

SimaPro 7

Database Manual

Japanese input output 2000



product ecology
consultants

LCA Database based on 2000 Input-Output Tables for Japan

User Guidelines

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1 Introduction

This document contains considerations when using the LCA Database based on Japanese Input-Output tables (hereafter called IO tables) developed by Toshiba Corporation. This database utilizes the IO table of Japan for the year 2000, which was released in 2004, and is also a generic LCA database constructed using the latest statistical data in Japan.

This document is based on the report “LCA Database based on 2000 Input-Output Tables for Japan” produced by the Environmental Technology Laboratory of the Corporate Research & Development centre, Toshiba Corporation. From now on (I-O Toshiba 2000).

1.1 About the IO table

1.1.1 Characteristics and limitations of the Japanese IO table

1. The IO table of Japan is constituted of approximately 400 domestic industrial sectors. The production processes of imported commodities are outside the target range. Regarding the IO method, a model that estimates the "ripple-effect on production" (noncompetitive import-type model) assuming the import ratios for each of the IO sectors are constant, and limiting the scope to domestic industries, is used frequently. A model that also considers the "ripple-effect on production" of commodities imported into Japan (competitive import-type model) is also known, but this model assumes that all the commodities are produced within the country. The importing ratio of natural resources is especially high in Japan. The state depends mostly on imported goods, and the production technologies and industrial structures of the countries producing the natural resources are quite different from those of Japan. Therefore, the "embodied intensities of the environmental burdens" estimated from the "competitive import-type" model have a possibility of diverging quite a ways from reality.

This problem is solved using the method proposed by Hondo. This method is characterized in that it handles only particular imported commodities in detail. Since, in the present state, it is impossible to take into consideration the overseas processes of all the imported commodities, the environmental burdens are calculated by obtaining the embodied intensities in detail only for the imported commodities that have great influences, and assuming that the other imported commodities are domestic. In this database, the overseas burdens for aluminum, iron ore, copper ore, lead ore, zinc ore, coking coal, steam coal and others, crude oil, LNG, and LPG were obtained using the Process Analysis method (traditional LCA inventory), and added up with the domestic environmental burdens.

2. The IO table is a matrix that has all the commodities and services consolidated into 400 sectors, and each of the sectors consists of multiple commodities. Therefore, the "embodied intensities of the environmental burdens" based on the IO table are calculated as average values of multiple commodities. In cases where a particular commodity included in a particular sector is the only emission source of an environmental burden, an "embodied intensity of the environmental burden" with a high margin of error will be calculated.

1.1.2 The Matrix

The IO table of Japan for the year 2000, is a matrix with 517 rows and 405 columns. For the solution of this matrix it was necessary to unify the rows and columns to obtain a square matrix of 405 columns and rows. The adaptations to the matrix are included in tables 1 and 2.

Table 1 Modification of the IO sector classifications for the year 2000

Sectors	Action	Comment
"0111-011 Rice" and "0111-012 Rice straw"	Unified	
Sectors "2612-01 Scrap iron" and "2712-01 Non-ferrous metal scrap"	Eliminated	Both are scrap products, and they do not exist in the column sectors as independent activities.
"0113-01 Vegetables (outdoor)" and "0113-02 Vegetables (under facilities)"	Unified	
"0311-01 Coastal fisheries," "0311-02 Off-shore fisheries," and "0311-03 Distant water fishery"	Unified	
0312-01 Inland water fisheries" and "0312-02 Inland-water culture"	Unified	
"5111-01 Electricity (nuclear power)," "5111-02 Electricity (thermal power)," and "5111-03 Electricity (water power, etc.)"	Unified	

Table 2 Modification of the IO sector classifications for the year 2000 (Cont.)

Sector name (conventional)	Sector name (modified)	Input destination (sectors)
Other industrial inorganic chemicals	Other industrial inorganic chemicals	Already entered in the IO table for the year 2000
	SF ₆ gas	SF ₆ gas, Semiconductor devices, Integrated circuits, Liquid crystal elements, Relay switches and switchboards, Transformers and reactors
Methane derivatives	Methane derivatives	Already entered in the IO table for the year 2000
	HFC gas	HFC gas, Medicaments, Cosmetics and toilet preparations, Paint and varnishes, Agricultural chemicals, Plastic products, Refrigerators and air conditioning apparatuses, Machinery for service industries, Household air-conditioners, Household refrigerators, Semiconductor devices, Integrated circuits, Motor vehicles parts accessories
	HCFC22 gas	HCFC22 gas, Other resins, Refrigerators and air conditioning apparatuses, Machinery for service industries, Household air-conditioners
	PFC gas	PFC gas, Semiconductor devices, Integrated circuits, Liquid crystal elements, Other electronic components
	Other CFC gases	Other CFC gases, Household air-conditioners, Refrigerators and air conditioning apparatuses
Household electric appliances (except air-conditioners)	Household electric appliances (except air-conditioners)	Already entered in the IO table for the year 2000
	Household refrigerators	Same as the " Household electric appliances (except air-conditioners)"

2 Data Documentation

In this chapter, we will be giving explanations centering on the data sources that were utilized in constructing the database. The environmental burden items to be the target of this database are indicated in Table 3.

Table 3 List of inventories in the IO table database for the year 2000

Category	Items	
Output	Atmosphere	CO ₂ , SO _x , NO _x , SPM, HFC, HFC23, PFC, SF ₆
	Hydrosphere	BOD, COD, SS, T-N, T-P
Input	Fuel	Crude oil (fuel), coal, natural gas
	Raw materials	Crude oil (raw material), iron, copper, aluminum, lead, zinc, manganese, nickel, chrome, gravel, crushed stone, limestone, wood
Energy	Energy consumption (calorific value)	

HFC: Hydrofluorocarbon

HFC23: Trifluoromethane

PFC: Perfluorocarbon

SF₆: Sulfur hexafluoride

BOD: Biochemical oxygen demand

COD: Chemical oxygen demand

SS: Suspended substance

T-N: Total nitrogen

T-P: Total phosphorus

2.1 Emissions and Resource consumption (energy originated)

Emissions are associated to each IO sector with the help of the bibliography and data published by the Ministry of the Environment. For emissions to the atmosphere the inventory of emissions is limited to energy consumption, with the help of emissions coefficients for each type of fuel.

2.1.1 Fuel consumption

The emissions caused by the consumption of fuels is calculated excluding the part of it which is used as raw material. Most of the crude oil consumption in the "2111-01 Petroleum refinery products" sector is considered as a raw material. Since it cannot be estimated, all of it will be treated as a fuel input, the fuel input should be assumed to be 2% of the total consumption. Regarding the various fuel consumptions in the "5121-01 gas supply" sector, all of them will be treated as a fuel input. Among the fuels types that have fuel inputs, the fuel input ratio is assumed to be approximately 0.22% for naphtha, 2.8% for LPG and 1.4% for LNG. The fuel input ratio for coal, coke, and natural gas is assumed to be "0." 100% fuel input is considered for fuel types other than those mentioned above.

The calorific values for each of the fuel are shown in Table 4 The "Fuel oils B and C" is the weighted average of the consumed amounts of fuel oil B and fuel oil C. The calorific value of "other petroleum refinery products" was adopted for the "hydrocarbon oil," and the calorific value of "Lindz donawitz gas" was adopted for the "electric furnace gas." Since the "Petroleum gas" (petroleum-related hydrocarbon gas) means the gases that come out of the oil refineries excluding the LPG refineries, and matches the definition of oil refinery gases, the calorific values for the oil refinery gases (indicates the gases that are produced as by-products in the various refining processes of the oil refineries, and whose main ingredients are methane, ethane, etc. that are left over after the LPG ingredients have been recovered) were adopted. Table 4 summarizes the data sources for the consumption of resources for energy carriers.

Table 4 Calorific values for each of the fuel types

Category	Class	Subclass	IO sector code	Unit	kcal/Unit	MJ/Unit (A)
Petroleum - related fuel	Crude oil	Crude oil	0721011	L	9,126	38.2
	Petroleum products	Gasoline	2111011	L	8,266	34.6
		Naphtha	2111017	L	8,146	34.1
		Kerosene	2111013	L	8,767	36.7
		Diesel oil	2111014	L	9,126	38.2
		Fuel oil A	2111015	L	9,341	39.1
		Fuel oils B and C	2111016	L	9,961	41.7
		Fuel oil B	-	L	9,651	40.4
		Fuel oil C	-	L	9,962	41.7
		Hydrocarbon oil	2111019 (Other petroleum refinery products)	L	10,105	42.3
		LPG (Liquefied Petroleum Gas)	2111018	kg	11,992	50.2
		Petroleum gas (NGL)	2111019 (Other petroleum refinery products)	m ³	10,726	44.9
		Petroleum coke	2111019 (Other petroleum refinery products)	kg	8,500	35.6
		Jet fuels	2111012	L	8,767	36.7
Non petroleum - related fuel	Coal related fuels	Coking coal Imported	0711011 (Coal mining)	kg	6,904	28.9
		Steam coal and others domestic		kg	5,375	22.5
		Imported		kg	6,354	26.6
		Coke	2121011	kg	7,191	30.1
	Other fuels	Coke-oven gas	-	m ³	5,041	21.1
		Blast furnace gas	-	m ³	815	3.41
		Lindz donawitz gas	-	m ³	2,009	8.41
		Electric furnace gas	-	m ³	2,009	8.41
		Natural gas	0721012	m ³	9,771	40.9
		LNG	0721012	kg	13,019	54.5
		Mains gas	5121011	m ³	9,818	41.1

- The calorific values were re-configured in fiscal year 2000 (General Policy Division, Agency for Natural Resources and Energy).

Table 5 Data sources for the consumption of resources for energy carriers

Crude oil	The IO table (values and quantities) was adopted.
Coal	For total consumption of coal in the year 2000, the IO table (values and quantities) was adapted. Environmental burdens outside Japan and the consumption as a fuel were estimated. The coal consumption in each IO sectors were divided into four types, according to whether it is domestic or imported coal, and whether it is coking or steam coal and others.
Natural gas	The IO table (values and quantities) was adopted.
Petroleum products	The IO table (basic transaction table) was used for the consumption of petroleum products such as gasoline, naphtha, kerosene, light oil, fuel oil A, fuel oils B and C, jet fuel, and LPG. The "inputted amount of money" for "other petroleum products" sector was proportionally divided according to the ratio of the consumptions for hydrocarbon oil, petroleum coke, and petroleum-related hydrocarbon gases.
Coke	The IO table (basic transaction table) was adopted.
Other coal products	The "inputted amount of money" for "other coal products" sector was proportionally divided according to the ratio of consumptions for coke-oven, electric furnace, blast furnace, and lindz donawitz gas.
Others	The consumptions of limestone and dolomite were estimated from literature

2.1.2 Emission coefficients

The values in the "A guideline for the method to calculate greenhouse gas emission from business establishments" by the Ministry of the Environment in Japan was adopted for the CO₂ emission coefficients (Table 6).

Table 6 CO₂ emission coefficients for each of the raw materials and fuel types

Category	Class	Sub-class	IO sector code	Unit	kgCO ₂ /MJ (B)	MJ/Unit (A of Table 4.1.2)	kgCO ₂ /Unit (C) (B * A)
Petroleum-related fuel	Crude oil	Crude oil	0721011	L	0.0684	38.2	2.61
	Petroleum products	Gasoline	2111011	L	0.0671	34.6	2.32
		Naphtha	2111017	L	0.0666	34.1	2.27
		Kerosene	2111013	L	0.0679	36.7	2.49
		Diesel oil	2111014	L	0.0687	38.2	2.62
		Fuel oil A	2111015	L	0.0693	39.1	2.71
		Fuel oils B and C	2111016	L	0.0716	41.7	2.99
		Fuel oil B	-	L	0.0705	40.4	2.85
		Fuel oil C	-	L	0.0716	41.7	2.99
		Hydrocarbon oil	2111019 (Other petroleum refinery products)	L	0.0762	42.3	3.22
		LPG (Liquefied Petroleum Gas)	2111018	kg	0.0598	50.2	3.00
		Petroleum gas (NGL)	2111019 (Other petroleum refinery products)	m ₃	0.0519	44.9	2.33
		Petroleum coke	2111019 (Other petroleum refinery products)	kg	0.0930	35.6	3.31
		Jet fuel	2111012	L	0.0671	36.7	2.46
Non petroleum-related fuel	Coal related fuels	Coking coke Imported	0711011 (Coal mining)	kg	0.0867	28.9	2.51
		Steam coal and others Domestic		kg	0.0913	22.5	2.05
		Imported		kg	0.0906	26.6	2.41
		Coke	2121011	kg	0.1080	30.1	3.25
		Coke-oven gas	-	m ₃	0.0403	21.1	0.850
	Other fuels	Blast furnace gas	-	m ₃	0.2580	3.41	0.880
		Lindz donawitz gas	-	m ₃	0.1820	8.41	1.53
		Electric furnace gas	-	m ₃	0.1820	8.41	1.53
		Natural gas	0721012	m ₃	0.0494	40.9	2.02
		LNG	0721012	kg	0.0494	54.5	2.69
Mains gas	5121011	m ₃	0.0513	41.1	2.11		
Others	Limestone	Manufacturing of cement	-	kg	-	-	0.417
		Manufacturing of quicklime		kg	-	-	0.428
		Other uses of limestone		kg	-	-	0.435
	Dolomite	Manufacturing of quicklime	-	kg	-	-	0.449
		Other uses of limestone		kg	-	-	0.471

Unlike CO₂, the emission coefficients of SO_x, NO_x, and SPM vary with the mode in which the fuels are burned. In this database, the emission sources are divided roughly into two classifications; the "stationary sources" such as the factories and business establishments, and the "mobile emission sources" such as automobiles, ships, and aircrafts.

Method to calculate the emission coefficients of the "stationary sources"

The emission coefficients take into consideration the desulphurization, denitrification, and dust collection ratios for the various industries, as of 1995, and updated with data released by the 'National Institute for Environmental Studies (NIES)' to an scenario for the year 2000.

Regarding SO_x emissions from mobile emission sources, it is assumed that the sulfur contents in each of the fuels are all emitted as SO₂. The sulfur content was set to be 0.003% for gasoline, 0.050% for kerosene, 0.480% for fuel oil A, 2.000% for fuel oil C, and 0.015% for jet fuels, from the fact-finding surveys implemented to the Petroleum Association of Japan. Although the

sulfur content in diesel oils is decreasing every year, due to the restrictions to them becoming more severe, the restriction value 0.050% for the year 2000 is still being applied to this database.

The emission coefficients for the NO_x and SPM of the automobiles were calculated based on the embodied intensities of NO_x and SPM per unit running distances of 7 types of automobiles.

Table 7 NO_x emission coefficients of automobiles

Vehicle type	Embodied intensity of NO _x [g/km]	Embodied intensity of CO ₂ [g/km]	Fuel type	CO ₂ emission coefficient [kg/TOE]	NO _x emission coefficient kg/TOE
"Light-automobile" passenger-cars	0.16	205.77	Gasolene	2808.8	2.184
Passenger-cars	0.20	265.51	Gasolene	2808.8	2.116
Passenger-cars	0.44	199.51	Diesel oil	2875.8	6.342
"Light-automobile" freight-cars	0.38	129.70	Gasolene	2808.8	8.229
"Compact-automobile" freight-cars	0.47	265.30	Gasolene	2808.8	4.976
"Compact-automobile" freight-cars	1.00	245.68	Diesel oil	2875.8	11.71
"Standard-sized" freight-cars	4.33	585.71	Diesel oil	2875.8	21.26
Buses	3.60	513.48	Diesel oil	2875.8	20.16
Special-type vehicles	2.18	352.01	Diesel oil	2875.8	17.81

Table 8 The SPM emission coefficient of automobiles

Vehicle type	Embodied intensity of SPM [g/km]	Embodied intensity of CO ₂ [g/km]	Fuel type	CO ₂ emission coefficient [kg/TOE]	SPM emission coefficient [kg/TOE]
"Light-automobile" passenger-cars	0.00	205.77	Gasolene	2808.8	0.00
Passenger-cars	0.00	265.51	Gasolene	2808.8	0.00
Passenger-cars	0.12	199.51	Diesel oil	2875.8	1.73
"Light-automobile" freight-cars	0.00	129.70	Gasolene	2808.8	0.00
"Compact-automobile" freight-cars	0.00	265.30	Gasolene	2808.8	0.00
"Compact-automobile" freight-cars	0.13	245.68	Diesel oil	2875.8	1.52
"Standard-sized" freight-cars	0.50	585.71	Diesel oil	2875.8	2.45
Buses	0.43	513.48	Diesel oil	2875.8	2.41
Special-type vehicles	0.24	352.01	Diesel oil	2875.8	1.96

2.2 Emissions to the atmosphere (productions abroad)

Nine types of commodities, coal, crude oil, LPG, LNG, iron ore, copper ore, lead and zinc ores, and primary aluminum ingot were selected as the major imported commodities in Japan, and the environmental burdens generated by them abroad, before they reach Japan, were estimated based on the process analysis. The consumptions of fuels and electricity were estimated based on the 2000 achievements, and the environmental burdens emitted per "unit amount of imported commodities" was calculated for the energy consumption (calorific value), CO₂, NO_x, SO_x, and fluorocarbon being generated as a result. Fluorocarbon was converted into CO₂ using the Global Warming Potential (GWP), and included in the total calculation, regarding it as an CO₂ emission. The installations or maintenances of production equipment, or production material inputs other than those of fuel are outside the system boundary of this database.

The environmental burdens were estimated based on the achievements of the 5 countries from where it was imported the most, for each of the imported commodities. The amounts of imports for each of the countries are based, basically, on the "White Paper on Trade and

Commerce, ". The consumptions of fuels and electricity in the target processes are based on various literatures concerning to Life Cycle Inventory analysis (hereafter called LCI). The environmental burdens accompanying the combustion of fossil fuels were calculated, basically, by multiplying the fuel consumptions, by the emission coefficients. However, when actually measured values are used in the reference literatures, those actually measured values were given priority (examples of emission coefficients: refer to Table 9)

Table 9 Emission coefficients of fuels (examples of the major fuel types) *

		MJ/Unit (a) [17] (MJ/ Unit)	kgCO ₂ /Unit (a*b) (kg/ Unit)	NO _x [g/Unit]	SO _x [g/Unit]
Gasoline	L	34.60	2.32	12.20	0.0583
Diesel oil (roads)	kg	46.02	3.16	27.40	7.05
Diesel oil (railways)	kg	46.02	3.16	54.13	7.05
Diesel oil (nonmetal mining)	kg	46.02	3.16	9.62	7.05
Fuel oil A (roads)	kg	45.47	3.15	27.40	10.11
Fuel oil A (ships)	kg	45.47	3.15	54.13	19.98
Fuel oil C (nonmetal mining)	kg	44.36	3.18	5.84	35.93
Fuel oil C (ships)	kg	44.36	3.18	54.13	67.94
Hydrocarbon oil	L	42.30	3.22	5.22	10.72
LPG (Liquefied Petroleum Gas)	kg	50.20	3.00	2.63	0.016
Petroleum coke	kg	35.60	3.31	5.84	12.89
Steam coal and others (imported)	kg	26.60	2.41	7.50	13.39
Coke-oven gas	m ³	21.10	0.85	1.15	0.178
Natural gas	m ³	40.90	2.02	2.19	0.0092

* Based on literatures [2,13]. It is indicated as a weight standard for diesel oils and fuel oils, with the specific gravity being 0.83 for diesel oils, 0.86 for fuel oil A, 0.94 for fuel oil C, and 0.794 for hydrocarbon oil. The percentage of sulphur content was assumed to be 3.4% for the fuel oils for ships according to the literature.

Regarding the electric powers, the emissions to the atmosphere were estimated tracking back to the fossil fuel consumptions, using the weighted average of the constitutions of the electricity sources in each of the countries, as investigated by OECD. Although NO_x and SO_x emissions will vary with the degree the desulphurization or denitrification apparatuses for the power generation boilers have come to be used, we assumed that although the degree of their diffusion is very high in Japan, there is almost none of them installed abroad in the year 2000, and that the boiler exhaust gases of the electricity abroad are emitted without any desulphurization or denitrification. Although there is no data to identify the installation ratios of the desulphurization and denitrification apparatuses in each of the countries, the installation ratio of denitration apparatuses in American power plants for the year 2000 was about 20%, according to the Department of Energy, USA. Since it is difficult to assume that the desulphurization ratios in the other countries, especially those of the countries exporting resources, are higher than USA, we figured that it will be allowed as being within the margin of error to assume that the ratio of facilities having desulphurization or denitrification apparatuses installed was 20% or less.

2.3 Emissions to the atmosphere (other greenhouse gases)

The data sources for estimating the other greenhouse gas emissions will be described in the following. The substances to be the target are HFC, HFC23, PFC, and SF₆. There are multiple gases with different GWP's, among the other greenhouse gases. In this database, HFC-134a, which is produced the most, was made to represent HFC. Similarly, the average of PFC-14 and PFC116, which are produced the most, was used for PFC.

The emission sources of the other greenhouse gases (activity classification) are described in table 11. Table 12 indicates the transition of the other greenhouse gas emissions in Japan.

Table 11 Sources of the other greenhouse gases

(1) Leakages upon manufacturing	When manufacturing gases, some percent of the produced amount leaks. The recovery rate has been improved for all the gases, and the gas emissions are tending to decrease. Especially the SF ₆ emissions have decreased significantly due to a decrease on the gas production. However, the output of HFC23 has increased slightly in 1999, accompanying the increase in its production.
(2) Refrigerants	Refrigerants in air conditioners (household use, business use, and automobiles) and refrigerators (household and business use) are emitted at the time of manufacturing, upon use, and upon their disposals. The emissions are very small in all cases. In the future, the emissions will be greatly affected by the recovery rate upon disposals of the air conditioners and refrigerators.
(3) Aerosol propellants	The calculation method according to the IPCC was adopted. The amount of aerosol emitted for the year t = 50% of the amount used in the year t + 50% of the amount used in the year (t - 1)
(4) Foamed materials and heat-insulating materials	Greenhouse gases are emitted when manufacturing urethane foam, extruded expanded-polystyrene, and phenol foam. All polyethylene foams are HFC-134a, and used as heat-insulating material and cushion material. Polypropylene is characterized in that, since its gas permeability is high, it is considered that 100% of the gas inside it will be emitted to the atmosphere within 1 year, and the amount used will be the amount generated.
(5) Washing agents of electronic parts	It is used in the precision washing, precision drying, etc. of electronic parts, and PFC-51-14 (C ₆ F ₁₄) and such are mainly used.
(6) Electrical insulation agents	Although the leakage rate upon manufacturing devices that use electrical insulation gases was very high, it is gradually decreasing in recent years. In regard to transformer substations, the recovery rate has been improved by additional placement of recovery apparatuses and the application of the recovery apparatuses to actual tasks, and the emissions has been decreasing. Since the emissions at the transformer substations are administered with ledgers, it is the actual emissions.
(7) Refining of metals	The greenhouse gases are emitted upon aluminum refining and magnesium casting.

The corresponding relationship between the activity classification of each gases and the IO sector classification is indicated in Table 13.

Table 12 The emissions of HFC, etc in Japan (1995 to 2000)

	Activity classification	Name of GHG	Year 1995	1996	1997	1998	1999	2000		
1	Leakage upon manufacturing	Manufacturing of HFC	HFC	0.492	0.474	0.380	0.267	0.159	0.253	
		Manufacturing of HCFC22	HFC23	16.965	15.596	14.695	13.783	14.099	12.402	
		Manufacturing of PFC	PFC	0.763	1.008	1.417	1.390	1.274	1.382	
		Manufacturing of SF ₆	SF ₆	4.708	4.183	2.581	2.103	1.527	0.860	
		Subtotal		22.928	21.261	19.0	17.5	17.0	14.8	
2	Refrigerants	Air conditioners for cars	HFC	0.7	1.0	1.3	1.6	1.8	2.1	
		Air conditioners for household use	HFC	0.0	0.0	0.0	0.0	0.0	0.1	
		Air conditioners for business use	HFC	0.0	0.0	0.0	0.0	0.0	0.1	
		Vending machines	HFC					0.0	0.0	
		Refrigerators for household use	HFC	0.0	0.0	0.0	0.0	0.0	0.1	
		Subtotal		0.7	1.0	1.3	1.6	1.8	2.4	
3	Aerosol propellants	HFC	1.4	2.1	2.6	2.8	2.8	2.8		
4	Foamed materials and heat-insulating materials	Urethane foams	HFC						0.022	
		Polyethylene foams	HFC	0.5	0.4	0.4	0.4	0.4	0.4	
		Extruded expanded-polystyrene	HFC							
		Phenol foams	HFC							
		Subtotal		0.5	0.4	0.4	0.4	0.4	0.4	
5	Washing agents of electronic parts	PFC	PFC	7.0	6.7	8.2	6.7	5.1	5.0	
		Manufacturing of semiconductors	HFC	HFC	0.1	0.1	0.1	0.1	0.1	0.1
			HFC23	HFC23	0.145	0.146	0.163	0.152	0.155	0.156
			PFC	PFC	3.7	3.5	4.3	4.3	4.7	5.0
		SF ₆	SF ₆	1.0	1.2	1.5	1.6	1.9	2.1	
Subtotal		11.9	11.6	14.3	12.9	12.0	12.4			
6	Electrical insulation gases	Manufacturing	SF ₆	9.6	10.0	8.5	7.7	4.2	2.3	
		Transformer substation	PFC	0.0	0.0	0.0	0.0	0.0	0.0	
			SF ₆	1.4	1.7	1.8	1.3	1.8	0.5	
		Subtotal		11.0	11.8	10.3	9.1	5.0	2.8	
7	Refining of metals	Aluminum	PFC	0.07	0.064	0.059	0.049	0.030	0.018	
		Magnesium	SF ₆	0.12	0.143	0.191	0.406	0.645	1.028	
		Subtotal		0.189	0.209	0.251	0.456	0.674	1.046	
8	Others		0.0	0.0	0.0	0.0	0.0	0.1		

(million GWPt)

Table 13 Correspondences between the activity and IO classifications, for HFC, etc.

	Activity classification	IO code	The names of the IO sector classifications
1	HFC leakages upon manufacturing	2039-0111	HFC gas
	HFC23 leakages upon manufacturing	2039-0111	HCFC22 gas
	PFC leakages upon manufacturing	2039-0111	PFC gas
	SF ₆ leakages upon manufacturing	2029-099	SF6 gas
2	Air conditioners for cars	3541-0311	Motor vehicle parts and accessories
	Air conditioners for household use	3212-011	Household air-conditioners
	Freezing and Air conditioning devices for business use	3013-0111	Refrigerators and air conditioning apparatus
	Vending machines	3112-0111	Vending machines
	Refrigerators for household use	3212-0111	Household refrigerators
3	Aerosol	2061-012	Medicaments (Pharmaceuticals)
		2071-021	Cosmetics, toilet preparations and dentifrices
		2072-011	Paint and varnishes
		2074-011	Agricultural chemicals
4	Urethane foams	2211-013	Foamed plastic products
	Polyethylene foams	2211-013	Foamed plastic products
	Extruded expanded-polystyrene	2211-013	Foamed plastic products
	Phenol foams	2211-013	Foamed plastic products
5	Washing of electronic parts Manufacturing of semiconductors	3341-01	Semiconductor devices
		3341-01	Semiconductor devices
		3359-021	Liquid crystal elements
		3359-099	Other electronic components
6	Use of electrical insulation gases	3411-02	Relay switches and switchboards
7	Metal castings	2711-031	Aluminum (inc. regenerated aluminum)
		2711-099	Other nonferrous metals

2.4 Emissions to the hydrosphere

In this database, the emissions data in the "FY2000 Comprehensive Survey on Water Pollutant Discharge" have been utilized. The emissions to the hydrosphere [g/day/year] for each of the industries were investigated in this statistics. Since all the industries are covered, and since it is a result of an investigation conducted in the fiscal year 2000, there is consistency with the IO table for the year 2000, and it is suited for constructing this database.

First of all, the numbers of days in operation during a 1 year period [days/year] for each of the industries are multiplied to emissions to the hydrosphere [g/day/year], to estimate the annual emissions [t/year]. The annual emissions for each of the industries are indicated in Table 14.

Table 14 The annual emissions for each of the industries

Industrial classification	BOD	COD	SS	T-N	T-P	Days in operation
	t	t	t	t	t	Days/year
Agriculture	5,802.6	249.2	7,215.1	183.6	36.0	365.0
Forestry	0.1	0.0	0.1	0.0	0.0	365.0
Fisheries	2.0	5.4	3.5	1.4	0.6	365.0
Aquaculture	11.5	26.7	24.6	16.9	2.8	365.0
Metal mining	27.0	53.3	266.3	42.7	0.7	365.0
Coal and lignite mining	0.8	573.5	4,187.5	0.0	0.0	365.0
Crude petroleum and natural gas production	10.4	341.9	198.1	722.6	0.0	365.0
Non-metal mining	97.8	149.2	1,390.8	6.3	0.3	365.0
Construction work, general including public and private construction work	243.4	220.1	1,217.1	132.1	16.1	365.0
Construction work by specialist contractor, except equipment installation work	1.1	1.5	13.4	0.1	0.0	365.0
Equipment installation work	0.1	0.8	2.2	0.0	0.0	365.0
Manufacture of food	11,587.3	11,327.1	12,037.8	3,884.3	650.2	287.0
Manufacture beverages, tobaccos, and feed	848.1	1,936.6	1,251.2	705.1	120.2	271.0
Manufacture of Textile mill products, except apparel and other finished products made from fabrics and similar materials	3,368.0	6,932.8	3,282.6	1,360.4	134.0	265.2
Manufacture of apparel and other finished products made from fabrics and similar materials	108.5	190.9	96.4	22.9	2.1	260.6
Manufacture of lumber and wood-products, except furniture	19.6	38.7	26.3	7.8	0.7	249.7
Manufacture furniture and fixtures	11.9	14.7	7.2	5.7	1.3	251.7
Manufacturing pulp, paper, and paper products	51,080.0	125,170.8	57,898.6	4,971.6	508.5	297.7
Printing, and allied industries	51.0	40.4	34.7	49.8	3.2	282.7
Manufacture of chemical and allied products	14,620.5	39,021.9	46,824.5	44,459.3	1,545.1	295.4
Manufacture of petroleum and coal products	2,260.8	8,890.1	11,175.6	8,473.7	171.0	333.6
Manufacture of plastic products, except otherwise classified	715.9	458.4	315.1	305.5	7.4	289.4
Manufacture of rubber products	88.2	135.4	91.8	66.4	8.6	269.1
Manufacture of leather tanning, leather products, and fur skins	34.3	21.7	31.7	52.1	0.1	267.5
Manufacture of ceramic and stone and clay products	265.0	393.5	810.8	196.0	14.0	266.5
Manufacture of iron and steel	550.7	20,355.6	34,287.9	15,483.8	457.7	297.5
Manufacture of non-ferrous metal and products	728.9	1,786.1	3,804.6	2,283.8	141.8	292.2
Manufacture of fabricated metal products	653.3	585.8	531.8	584.0	55.5	253.3
Manufacture of general machineries	236.1	229.6	208.0	290.0	31.0	252.2
Manufacture of electric machinery, equipment and supplies	1,609.8	1,569.6	1,585.9	2,713.4	155.5	275.2

	BOD	COD	SS	T-N	T-P	Days in operation
Industrial classification	t	t	t	t	t	Days/year
Manufacture of transportation equipment	572.7	1,306.0	653.5	1,701.8	167.7	261.3
Manufacture of precision instruments and machineries	79.6	48.7	66.2	52.0	15.3	257.2
Manufacture of ordnance and accessories	2.5	1.7	4.6	5.6	0.2	270.6
Miscellaneous manufacturing industries	74.4	94.1	67.3	118.6	9.9	243.3
Production, transmission and distribution of electricity	120,547.6	167,495.4	183,490.0	204,365.6	4,208.6	365.0
Manufacture of gas	31.8	900.7	1,128.0	141.4	17.4	365.0
Heat supply	5.3	23.8	21.8	21.4	9.4	365.0
Collection, Purification and distribution of water, and sewage collection, processing and disposal	68,944.0	143,669.6	58,938.6	194,813.7	14,819.8	365.0
Railway transport	171.4	613.3	148.8	941.7	119.4	365.0
Road passenger transport	8.2	7.9	5.4	2.0	0.3	365.0
Road freight transport	2.2	5.5	1.8	2.7	0.3	365.0
Water transport	0.1	0.3	0.2	0.2	0.0	365.0
Air transport	0.1	0.2	0.1	0.1	0.1	365.0
Warehousing	0.3	1.5	0.7	1.4	0.3	365.0
Service incidental to transport	21.0	37.3	16.7	64.4	9.9	365.0
Postal services	0.0	0.0	0.0	0.0	0.0	365.0
Telecommunications	2.4	4.1	11.6	0.1	0.0	365.0
Wholesale trade, general merchandise	17.5	6.9	21.3	29.2	9.9	365.0
Wholesale trade (textiles and apparel)	0.2	0.3	0.4	0.9	0.1	365.0
Wholesale trade (food and beverages)	19.6	16.1	23.4	6.8	0.9	365.0
Wholesale trade (building materials, and minerals and metals, etc)	2.2	6.5	1.6	0.0	0.0	365.0
Wholesale trade (machinery and equipments)	0.9	1.8	1.0	2.0	0.2	365.0
Miscellaneous wholesale trade	3.5	5.4	5.0	4.3	0.8	365.0
Retail trade, general merchandise	186.5	225.7	197.6	172.8	36.8	365.0
Retail trade (dry goods, apparel and apparel accessories)	3.5	2.7	2.1	1.2	1.0	365.0
Retail trade(food and beverage)	79.9	70.5	67.4	30.0	8.2	365.0
Retail trade (motor vehicles and bicycles)	0.1	0.7	0.2	0.6	0.1	365.0
Retail trade (furniture, household utensil and household appliance)	0.5	0.1	0.1	0.1	0.0	365.0
Miscellaneous retail trade	8.4	10.7	3.4	1.2	0.7	365.0
General eating and drinking places	62.4	138.2	87.7	65.1	12.5	365.0
Spree eating and drinking places	1.3	1.3	1.1	0.8	0.2	365.0
Banking	0.8	1.2	0.9	1.2	0.1	365.0
Financial institutions for small-business	0.0	0.0	0.0	0.0	0.0	365.0
Financial institutions for agriculture, forestry and fisheries finances	0.0	0.1	0.0	0.1	0.0	365.0
Government-related financial institutions	0.5	0.0	0.7	0.0	0.0	365.0
No- deposit moneycooperations engaged in the provision of finance, credit and investment	0.0	0.0	0.0	0.0	0.0	365.0

	BOD	COD	SS	T-N	T-P	Days in operation
Industrial classification	t	t	t	t	t	Days/year
Financial auxiliaries	0.0	0.0	0.0	0.0	0.0	365.0
Securities futures commodity dealing activities	0.0	0.0	0.0	0.0	0.0	365.0
Insurance institutions	0.1	0.1	0.1	0.0	0.0	365.0
Real estate agencies	24.5	23.5	27.5	19.2	2.6	365.0
Real estate lessors and managers	256.5	173.7	250.2	284.2	20.6	365.0
Laundry, beauty and bath services	496.7	1,143.7	388.3	480.6	57.6	365.0
Automobile parking	5.8	8.4	7.7	8.0	1.6	365.0
Miscellaneous living-related and personal services	14.7	12.0	15.9	13.2	1.8	365.0
Accommodations	1,713.2	1,268.6	1,562.3	1,360.0	103.4	365.0
Services for amusement and hobbies (excluding motion picture and video production)	226.9	371.6	282.9	304.2	44.1	365.0
Automobile maintenance services	2.0	2.2	0.8	2.6	0.5	365.0
Machine, etc. repair services, except otherwise classified	1.4	1.6	1.3	3.2	0.5	365.0
Goods rental and leasing	0.0	0.0	0.0	0.1	0.1	365.0
Motion picture and video production	0.0	0.0	0.0	0.0	0.0	365.0
Broadcasting	0.2	0.0	0.0	0.0	0.0	365.0
Information services	2.0	2.9	1.8	3.1	0.5	365.0
Advertising	0.9	1.4	0.0	2.9	0.0	365.0
Professional service n.e.c.	3.5	2.0	2.9	0.8	0.1	365.0
Cooperative associations, n.e.c.	317.1	367.0	452.1	273.4	36.1	365.0
Miscellaneous businesses services	7.2	5.5	5.3	2.7	0.4	365.0
Waste disposal business	1,768.5	3,935.3	2,098.6	4,270.4	543.4	365.0
Medical and other health services	467.3	737.3	701.9	502.9	80.5	365.0
Public health and hygiene	298.6	234.5	44.1	14.4	1.5	365.0
Social insurance and social welfare	173.4	71.9	247.5	54.2	8.6	365.0
School education	343.8	355.3	368.4	411.4	53.3	365.0
Scientific and development research institutes	589.9	736.6	1,011.0	2,503.9	52.0	365.0
Religion	15.7	25.9	15.7	221.9	0.5	365.0
Political, business and cultural organizations	10.7	10.6	8.8	2.1	0.2	365.0
Miscellaneous service	289.4	261.7	353.8	243.1	39.6	365.0
Foreign governments and international agencies in Japan	0.0	0.0	0.0	0.0	0.0	365.0
National government services	75.3	71.8	92.5	56.3	10.8	365.0
Local government services	1,334.6	2,733.1	1,703.9	4,744.4	136.1	365.0
Industries unable to classify	2,238.3	3,743.8	2,042.2	3,748.9	504.7	365.0
Unclear	52.3	67.6	124.7	28.9	4.6	365.0

In the above-mentioned statistics, the emissions to the hydrosphere have been calculated by multiplying the amount of drainage [m³] in each of the industries, by the drainage concentration [mg/l] of the industries. However, it is not known to what degree the concentration is a result of the industrial activity since the water has a given concentration at

the input already. The emissions to be accounted to the industrial activity are obtained using the following equation:

$$E_i^* = E_i \times \frac{D_i - R_i}{D_i}$$

Where E*: modified emissions to the hydrosphere [kg/year], E: investigated result of the emissions in the statistic, D: investigated result of drainage concentration [mg/L], R: the environmental quality standard [mg/L], i: substances. The environmental quality standard

values to be used as entrance concentration values to be utilized by the LCA are indicated in Table 15.

Table 15 List of environmental quality standard values

Substances	Standard Values [mg/L]	Water Use
BOD	1.0	Rivers (Water supply class 1, conservation of natural environment, etc.)
COD	2.0	Coastal Waters (Fishery class 1, bathing, conservation of natural environment, etc.)
SS	25.0	Rivers (Water supply class 1, conservation of natural environment, etc.)
T-N	0.2	Coastal Waters (Conservation of natural environment, etc.)
T-P	0.02	Coastal Waters (Conservation of natural environment, etc.)

The direct-emission matrix related to the hydrosphere burdens is calculated, by making the emissions to the hydrosphere of each industry correspond to the IO sector classification, and dividing them by the domestic production in the IO table. Since the data on the amount of burdens are made at the medium level of the Japan Standard Industrial Classification, they should be converted to the IO sector classification based on the corresponding relationship between the Japan Standard Industrial Classification and the IO sector classification. It will be possible to calculate the direct-emission matrix, using above-mentioned method. Furthermore, by multiplying it with an inverse matrix, an "embodied emissions intensities" matrix [mg/yen] can be calculated.

2.5 Resource consumptions

The substances to be the target are crude oil (for raw material and fuel), coal, natural gas, iron, copper, aluminum, lead, zinc, manganese, nickel, chrome, gravel, crushed stone, limestone, and wood.

2.5.1 Scope of the investigation

- Should it be the total amount of the resource minerals, or the metal content of the resources?
Statistics data were consolidated by unifying it with the "metal content of the resources."
- Should it be limited to new natural resources, or should recycled materials be included?
As a practical matter, since there were no statistics data written about recycled materials regarding crushed stone, gravel, limestone, and fossil resources, all of them were treated as new natural resources. Regarding the inventory of metal resources and wood, we adopted a statistics data that has the new natural resources classified from the recycled materials.
- Domestic resources or imported resources?
It should not be necessary to distinguish whether it is domestic or imported, and the total amount should be estimated. It will be easy to conduct totalization if a statistics data has summarized with the domestic ones separated from imported ones, or if both were included. However, there are cases when it is not clear whether it includes the

imports, or it only includes the domestic ones. Therefore we must use statistics data carefully in those cases.

4. The risk when selecting multiple statistics data

When using multiple statistics data to complement insufficiency, caution should be taken so that there are no redundancies or omissions in the statistics values. For example, since the classification method of the industry fields (products) into which resources are inputted varies with each of the documents, there arise risks of redundancies or omissions. Furthermore, there is also a risk of redundancies or omissions even in cases when data is obtained from a single statistics data, if you do not collect data of the same level for the multiple industry fields (products) covering from the intermediate demands to the final demands of that resource.

5. The statistics data to be adopted

Since it is necessary to multiply the environmental burden coefficient by the inverse matrix coefficient to calculate the embodied intensities, it will be easier to make matches with each other, with the "amount of resources inputted" data based on the same IO table. For example, it excels the other statistics from the viewpoint of consistency in the industry classifications, prevention of redundancies or omissions in the statistics, etc. For this reason, in this investigation, the "IO table on values and quantities" was adopted in priority when there was an independent sector for the resource to be focused on. On the other hand, other statistics data were adopted, when multiple resources were consolidated to form a sector (e.g. metallic mineral sector), or when there were problems in the treatment of recycled or imported materials. We also summarized our investigations for other statistics data, even though they were not adopted in the final stages, and used them as comparison data.

Estimation of resource consumptions are listed in tables 16, 17 and 18

Table 16 Estimation of fuel resource consumption

Crude oil	The inputted sectors and inputted amounts from the crude oil sector in the "IO table on values and quantities" were adopted. The "embodied intensities for resource-consumptions" were calculated with the inputted amount of resources divided into those for the raw material of petrochemical products, and those for fuels, using the raw-material/fuel ratio data for each of the industries, in the "Statistics on the consumption structure of petroleum, etc.".
Coal	The inputted sectors and inputted amounts from the coal sector of the "IO table on values and quantities" were adopted.
Natural gas	The inputted sectors and inputted amounts from the natural gas sector of the "IO table on values and quantities" were adopted.

Table 17 Estimation of metal resources consumption

Iron	The inputted sectors and inputted amounts from the iron ore sector of the "IO table on values and quantities" were adopted. Since the "IO table on values and quantities" consists of ore based weights, they were converted to the weight of iron content. The value publicized in the websites of the steel manufacturers (approximately 60%) was used for the constituent percentage of iron contents within the iron ores.
Copper	Data was made based on the "Consumer receipt and payment table for each of the industries and product items" in the "Yearbook of minerals non-ferrous metals statistics". The input of recycled material to the copper sector of the "IO table on values and quantities" is difficult to model. In the adopted receipt and payment table, the amounts of copper consumptions are written for each of the 3 classifications, electrolytic copper, copper scrap, and copper alloy scrap, and also for each of the 15 classified industries such as the chemical industry and steel industry. Recycled materials were explicitly excluded, by totalizing only the electrolytic copper's worth. Regarding the consumption amount for each of the industries, they were allocated to the inputted sectors in the copper sector of the "IO table on values and quantities," with the ratio of the amounts of materials inputted in the "Tables on Values and Quantities"
Lead	Data were made based on the "Consumer receipt and payment table for each of the industries and product items" in the "Yearbook of minerals non-ferrous metals statistics." In the "IO table on values and quantities," metal ores other than iron were consolidated into the nonferrous metal mineral sector or the lead and zinc (includes recycled ones) sector, and it was difficult to obtain an individual data on lead resources in either of the cases. The amount of resources inputted for the 15 industry classifications in the receipt and payment table were allocated to the corresponding IO table sectors.
Zinc	Data were made based on the "Consumer receipt and payment table for each of the industries and product items" in the "Yearbook of minerals non-ferrous metals statistics." The "IO table on values and quantities" was in a state similar to lead, and it was difficult to obtain an individual data on zinc resources. The amount of resources inputted for the 15 industry classifications in the receipt and payment table were allocated to the corresponding IO table sectors.
Manganese	Data was made based on the "Material flow of mineral Resources" on the website of the Mineral Resources Information Center, "Japan Oil, Gas and Metals National Corporation (independent administrative institution)" (JOGMEC). There were no individual data on manganese resources in the "IO table on values and quantities," or the "Yearbook of minerals non-ferrous metals statistics." Material flow was described clearly using a flowchart, in the data on the website that we adopted, and it was very effective because information about the imported materials' worth, recycled materials' worth, and the quantity of the metal content were able to be obtained. Since there was no year 2000 version of the manganese data in the Resources Information Centre website, the material flow from the nearest version, the year 1999 version, was adopted. The amount of resources inputted for the resource consuming sectors (products) were allocated to the corresponding IO table sectors.
Nickel	Data were made based on the "Consumer receipt and payment table for each of the industries and product items" in the "Yearbook of minerals non-ferrous metals statistics." It was difficult to obtain an individual data on nickel resources from the "IO table on values and quantities." The amount of resources inputted for the 15 industry classifications in the receipt and payment table were allocated to the corresponding IO table sectors.
Chrome	Data was made based on the "Material flow of mineral Resources" on the website of the Mineral Resources Information Center of JOGMEC. There was no individual data on chrome resources in the "IO table on values and quantities," or the "Yearbook of minerals

	non-ferrous metals statistics." Since there was no year 2000 version of chrome data in the Resources Information Centre website, the material flow from the nearest version, the year 1999 version, was adopted. The amount of resources inputted for the resource consuming sectors (products) were allocated to the corresponding IO table sectors.
Aluminum	Data was made based on the "Consumer receipt and payment table for each of the industries and product items" in the "Yearbook of minerals non-ferrous metals statistics." The aluminum sector data in the "IO table on values and quantities" includes recycled material data, and it was difficult to exclude the recycled material's worth. The amount of resources inputted for the 15 industry classifications in the receipt and payment table were allocated to the corresponding IO table sectors. Regarding the consumption amount for each of the industries, they were distributed to the inputted sectors in the aluminum (including recycled materials) sector of the "IO table on values and quantities," with the ratio of the amount of materials inputted in the "Tables on Values and Quantities."

Table 18 Estimation of other resources consumption

Crushed stones	The inputted sectors and inputted amounts from the "crushed stones" sector of the "IO table on values and quantities" were adopted.
Gravel	The inputted sectors and inputted amounts from the "gravel and quarrying" sector of the "IO table on values and quantities" were adopted.
Limestone	The inputted sectors and inputted amounts from the limestone sector of the "IO table on values and quantities" were adopted.
Wood	The inputted sector having the logs (domestic) sector and the logs (import) sector of the "IO table on values and quantities" consolidated, and its inputted amount was adopted.

The amount of environmental burdens related to resource consumptions that are directly generated in each of the industries, was divided by the amount of domestic production for each of the industries, and the direct environmental burden matrix E was made for each of the resources. By obtaining a product of the matrix and the Inverse matrix of the IO table, it will be possible to calculate the "embodied intensities of the environmental burdens".

In setting the amount of direct inputs, the destination sectors into which each of the resources are inputted (consumed) are consolidated. Since this sector depends on the statistics data adopted, the sector handling the "most up-stream stage" resource of that resource in the IO table is not necessarily selected. Regarding the intermediate demand sectors down stream from the sector that has had direct inputs set, all the "ripple-effects on production" can be calculated by multiplying it with the inverse matrix. However, if there is a sector handling that resource up-stream of the sector that has had direct inputs set in the IO table, there is not going to be any handling of that resource for this sector.

For this reason, we added a process in which 11 raw material sectors in the upper-stream stages of each of the resources are extracted from the IO table, and the amounts of resources consumed in the same sectors were added to them. If the adding process is implemented at the stage the amount of direct inputs is set, it would become a redundant totalization due to taking into consideration the ripple-effect caused by multiplying the inverse matrix.

Therefore, the adding process was implemented after multiplying the inverse matrix. The amounts to be added were obtained by dividing the quantities produced in each of the sectors, which are written in the "Table on Domestic Products by Sector and Commodity" (one of the accompanying tables of the IO table, by the amount of production.

3 Implementation in SimaPro

3.1 Substance names

Table 19 includes the name equivalency between the original Input/Output table and the implemented version in SimaPro

Name in original Toshiba database	Name after implementation in SimaPro
Aluminum	Aluminium, in ground
Bod	Bod5, biological oxygen demand
Chrome	Chromium, in ground
Co2	Carbon dioxide
Coal	Coal, hard, unspecified, in ground
Cod	Cod, chemical oxygen demand
Copper	Copper, in ground
Crude oil (fuel)	Oil, crude, 38400 mj per m3, in ground
Crude oil (raw material)	Oil, crude, 38400 mj per m3, in ground
Crushed stone	Sand, gravel and stone, extracted for use
Energy	Energy, unspecified
Gravel	Gravel, in ground
HFC	Ethane, 1,1,1,2-tetrafluoro-, hfc-134a
HFC23	Methane, trifluoro-, hfc-23
Iron	Iron, in ground
Lead	Lead, in ground
Limestone	Limestone, in ground
Manganese	Manganese, in ground
Natural gas	Gas, natural, 30.3 mj per kg, in ground
Nickel	Nickel, in ground
NOx	Nitrogen oxides
PFC	Ethane, hexafluoro-, hfc-116
SF6	Sulfur hexafluoride
SOx	Sulfur oxides
SPM	Particulates, spm
SS	Suspended solid, unspecified
T-n	Nitrogen, total
T-p	Phosphorus, total
Wood	Wood, unspecified, standing/m3
Zinc	Zinc, in ground

3.2 Input of Natural Gas

The original database considers input of gas with a heat content of 40,9 MJ/m³ (34,4 MJ/kg). The amounts of natural gas were adjusted to an input of gas with a heat content of 30,3 MJ/kg. This in order to match the impact assessment methodologies included in SimaPro. This adjustment is based on the fact that what is constant is the energy input as natural gas.

3.3 Crude Oil

The input of crude oil as fuel and raw material were aggregated into a single input of crude oil.