Material Flow in Japan

2006

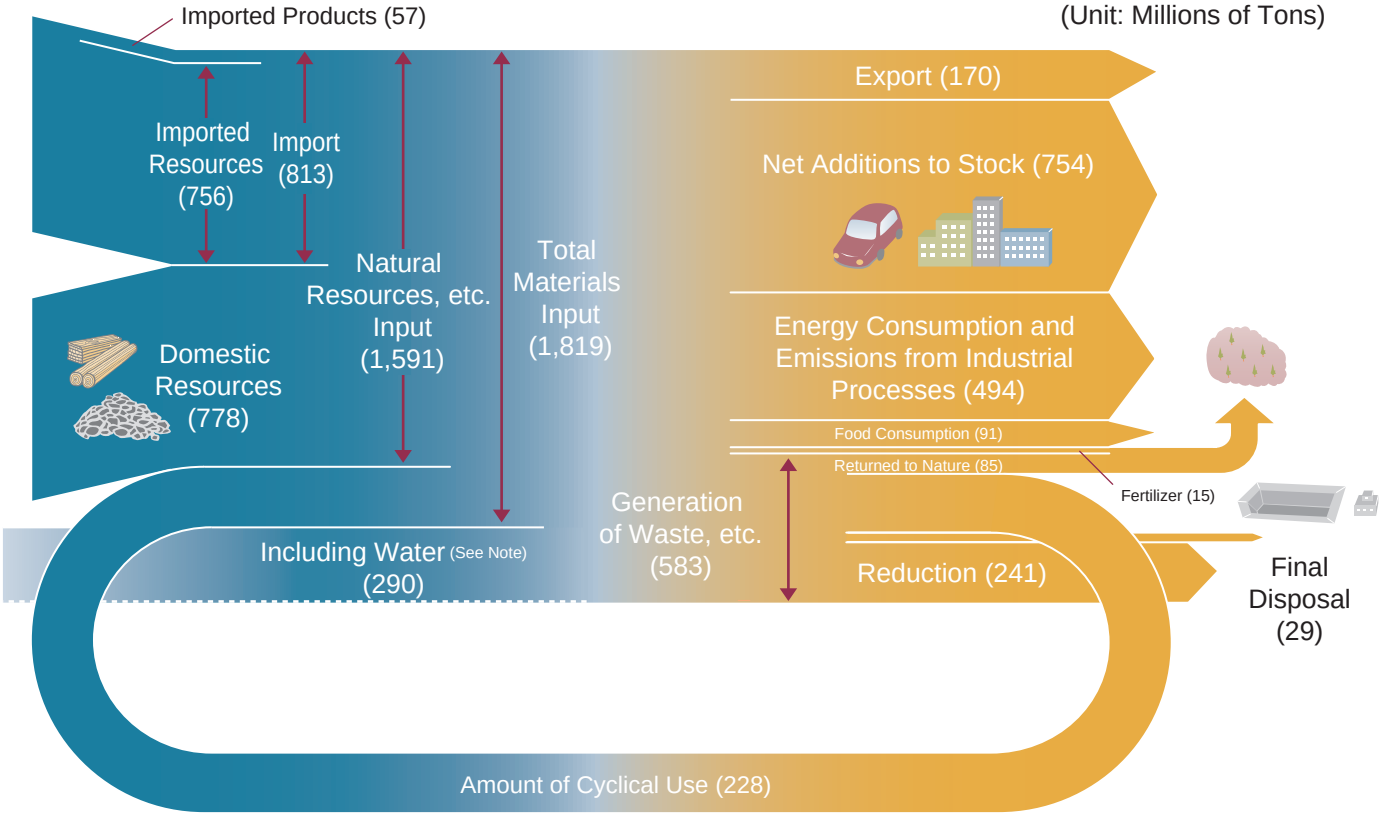
Ministry of the Environment Government of Japan

Overview of the Material Flow in Japan

The first step in building a sound material-cycle society is to understand the flows of materials (material flows) in the economic sector in terms of the resources extracted, consumed, and disposed of. By accurately understanding these flows, we can not only promote the reduced generation and cyclical use of wastes, but also apply this knowledge to the promotion of the efficient use of all materials input to society, thus making it possible to obtain information that is highly useful for formulating future policies.
In the Second Fundamental Plan for Establishing a Sound Material-Cycle Society, which was decided by the Cabinet in March 2008, we added new targets to the indexes on “Inlet,” “Outlet,” and “Cycle,” which are different aspects of the material flows, in order to achieve the formation of a sound material-cycle society in which measures such as reduced generation, reuse, recycling, and appropriate disposal have been advanced in a balanced manner.
This pamphlet presents an overall picture of the material flow in our country based on material flow accounts (MFAs); these MFAs enable us to identify the whole system of material flow in the economic sector of Japan, and provide overviews by item.

In the material flow in Japan in 2006, the quantities of domestic and foreign resources and products entering the economic sector (total amount of input materials) was 1.8 billion tons, of which 750 million tons (approximately half) were accumulated in the form of durable goods, buildings and social infrastructure. In addition, 170 million tons were exported in the form of products, 490 million tons were consumed as energy or emitted through industrial processes, and 580 million tons were produced as waste. Of this waste material, cyclical use accounted for 230 million tons, which represented 12.5% of the total amount of the input materials.

Material Flow in Japan (in Fiscal Year 2006)



(Note) Including water: Input of water included in waste and the like (sludge, animal manure, human waste, waste acid, and waste alkali) and sediment and the like associated with economic activities (sludge from mining, building and water works and tailing from mining).

Explanation of the Items that Constitute the Material Flow

Item			Explanation
Inlet Side	Total Materials Input		- Sum of the amount of natural resources, etc. input and the amount of cyclical use
	Natural Resources, etc. Input		- Sum of the domestic resources and amount of import
		Domestic Resources	- Amount of domestically extracted resources
		Import	- Amount of resources and products imported to Japan
	Amount of Cyclical Use		- Amount of cyclical use excluding returned to nature
	Including Water		- Amount of water not included in "natural resources, etc. input" but included in "waste, etc." - Amount of accompanying inputs including soil that are related to economic activities (sludge from the mining industry, construction industry, and water/sewage industry, and slag from the mining industry) - Amount of air as part of industrial products taken in through industrial processes
Outlet side	Export		- Amount of resources and products exported from Japan
	Net Additions to Stock		- Amount of materials newly accumulated in a given year such as civil engineering structures, buildings, and durable goods, which cannot be disposed of immediately, but are accumulated through economic activities, excluding those that are disposed of/ turned into waste, etc. in the same year
	Energy Consumption and Emissions from Industrial Processes		- Amount of exhaust gases or waste water from fossil and biomass resources (excluding waste, etc.) that are used as energy - Amount of materials discharged as a result of substance change in industrial processes, such as oxygen reduced from iron oxide contained in iron ores and carbon dioxide separated from limestone
	Food Consumption		- Amount of human food and livestock feed excluding that directly converted to waste, etc. or converted after being consumed
	Fertilizer		- Amount of fertilizers spread on farmland
	Generation of Waste, etc.		- Amount of generated waste, etc.
		Returned to Nature	- Amount of rice straw, wheat and barley straw, and husks that are directly plowed back into farmland, and of those returned to farmland after being used as spreads at animal manure - Amount of animal manure returned to farmland without being treated
		Cyclical Use	- Amount of cyclical use excluding those naturally returned
		Reduction	- Amount of materials reduced through intermediate treatment in order to treat waste, etc. The wastes whose volumes are reduced at facilities equipped with waste power generators are included in this item, not in energy consumption.
		Final Disposal	- Amount of waste, etc. disposed of directly or after intermediate treatment

■ COLUMN : What is the Fundamental Plan for Establishing a Sound Material-Cycle Society?

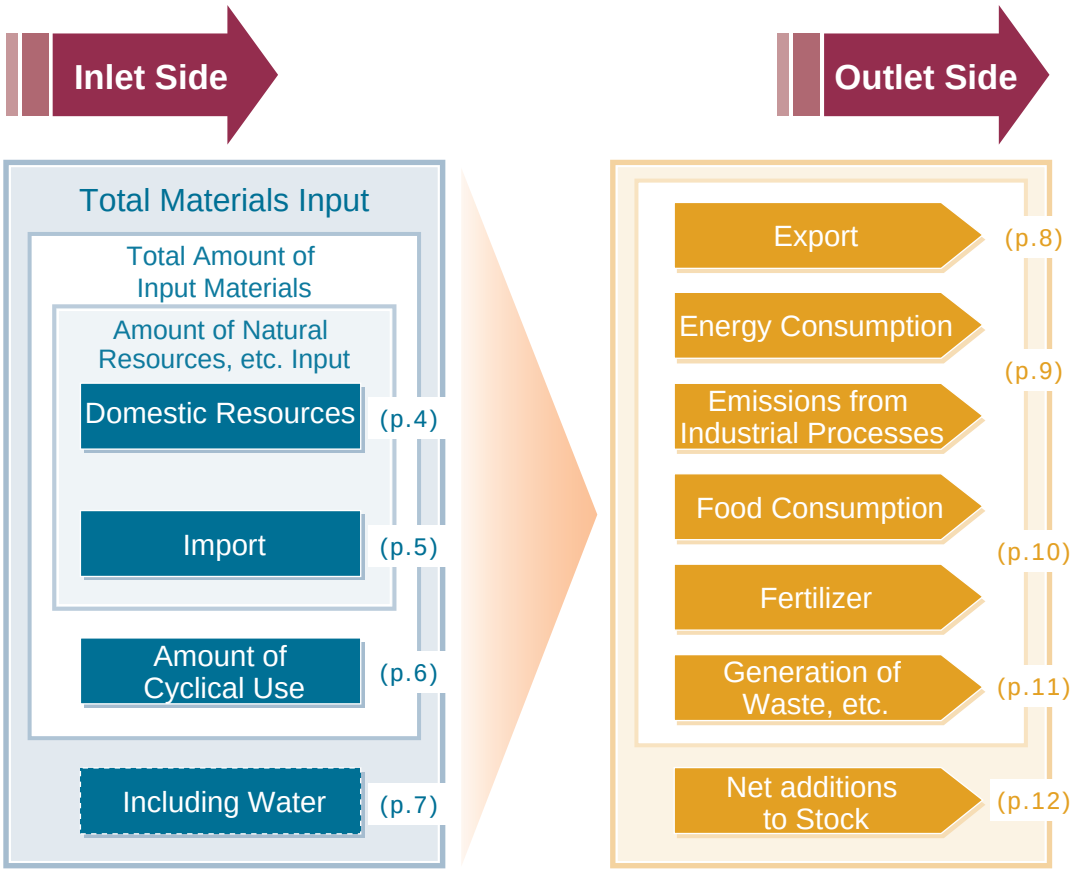
The Fundamental Plan for Establishing a Sound Material-Cycle Society (hereafter called "Fundamental Plan for Sound Material Cycle") was established in March 2003 (first plan), and revised in March 2008 (second plan), in accordance with the provisions of Article 15 of the Fundamental Law for Establishing a Sound Material-Cycle Society (Law No. 110 of 2000) in order to radically review the existing mechanism of social–economic activities based on mass production, mass consumption, and mass disposal and to establish a sound material-cycle society.

The Fundamental Plan for Sound Material Cycle defines a concrete image of a sound material-cycle society that Japan aims to establish. Numerical targets, roles that the respective entities should play, and measures and actions to cope with wastes and promote recycling are being comprehensively and systematically taken in accordance with the plan.

The numerical targets of the Second Fundamental Plan for Sound Material Cycle, which was revised in FY 2007, are described on page 14.

Details of the Material Flow in Our Country

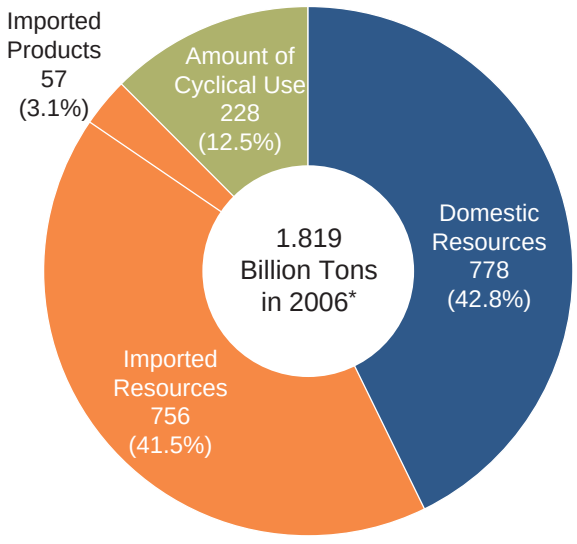
In this section, the material flow is divided into “Inlet” and “Outlet,” and the details are organized according to item.



Inlet Side

The total amount of input materials on the inlet side includes [Domestic Resources] such as non-metallic minerals, [Import] such as imported resources and imported products, and [Amount of Cyclical Use].

The total materials input in Japan in 2006 was 1.8 billion tons, consisting of 780 million tons (42.8%) of domestic resources, 760 million tons (41.5%) of imported resources, 60 million tons (3.1%) of imported products, and 230 million tons (12.5%) of cyclical use.



* Sum of the total materials input excluding including water

Domestic Resources

[Domestic Resources] include “fossil fuels” such as petroleum and natural gases mined domestically, “metallic minerals” such as gold ores and zinc ores, “nonmetallic minerals” such as rocks and gravels, “food resources” such as rice and vegetables, “other resources” such as wood and industrial crops, and “agricultural residues” such as rice straw.

Of the domestic resources, “nonmetallic minerals” represent the largest proportion, accounting for 87.3%, followed by “food resources,” which account for 8.7%.

“Nonmetallic minerals” include rocks (47.2%), gravels (25.2%), and limestone (24.5%); they are mainly used for roads and buildings.

The amount of input domestic resources from 2000 peaked in 2001, and has since decreased year by year in line with the decline in the demand for nonmetallic minerals, which represent the largest proportion of domestic resources.

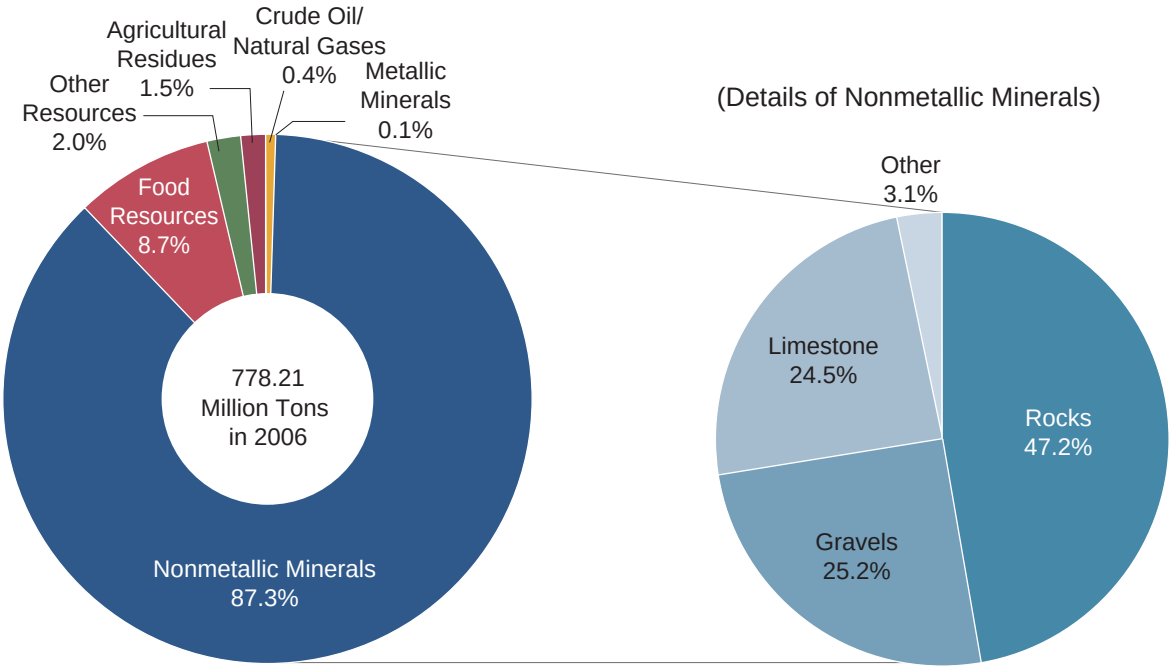


Fig.1 Component ratios of the amount of input domestic resources

Fig.2 Component ratios of nonmetallic minerals

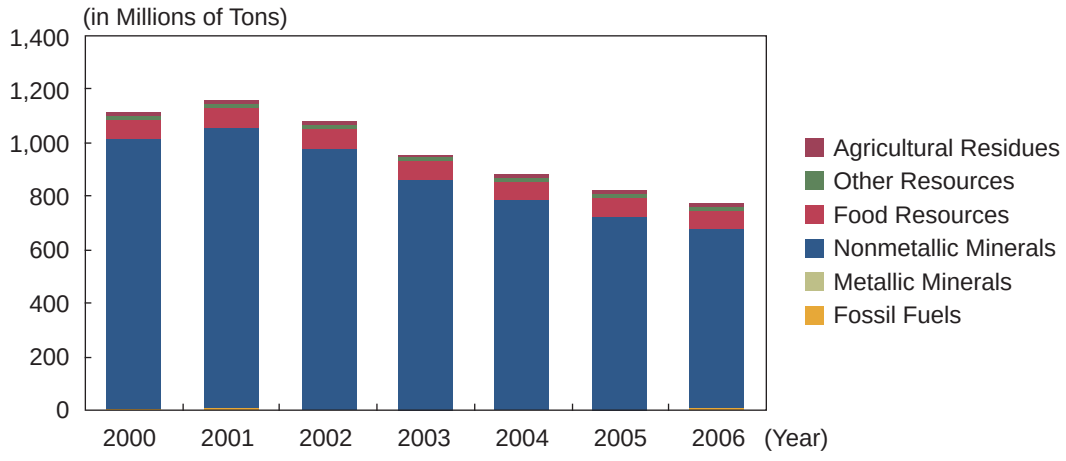


Fig.3 Changes in the amount of input domestic resources

Import

[Import] is divided into “imported resources” including fossil fuels such as petroleum and coals and food resources such as meats and vegetables, and “imported products” such as clothing, furniture, and electric appliances.

Regarding the changes since the year 2000, import decreased in 2001, increased thereafter, and have remained nearly flat since 2004.

Of the “imported resources,” which account for over 90% of all import in 2006, there are 490 million tons of fossil fuels such as coals, petroleum, and natural gases; these fuels account for approximately two-thirds of these resources. Since there are only approximately 3.45 million tons of fossil fuels mined in Japan, our country depends on import from foreign countries for almost all of our energy needs.

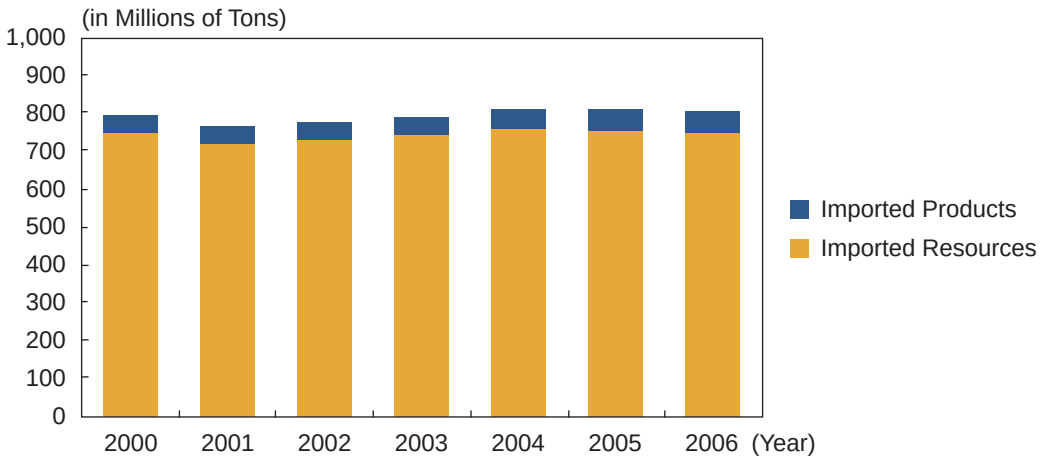


Fig. 4 Change in the amount of import

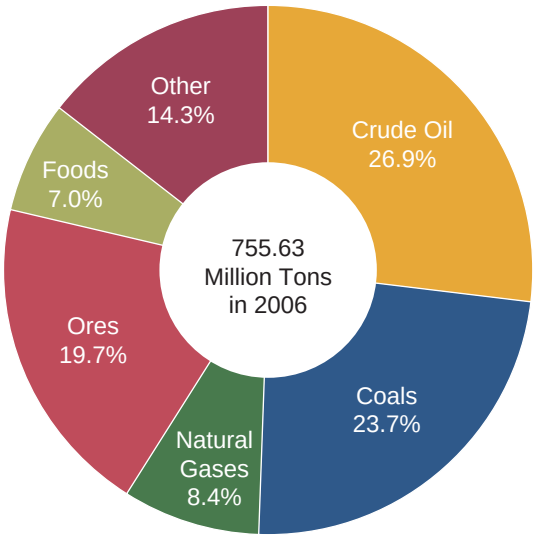


Fig. 5 Details of the amount of imported resources

Amount of Cyclical Use

[Amount of Cyclical Use] are classified into “nonmetallic mineral based” such as rubble, slag, and dust, “biomass based” such as used paper and animal manure, “metal based” such as iron scrap and waste metals, and “fossil fuel based” such as waste plastics.

Although the amount increased between 2001 and 2004, it has since remained nearly flat.

As for the details of the amounts, “nonmetallic mineral-based” materials such as rubble, slag, and dust represent approximately 60% of the total amount, of which rubble represents the largest proportion (25.4%).

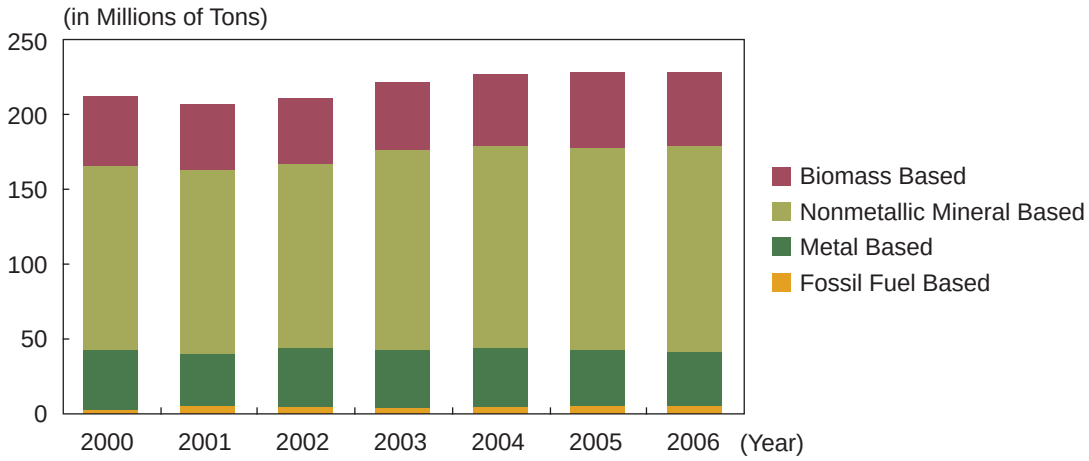


Fig. 6 Changes in the amount of cyclical use

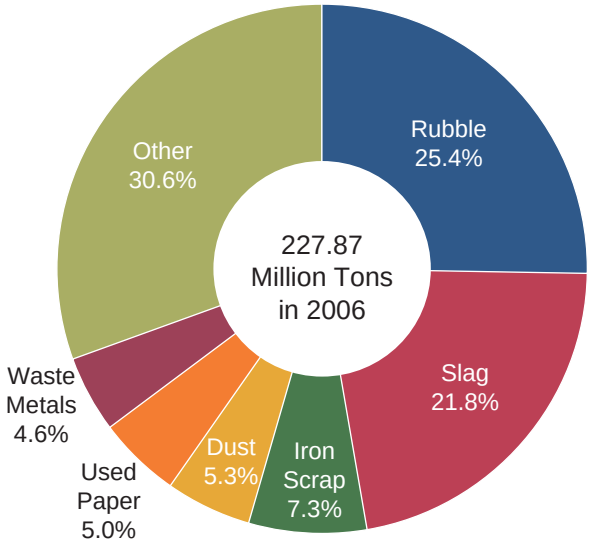


Fig. 7 Details of the amount of cyclical use

Including Water

[Including Water] includes “including water such as waste, etc.,” which are regarded as water not contained in natural resources but contained in animal manure and sludge, “accompanying inputs” such as sludge produced from the mining, construction, and water supply industries and soil contained in slag, and “intakes as raw material of air,” which are collected in industrial processes and transformed into industrial products.

The amount of these materials has remained nearly flat since 2000, and “including water such as waste, etc.” represent 99%.

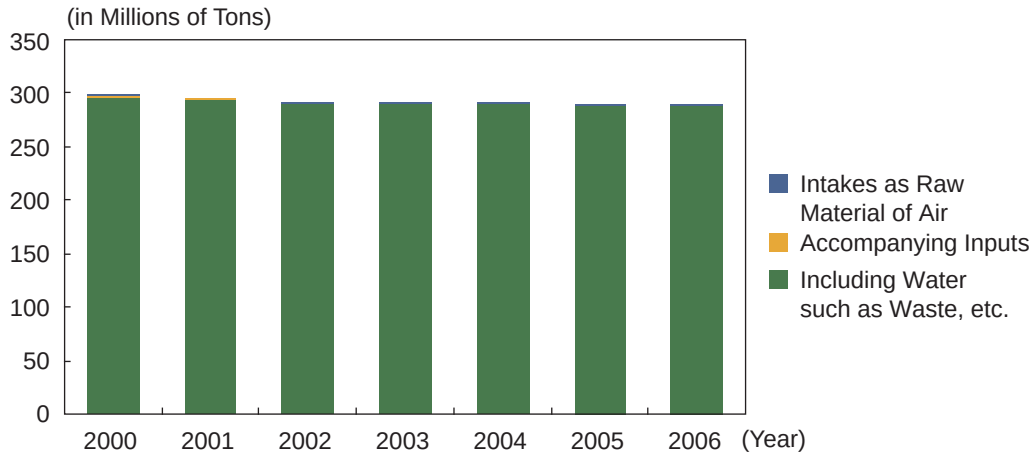


Fig. 8 Changes in the amount of including water

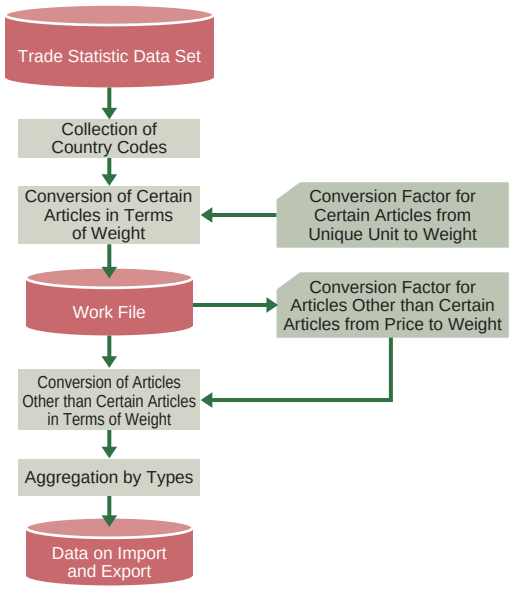
■ COLUMN : Method for Estimating Data on Import and Export

Data on import and export are estimated along the flow indicated in the flow diagram shown on the right.

(1) Collection of Country Codes
Since “Trade Statistics of Japan” of Ministry of Finance consist of data compiled according to articles and countries, this information can be collected and the data can be compressed.

(2) Conversion of Certain Articles in Terms of Weight
Of certain articles whose volume units other than weight are supplemented, those articles whose units can be converted to weight if multiplied by a common coefficient are so converted. For example, in the case of wood, the conversion is performed by multiplying it by 0.5 ton per m^3.

(3) Conversion of Articles Other than Certain Articles in Terms of Weight
Regarding articles other than certain articles, data of those not supplemented with weight are converted in terms of weight. In principle, the conversion is performed by multiplying the weight unit price (t/Yen) created with data supplemented with weight by the transaction amount of data not supplemented with weight. Articles are classified using the first two digits of the respective article code provided in “Trade Statistics of Japan.”

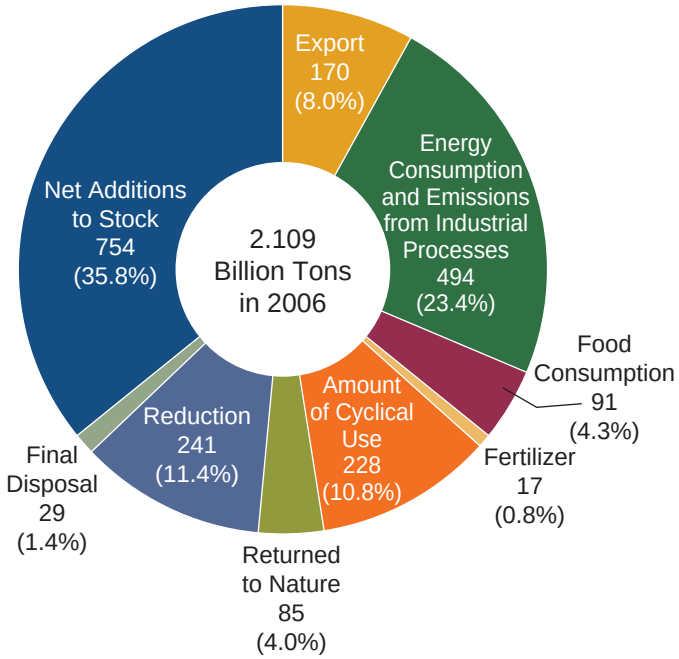


Flow of Estimating Data on Import and Export

Outlet Side

The outlet side includes [Energy Consumption and Industrial Process Emissions], [Export] such as exported products, [Reduction], and [Amount of Cyclical Use] such as waste, etc., and [Net Additions to Stock], which are accumulated in the form of durable goods, buildings and social infrastructure.

Of the 2.1 billion tons of resources input in 2006, 750 million tons (35.8%) were accumulated in economic activities such as civil engineering structures and durable goods, and 490 million tons (23.4%) were discharged through energy consumption and substance change in industrial processes.
In addition, 580 million tons (27.6%) were generated in the form of waste, etc., which included reduction of 240 million tons (11.4%) achieved through intermediate treatment of wastes.



Export

[Export] includes iron and steel, and exported machines, machinery, and foods.
[Iron and Steel] represent the largest proportion at 40 million tons (22.7%), followed by [Export Machines] such as vehicles at 30 million tons (16.1%).
[Other] includes wood pulp products, chemical industrial products, and miscellaneous goods such as fiber products and furniture.

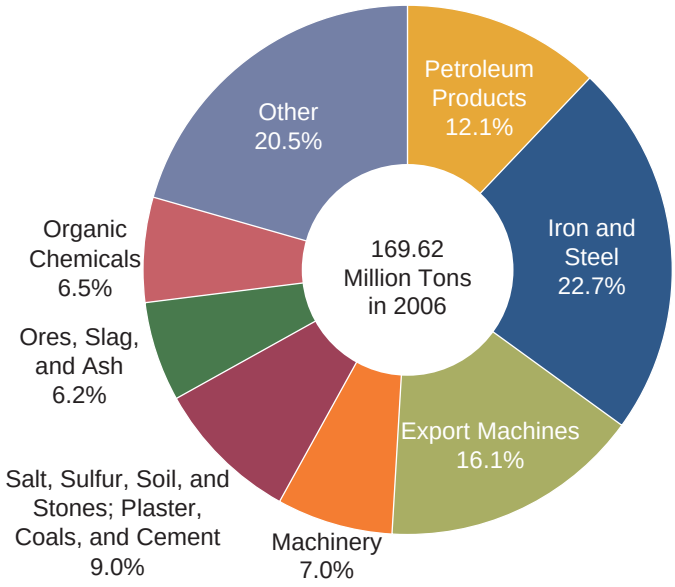


Fig. 9 Details of the amount of export

Energy Consumption and Emissions from Industrial Processes

[Energy Consumption] includes the amount of fossil fuels and biomasses (excluding waste, etc.) used as energy, while [Industrial Process Emissions] include CO_2 separation from “limestone” and “dolomite,” and “separation of oxygen from iron ores.”

Since 2000, the energy consumption and industrial process emissions have not significantly fluctuated.

Of the details in 2006, the amount of energy consumption, which accounts for more than 80%, was 420 million tons. Fossil fuels represented 98% of the energy consumption, and the fossil fuels consisted of crude oil and petroleum products (43.8%), coals and coal products (37.8%), and natural gases (16.4%).

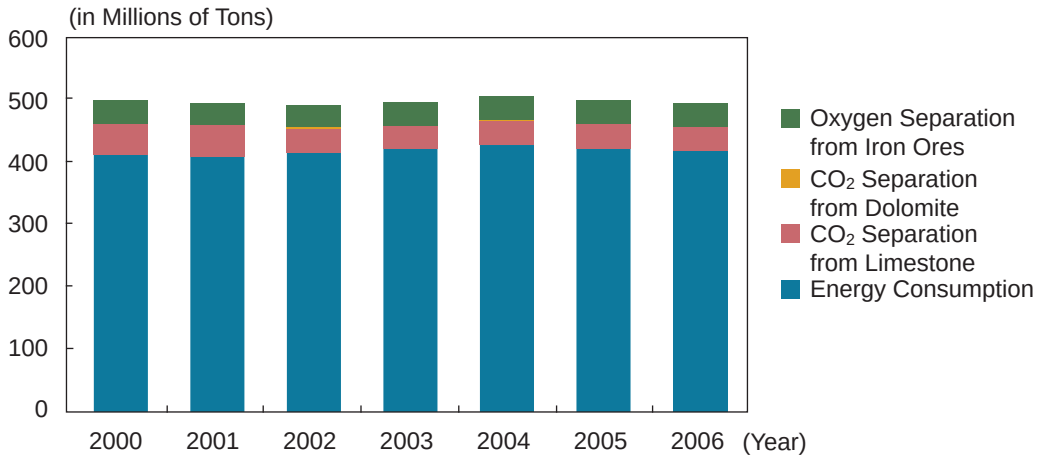


Fig. 10 Change in energy consumption and emissions from industrial processes

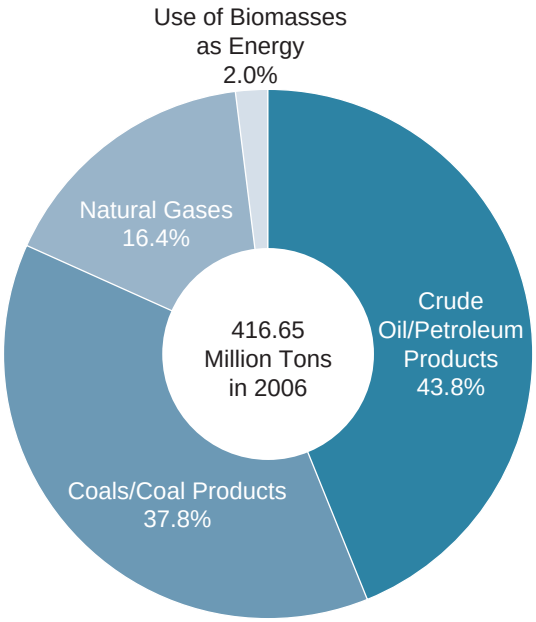


Fig. 11 Changes in energy consumption

Food Consumption/Fertilizer

[Food Consumption] is the amount obtained by subtracting the “amount of animal manure,” “amount of sewage sludge/amount of human wastes,” “reduction amount and final disposal amount of food wastes,” and “amount of recycled food wastes for use other than feeds” from the “amount of domestic supply of foods/feeds.” [Fertilizer] is the amount obtained by subtracting the “amount of export” from the value obtained by adding the “amount of import” to the “amount of domestic production of fertilizer.”

The amount of [Food Consumption] in 2006 was 90 million tons, while the amount of [Fertilizer] was 20 million tons. Since 2000, the fertilizer amount has remained nearly flat, while the amount of food consumption has decreased by 5.8% from 2000.

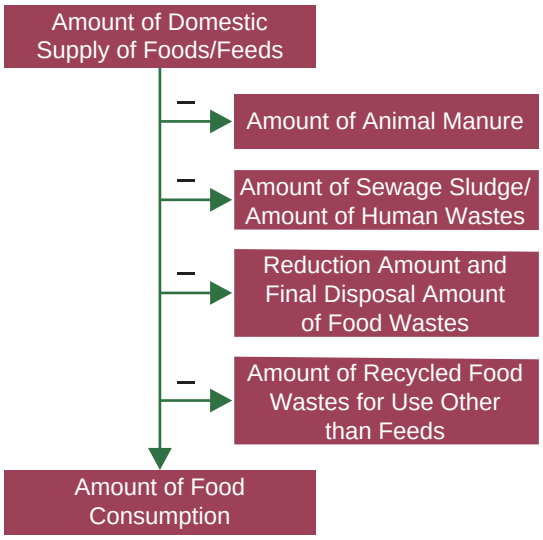


Fig. 12 Flow of estimating food consumption

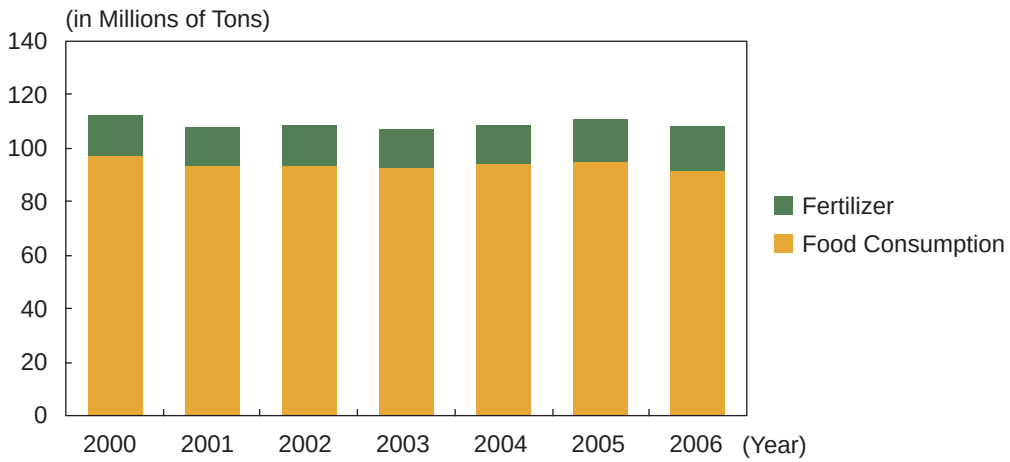


Fig. 13 Changes in the amount of food consumption and the amount of fertilizer

Generation of Waste, etc.

[Generation of Waste, etc.] includes the amount of cyclical use, amount of returned to nature, amount of reduction, and final disposal amount.
The total amount has remained nearly flat since 2000. By composition, the final disposal amount has decreased; whereas, the amount of reduction and the amount of returned to nature have increased.

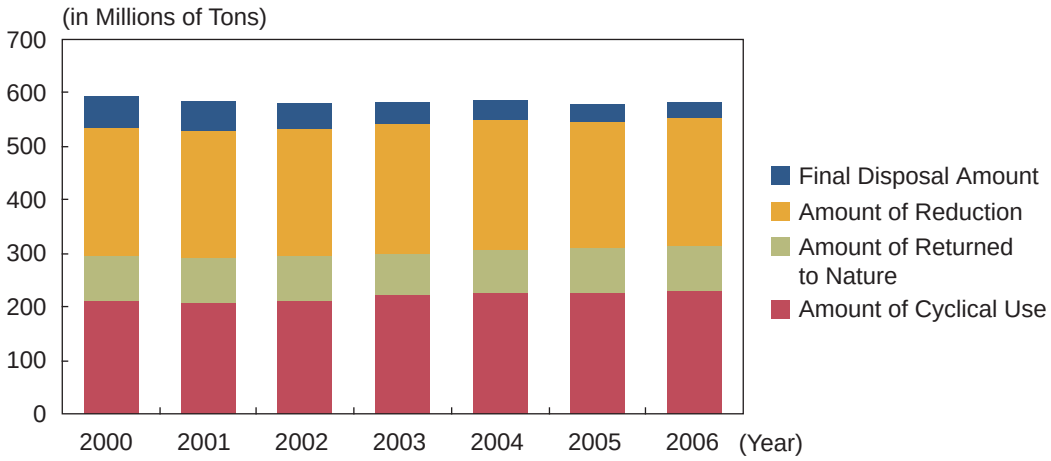
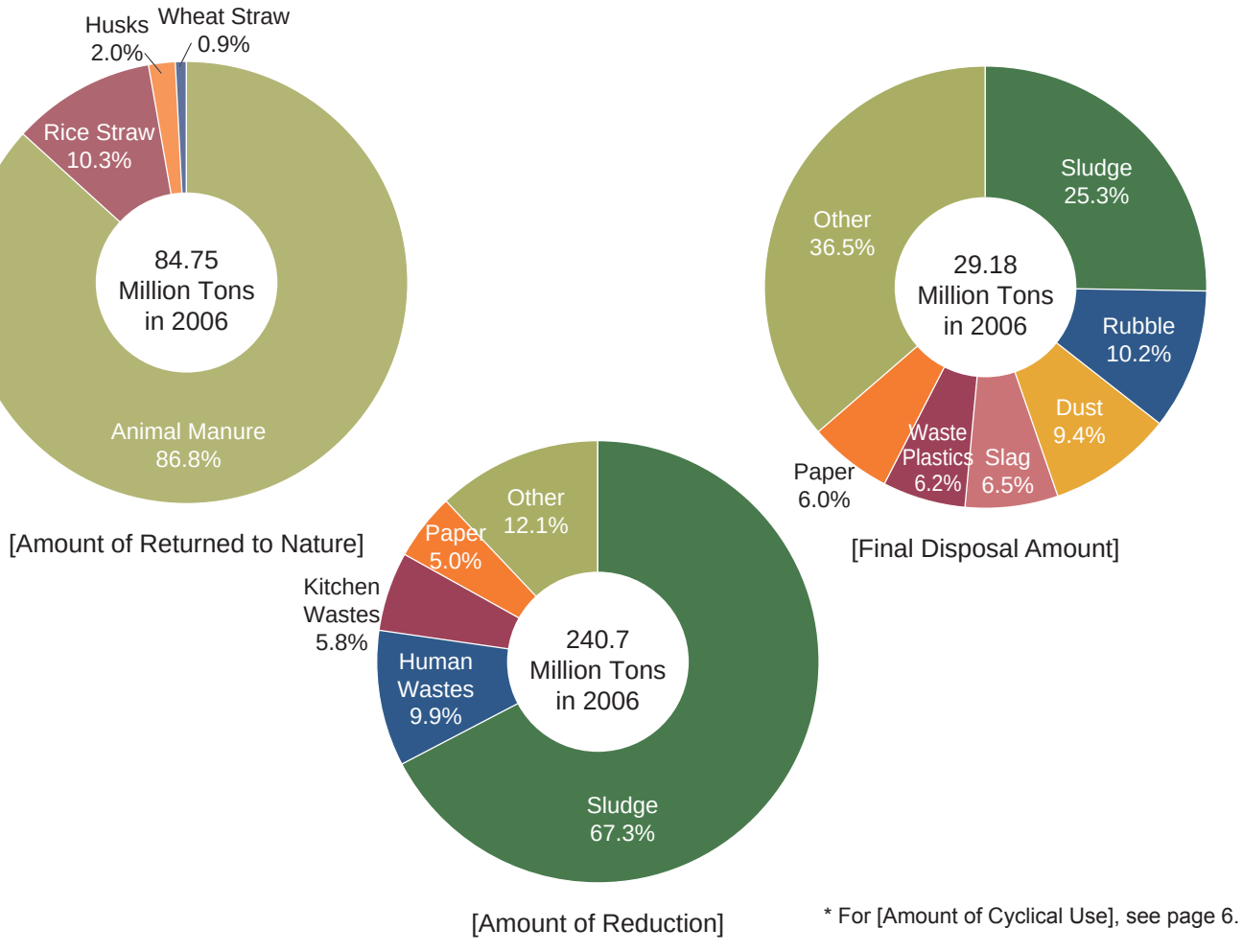


Fig. 14 Changes in the amounts of generated waste, etc.



* For [Amount of Cyclical Use], see page 6.

Fig. 15 Details of the amount of returned to nature, amount of reduction, and final disposal amount

Net Additions to Stock

[Net Additions to Stock] are the amounts of materials accumulated in one year through economic activities such as civil engineering structures, buildings, and durable goods. However, since it is impossible to identify the actual amount, it is estimated by subtracting the “amount of export,” “amount of energy consumptions,” “amount of emissions from industrial processes,” “amount of food consumptions,” “amount of fertilizer,” and “amount of generated waste, etc.” from the “sum of the inlet side items.”

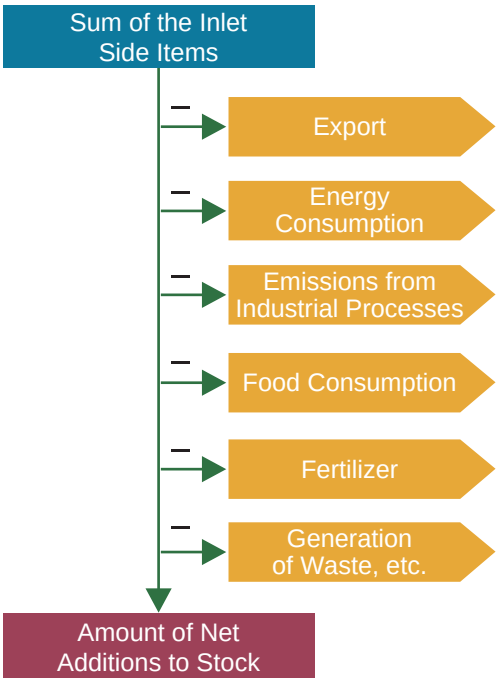


Fig. 16 Flow of estimating the amount of net additions to stock

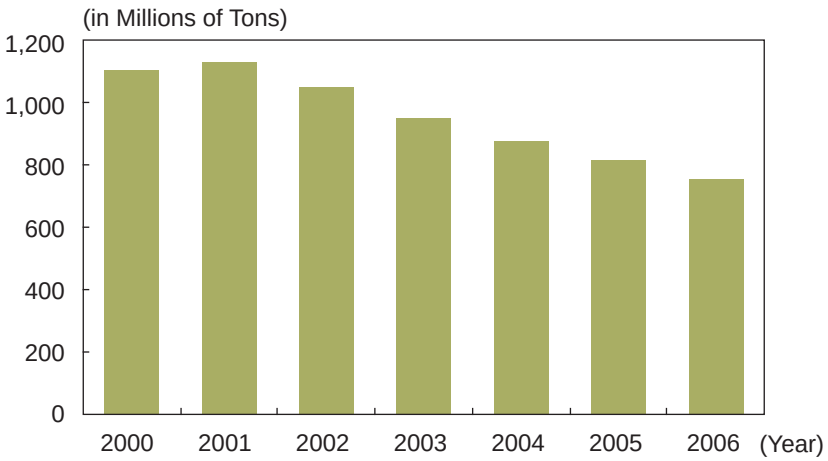


Fig. 17 Changes in the amount of net additions to stock

Material Flow 2006 Details and Sources

Ministry of the Environment has prepared this document based on data from the following sources.

Item	Quantity (in 10,000 tons)	Source
Inlet Side		
Domestic Resources	77,821	
Crude Oil/Natural Gases	345	- "General Energy Statistics" by Agency for Natural Resources and Energy - "Yearbook of Mineral Resources and Petroleum Products Statistics" by Ministry of Economy, Trade and Industry - "Result of Aggregating Reports on the State of Operations by Quarry Businesses" by Agency for Natural Resources and Energy - "Aggregate Supply-Demand Table" from the website of the Japan Crushed Stone Association
Metallic Minerals	42	
Nonmetallic Minerals	67,937	
Rocks	32,052	
Gravels	17,100	
Limestone	16,662	
Other	2,122	
Food Resources	6,742	- "Crop Statistics," "Statistics on Production and Shipment of Vegetables," "Statistics on Production and Shipment of Fruits and Nuts," "Statistics of Agriculture, Forestry and Fisheries," "Statistics on Production and Shipment of Flowers," and "Report on Supply and Demand of Lumber" by Ministry of Agriculture, Forestry and Fisheries
Other Resources	1,558	
Agricultural Residues	1,197	- "Survey on the Study of Measures to Cope with Wide-Area Transfer of Wastes and Fact-Finding Survey on the Amount of Recycled Wastes (Chapter on Fact-Finding Survey on the Amount of Recycled Wastes)" by Ministry of the Environment
Import (Resources)	75,563	
Fossil Fuels	44,594	- "General Energy Statistics" by Agency for Natural Resources and Energy - Estimated from "Trade Statistics of Japan" by Ministry of Finance
Coals	17,910	
Crude Oil	20,359	
Natural Gases	6,326	
Ores, Slag, and Ash	14,876	
Foods	5,255	
Other	10,837	
Import (Products)	5,714	
Chemical Industrial Products	1,277	- Estimated from "Trade Statistics of Japan" by Ministry of Finance
Base Metals and their Products	1,442	
Machinery/Electric Appliances	724	
Other	2,272	
Amount of Cyclical Use	22,787	
Rubble	5,785	- "Survey on the Study of Measures to Cope with Wide-Area Transfer of Wastes and Fact-Finding Survey on the Amount of Recycled Wastes (Chapter on Fact-Finding Survey on the Amount of Recycled Wastes)" by Ministry of the Environment
Slag	4,977	
Iron scrap	1,664	
Dust	1,205	
Used paper	1,133	
Waste metals	1,045	
Other	6,977	
Including Water	28,997	
Including Water such as Waste, etc.	28,810	- "Survey on the Study of Measures to Cope with Wide-Area Transfer of Wastes and Fact-Finding Survey on the Amount of Recycled Wastes (Chapter on Fact-Finding Survey on the Amount of Recycled Wastes)" by Ministry of the Environment
Waste Acids	535	
Waste Alkalis	254	
Animal Manure	7,444	
Sludge	18,162	
Human Wastes	2,415	
Accompanying Inputs	78	- "Survey on the State of Industrial Waste Discharge and Disposal" by Ministry of the Environment
Intakes as Raw Material of Air	109	- Estimated from the "Yearbook of Chemical Industry Statistics" by Ministry of Economy, Trade and Industry

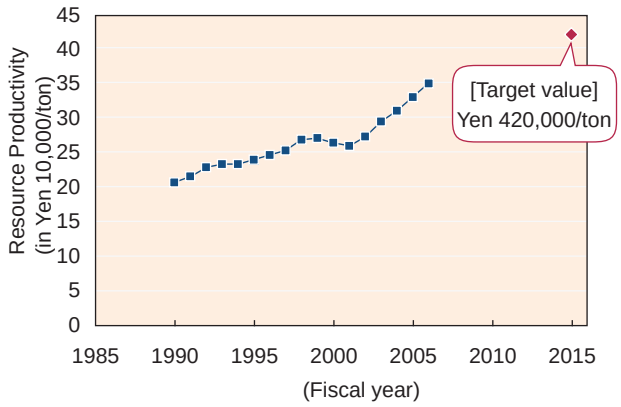
Item	Quantity (in 10,000 tons)	Source
Outlet Side		
Export	16,962	
Petroleum Products	2,060	- "General Energy Statistics" by Agency for Natural Resources and Energy - Estimated from "Trade Statistics of Japan" by Ministry of Finance
Iron and Steel	3,854	
Machinery	1,190	
Transport Machines	2,727	
Other	7,130	
Energy Consumption and Emissions from Industrial Processes	49,448	
Energy Consumption	41,665	- "General Energy Statistics" by Agency for Natural Resources and Energy - "Current Survey of Energy Consumption" and "Yearbook of Mineral Resources and Petroleum Products Statistics" by Ministry of Economy, Trade and Industry - Estimated from "Trade Statistics of Japan" by Ministry of Finance
CO_2 Separation from Limestone	4,004	
CO_2 Separation from Dolomite	28	
Oxygen Separation from Iron Ores	3,751	
Food Consumption	9,145	
Amount of Domestic Supplies of Foods and Feeds	12,565	Domestic Resources + Amount of Import – Amount of Export
(Portions to be Subtracted)	3,421	- Estimated from "Trade Statistics of Japan" by Ministry of Finance - "Survey on the Study of Measures to Cope with Wide-Area Transfer of Wastes and Fact-Finding Survey on the Amount of Recycled Wastes (Chapter on Fact-Finding Survey on the Amount of Recycled Wastes)" by Ministry of the Environment
Amount of Animal Manure	1,314	
Amount of Sewage Sludge/ Amount of Human Wastes	207	
Amount of Reduction of Food Wastes and Final Disposal Amount	1,654	
Amount of Recycled Food Wastes for Use Other than Feeds	247	
Fertilizer	1,667	"Pocket Guidebook on Fertilizers" by the Association of Agriculture & Forestry Statistics
Generation of Waste, etc.	58,250	
Amount of Cyclical Use (Re-published)	22,787	- "Survey on the Study of Measures to Cope with Wide-Area Transfer of Wastes and Fact-Finding Survey on the Amount of Recycled Wastes (Chapter on Fact-Finding Survey on the Amount of Recycled Wastes)" by Ministry of the Environment
Amount of Returned to Nature	8,475	
Animal Manure	7,356	
Other	1,119	
Amount of Reduction	24,070	
Sludge	16,193	
Human Wastes	2,383	
Kitchen Wastes	1,388	
Paper	1,199	
Other	2,908	
Final Disposal Amount	2,918	
Sludge	737	
Rubble	297	
Dust	273	
Slag	189	
Waste Plastics	182	
Other	1,240	
Net Additions to Stock	75,411	
Sum of Inlet Side Items	210,883	
(Portion to be Subtracted) Sum of Outlet Side Items	135,472	

Three Targets in the Fundamental Plan for a Sound Material-Cycle

The Fundamental Plan for Establishing a Sound Material-Cycle Society, which was decided by the Cabinet in accordance with the Fundamental Law for Establishing a Sound Material-Cycle Society (2000), has set numerical targets concerning “material flow indexes” for identifying the overall flow of materials in the economic sector in order to form a sound material-cycle society. Specifically, the plan has set an index for each of the three aspects of the material flows.

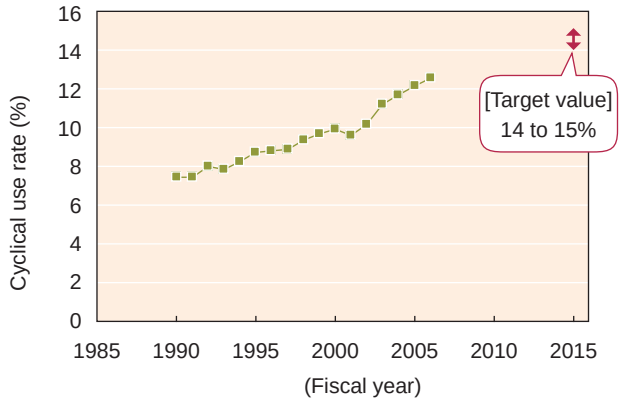
Inlet : resource productivity (= GDP/natural resources, etc. input).

“Resource Productivity” is the index to comprehensively represent how effectively materials are used by industries and in people’s lives. Natural resources are limited in quantity, cause environmental loads when extracted, and finally become waste. Therefore, it is desirable that the GDP is effectively generated with a lower input of natural resources. That is, an improvement of resource productivity is desired.



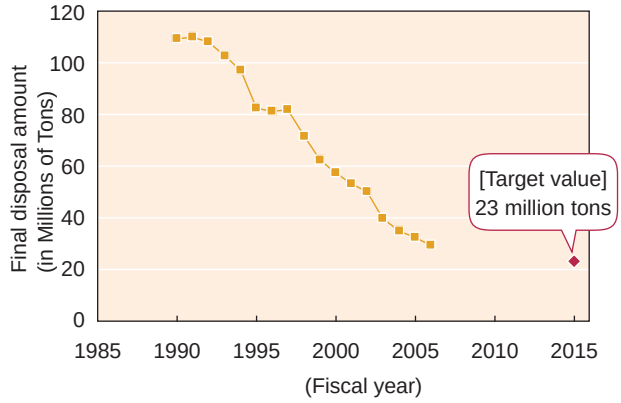
Cycle : cyclical use rate (= cyclical use amount/(natural resources, etc. input + cyclical use amount))

“Cyclical use Rate” is the index to represent the percentage of the amount of cyclical use in the total amount of things input into an economic society. It is desirable, in principle, that this rate is increased, which means correct cyclical use is promoted to reduce the final disposal amount. The “total amount of things input into an economic society” is the sum of the natural resources input and the amount of cyclical use.



Outlet : final disposal amount

“Final disposal amount” is an index that directly concerns the urgent issue to face the shortage of landfill capacity at final disposal sites. Since the index is expressed as the sum of general wastes and industrial waste. That is, a decrease of final disposal amount is desired.



Reduce
Reuse
Recycle

Material Flow in Japan Published in March 2009

Office of Sound Material-cycle Society
Policy Planning Division
Waste Management and Recycling Department
Minister's Secretariat
Ministry of Environment
Government of Japan

1-2-2 Kasumigaseki, Chiyoda-ku, Tokyo 100-8975, Japan
Tel: +81-(0)3-3581-3351 (extension 6819); Fax: +81-(0)3-3593-826
E-mail: junkan@env.go.jp