



# New System of Integrated Environmental and Economic Accounting

(Trial Calculation on Hybrid Accounting System integrating  
Environmental Pressures and Economic Activities)

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# Introduction: Research Projects on Integrated Environmental and Economic Accounting by ESRI

- **92~00:** Trial Estimation on Japanese SEEA based on UN's SEEA93 (System for Integrated Environmental and Economic Accounting, 1993), version IV.2 (Maintenance cost approach)
- **01~03:** Trial Estimation on HASEPEA (Hybrid Accounting System integrating Environmental Pressures and Economic Activities) based on Dutch framework called NAMEA (National Accounting Matrix including Environmental Accounts)
- **01~03:** Trial Estimation on Japanese Supply and Use Table for Environmental Protection Services based on UN's SEEA2003

# I. New System of Integrated Environmental and Economic Accounting

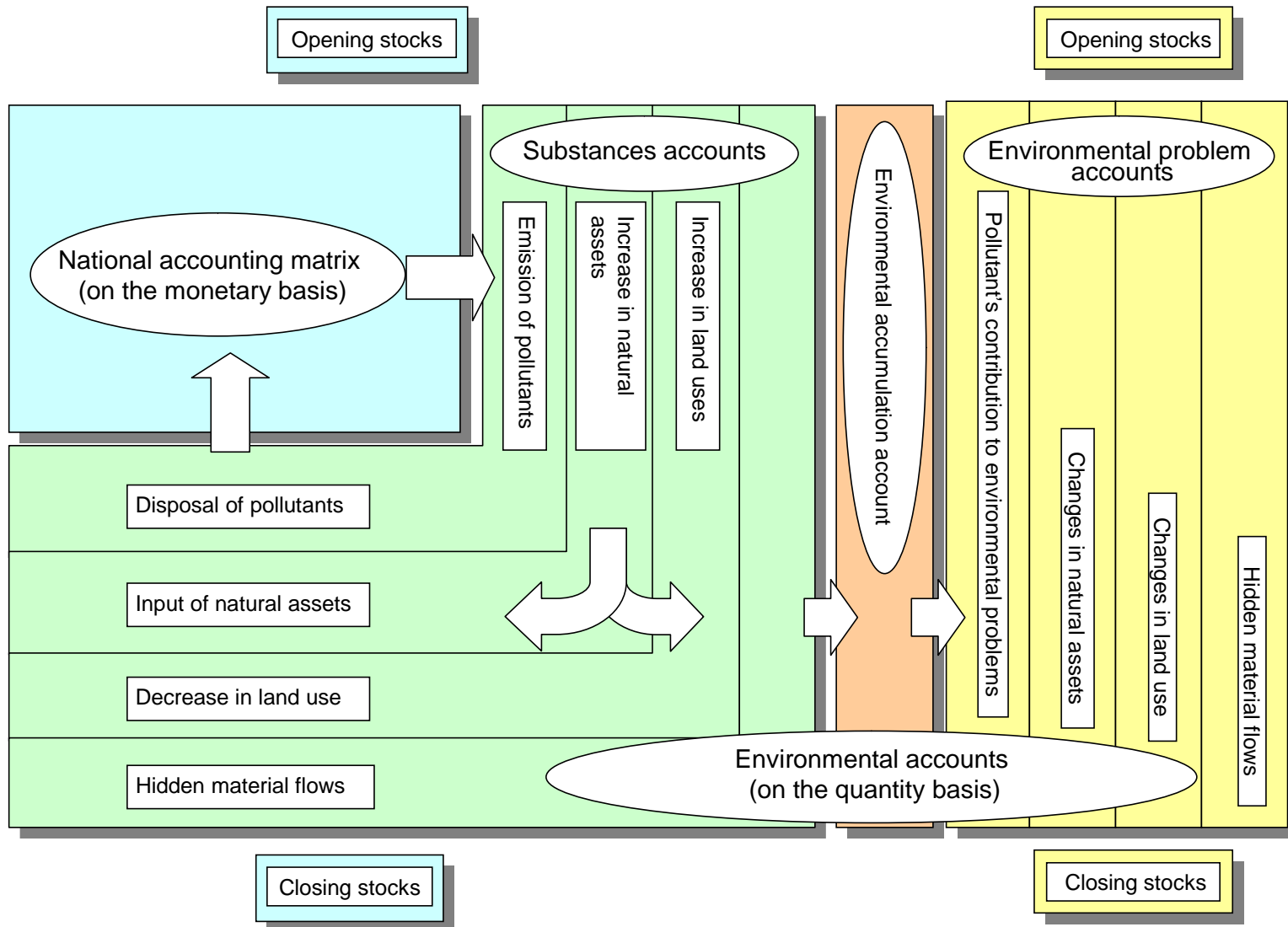
## 0. Japanese SEEA

- It's based on UN's SEEA93 (System for Integrated Environmental and Economic Accounting, 1993), version IV.2 (Maintenance cost approach)
- $\text{Imputed environmental costs} = (\text{maintenance costs} / \text{eliminated environmental pressures}) \times \text{environmental pressures}$
- $\text{EDP} = \text{NDP} - \text{Imputed environmental costs}$   
(EDP: Environmentally adjusted net Domestic Products)
- Weak points
  - 1) There is no international consensus on maintenance cost approach
  - 2) Imputed environmental costs at real-term are easily influenced by actual economic performance

# 1. Hybrid Accounting System integrating Environmental Pressures and Economic Activities (HASEPEA)

- (1) It's based on Dutch framework called NAMEA (National Accounting Matrix including Environmental Accounts)
- (2) Twofold parallel structure: national accounting matrix (NAM) at monetary term and environmental accounts (EA) at physical term
- (3) Environmental accounts include physical accounts, environmental accumulation accounts, and environmental problem accounts

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



#### (4) Features of HASEPEA to Dutch NAMEA

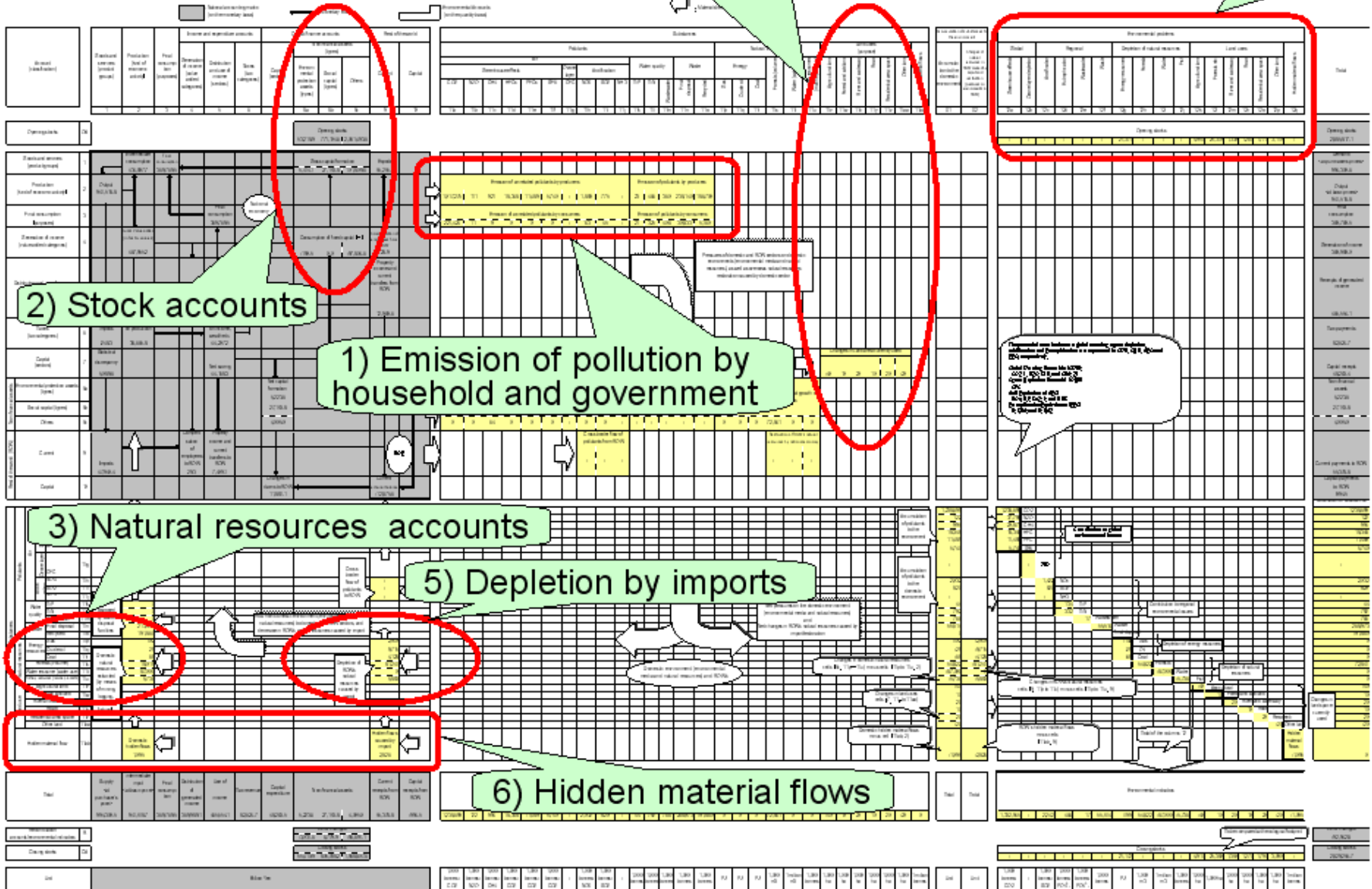
- 1) It estimates the emission of pollutions not only by households, but also by the government.
- 2) It attaches the stock accounts to capital accounts and records the various social capitals and environmental protection plants.
- 3) It adds coal, forests, water, and fish to the category of natural resources.
- 4) It introduces the land use accounts.
- 5) It records the depletion of natural resources in the rest of the world caused by imports.
- 6) It records the hidden material flows induced by domestic activities and imports.
- 7) It attaches the stock accounts to parts of the environmental theme accounts.

# Features of HASEPEA

## 4) Land use accounts

## 7) Stock accounts

Annexure 01-3, Trial Estimate on Hybrid Accounting System Integrating Environmental Processes and Economic Activities (2000)



## 2) Stock accounts

## 1) Emission of pollution by household and government

## 3) Natural resources accounts

## 5) Depletion by imports

## 6) Hidden material flows

## **2. Supply and Use Table for Environmental Protection Services**

- (1) It's based on UN's SEEA2003 (final version)
- (2) It estimates data on the following categories:
  - 1) Waste management
  - 2) Wastewater management
  - 3) Pollution reduction

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

		Government service providers	Industry				Total	Related products	
			Sewerage and waste treatment services (at publicly owned facilities)	Professional service providers	Non-professional service providers				
				Waste treatment services provided (by the industry sector)	Secondary activities Recycling industry	Secondary activities Internal environmental protection activities			
		1	2	3	4	5	6	7	8
<b>Supply table</b>									
Intermediate consumption	1	○	●	○	●	○	○	●	
Consumption of fixed capital	2	○	●	○	●	○	○	●	
Product tax	3	○	●	○	●	○	-	●	
(less) Production subsidy	4	-	●	○	●	○	○	●	
Compensation of employees	5	○	●	○	●	○	○	●	
Net operating surplus	6	-	●	○	●	○	-	●	
<b>Production subtotal</b>	7	●	●	●	●	●	●	●	●
Import	8								
<b>Total supply at basic price</b>	9	●		●	●	●	●	●	●
Transport and commercial margins	10							●	
<b>Total supply at purchasers' price</b>	11	●		●	●	●	●	●	●
<b>Use table</b>									
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	○		○		○			
<b>Use total</b>	21	●	●	●	●	●	●	●	●
<b>Discapancy (supply-use)</b>	22								
<b>Additional information</b>									
Gross fixed capital formation	23							●	
Fixed capital stock	24							●	

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

## II. Calculation Results

### 1. National Accounting Matrix (NAM) in HASEPEA

Table 2

### 2. Environmental Accounts (EA) in HASEPEA

Table 3

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

In : 1 billion, %

Year	GDP	Environmental protection activities (industry + government) <sup>1)</sup>								
		Industry + government	Industry			Government			Sewage treatment	Waste disposal
			Internal environmental protection activities	Waste disposal service	Recycling service	environmental protection activities				
1990	440124.8	6684.5	3462.9	706.2	1591.1	1165.6	3221.6	1056.4	1105.1	1060.1
1995	496922.2	7616.7	3299.6	647.7	1871.6	780.3	4317.1	1435.9	1658.5	1222.7
2000	511462.4	9491.1	4235.6	561.4	2112.5	1561.7	5255.5	2033.9	1946.4	1275.2
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

	Gross capital formation	Capital formation for environmental protection <sup>2)</sup>							Social capital <sup>3)</sup>	Others
		Industry + government	Industry			Government				
			Internal environmental protection activities	Waste disposal service		Sewage treatment	Waste disposal			
1990	144780.3	3664.7	322	292.7	29.3	3342.7	2905.8	436.9	25984.6	115131.0
1995	140331.4	6105.6	450.8	409.8	41.0	5654.8	4791.9	862.9	38752.4	95473.4
2000	134377.6	5414.2	246.7	224.3	22.4	5167.5	4252.3	915.2	27153.8	101809.6
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

	Non-financial assets	Environmental protection assets <sup>4)</sup>							Social capital	Others
		Industry + government	Industry			Government				
			Internal environmental protection activities	Waste disposal service		Sewage treatment	Waste disposal			
1990	3501659.3	33814.0	2346.2	2132.9	213.3	31467.8	27355.0	4112.8	453171.1	3014674.2
1995	3046192.9	44098.7	2018.1	1834.6	183.5	42080.6	36741.1	5801.3	637280.6	2364813.6
2000	2829256.7	55410.9	1836.1	1669.2	166.9	53574.8	44092.0	9482.8	805038.2	1968807.6
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

### Table 3. Environmental Accounts

1) Global warming (CO <sub>2</sub> : approximate estimate) <sup>1)</sup>		Unit	1990	1995	2000	Growth rate (95.00)	Growth rate (00.05)	Growth rate (00.00)
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
CO <sub>2</sub>	Production activities	1,000 tonnes (CO <sub>2</sub> )	959,805	1,015,987	1,017,275	5.9	0.1	6.0
	Emission level vs. output	1 tonne (CO <sub>2</sub> )/¥100 million	111.6	110.1	108.0	(1.4)	(1.8)	(3.2)
	Final consumption	1,000 tonnes (CO <sub>2</sub> )	162,312	194,921	221,424	20.1	13.6	36.4
	Emission level vs. final consumption	1 tonne (CO <sub>2</sub> )/¥100 million	55.7	55.8	59.9	0.0	7.4	7.4

Pollutants (air/water pollution) <sup>2)</sup>		Unit	1990	1995	2000	Growth rate (95.00)	Growth rate (00.05)	Growth rate (00.00)
Greenhouse gases (CO <sub>2</sub> , N <sub>2</sub> O, CH <sub>4</sub> , HFCs, PFCs, SF <sub>6</sub> )		1,000 tonnes (CO <sub>2</sub> )	1,187,050	1,323,288	1,332,945	11.5	0.7	12.3
Acidification gases (NO <sub>x</sub> , SO <sub>2</sub> )		1,000 tonnes (SO <sub>2</sub> )	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 <sub>4</sub> <sup>3-</sup> )	556	539	483	(3.0)	(10.4)	(13.1)
Eutrophication (T-P, T-N)		1,000 tonnes (PO <sub>4</sub> <sup>3-</sup> )	534	521	466	(2.6)	(10.4)	(12.8)

Waste disposal		Unit	1990	1995	2000	Growth rate (95.00)	Growth rate (00.05)	Growth rate (00.00)
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 (95.00)	Growth rate (00.05)	Growth rate (00.00)
Overseas natural resources extracted due to imports								
Energy		PJ	14,297	16,246	16,813	13.6	3.5	17.6
Forest <sup>1)</sup>		1,000m <sup>3</sup>	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 <sup>1)</sup>		1,000m <sup>3</sup>	29,367	22,915	18,019	(22.0)	(21.4)	(38.6)

Notes: 1) A forest usually absorbs more volume of CO<sub>2</sub> in the growth period than in the mature period. However, the research team did not evaluate the fluctuation in forest CO<sub>2</sub> 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)

$$EEII = \left( 1 - \frac{\text{Closing EP} / \text{Opening EP}}{\text{Closing DF} / \text{Opening DF}} \right) \times 100$$

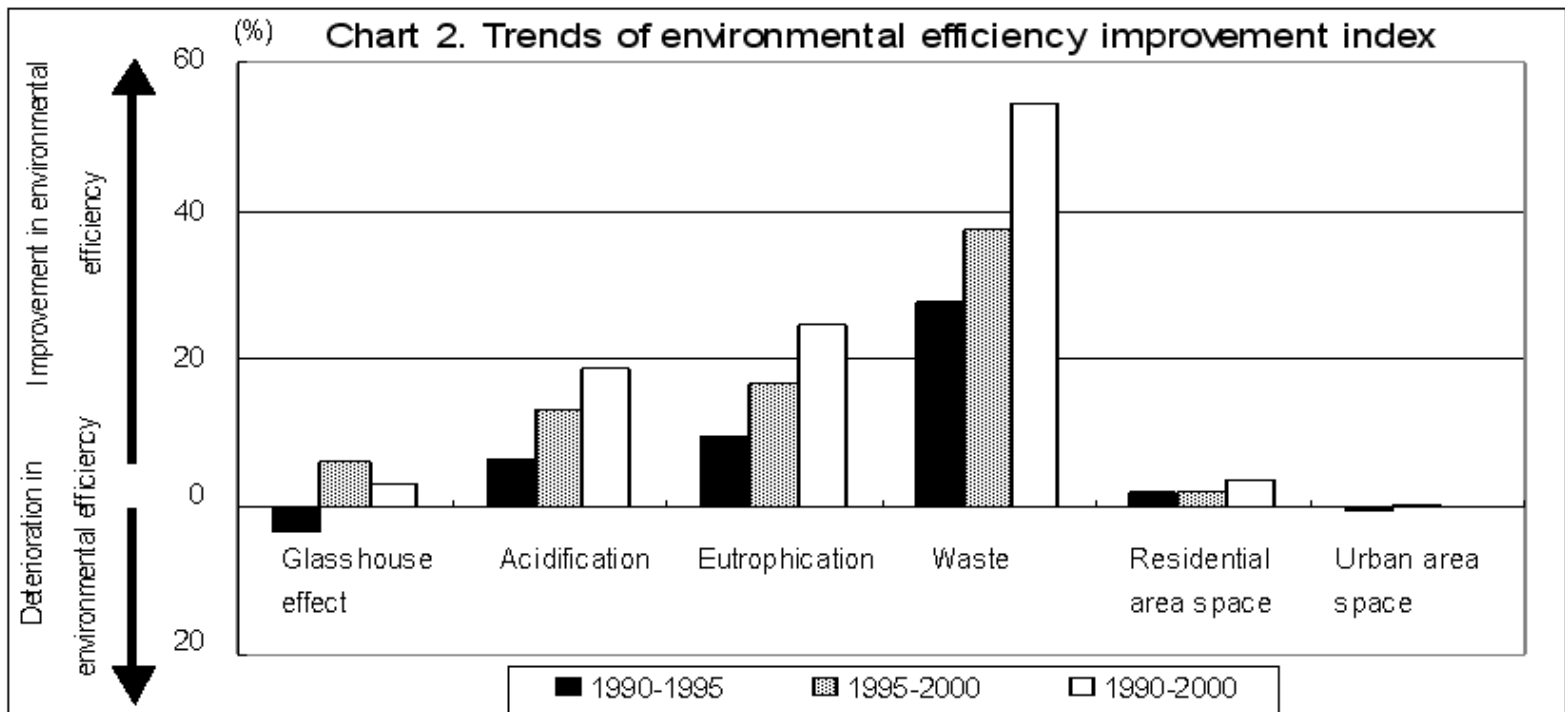
EP: Environmental Pressures

DF: Driving Forces

- $EEII \geq 0 \Rightarrow$  EP's growth rate  $\leq$  DF's growth rate  
 $\Rightarrow$  "Environmental efficiency is improving"
- $EEII < 0 \Rightarrow$  EP's growth rate  $>$  DF's growth rate  
 $\Rightarrow$  "Environmental efficiency is deteriorating"

## Remarks on EEI

- EEI represents the relationship between economic activities and environmental pressures .
- EEI does not represent strong sustainability because environmental pressures may be growth more than sustainable level even if environmental efficiency is improving.
- EEI is flow indicator and not stock indicator .
- OECD calls this type of index "the decoupling indicator."



**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%)

**Table 5. Environmental Efficiency Improvement Index by Industry Category**

**1) CO<sub>2</sub>: Power generation industry**

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

Estimation formula  $\frac{(EP)}{(DF)} = \frac{(\text{CO}_2 \text{ emission})}{(\text{Total electricity demand})} = \frac{(\text{CO}_2 \text{ emission})}{(\text{Fossil fuel input})} \times \frac{(\text{Fossil fuel input})}{(\text{Power generation level})} \times \frac{(\text{Power generation level})}{(\text{kWh})}$

**2) NO<sub>x</sub><sup>1)</sup>: Transport industry**

	NO <sub>x</sub> emission (in 1995)		Output (in 1995)		EEII  (1-① / ② ) ×100
	1,000 tonnes (NO <sub>x</sub> )	① 1990 = 100	¥1 billion	② 1990 = 100	
1990-1995	2,123	105	54,110	122	13.7%

Estimation formula  $\frac{(EP)}{(DF)} = \frac{(\text{NO}_x \text{ emission})}{(\text{Output level in the transport/telecommunication industries})} = \frac{(\text{NO}_x \text{ emission})}{(\text{Road transport mileage})} \times \frac{(\text{Road transport mileage})}{(\text{Total transport mileage})} \times \frac{(\text{Total transport mileage})}{(\text{Output level in the transport/telecommunication industries})}$

**3) SO<sub>2</sub><sup>1)</sup>: Agriculture, forestry and fisheries industry**

	SO <sub>2</sub> emission (in 2000)		Output (in 1995)		EEII  (1-① / ② ) ×100
	1,000 tonnes (SO <sub>2</sub> )	① 1990 = 100	¥1 billion	② 1990 = 100	
1990-1995	123	90	16,329	88	(1.6%)

Estimation formula  $\frac{(EP)}{(DF)} = \frac{(\text{SO}_2 \text{ emission})}{(\text{Output level of the agriculture, forestry and fisheries industry})}$

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.

**Table 6. Major EElIs at Final Consumption Level**

**1) CO<sub>2</sub>**

Pollutant volume at final consumption level		Final consumption expenditures of Japanese households (in real terms)		EElI	
		1,000 tonnes (CO <sub>2</sub> )	① 1990= 100		¥1 billion
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<sub>2</sub>**

Pollutant volume at final consumption level		Final consumption expenditures of Japanese households (in real terms)		EElI	
		1,000 tonnes (SO <sub>2</sub> )	① 1990= 100		¥1 billion
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**

Table 7, Table 8, and Table 9

# Table 7. Waste Disposal Volume vs. Intermediate Treatment Costs<sup>1)</sup>

## (a) Recycled volume<sup>2)</sup>

In 1,000 tonnes

	Production		Consumption	Total
	Industrial wastes	Nonindustrial wastes	Nonindustrial wastes	
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	Total
	Industrial wastes	Industrial wastes	Nonindustrial wastes	
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

## (d) Final disposal volume

In 1,000 tonnes

	Production		Consumption	Total
	Industrial wastes	Industrial wastes	Nonindustrial wastes	
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)

## (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

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

**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<sup>3-</sup>)

	1990			1995			2000		
	Treatment cost <sup>1)</sup>	Final wastewater volume <sup>2)</sup>		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

## **5. Issues for the future**

- Further improvements of the hybrid accounting system
- Development of regional version of the hybrid accounting system, for example, regional hybrid accounting system on waste.
- Development of stock indicators which represent strong sustainability.
- Application of the hybrid accounting system to policy analysis.