New System of Integrated Environment and Economic Accounting (Trial Calculation on Hybrid Accounting System integrating Environmental Pressures and Economic Activities)

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Department of National Accounts
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I. New SEEA

Based on the SEEA (System of Integrated Environment and Economic Accounting) proposed by the United Nations in 1993, Department of National Accounts, Economic and Social Research Institute (ESRI), Cabinet Office has been making researches on a proper SEEA approach to identify the relationships between the Japanese economy and environments.

Traditional research approaches aimed to calculate Green GDP by evaluating economic activities' environmental pressures on the monetary basis, recognizing them as external diseconomies and deducting them from domestic economic activities. However, there is no international consensus on how to properly value environmental pollutants on the monetary basis; in addition, the United Nations also started revising SEEA based on new philosophies. In this context, Department of National Accounts developed new "Hybrid Accounting System integrating Environmental Pressures and Economic Activities." ESRI's new hybrid accounting system indicates national accounts (representing domestic economic performances) in parallel with resultant environmental pressures. Based on this new hybrid accounting system, the research team did some trial calculations for the years 1990, 1995 and 2000. When developing this new accounting framework, the research team adopted the Dutch framework called NAMEA (National Accounting Matrix including Environmental Accounts) and made some adjustments in a suitable manner to Japan.

ESRI's new hybrid system has successfully identified the correlation between "driving forces" and "environmental pressures." To be more specific, the research team newly created "Environmental efficiency improvement index," which shows economic and environmental sustainability based on the estimated figures for the years 1990, 1995 and 2000.

In addition, the team has also developed Japan's "Supply and Use Table for Environmental Protection Services" in accordance with UN's "SEEA 2003 (final draft)." This table lists up who is providing/consuming environmental protection services (e.g., sewerage treatment, waste disposal and recycling services) for a certain purpose. This table and ESRI's new hybrid accounting system provide the overall relationships among economic activities, private/public sectors' environmental protection services and environmental pressures in Japan.

Note 1) SEEA
In order to achieve "sustainable development," the UN Earth Summit in 1992 adopted Agenda 21, which calls for a proper statistical framework to identify the relationship between environment and economic activities. In this context, the UN published "Handbook of National Accounting: Integrated Environment and Economic Accounting (SEEA)." While SNA (System of National Accounts) quantifies economic activities, SEEA is SNA's satellite account that identifies environmental degradation (i.e., environmental pollution) resulting from economic activities. The UN has revised the handbook several times and posted the final draft (SEEA2003) on the UN web site. NAMEA provides valuable framework for SEEA2003 as well.
URL: http://unstats.un.org/unsd/envaccounting/seea.htm

2) Green GDP

Green GDP means the value added calculated as the net domestic product (NDP) less the imputed environmental costs. The imputed environmental cost represents necessary costs for preserving the environment at a certain level by eliminating external diseconomy, which is, in this case, environmental pollutants already emitted to the environment. The imputed environmental costs are usually calculated with the Maintenance Cost Valuation Method. However, some experts doubt its accuracy. In addition, the imputed environmental cost is frequently overestimated or underestimated because the real-term imputed environmental is calculated based on monetary value at a given time and, therefore, easily influenced by the actual economic performance.

3) NAMEA

NAMEA is an accounting framework developed by Statistics Netherlands. It consists of two parts: the national accounting matrix (NAM) portion, which expresses economic activities on the monetary value basis, and the environment accounts portion (EA) for identifying resultant environmental pressures on the quantity basis. As NAMEA expresses environmental pressures on the quantity basis, it will not yield any problem coming from conversion into monetary value.

The Research Team

This research project is financed with Environment Ministry's Global Environmental Research Promotion Budget Fund (Project name: Research on Developing a new Sustainability Evaluation Method at Corporate, Industrial and National Economic Levels based on Environmental Accounts and Environmental Indexes). The Cabinet Office commissioned the Japan Research Institute (JRI; President: Noboru Nishifuji) to conduct this research project. In the process of this research project, JRI held expert meetings (chairperson: Professor Kimio Uno, Keio University) and also gained cooperation from statistic experts.

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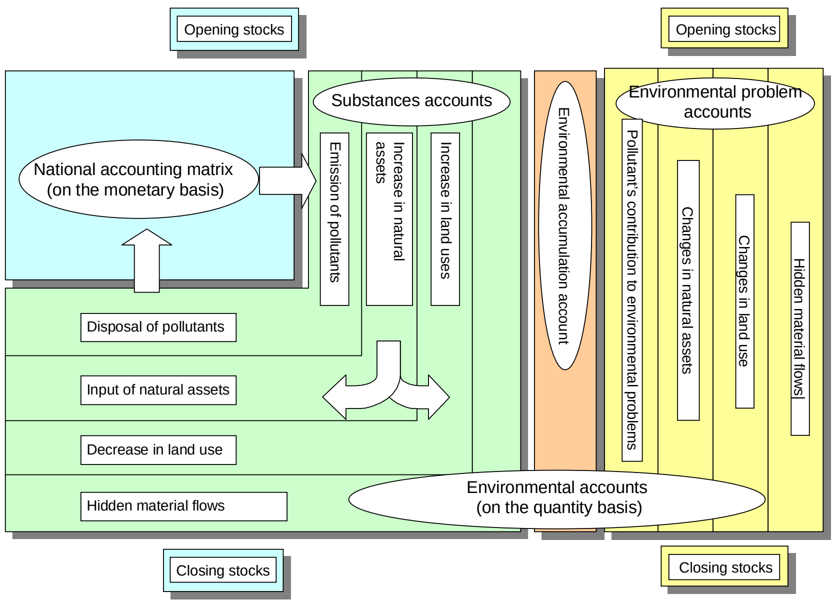
Reports:
"Research Project entrusted from the Cabinet Office: Research on Restructuring Environmental and Economic Activities based on Revised SEEA" in FY2003 by the Japan Research Institute
This document, "New System of Integrated Environment and Economic Accounting" is based on the above-mentioned final report. In addition, related documents are also attached as "Attachments" at the end of this report.

Attachments:
Attachments #1-1 to #1-3: Trial Estimate on Hybrid Accounting System integrating Environmental Pressures and Economic Activities (1990, 1995 and 2000)
Attachments #2-1 to #2-3: Supply and Use Table for Environmental Protection Services (1990, 1995 and 2000)
Attachment #3: Data for "Hybrid Accounting System integrating Environmental Pressures and Economic Activities"
Attachment #4: Breakdown of Air Substances by Sector

1. Hybrid Accounting System integrating Environmental Pressures and Economic Activities

As shown in Chart 1, “Hybrid Accounting System integrating Environmental Pressures and Economic Activities (HASEPEA)” has a twofold parallel structure: the national accounting matrix (NAM) portion for economic activities on one hand, and the environmental accounts (EA) portion for environmental pressures on the other. (The United Nations calls such parallel structure the "hybrid-type accounts"). This hybrid model is designed to identify the relationship between economic activities and environmental pressure. The model framework is based on Dutch NAMEA that plays an important role in SEEA2003, but the research team considered Japan's economic conditions and made the following adjustments: 1) Modifying the consumption portion (i.e., adding the government consumption expenditures), 2) incorporating the stock accounts (e.g., environmental protection assets, social capitals and others), 3) adding some natural resource accounts (e.g., coal, forest resources, water resources and fishery resources), and 4) incorporating land use accounts.

Chart 1. Hybrid Accounting System integrating Economic Activities and Environmental Pressures (conceptual diagram)



(1) National accounting matrix (NAM)

- NAM has a matrix format of 10 sectors X 10 sectors. Each cell has some subaccounts. For example, Goods and Services Account has some subaccounts classified by product group, while production account has some subaccounts based on types of economic activities.
- To clearly indicate the relationship between the environment and economic activities, the matrix has the production portion and the final consumption portion. The production portion has the same industry classification as SNA, while the final consumption portion is divided into the government sector and the household sector.
- Stocks are divided to "Environmental protection non-financial assets," "Social capital" and "Others" categories in order to distinguish environment-related assets from other assets.

(2) Environmental Accounts

Environmental accounts consist of three sections: the substances accounts, the "Accumulation to the environment" accounts and the environmental problem accounts. Pollutant emitters are divided into two groups (the "production sector" and the "consumption sector") to keep coherency with NAM. The "consumption sector" only includes consumption of the household sector, while the government final consumption is excluded from the environmental accounts. The "consumption sector" is further subdivided into the "civilian sector (household)" and the "household consumption portion in the transport sector (automobile)." This is because automobiles emit pollutants in a totally different manner. The "Others" portion covers leakage not belonging to the production or consumption sector. "Others" corresponds to assets in NAM.

(2-1) Substances Accounts

The substances accounts consist of 1) pollutants, 2) natural resources, 3) land uses and 4) hidden material flows. Description of the substances accounts is as follows:

1) Pollutants
   - a. Air-related
     - Global warming (CO_2, N_2O, CH_4, HFCs, PFCs, and SF_6)
     - Acidification (NOx, and SO_2)
   - b. Water quality (T-P, T-N and wastewater)
   - c. Waste (final disposal and reuse)
2) Natural resources
   - a. Energy resources (gas, crude oil and coal)
   - b. Forest resources
   - c. Water
   - d. Fishery resources
3) Land use
   - a. Agricultural land
   - b. Forest and wildland
   - c. River and waterway
   - d. Road
   - e. Residential space
   - f. Other land
4) Hidden material flows[1)]

(2-2) "Accumulation to the Environment" Accounts and Environment Problem Accounts

The "Accumulation to the Environment" section identifies the final pollutant emission volume to the environment (calculated as the emitted pollutants minus the treated pollutants). This section also represents how much natural resources have changed due to forest growth, tree logging or other factors as well as how much land use has changed, including agricultural land, residential areas and roads.

Based on the figures in the environmental accumulation section, the environmental problems section expresses environmental burdens for each environmental problem type. As each of environmental pollutants has different impacts on global warming, it is necessary to calculate their contributions to the greenhouse effect in a coherent manner. For this reason, the research team multiplied the pollutant volume by applicable conversion coefficient[2)] when estimating the impacts on global warming.

1) Hidden material flow refers to materials that are collected/extracted ancillarily or dumped as waste without directly entering Japan's economy. Figures in this account represent the volume of extracted materials that are dumped to the environment without being used. Examples include excavation or scoria during construction works.

2) The conversion coefficient represents a certain pollutant's contribution to environmental problems. One example is "Global Warming Potential (GWP)." GWP means how much a certain greenhouse effect gas contributes to global warming in comparison with CO_2. The GWP for CH_4 is 21 since CH_4 contributes to global warming 21 times as much as CO_2 in a 100-year span.

2. Supply and Use Table for Environmental Protection Services

In relation with HASEPEA, it is important to understand how much each actor in the economy provides environmental protection services as its economic activities. The UN's SEEA2003 also urges governments to prepare "Supply and Use Table for Environmental Protection Services."

According to 93SNA, the environmental protection services consist of the following economic activities: 1) Waste management, 2) wastewater management, 3) pollution reduction, 4) biodiversity and landscape conservation, 5) R&D for environmental protection, and 6) other environmental protection efforts. Economic actors include 1) government service producers and 2) industry (professional and non-professional service providers). When preparing Japan's "Supply and Use Table for Environmental Protection Services," the research team paid due attentions importance and data availability and then calculated data on the following categories: 1) Waste management, 2) wastewater management, and 3) pollution reduction.

1) Waste management

The research team assumed that the government service providers would handle general wastes from households and business enterprises. Since industrial waste treatment would require certain skills, the research team divided the industry sector into two groups: professional service providers and non-professional service providers. In our model, professional service providers would manage industrial wastes, while non-professional service providers are involved in recycling services as their secondary business activities.

2) Wastewater management

The team assumed that the government service producers would provide sewerage treatment services.

3) Pollution reduction

In our model, internal environmental protection activity means the smoke/wastewater control efforts and other pollution prevention efforts at corporate level in their premises.

Table 1. Supply and Use Table for Environmental Protection Services (conceptual diagram)

		Government service providers	Industry					Total	Related products
				Professional service providers	Non-professional service providers				
						Secondary activity	Secondary activity		
		Sewerage and waste treatment services (at publicly owned facilities)		Waste treatment services provided (by the industry sector)		Recycling industry	Internal environmental protection activities		Combined treatment septic tanks and automobile emission treatment catalysts
		1	2	3	4	5	6	7	8
Supply table									
Intermediate consumption	1	○	●	○	●	○	○	●	
Consumption of fixed capital	2	○	●	○	●	○	○	●	
Product tax	3	○	●	○	●	○	-	●	
(less) Production subsidy	4	-	●	○	●	○	○	●	
Compensation of employees	5	○	●	○	●	○	○	●	
Net operating surplus	6	-	●	○	●	○	-	●	
Production subtotal	7	●	●	●	●	●	●	●	●
Import	8								
Total supply at basic price	9	●		●	●	●	●	●	●
Transport and commercial margins	10							●	
Total supply at purchasers' price	11	●		●	●	●	●	●	●
Use table									
Intermediate consumption	12	●	●	●	●	●	●	●	●
Government service providers	13	○	●		●			●	
Professional service providers	14	○	●		●			●	
Non-professional service providers (secondary)	15		●	○	●		○	●	
Non-professional service providers (other)	16		●		●	○		●	
Government final consumption	17	○	●		●			●	
Household final consumption	18	○	●	○	●			●	
Gross capital formation	19		●		●			●	
Export	20	○		○		○			
Use total	21	●	●	●	●	●	●	●	●
Discrepancy (supply-use)	22								
Additional information									
Gross fixed capital formation	23							●	
Fixed capital stock	24							●	

Black circle: total value; and white circle: estimated figures.

II. Calculation Results

Since basic data are not sufficiently available, close attentions are necessary when making judgment based on the calculation results for the environmental accounts. In addition, some calculation results seem to have incoherent relation with their growth rates because the research team calculated the growth rates based on fractional figures not shown in the charts.

1. National Accounting Matrix Portion in HASEPEA

(1) Environmental protection activities and environmental protection assets

The environmental protection activities/assets columns have two sectors: "Industry" and "Government." In our HASEPEA, the industry sector is providing 1) internal environmental protection activities (pollution control efforts, such as internal wastewater treatment, emission control and waste disposal services), 2) waste disposal and 3) recycling services, while the government sector is involved in 1) environmental protection activities (i.e., environmental public administration services, antipollution measures and other environmental protection services), 2) sewerage treatment, and 3) waste disposal services.

(1-1) Environmental protection activities

From 1990 to 2000, overall environmental protection activities increased by 42.0%. Especially, the government sector boosted its environmental protection efforts by 63.1%.

As of 2000, the environmental protection activities in Japan is worth ¥9,491.1 billion, accounting for 1.9% of Japan's GDP. From 1990 to 2000, the environmental protection activities have risen sharply (up 42.0%). In the industry sector, the environmental protection activities have expanded by 32.8% for industrial waste disposal service providers and 34.0% for recycling service providers, but internal environmental protection activities (including maintenance services for internal pollution control equipment) have decreased by 20.5%. The industry sector as a whole has seen 22.3% increase in their environmental protection activities. On the other hand, the government sector has boosted its environmental protection efforts sharply by 63.1%. In the government sector, the environmental protection activities, including antipollution measures and environmental public administration services, have increased by 92.5%, while the sewage treatment and waste disposal services have increased by 76.1% and 20.3%, respectively.

(1-2) Capital formation for environmental protection

From 1990 to 2000, the industry sector has seen a decrease, but the government sector has enjoyed an increase.

As of 2000, the environmental protective investments are worth ¥5,414.2 billion, accounting for 4.0% of gross capital formation in Japan. It shows a sharp rise (up 47.7%) from the 1990 level. To be more specific, Japan saw active investments from 1990 to 1995 and, as a result, comparably modest investments during the 1995-2000 period. The "Others" column, which corresponds to private capital investment, shows an opposite trend.

(1-3) Environmental protection assets

The government sector owns about 96.7% of the total environmental protection assets in Japan, increasing by 70.3% from the 1990 level.

As of 2000, the environmental protection assets stand at ¥55,410.9 billion, occupying about 2% of the overall non-financial assets in Japan. Out of this, the government sector owns 96.7% of the assets, standing at ¥53,574.8 billion. In the government sector, sewerage treatment facilities occupy 82.3%

of the total value, while waste disposal facilities account for 17.7%. From 1990 to 2000, the government sector has increased its environmental protection assents by 70.3%, because the sewage treatment facilities and waste disposal facilities have been expanded by 61.2% and 130.6%, respectively, from 1990 to 2000. On the other hand, the environmental protection assets in the industry sector decreased by 21.7% because the private sector suffered 20% decreases both in its internal environmental protection assets and in waste disposal assets.

Table 2. Environmental Protection Activities, Environmental Protective Capital Formation and Environmental Protection Assets

In ¥1 billion, %

Year	GDP	Industry + government	Environmental protection activities (industry + government)[1] Industry	Industry: Internal environmental protection activities	Industry: Waste disposal service	Industry: Recycling service	Government	Government: Environmental protection activities	Government: Sewage treatment	Government: Waste disposal
1990	440,124.8	6,684.5	3,462.9	706.2	1,591.1	1,165.6	3,221.6	1,056.4	1,105.1	1,060.1
1995	496,922.2	7,616.7	3,299.6	647.7	1,871.6	780.3	4,317.1	1,435.9	1,658.5	1,222.7
2000	511,462.4	9,491.1	4,235.6	561.4	2,112.5	1,561.7	5,255.5	2,033.9	1,946.4	1,275.2
1995/1990	12.9	13.9	(4.7)	(8.3)	17.6	(33.1)	34.0	35.9	50.1	15.3
2000/1995	2.9	24.6	28.4	(13.3)	12.9	100.1	21.7	41.6	17.4	4.3
2000/1990	16.2	42.0	22.3	(20.5)	32.8	34.0	63.1	92.5	76.1	20.3

In ¥1 billion, %

	Gross capital formation	Industry + government	Capital formation for environmental protection[2] Industry	Industry: Internal environmental protection activities	Industry: Waste disposal service	Government	Government: Sewage treatment	Government: Waste disposal	Social capital[3]	Others
1990	144,780.3	3,664.7	322.0	292.7	29.3	3,342.7	2,905.8	436.9	25,984.6	115,131.0
1995	140,331.4	6,105.6	450.8	409.8	41.0	5,654.8	4,791.9	862.9	38,752.4	95,473.4
2000	134,377.6	5,414.2	246.7	224.3	22.4	5,167.5	4,252.3	915.2	27,153.8	101,809.6
1995/1990	(3.1)	66.6	40.0	40.0	39.9	69.2	64.9	97.5	49.1	(17.1)
2000/1995	(4.2)	(11.3)	(45.3)	(45.3)	(45.4)	(8.6)	(11.3)	6.1	(29.9)	6.6
2000/1990	(7.2)	47.7	(23.4)	(23.4)	(23.5)	54.6	46.3	109.5	4.5	(11.6)

In ¥1 billion, %

	Non-financial assets[4]	Industry + government	Environmental protection assets Industry	Industry: Internal environmental protection activities	Industry: Waste disposal service	Government	Government: Sewage treatment	Government: Waste disposal	Social capital[3]	Others
1990	3,501,659.3	33,814.0	2,346.2	2,132.9	213.3	31,467.8	27,355.0	4,112.8	453,171.1	3,014,674.2
1995	3,046,192.9	44,098.7	2,018.1	1,834.6	183.5	42,080.6	36,741.1	5,801.3	637,280.6	2,364,813.6
2000	2,829,256.7	55,410.9	1,836.1	1,669.2	166.9	53,574.8	44,092.0	9,482.8	805,038.2	1,968,807.6
1995/1990	(13.0)	30.4	(14.0)	(14.0)	(14.0)	33.7	34.3	41.1	40.6	(21.6)
2000/1995	(7.1)	25.7	(9.0)	(9.0)	(9.0)	27.3	20.0	63.5	26.3	(16.7)
2000/1990	(19.2)	63.9	(21.7)	(21.7)	(21.8)	70.3	61.2	130.6	77.6	(34.7)

The research team calculated these figures based on National Accounting Matrix (SNA's matrix format) and "Supply and Use Table for Environmental Protection

1) a) Environmental protection activities

The industry sector: Internal environmental protection activities = Maintenance cost on antipollution facilities (e.g., air control, water quality control, antinoise and waste disposal facilities, etc.)

The government sector: Environmental protection activities = Environmental public administration services and antipollution measures

b) Sewage treatment

The 2000 Input-Output Table recognized sewage treatment facility's fixed capital depreciation as social capital depreciation and reported it in the "Public Administration" column. So, the research team made the following adjustments when calculating the data for the year 2000:

Fixed capital depreciation rate in 2000 = (Depreciation rate in 1990 + depreciation rate in 1995) divided by 2, where annual fixed capital depreciation rate = fixed capital depreciation divided by closing stocks.

Fixed capital depreciation = closing stocks multiplied by fixed capital depreciation rate

2) The "recycling service" column only reports the environmental protection activities because statistical data is not sufficiently available.

3) The research team calculated the social capital data based on "Social Capitals in Japan" edited by Director General of Cabinet Office.

4) Calculation of non-financial assets

Internal environmental protection assets: Dust control devise, antinoise devise, emission control devise and other antipollution equipment installed at factories, etc. "Survey on Antipollution Capital Investments" provides basic data for the "internal environmental protection activities" and "waste disposal" columns in the industry sector.

Figures in the "sewage treatment" and "waste disposal" columns are based on the corresponding data from "Social Capitals in Japan" (in the main 20 sectors'

Social capitals = Main 20 sectors' social capital stocks less sewage less waste disposal

2. Major Environmental Pollutants Volume: from "Environmental Accounts"

CO_2 emission volume has been decreasing in comparison with the output level, but it is getting higher in relation with final consumption

As of 2000, Japan emits 1,332,945,000 tonnes (on the CO_2 equivalent basis) of greenhouse effect gases that leads to global warming. Japan's greenhouse effect gas emission volume slightly increased (up 0.7%) from the 1995 level. As CO_2 emission gives the most significant impacts on the global warming, the research team analyzed the CO_2 emission on the production side as well as on the consumption side, and then compared them with the output level and the final consumption level. This analysis yielded the conclusion: CO_2 emission volume has been decreasing in relation with the output level, but it is getting higher in relation with final consumption.

Pollutant volume (except for CO_2) and waste disposal volume (final disposal) are both taking a downward trend.

Table 3. Environmental Accounts

1) Global warming (CO2: approximate estimate)[1]	Unit	1990	1995	2000	Growth rate (95/90)	Growth rate (00/95)	Growth rate (00/90)
Output	¥1 billion	859,688.1	922,938.0	941,518.8	7.4	2.0	9.5
Final consumption	¥1 billion	291,161.4	349,633.2	369,769.5	20.1	5.8	27.0
CO2: Production activities	1,000 tonnes (CO_2)	959,805	1,015,987	1,017,275	5.9	0.1	6.0
Emission level vs. output	1 tonne (CO_2)/¥100 million	111.6	110.1	108.0	(1.4)	(1.8)	(3.2)
CO2: Final consumption	1,000 tonnes (CO_2)	162,312	194,921	221,424	20.1	13.6	36.4
Emission level vs. final consumption	1 tonne (CO_2)/¥100 million	55.7	55.8	59.9	0.0	7.4	7.4

Pollutants (air/water pollution)[2]	Unit	1990	1995	2000	Growth rate (95/90)	Growth rate (00/95)	Growth rate (00/90)
Greenhouse gases (CO_2, N_2O, CH_4, HFC_S, PFC_S, SF_6)	1,000 tonnes(CO_2)	1,187,050	1,323,288	1,332,945	11.5	0.7	12.3
Acidification gases (NOx, SO_2)	1,000 tonnes (SO_2)	2,388	2,407	2,242	0.8	(6.9)	(6.1)
Water quality-related substances (T-P, T-N, wastewater)	1,000 tonnes (PO_4^{3-})	556	539	483	(3.0)	(10.4)	(13.1)
Eutrophication (T-P, T-N)	1,000 tonnes (PO_4^{3-})	534	521	466	(2.6)	(10.4)	(12.8)

Waste disposal	Unit	1990	1995	2000	Growth rate (95/90)	Growth rate (00/95)	Growth rate (00/90)
Waste disposal (final disposal volume)	1,000 tonnes	105,810	82,602	55,514	(21.9)	(32.8)	(47.5)
Total recycled volume	1,000 tonnes	153,669	152,185	191,860	(1.0)	26.1	24.9

Natural resources extracted	Unit	1990	1995	2000	Growth rate (95/90)	Growth rate (00/95)	Growth rate (00/90)
Overseas natural resources extracted due to imports							
Energy	PJ	14,297	16,246	16,813	13.6	3.5	17.6
Forest[1]	1,000m^3	81,793	89,015	81,241	8.8	(8.7)	(0.7)
Domestic natural resources extracted							
Energy	PJ	370	279	199	(24.5)	(28.8)	(46.2)
Forest[1]	1,000m^3	29,367	22,915	18,019	(22.0)	(21.4)	(38.6)

Notes: 1) A forest usually absorbs more volume of CO2 in the growth period than in the mature period. However, the research team did not evaluate the fluctuation in forest CO2 absorption capacity because there is much uncertainty. If any reliable calculation result becomes available in the future, it will be incorporated in the above tables.

2)The research team employed applicable conversion coefficients in order to grasp pollutant's contribution to environmental problems. (For details, see 2. on Page 4.)

3. Environmental Efficiency Improvement Index (EEII)

If environmental pressure (EP) increases at slower pace than driving force (DF), it is desirable from the viewpoint of environmental sustainability. "Environmental efficiency improvement index" represents this relationship and is defined as follows:

$$\text{Environmental Efficiency Improvement Index (EEII)} = \left(1 - \frac{(EP/DF)_{\text{Term end}}}{(EP/DF)_{\text{Term's start}}}\right) \times 100$$

From this definition,

- EEII≧0 ⇒DF's growth rate ＞EP's growth rate ⇒"Environmental efficiency is improving"
- EEII＜0 ⇒DF's growth rate≦ EP's growth rate ⇒"Environmental efficiency is deteriorating

Note: EEII represents the relationship between economic activities and environmental pressures and shows how much the environmental pressure has been mitigated in relation with economic benefits. OECD calls this type of index "the decoupling indicator." Improvement in EEII is one of the main goals of "OECD Environmental Strategy for the First Decade of the 21st Century," which was adopted at the OECD Environmental Ministers meeting in 2001.

(1) Calculating EEII

The research team calculated EEII for the 1990-1995, 1995-2000 and 1990-2000 periods in terms of six themes, such as glasshouse effect, acidification, eutrophication, waste final disposal and land uses. (In the context of land use, the team employed two indicators: "residential area space vs. GDP" and "urban area space vs. densely inhabited district's population.")
(As for DF, the research team used the calendar-year-based data (in real terms) from "Annual Report on National Accounts of 2004" (Economic and Social Research Institute, Cabinet Office). In terms of EP, the team calculated global worming potentials and acid equivalents based on HASEPEA .)

1) Land use

Environmental efficiency is improving in terms of the residential area space. It is also improving in the urban area during the 1990-1995 period.

In terms of "residential area space," the environmental efficiency is improving both in the 1990-1995 period and in the 1995-2000 period. This suggests that growth of urban areas has been slower than the pace of economic growth. But, in terms of "urban area space vs. densely-inhabited district's population," the environmental efficiency is not improving in the 1990-1995 period, implying that the size of urban areas is not getting smaller. However, as the 1995-2000 period has seen marginal improvement, the situations are slightly getting better.

2) Greenhouse effect

Environmental efficiency takes upturn in the 1995-2000 period.

The environmental efficiency gets worse in the 1990-1995 period, but it improves in the 1990-2000 period and in the 1995-2000 period. This mainly results from two factors: Energy-saving approaches and products have gained popularity; and environmentally harmless industries (e.g., service industry) have been accounting for a larger percentage to GDP.

3) Acidification, eutrophication and waste

Waste enjoys a sharp improvement. Acidification and eutrophication also see some improvements

Environmental efficiency gets improved in all of these three categories. Especially, waste enjoys a sharp rise in environmental efficiency.

EEIIs shows larger figures for the 1995-2000 period than for the 1990-1995 period, suggesting that the environmental efficiency gets better as time goes by. This improvement results from the following three factors: Acidification has been mitigated because more and more factories adopted flue gas desulfurization/denitrification equipment; eutrophication has also been decreasing as more people have access to sewage system and are using combined treatment septic tanks, furthermore, many large-scale farms have purchased wastewater treatment equipment; and wastes are getting decreased due to increased recycling volume as well as growing intermediate treatment volume.

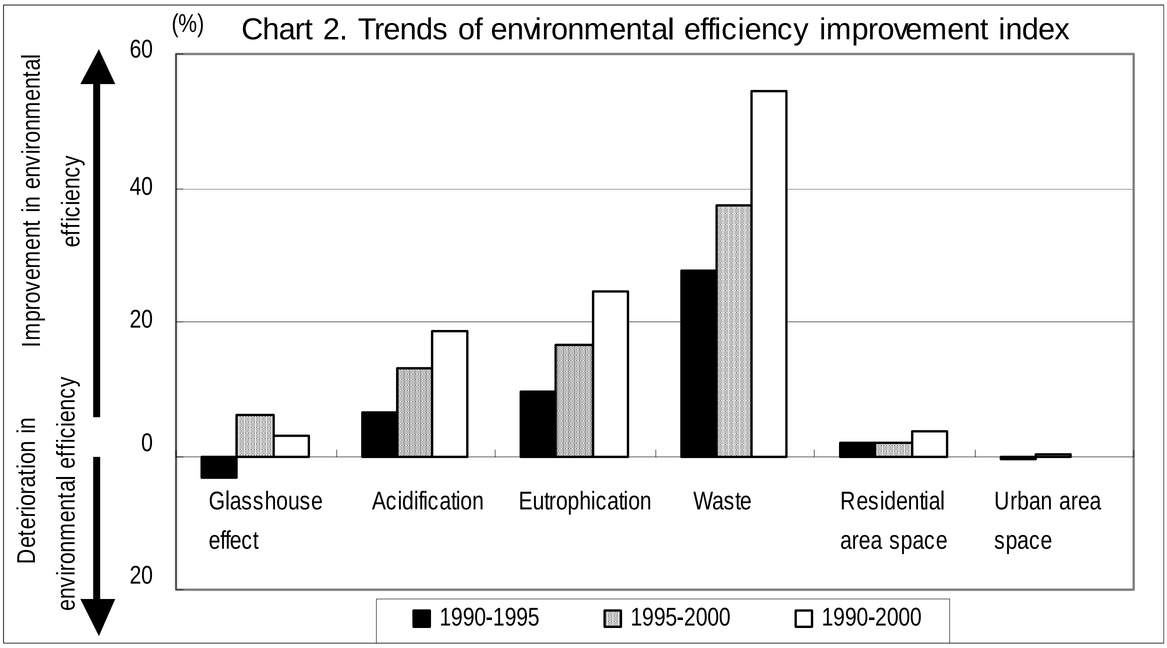


Table 4. Trends of Environmental Efficiency Improvement Index

Environmental efficiency improvement index						
	Glasshouse effect	Acidification	Eutrophication	Waste	Residential area space	Urban area space
1990-1995	(3.4%)	6.5%	9.5%	27.6%	2.1%	(0.5%)
1995-2000	6.0%	13.1%	16.5%	37.3%	1.8%	0.3%
1990-2000	2.8%	18.7%	24.5%	54.6%	3.8%	(0.2%)

(2) Estimating EEII for each industry category

In the industry sector, the environmental efficiency improves for CO_2 (in the power generation industry) and NOx (in the transport industry), but it deteriorates for SO_2 (in the agriculture, forestry and fisheries industry)

Based on Attachment #4, the research team calculated EEII for some industries that are emitting significant amount of pollutants (CO_2 from the power generation industry, NOx from the transport industry and SO_2 from the agriculture, forestry and fisheries industry).

According to our calculation results, environmental efficiency improves in the power generation and transport industries while it deteriorates in the agriculture, forestry and fisheries industry. The agriculture, forestry and fisheries industry now emits less amount of SO_2 than in the past, mainly because of its decreased output.

Table 5. Environmental Efficiency Improvement Index by Industry Category

1) CO_2: Power generation industry

	CO_2 emission (in 2000)		Total electricity demand (in 2000)		EEII
	1,000 tonnes (CO2)	①1990＝100	1 million kWh	②1990＝100	(1-①/②) ×100
1990-1995	356,535	104	989,880	115	9.7%
1990-2000	366,300	107	1,091,500	127	15.9%

Estimation formula $\frac{(EP)}{(DF)} = \frac{\text{(CO2 emission)}}{\text{(Total electridcity demand)}} = \frac{\text{(CO2 emission)}}{\text{(Fossil fuel input)}} \times \frac{\text{(Fossil fuel input)}}{\text{(Power generation level)}} \times \frac{\text{(Power generation level)}}{(kWh)}$

2) NOx[1]: Transport industry

	NOx emission (in 1995)		Output (in 1995)		EEII
	1,000 tonnes (NOx)	①1990＝100	¥1 billion	②1990＝100	(1-①/②) ×100
1990-1995	2,123	105	54,110	122	13.7%

Estimation formula $\frac{(EP)}{(DF)} = \frac{\text{(NOx emission)}}{\text{(Output level in the transport/ telecommunication industries)}} = \frac{\text{(NOx emission)}}{\text{(Road transport mileage)}} \times \frac{\text{(Road transport mileage)}}{\text{(Total transport mileage)}} \times \frac{\text{(Total transport mileage)}}{\text{(Output level in the transport/ telecommunication industries)}}$

3) SO_2[1]: Agriculture, forestry and fisheries industry

	SO_2 emission (in 2000)		Output (in 1995)		EEII
	1,000 tonnes (SO2)	①1990＝100	¥1 billion	②1990＝100	(1-①/②) ×100
1990-1995	123	90	16,329	88	(1.6%)

Estimation formula $\frac{(EP)}{(DF)} = \frac{\text{(SO2 emission)}}{\text{(Output level of the agriculture, forestry and fisheries industy)}}$

Note 1): The above tables do not indicate the 1990-2000 data for the transport industry and the agriculture, forestry and fisheries industry, because of unavailability of basic data.

(3) Estimating EEIIs at final consumption level

Environmental efficiency at the household level is deteriorating for CO_2 in the civilian purpose category but improving for SO_2 in the transport purpose category (automobile).

The research team estimated EEII at the household final consumption level by calculating CO_2 and SO_2 volume in the two categories: the "civilian purpose category (household)" and the "transport purpose category (automobile)."In this context, "civilian purpose" corresponds to pollutant volume resulting from burning oil or coal (for hot-water supply and space heating purposes), while "transport purpose" refers to the pollutant volume coming from burning gasoline or diesel.

EEII for CO_2 is deteriorating in the civilian purpose category as well as in the transport purpose category, but it gets worse in the transport purpose category than in the civilian sector. EEII for SO_2 almost remains flat in the civilian purpose category, but it improves sharply in the transport purpose category.

Table 6. Major EEIIs at Final Consumption Level

1) CO_2

		Pollutant volume at final consumption level		Final consumption expenditures of Japanese households (in real terms)		EEII
		1,000 tonnes (CO2)	①1990＝100	¥1 billion	②1990＝100	(1-①/②) ×100
Civilian purpose (household)						
	1990-1995	66,847	117	269,399	111	(4.8%)
	1990-2000	69,070	121	281,521	116	(3.6%)
Household consumption for transport purpose (automobile)						
	1990-1995	128,074	122	269,399	111	(9.5%)
	1990-2000	152,354	145	281,521	116	(24.6%)

2) SO_2

		Pollutant volume at final consumption level		Final consumption expenditures of Japanese households (in real terms)		EEII
		1,000 tonnes (SO2)	①1990＝100	¥1 billion	②1990＝100	(1-①/②) ×100
Civilian purpose (household)						
	1990-1995	44.9	150	269,399	111	(34.4%)
	1990-2000	34.9	116	281,521	116	0.1%
Household consumption for transport purpose (automobile)						
	1990-1995	13.0	60	269,399	111	45.7%
	1990-2000	9.6	45	281,521	116	61.6%

4. Relationships between Environmental Protection Services and Environmental Pressures

(1) Waste disposal volume

Waste recycling volume rises sharply, but waste final disposal volume significantly decreases.

Wastes from business enterprises, households and the government are divided into two categories: wastes directly recyclable on the one hand, and those requiring intermediate treatment at bulky garbage treatment plants or incineration facilities on the other. Table 7 shows the relationships between waste disposal volume and intermediate treatment effort's monetary value.

From 1990 to 2000, the recycled volume expanded sharply by 24.9% probably because Recycling Law in 1991 and Container and Packaging Recycling Law in 1995 have provided the legal framework for resource recycling efforts. As a result, the recycling efforts stand at ¥1,398.8 billion as of 2000, up 43.6% from the 1990 level.

Waste volume decreases by 7.8% from the 1990 level. Incineration facilities and other intermediate treatment plants are burning 213,459,000 tonnes of wastes, while the treatment cost stands at ¥3,387.7 billion (i.e., ¥15.87 million per 1,000 tonnes of wastes).

Due to increases in recycling activities and in intermediate treatment volume, the final disposal volume has decreased by 47.5% from the 1990 level.

Table 7. Waste Disposal Volume vs. Intermediate Treatment Costs[1)]

(a) Recycled volume[2)] In 1,000 tonnes

	Production		Consumption	
	Industrial wastes	Nonindustrial wastes	Nonindustrial wastes	Total
2000	184,000	2,700.7	5,159.3	191,860
1995/1990	(2.7)	94.3	94.3	(1.0)
2000/1995	27.2	52.4	51.2	26.1
2000/1990	21.9	196.1	193.6	24.9

(a)-1. Recycling costs In ¥1 billion

2000	1,398.8
1995/1990	(33.4)
2000/1995	115.6
2000/1990	43.6

(b) Net waste volume **(gross waste volume less (a) recycled volume)** In 1,000 tonnes

	Production		Consumption	
	Industrial wastes	Industrial wastes	Nonindustrial wastes	Total
2000	222,000	16,139.9	30,833.1	268,973
1995/1990	1.2	(1.0)	(1.0)	0.9
2000/1995	(10.1)	0.2	(0.6)	(8.6)
2000/1990	(9.0)	(0.7)	(1.6)	(7.8)

(c)-1. Intermediate treatment volume In 1,000 tonnes

	Industrial wastes	Nonindustrial wastes		Total
		Production	Consumption	
2000	177,000	12,527.3	23,931.7	213,459
1995/1990	14.8	8.9	8.9	13.9
2000/1995	(0.6)	9.4	8.5	0.9
2000/1990	14.2	19.1	18.1	14.9

(c)-2. Disposal costs In ¥1 billion

	Industry	Government	Total
2000	2,112.5	1,275.2	3,387.7
1995/1990	17.6	15.3	16.7
2000/1995	12.9	4.3	9.5
2000/1990	32.8	20.3	27.8

(d) Final disposal volume In 1,000 tonnes

	Production		Consumption	
	Industrial wastes	Industrial wastes	Nonindustrial wastes	Total
2000	45,000	3,612.6	6,901.4	55,514
1995/1990	(22.5)	(19.1)	(19.1)	(21.9)
2000/1995	(34.8)	(22.3)	(22.9)	(32.8)
2000/1990	(49.4)	(37.1)	(37.6)	(47.5)

1) The intermediate treatment cost is calculated from "Supply and Use Table for Environmental Protection Services" and "Contingency Table for Environmental Protection Services."
Treatment cost does not include export/import.
Wastes consists of two categories: Industrial wastes and nonindustrial wastes.
Industrial wastes: animal feces and urine, waste metal, wreckage, paper waste, scrap plastic, etc. (Waste in the environmental account corresponds to "wastes" in I-O Table.)
Nonindustrial wastes (households + industries): collected trash + garbage directly accepted by disposal facilities. It does not include the disposal volume at the waste sources.

2) (a) Recycled volume = directly recycled volume + waste volume recycled after intermediate treatment

(2) Sewage treatment

With sewage treatment volume increased, the final sewage volume decreases by more than 10%.

As of 2000, the sewage treatment cost (at publicly owned facilities) stands at ¥1,946.4 billion. Out of this amount, the government sector charges ¥623.4 billion to the industry sector and ¥725.8 billion to the household sector while absorbing the remaining ¥597.2 billion by itself. As the sewage treatment cost have increased by 76.3% from 1990 to 2000, the final sewage volume has decreased by 12.5% for eutrophication (T-N and T-P) and 22.7% for contaminated wastewater (COD). Capital formation plays significantly important roles in sewage treatment. It stands at ¥4,252.3 billion in 2000, down from the 1995 investment level, but increasing by 46.3% from the 1990 level. With sewage treatment capacity and treatment cost both increased, the pollutant volume in the final sewage has been decreasing.

Table 8. Trends of Sewage Treatment Costs (at publicly owned facilities) and Wastewater Volume

(Units) Monetary value: ¥1 billion; and wastewater volume: 1,000 tonnes ($PO4^{3-}$)

	1990			1995			2000		
	Treatment cost[1)]	Final wastewater volume[2)]		Treatment cost	Final wastewater volume		Treatment cost	Final wastewater volume	
		Eutrophication	Wastewater		Eutrophication	Wastewater		Eutrophication	Wastewater
Industry	343.5	317	10	501.1	305	9	623.4	267	8
Household	324.3	217	12	562.2	215	10	725.8	200	9
Government	436.5			593.9			597.2		
Total sewage treatment costs (at publicly owned facilities)	1,104.3	534	22	1,657.2	520	19	1,946.4	467	17

Changes (%) (Unit) %

	1995/1990			2000/1995			2000/1990		
	Treatment cost	Final wastewater volume		Treatment cost	Final wastewater volume		Treatment cost	Final wastewater volume	
		Eutrophication	Wastewater		Eutrophication	Wastewater		Eutrophication	Wastewater
Industry	45.9	(3.8)	(10.0)	24.4	(12.5)	(11.1)	81.5	(15.8)	(20.0)
Household	73.4	(0.9)	(16.7)	29.1	(7.0)	(10.0)	123.8	(7.8)	(25.0)
Government	36.1			0.6			36.8		
Total sewage treatment costs (at publicly owned facilities)	50.1	(2.6)	(13.6)	17.5	(10.2)	(10.5)	76.3	(12.5)	(22.7)

Table 9. Trends of Capital Formation at Sewage Treatment Facilities (publicly owned facilities)

(Unit) ¥1 billion, %

Capital formation			Changes (%)		
1990	1995	2000	1995/1990	2000/1995	2000/1990
2,905.8	4,791.9	4,252.3	64.9	▲ 11.3	46.3

The research team calculated these figures based on National Accounting Matrix (the matrix format of SNA) and "Supply and Use Table for Environmental Protection Services."

1) "Treatment cost" in the industry and household sectors represent the monetary value of sewage treatment services purchased from the government sector.
"Treatment cost" in the government sector shows the self-pay cost burdens on the government side.
"Total sewage treatment costs (at publicly owned facilities)" is not coherent with the table, "Environmental protection activities, environmental protective capital formation and environmental protection assets" because it import is not included.
Treatment cost for each sector is estimated from the sewage treatment cost ratio (at publicly owned facilities) of Input-Output Table.
The sewage treatment costs in the government sector mainly consist of employee compensations and fixed capital depreciation. Due to amendments to 93SNA, the 2000 Input-Output Table reports sewage treatment facility's fixed capital depreciation as social capital depreciation in the "Public Administration" column. So, the research team made the following adjustments for calculation purpose:
Fixed capital depreciation rate in 2000 = (Depreciation rate in 1990 + Depreciation rate in 1995) divided by 2, where annual fixed capital depreciation rate = Fixed capital depreciation divided by closing stocks.
Self-pay cost burden on the government side in 2000 = Employee compensations in 2000 + (sewage stock (at publicly owned facilities) at the end of 2002 multiplied by the fixed capital depreciation rate in 2000) + indirect taxes

2) In terms of water contamination, the research team used applicable eutrophication equivalent conversion coefficient (T-P: 3.06, T-N: 0.42 and COD: 0.022) for maintaining coherency.

5. Trends of SEEA in Japan and Foreign Nations

Western nations have been working on developing their SEEA framework in accordance with the UN SEEA handbook. "Structural Change and Economic Dynamics, Volume 10, Issue 1, 1999" explains some examples of their efforts on NAMEA.

The international expert group in charge of revising the UN handbook will play new roles in the future. It will provide and discuss environmental satellite account theories and related practices. The expert group will have four working groups in charge of: 1) water accounting, 2) energy and mineral resource accounting, 3) policy uses of environmental accounts, and 4) means of introducing social dimensions into environmental accounts as a basis for contributing to sustainability assessment.

Department of National Accounts, ESRI published its first SEEA calculation results in 1995 and the second calculation results in June 1998. In June 2000, the department also made available its trial estimation on "Environmental protection expenditure account" and "Waste account."