to remain in the technosphere, until it is released into nature when it is finally abandoned.

This subsector does not include the handling of high-level nuclear waste, which is treated in the grid electricity subsector.

3.4.7 Transport infrastructure subsector

3.4.7.1 General

The transport infrastructure subsector includes the following general-purpose facilities: roads, railtrack, waterways, harbours and airports.

The model structure that shall be used to describe technical energy systems in the transport infrastructure subsector consists of one model box. See Figure 20.

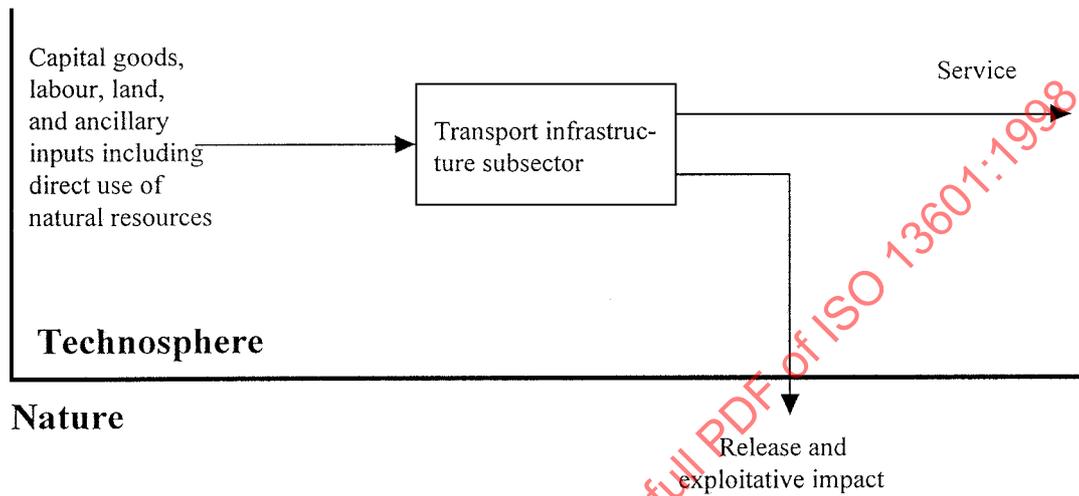


Figure 20 — Model structure of technical energy systems in the transport infrastructure subsector

3.4.7.2 Inputs

This subsector has as main inputs capital goods, labour and land. Resource expenditure in this subsector shall be accounted for as an overhead in the relevant subsector.

Other inputs include ancillary materials and services for the operation and maintenance of streets and roads, airports, harbours, petrol stations, railway stations and lines, etc.

3.4.7.3 Outputs

The main output from this model box is services to other subsectors.

Releases and exploitative impact are other outputs.

Annex A (normative)

Economic activities in the subsectors of the technosphere

A.1 Introduction

This International Standard ISO 13600 specifies that the technosphere shall be subdivided according to economic activity, i.e. according to the economic purpose or core business of the systems being studied. To this end the technosphere is divided in two sectors:

- the **Energyware Supply Sector**, comprising all those economic entities whose core business it is to produce and sell energyware on the market, and
- the **Energyware Demand Sector**, comprising all other economic entities whose core business it is to provide different products and services, using energyware as one of its inputs. (Some of these entities may also produce energyware as a by-product.)

The further subdivision of the two sectors is given in this International Standard, see Figure 1.

This Annex A gives a list of economic activities belonging to each subsector. Reference has been made to the document International Standard Industrial Classification of All Economic Activities, ISIC revision 3. (*Statistical Papers*, Series M, No 4, Rev 3, United Nations, New York 1990 ST/ESA/STAT/SER.M/4/Rev. 3). The ISIC provides a decimal classification of all economic activities. The subsectors are described by listing the corresponding ISIC codes.

A.2 Relationship between the subsectors of this International Standard and the ISIC classification

Although the ISIC classification has been followed wherever possible, deviations have been made whenever necessary for the purpose of technical system analysis. Some ISIC classes have in such cases been split between two or more subsectors.

Two notable examples are:

a) Transport

601	6010	Transport via railways
602		Other land transport
611	6110	Sea and coastal water transport
612	6120	Inland water transport
621	6210	Scheduled air transport
622	6220	Non-scheduled air transport

These activities shall be split up and accounted for in subsectors where they appear.

b) Construction

451	4510	Site preparation
452	4520	Building of complete constructions or parts thereof; civil engineering
453	4530	Building installation
454	4540	Building completion

These activities shall be split up and accounted for in subsectors where they appear.

A.3 Subsectors of the technosphere**Energyware supply sector**

S.1	Energy coal subsector
S.2	Biomass and energy peat subsector
S.3	Crude oil subsector
S.4	Petroleum refineries subsector
S.5	Natural gas subsector
S.6	Converted gas subsector
S.7	Hydrogen subsector
S.8	Uranium and thorium mining subsector
S.9	Grid electricity subsector
S.10	Commercial heat, district heating subsector

Energyware demand sector

D.1	Mining, quarrying and extraction subsector
D.2	Manufacturing subsector
D.2.1	Basic materials industry
D.2.2	Intermediary goods industry
D.2.3	Investment goods industry
D.2.4	Construction materials industry
D.2.5	Consumer goods industry
D.3	Biological industries subsector
D.4	Residential subsector
D.5	Commercial and institutional subsector
D.6	Waste handling and processing subsector
D.7	Transport infrastructure subsector

S.1 Energy coal subsector

101	1010	Mining and agglomeration of hard coal
102	1020	Mining and agglomeration of lignite

Relevant share of transport and construction, see A.2.

S.2 Biomass and energy peat subsector

020	0200	Forestry logging and related services
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There is no economic activity in the ISIC classification corresponding to the cultivation or harvesting of energy forests, and of reeds and the collection of by-products such as straw.

103	1030	Extraction and agglomeration of peat
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Relevant share of transport and construction, see A.2.

S.3 Crude oil subsector

- 111 1110 Extraction of crude petroleum and gas
- 112 1120 Service activities incidental to oil and gas extraction excluding surveying
- 603 6030 Transport via pipelines

Relevant share of transport and construction, see A.2.

S.4 Petroleum refineries subsector

- 232 2320 Manufacture of refined petroleum products
- 603 6030 Transport via pipelines

Relevant share of transport and construction, see A.2.

S.5 Natural gas subsector

- 111 1110 Extraction of crude petroleum and gas
- 112 1120 Service activities incidental to oil and gas extraction excluding surveying
- 603 6030 Transport via pipelines

Relevant share of transport and construction, see A.2.

S.6 Converted gas subsector

- 402 4020 Production of gas; distribution of gaseous fuels through mains
- 603 6030 Transport via pipelines

Relevant share of transport and construction, see A.2.

S.7 Hydrogen subsector

This subsector has no correspondence in the ISIC classification.

S.8 Uranium and thorium mining subsector

- 120 1200 Mining of uranium and thorium ores
- 233 2330 Processing of nuclear fuel

Relevant share of transport and construction, see A.2.

S.9 Grid Electricity Subsector

- 401 4010 Production, collection and distribution of electricity

Relevant share of transport and construction, see A.2.

S.10 Commercial heat, district heating subsector

- 403 4030 Steam and hot water supply

Relevant share of transport and construction, see A.2.

D.1 Mining, quarrying and extraction subsector

- 131 1310 Mining of iron ores
- 132 1320 Mining of non-ferrous metal ores, except uranium and thorium ores

- 141 1410 Quarrying of stone, sand and clay
- 142 Mining and quarrying not elsewhere classified

Relevant share of transport and construction, see A.2.

D.2 Manufacturing subsector

D.2.1 Basic materials industry

- 201 2010 Sawmilling and planing of wood
- 210 Manufacture of paper and paper products
- 2101 Manufacture of pulp, paper and paper products. Here only manufacture of pulp
- 271 2710 Manufacture of basic iron and steel

Relevant share of transport and construction, see A.2.

D.2.2 Intermediary goods industry

- 171 Spinning, weaving and finishing of textiles
- 172 Manufacture of other textiles
- 173 Manufacture of knitted and crocheted fabrics and articles
- 202 Manufacture of products of wood, cork, straw and plaiting materials
- 2021 Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board and other panels and boards
- 2023 Manufacture of wooden containers
- 2029 Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials
- 210 Manufacture of paper and paper products
- 2101 Manufacture of pulp, paper and paper products. Here only manufacture of paper and paper products
- 222 Printing and service activities related to printing
- 2221 Printing
- 223 2230 Reproduction of recorded media
- 241 Manufacture of basic chemicals
- 242 Manufacture of other chemicals except 2423 and 2424
- 243 2430 Manufacture of man-made fibres
- 251 Manufacture of rubber products
- 252 2520 Manufacture of plastic products
- 261 2610 Manufacture of glass and glass products, part of

- 269 Manufacture of non-metallic mineral products not elsewhere classified, part of
- 272 2720 Manufacture of basic precious and non-ferrous metals
- 273 Casting of metals
- 289 Manufacture of other fabricated metal products; metal working services activities
- 2891 Forging, pressing, stamping and roll-forming of metal; powder metallurgy
- 2892 Treatment and coating of metals; general mechanical engineering on a fee or contract basis
- 2899 Manufacture of other fabricated metal products not elsewhere classified
- 292 Manufacture of special purpose machinery
- 2927 Manufacture of weapons and ammunition
- 312 3120 Manufacture of electricity distribution and control apparatus
- 313 3130 Manufacture of insulated wire and cable
- 314 3140 Manufacture of accumulators, primary cells and primary batteries
- 315 3150 Manufacture of electric lamps and lighting equipment
- 319 3190 Manufacture of other electrical equipment not elsewhere classified
- 321 3120 Manufacture of electronic valves and tubes and other electronic equipment
- 343 3430 Manufacture of parts and accessories for motor vehicles and their engines

Relevant share of transport and construction, see A.2

D.2.3 Investment goods industry

- 281 Manufacture of structural metal products, tanks, reservoirs and steam generators
- 2811 Manufacture of structural metal products
- 2812 Manufacture of tanks, reservoirs and containers of metal
- 289 Manufacture of other fabricated metal products; metal working service activities
- 2893 Manufacture of cutlery, hand tools and general hardware
- 291 Manufacture of general purpose machinery
- 2911 Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
- 2912 Manufacture of pumps, compressors, taps and valves
- 2913 Manufacture of bearings, gears, gearing and driving elements
- 2914 Manufacture of ovens, furnaces and furnace burners
- 2915 Manufacture of lifting and handling equipment
- 2919 Manufacture of other general purpose machinery
- 292 Manufacture of special purpose machinery

- 2921 Manufacture of agricultural and forestry machinery
- 2922 Manufacture of machine tools
- 2923 Manufacture of machinery for metallurgy
- 2924 Manufacture of machinery for mining, quarrying and construction
- 2925 Manufacture of machinery for food, beverage and tobacco processing
- 2926 Manufacture of machinery for textile, apparel and leather production
- 2929 Manufacture of other special purpose machinery
- 311 3110 Manufacture of electric motors, generators and transformers
- 322 3220 Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
- 331 Manufacture of medical appliances and instruments and appliances for measuring, checking, testing, navigating and other purposes, except optical instruments
- 3311 Manufacture of medical and surgical equipment and orthopaedic appliances
- 3312 Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
- 3313 Manufacture of industrial process control equipment
- 351 Building and repairing of ships and boats
- 3511 Building and repairing of ships
- 3512 Building and repairing of pleasure and sporting boats
- 352 3520 Manufacture of railway and tramway locomotives and rolling stock
- 353 3530 Manufacture of aircraft and spacecraft
- 359 Manufacture of transport equipment not elsewhere classified except 3592

Relevant share of transport and construction, see A.2.

D.2.4 Construction materials industry

- 202 Manufacture of products of wood, cork, straw and plaiting materials
- 2022 Manufacture of builders' carpentry and joinery
- 261 2610 Manufacture of glass and glass products, part of (e.g. glass used in construction, glass by casting or by the float or other processes, window glass)
- 269 Manufacture of non-metallic mineral products not elsewhere classified except part of
- 2691 Manufacture of other non-metallic mineral products not elsewhere classified, part of
- 281 Manufacture of structural metal products, tanks, reservoirs and steam generators
- 2813 Manufacture of steam generators, except central heating hot water boilers
- 289 Manufacture of other fabricated metal products; metal working service activities

2893 Manufacture of cutlery, hand tools and general hardware, part of

2899 Manufacture of other fabricated metal products not elsewhere classified, part of

Relevant share of transport and construction, see A.2.

D.2.5 Consumer goods industry

151 Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats

152 1520 Manufacture of dairy products

153 Manufacture of grain mill products, starches and starch products, and prepared animal feeds

154 Manufacture of other food products

155 Manufacture of beverages

160 1600 Manufacture of tobacco products

221 Publishing

242 Manufacture of other chemical products

2423 Manufacture of pharmaceuticals, medicinal chemicals and botanical products

2424 Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations

269 Manufacture of non-metallic mineral products not elsewhere classified

2691 Manufacture of non-structural non-refractory ceramic ware, part of (e.g. articles of porcelain and china, tableware and other kind of articles of a kind commonly used for domestic and toilet purposes)

293 2930 Manufacture of domestic appliances not elsewhere classified

323 3230 Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods

332 3320 Manufacture of optical instruments and photographic equipment

333 3330 Manufacture of watches and clocks

341 3410 Manufacture of motor vehicles

342 3420 Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers

359 Manufacture of transport equipment not elsewhere classified

3592 Manufacture of bicycles and invalid carriages

361 3610 Manufacture of furniture

369 3690 Manufacturing not elsewhere classified

Relevant share of transport and construction, see A.2.

D.3 Biological industries subsector

011 Growing of crops; market gardening; horticulture

012		Farming of animals
013	0130	Growing of crops combined with farming of animals (mixed farming)
014	0140	Agricultural and animal husbandry service activities, except veterinary activities
015	0150	Hunting, trapping and game propagation including related service activities
050	0500	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing

Relevant share of transport and construction, see A.2.

D.4 Residential subsector

This subsector consists of all private households. The ISIC classification only covers

701	7010	Real estate activities with own or leased property, part of (e. g . operating of self-owned or leased real estate such as apartment buildings and dwellings)
950	9500	Private household with employed persons

Relevant share of transport and construction, see A.2.

D.5 Commercial and institutional subsector

222		Printing and services related to printing
	2222	Service related to printing
410	4100	Collection, purification and distribution of water
455	4550	Renting of construction or demolition equipment with operator
501	5010	Sale of motor vehicles
502	5020	Maintenance and repair of motor vehicles
503	5030	Sale of motor vehicle parts and accessories
504	5040	Sale, maintenance and repair of motorcycles and related parts and accessories
505	5050	Retail sale of automotive fuel
511	5110	Wholesale on a fee or contract basis
512		Wholesale of agricultural raw materials, live animals, food, beverages and tobacco
513		Wholesale of household goods
514		Wholesale of non-agricultural intermediate products, waste and scrap
515	5150	Wholesale of machinery, equipment and supplies
519		Other wholesale
521		Non-specialized retail trade in stores
522	5220	Retail sale of food, beverages and tobacco in specialized stores
523		Other retail trade of new goods in specialized stores