The Development of Environmental Accounting Frameworks and Indicators for Measuring Sustainability in Japan[1]

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Overview of Research Activities on Environmental Accounting and Indicators in Japan

It was in 1991, more than 10 years ago, when several governmental research institutes in cooperation with researchers in universities started an inter-agency research project on environmental accounting and indicators in Japan. Since then, with some changes of participating institutions, the project has been renewed three times, under funding by the "Global Environmental Research Fund" of the Ministry of the Environment (formerly the Environment Agency of Japan).

The initiation of this research project in the early 1990's was strongly motivated by the worldwide studies on environmental accounting, which had been getting more and more active towards SEEA 1993. The National Institute for Environmental Studies (NIES), which used to belong to the Environmental Agency (Ministry) and later became an independent agency, has been taking a leadership role in organizing the project. The NIES mainly undertook studies on environmental accounting in physical terms. Another key institution in the project has been the Economic Research Institute (ERI) of the Economic Planning Agency (later restructured to be the Economic and Social Research Institute (ESRI) of the Cabinet Office). Apart from the environmental accounting studies, the ERI (ESRI) has been the responsible institution for the System of National Accounts (SNA) in Japan. Thus, both experts in environmental information and statistics and those in national accounting have played key roles in the project.

In the earlier phases of the project, more attention was paid to environmentally-adjusted aggregated indicators to follow up the SEEA 1993. The first trial estimate of the Japanese SEEA, which corresponded to SEEA version 4.2 (maintenance cost approach), was published in 1995. An updated/revised edition, as well as its time-series, was published later in 1998. They were all undertaken by the ERI. In the later phases, the attention of the ERI's study shifted from the SEEA version.4.2 to other components of the SEEA. In particular, it focused on the measurement of environmental protection expenditures and a case study on physical/monetary accounting, in which waste management activities were accounted for. As described later in more detail, the current

1. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the authors' institutes. We would like to thank the discussant at the workshop, Robert Smith of Statistics Canada, for providing helpful comments.

focus of the ERI (ESRI)'s study is to compile the Japanese edition of the National Accounting Matrix including Environmental Accounting (NAMEA).

On the other hand, the NIES consistently undertakes empirical studies on physical accounting. Initial attention was directed to international physical flows of natural resources to Japan from the rest of the world, which explained Japan's high dependency on imported natural resources. More in general, Material Flow Accounting (MFA) has been applied to the accounting for international trade flows, total inflows to and outflows from the national economy, as well as inter-industry (inter-sectoral) flows.

Key players of these Japanese studies have also actively participated in international efforts on environmental accounting and indicators, such as the London group and meetings organized by the OECD. Moreover, in 1996 the ERI and United Nations University(UNU) organized the International Symposium on "Integrated Environmental and Economic Accounting in Theory and Practice" in Tokyo, in cooperation with the International Association for Research in Income and Wealth (IARIW).

Physical MFA studies, which are mainly undertaken by the NIES, have been keeping in close collaboration with the OECD and other organisations' international activities. The NIES is one of the collaborators in the international joint publication of 'Resource Flows' (Adriaanse et al., 1997) and 'The Weight of Nations'(Matthews et al, 2000) by the World Resources Institute, which focused on the total material inflows and outflows of industrialized economies. In fact, this joint effort was triggered by an international scientific workshop for indicators of sustainable development at the Wuppertal Institute in Germany, organized by the Scientific Committee on Problems of the Environment (SCOPE). More recently, special sessions and workshops on MFA were organized by the working groups under the OECD Environmental Policy Committee (EPOC), and the NIES consistently contributed to these meetings. The linkage between the accounting framework(s) and the indicators was repeatedly discussed throughout these meetings.

The current Japanese research project in its fourth phase for FY 2001-2003 is being undertaken by the ESRI, the NIES, as well as another new participating institution. It is the National Institute for Advanced Industrial Science and Technology (AIST), which deals with studies on environmental accounting and performance indicators at the company level. The project as a whole aims at the development of environmental/sustainability indicators and accounting at three different levels, namely the national (macro) level, the sectoral (meso) level, and the company (micro) level. The ESRI, the NIES, and the AIST share their roles in these three levels' studies respectively. More ambitiously, possible linkages among these different scales are being considered.

The first author of this paper has been continuously involved in both the ERI (ESRI)'s and the NIES's studies. In the next section, the technical details of the Japanese studies will be described, focusing on the structure of accounting frameworks.

The role of environmental accounting frameworks in the Japanese research project

As denoted in the previous section, in the Japanese research project, the ESRI, the NIES, and the AIST share their roles in the three different levels and undertake the development of environmental accounting frameworks and indicators for measuring sustainable development. In this project, the linkage between the research done at the three levels, as well as the progress of the research, is very important.

In general, the research on sustainable development indicators has resulted in a large number of indicators giving information on developments in the economic, environmental and social areas. Thus, the interrelationships between these indicators are sometimes lost. For example, a little change in one economic area gives some effects to the environment and societal areas, as well as other parts of the economic area. Therefore each of the indicators has to reflect such actual interrelationships. In order to satisfy this requirement, it is necessary to construct a common accounting system that serves as an underlying statistical information system, which adequately represents the interrelationships between the economy, the environment and society, as well as bringing about the linkage between the various indicators. Such a common accounting system enhances the mutual consistency, reliability and comparability of the indicators.

The Japanese research project aims at the construction of a common accounting system and its derived indicator sets at the national economy level, the industrial sector level, and the company level. Figure 1 shows the relationships between the various kinds of accounts and indicators which the Japanese project undertakes. Though figure 1 gives a simple description of each account, more detailed structures of the accounts are shown in tables 1 through 8 at the end of paper.

(1) NAM (National Accounting Matrix)

In the center of figure 1, the National Accounting Matrix (NAM) of the SNA is shown. The NAM denoted here has the stock accounts of the non-financial assets, while the stock accounts of the financial assets are omitted for simplicity. The NAM is a core account of the Japanese system of accounts and indicators for sustainability.

(2) I-O table

To the left of the NAM, the I-O table is shown. It is an analytical accounting framework which is closely related to the NAM.

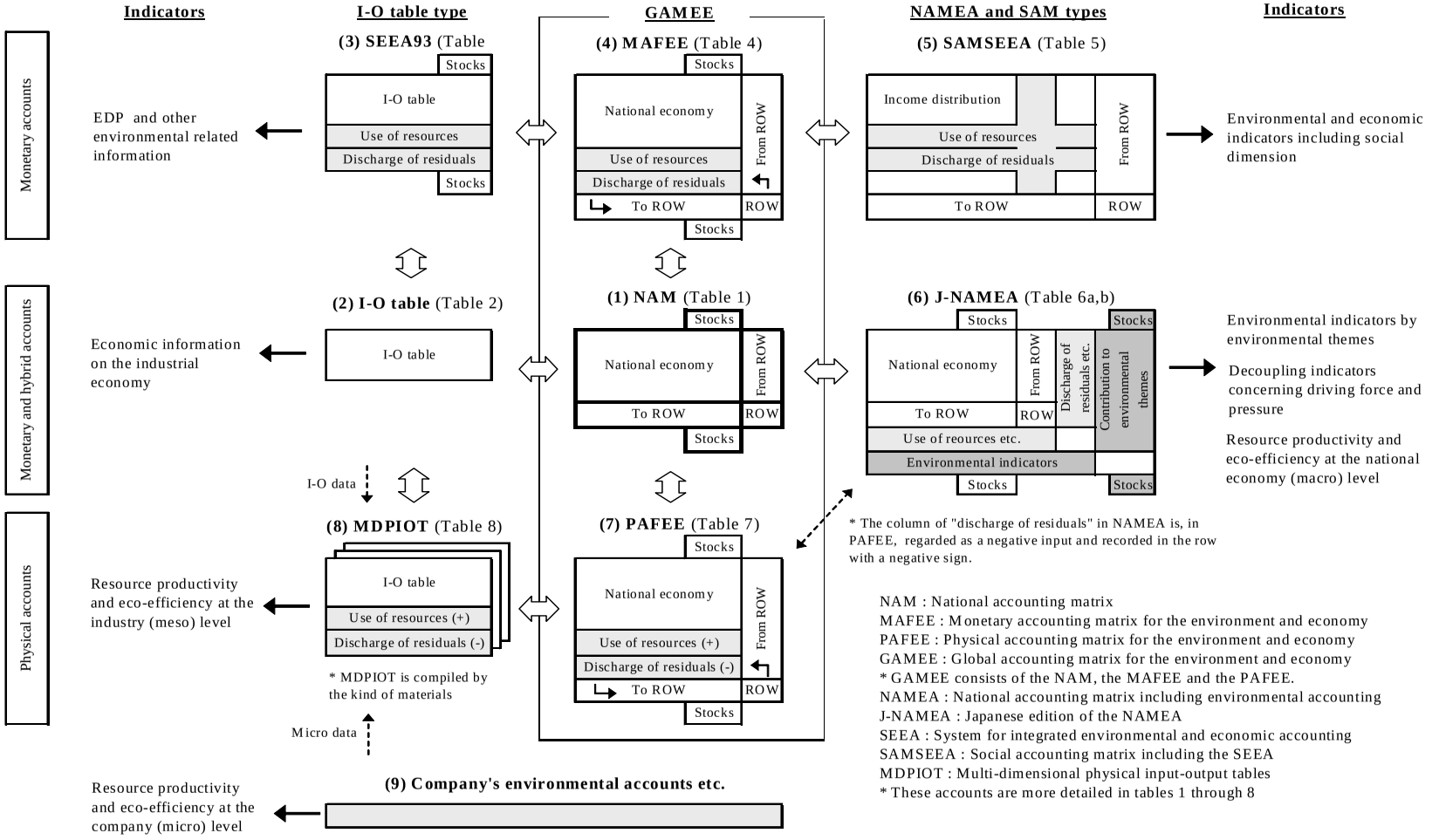
(3) SEEA93

In the top left of figure 1, the SEEA93 version 4.2 (maintenance cost approach) is shown. The research and trial estimation of the SEEA93 has been conducted by the ESRI (formerly the ERI) since 1991. The distinctive aims of the SEEA93 are to introduce the environmental related activities into the I-O table, to attach the stock account including non-produced natural assets, and to describe the environmental pressures caused by economic activities and the derived depletion of non-produced natural assets by those pressures. In figure 1, the environmental pressures are classified into the use of natural resources (input) and the discharge of residuals (output or negative input). In Japan, the research and trial estimation of the regional edition of the SEEA93 is also being undertaken (Yamamoto et al., 1998).

(4) MAFEE

In the top middle of figure 1, there is an unfamiliar account which is named the "Monetary Accounting Framework for the Environment and Economy" (MAFEE). The MAFEE is a kind of "mediate account" which links the NAM to the SEEA93. It is constructed by introducing the above mentioned distinctive features of the SEEA93 not to the I-O table but rather directly to the NAM.

Figure 1. Interrelationships between environmental accounts and indicators



(5) SAMSEEA

In the top right of figure 1, the Social Accounting Matrix including the SEEA (SAMSEEA) is shown. Recently, the first author of this paper started on the construction of the SAMSEEA and CGE analysis based on it along with his colleagues. The progress of this research may bring about a set of indicators including the social dimension as well as policy implications.

(6) NAMEA

To the right of the NAM, the Japanese edition of the NAMEA (J-NAMEA) that has been undertaken by the ESRI, is shown. A more detailed sketch of the J-NAMEA is shown in table 6a, and the first trial estimate of the J-NAMEA is given in table 6b. The J-NAMEA is revised regarding the following points in comparison with the Netherlands' NAMEA.

1) It estimates the emission of pollutions not only by households, but also by the government.

2) It attaches the stock accounts of non–financial assets to capital accounts and records the various social capitals and environmental protection plants. Refer to cell (OA, 8) and (CA, 8) in table 6b.

3) It adds coal, forests, water, and fish to the category of natural resources. Refer to the 11p-11u accounts.

4) It introduces the land use accounts which are closely related to environmental issues. Refer to the 11v-11aa accounts.

5) It records the depletion of natural resources in the rest of the world caused by imports, in order to figure out Japan's high dependency on imported natural resources. Refer to cell (11p-11u, 9).

6) It introduces the hidden material flow account, which records the hidden material flows caused by domestic activities and imports. Refer to the 11ab account.

7) It attaches the stock accounts to parts of the environmental theme accounts.

The ESRI adopts the Driving Force–Pressure–State–Effect–Response (DPSER) indicator framework which is an extension of the PSR framework and covers the economic and environmental dimensions. Thus, the J-NAMEA gives not only the indicators based on environmental themes, but also the decoupling indicator concerning the driving force and pressure in the DPSER framework. Moreover, it also gives the resource productivity and eco-efficiency indicators at the national economy (macro) level.

(7) PAFEE (Physical Accounting Framework for the Environment and Economy)

In the bottom middle of figure 1, there is another unfamiliar account which is named the "Physical Accounting Framework for the Environment and Economy" (PAFEE). The PAFEE is another kind of "mediate account" which links the NAM to the MDPIOT denoted shortly hereafter. It basically has the same accounting structure as the MAFEE. However, it is an account with physical terms and the discharge of residuals is recorded as negative inputs with physical terms. The PAFEE and the MAFEE along with the NAM

compose a core framework which is named the "Global Accounting Matrix for Environment and Economy" (GAMEE) (Ariyoshi, 1998).

(8) MDPIOT (Multi-Dimension Physical Input Output tables)

To the left of the PAFEE, the Multi-Dimension Physical Input Output tables (MDPIOT) is shown, which has been developed by the NIES. The distinctive features of the MDPIOT are denoted as follows:

1) It records not only the use of resources from the environment and discharge of residuals to the environment, but also the material flows between industrial sectors according to the kind of materials.

2) Data for the MDPIOT can be compiled in two ways, either top-down from I-O data or bottom-up from the company's data.

3) It gives indicators such as resource productivity and eco-efficiency at the industrial sector (meso) level.

4) The MDPIOT including the material flows induced by imports to Japan is being undertaken (reference table 8).

5) It has a sub-module to calculate the intersectional material flows induced by final demands.

(9) Company's environmental accounts

The data from the company's environmental accounts provide the information needed to calculate resource productivity and eco-efficiency at the industrial sector and company levels.

Among the accounts (1) – (9), the I-O table (2) and the J-NAMEA (6) are directly related to the NAM. Moreover, the SEEA93 (3) and the SAMSEEA (5) are indirectly related to the NAM via the MAFEE, and the MDPIOT (8) is indirectly related to the NAM via the PAFEE. Therefore, the indicators based on these accounts are considered to satisfy the requirements for indicators, such as mutual consistency, reliability and comparability. However, the company's environmental account (9) is not related to the NAM.

Thus, the establishment of the relationship between macro environmental accounting and the company's micro environmental accounting is considered an important task in achieving a consistent system of accounting frameworks and indicators for sustainable development.

Policy application of environmental accounting and derived indicators

There is no inter-agency activity in Japan to establish a comprehensive set of indicators covering the whole scope (environmental, economic and social pillars) of sustainable development. However, some efforts have been made to incorporate a harmonized set of indicators into the national environmental policy. In 1994, the first "Basic Environmental Plan" was established by the cabinet decision based on "Basic Environment Law". The plan mandated the government to develop comprehensive indicators for implementing the plan and for reviewing policy performance towards four long-term policy goals set by the plan. An expert advisory committee was established in the Environment Agency to elaborate the concept and to show options of the indicators,

drawing upon related activities in international organisations such as the OECD and the UNCSD, as well as those in other countries. The committee published "A draft set of comprehensive environmental indicators" in 1997, and then submitted a revised report to the Central Environmental Council in 1999. Several indicators based on the MFA were adopted in the report as a sub-set of indicators representing the "sound material cycle" (Moriguchi, 2000).

Very recently, indicators derived from physical material flow accounting were adopted more formally and clearly, with quantitative targets within another national environmental policy framework. The Government of Japan formulated "The Basic Plan for Establishing a Recycling-Based Society" in a Cabinet decision on March 14th, 2003, based on the provisions of Article 15 of "The Basic Law for Establishing a Recycling-Based Society". The purpose of the plan is to promote comprehensive and systematic policies for establishing a recycling-based society. Furthermore, the plan serves as a ten-year program aimed at changing unsustainable patterns of production and consumption into sustainable ones based on the "Plan of Implementation of the World Summit on Sustainable Development" held in September 2002.

For establishing a recycling-based society, the plan set quantitative targets for indicators based on Material Flow Accounts, which are used to understand the entire flow of materials in a national economy. More specifically, the plan set a target for each of the three indicators that represent the three aspects of the material flows in our society. They are indicators of input, cyclical use and output. As the input indicator, a so-called "resource productivity" indicator was adopted.

Resource Productivity = GDP / DMI (Direct Material Input)

This formula is completely identical to the material use indicator in the OECD's indicator set for measuring decoupling of environmental pressure from economic growth (OECD, 2002). The plan set a target that Resource Productivity should be about 390 thousand JPY per ton in FY 2010 (almost double that of about 210 thousand JPY per ton in FY 1990, and about a 40 per cent improvement from about 280 thousand JPY per ton in FY 2000).

Whereas the other two indicators on material cycle (cyclical use rate) and material output (final disposal amount of waste) stand for a more conventional view of waste management and recycling, this input indicator reflects a holistic view of the relationship between economic activities and material use.

Needless to say, statistical basis and analytical soundness have to be ensured and further improved, in order to meet the policy needs and to support the actual measurement of the indicators. It should also be kept in mind that a typical criticism against over-simplification (everything should not be equally measured by mass) has been repeatedly directed to this simple indicator. Physical material flow accounting, if classified by the type of material, enables us to not only weigh materials as the simple sum of the mass, but also to weigh with some weight reflecting economic, social or environmental values. We may seek further elaboration of the accounting framework and derived indicators through international joint studies.

References

Adriaanse, A., Bringezu, S., Hammond, A., Moriguchi, Y., Rodenburg, E., Rogich, D., and Schuetz, H. (1997): *Resource Flows: The Material Basis of Industrial Economies*, World Resources Institute, Washington D.C., 66pp.

Ariyoshi, N., (1998): Global Accounting Matrix for Environment and Economy (GAMEE): A Proposal for the SEEA Revision, *The Fifth Meeting of the London Group on Environmental Accounting: Proceedings and Papers*, pp.91-104.

Keuning, S. J., van Dalen, J., and de Haan, M. (1999): Netherlands' NAMEA: presentation, usage and future extensions, *Structural Change and Economic Dynamics*, 10, pp.15-37.

Matthews E., Amann, C., Bringezu, S., Fischer-Kowalski, M., Huettler, W., Kleijn, R., Moriguchi, Y., Ottke, C., Rodenburg, E., Rogich, D., Shandl, H., Schuetz, H., van der Voet, E., and Weisz, H. (2000): *The weight of nations –Material outflows from industrial Economies*-, World Resources Institute, Washington D.C., 125pp.

Moriguchi, Y. (2000): Material Flow Accounting and its application in Japan, presented at Special session on Material Flow Accounting, OECD/WGEIO, October 24, 2000, Paris.

OECD (2000): Indicators to measure decoupling of environmental pressure from economic growth, SG/SD (2002)1.

United Nations (1993): Handbook of National Accounting: Integrated Environmental and Economic Accounting, Interim version, United Nations, 182pp.

United Nations (2003): *The Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003*, United Nations (http://unstats.un.org/unsd/environment/ seea2003.htm).

Uno, K. (1998): Identifying Research Priority, Uno, K. and Bartelmus, P. eds., *Environmental Accounting in Theory and Practice*, Kluwer Academic Publishers, pp.409-419.

Yamamoto, M., Hayashi, T., and Demura, K. (1998): Estimation of Integrated Environmental and Economic Accounting in Hokkaido, *Studies in Regional Science*, 29 (1), pp.25-40.

Table 1. Basic structure of the NAM (National Accounting Matrix)

(Monetary term)

			Nation A				Rest of the world (ROW)	
			Goods & services (product groups)	Production (activity groups)	Distribution & use of income	Capital	Current account	Capital account
			1	2	3	4	5	6
Opening assets		0				Opening assets		
Nation A	Goods & services (product groups)	1		Intermediate consumption	Final consumption	Capital formation	Export	
	Production (activity groups)	2	Output					
	Distribution & use of income	3		Value added				
	Capital	4			Saving			Net lending from ROW
Rest of the world	Current account	5	Import					
	Capital account	6					Current external balance of ROW	
Closing assets		7				Closing assets		

→ : SNA's monetary flows

Table 2. Basic structure of the I-O table

(Monetary term)

		Nation A			Rest of the world (ROW)	
		Production activities (activity groups)	Final consumption	Capital formation	Export	Import
		1	2	3	4	5
Use of products (activity groups)	1	Intermediate consumption	Final consumption	Capital formation	Export	Import
Value added	2	Value added				
Output	3	Output				

Table 3. Basic structure of SEEA93 (version 4.2)

(Monetary term)

				Nation A				Rest of the world	
				Production (activity groups)	Final consumption	Non-financial assets (uses and stocks of assets)		Export	Import (negative sign)
						Produced assets	Non-produced assets		
				1	2	3	4	5	6
Opening assets			0			Opening assets			
Nation A	Use of products (activity groups)		1	Intermediate consumption	Final consumption	Capital formation		Export	Import(-)
	Use of non-produced natural assets	Use of natural resorces (types)	2	Use of resources (+)	Use of resources (+)		Depletion of natural resources (-)		
		Discharge of residuals (types)	3	Discharge of residuals (+)	Discharge of residuals (+)		Deterioration by residuals (-)	Discharge of residuals (+)	
		Eco-margin (negative sign)	4	Sum of the above pressures (-)	Sum of the above pressures (-)		Sum of the above pressures (+)	Sum of the above pressures (-)	
	Value added		5	Value added					
	output		6	Output					
Closing assets			7			Closing assets			

: Cells for environmental flow data

Table 4. Basic structure of the MAFEE (Monetary Accounting Framework for Environment and Economy)

(Monetary term)

				Nation A					Rest of the world	
				Goods & services (product groups)	Production (activity groups)	Disribution & use of income	Capital		Current	Capital
							Sectors	Non-financial assets (types)		
				1	2	3	4	5	9	10
Opening assets			0					Opening assets		
Nation A	Goods & services (product groups)		1		Intermediate consumption	Final consumption		Capital formation	Export	
	Production (activity groups)		2	Output						
	Distribution & use of income		3		Value added					
	Capital	Sectors	4			Saving				Net lending from ROW
		Natural Assets (types)	5				Capital formation			
	Use of non-produced natural assets	Use of natural resorces (types)	6		Use of resources(+)	Use of resources(+)		Depletion of resources (-)		
		Discharge of residuals (types)	7		Discharge of residuals (+)	Discharge of residuals (+)		Deterioration by residuals (-)	Discharge of residuals (+)	
		eco-margin (negative sign)	8		Sum of the above pressures (-)	Sum of the above pressures (-)		Sum of the above pressures (+)	Sum of the above pressures (-)	
ROW	Current account		9	Import					(Production etc. in ROW)	
	Capital Account		10						Current external balance of ROW	
	Discharge of residuals (types)		11		Discharge of residuals (+)	Discharge of residuals (+)			Discharge of residuals (+)	Deterioration by residuals(-)
	Sum of pressures		12		Sum of the above pressures (-)	Sum of the above pressures (-)			Sum of the above pressures (-)	Sum of the above pressures (+)
Closing assets			13					Closing assets		

: Monetary flows (including imputed environmental cost flows)

: Cells for environmental flow data

Table 5. Basic structure SAMSEEA

(Monetary term)

				Nation A											Rest of the world	
				Primary distribution of income	Secondary distribution of income (sectors)	Use of income (sectors)	Capital		Use of natural resorces (types)	Discharge of residuals (types)	eco-margin (negative sign)	Final consumption (purposes)	Production (activity groups)	Goods & services (product groups)	Current	Capital
							Sectors	Non-financial assets (types)								
				1	2	3	4	5	6	7	8	9	10	11	12	13
Nation A	Primary distribution of income (value sdded categories)		1										Value added		Compensation of emplyees from ROW	
	Secondary distribution of income (sectors)		2	National income											Property income and currnt transfers from ROW	
	Use of income (sectors)		3		Disposable income											
	Capital	Sectors	4			Saving										Net lending from ROW
		Natural Assets (types)	5				Capital formation									
	Use of non-produced natural assets	Use of natural resorces (types)	6					Depletion of resources (-)				Use of resources	Use of resources			
		Discharge of residuals (types)	7					Deterioration by residuals (-)				Discharge of residuals	Discharge of residuals			
		eco-margin (negative sign)	8					Sum of the above pressures				Sum of the above pressures (-)	Sum of the above pressures (-)			
	Final consumption (purposes)		9			Final consumption										
	Production (activity groups)		10											Output		
	Goods & services (product groups)		11					Capital formation				Final consumption	Intermediate consumption		Export	
ROW	Current account		12	Compensation of emplyees to ROW	Property income and currnt transfers from ROW									Import		
	Capital Account		13				Capital transfers to ROW (net9								Current external balance of ROW	

: Cells for environmental flow data

Table 6a. Basic structure of the Japanese edition of NAMEA

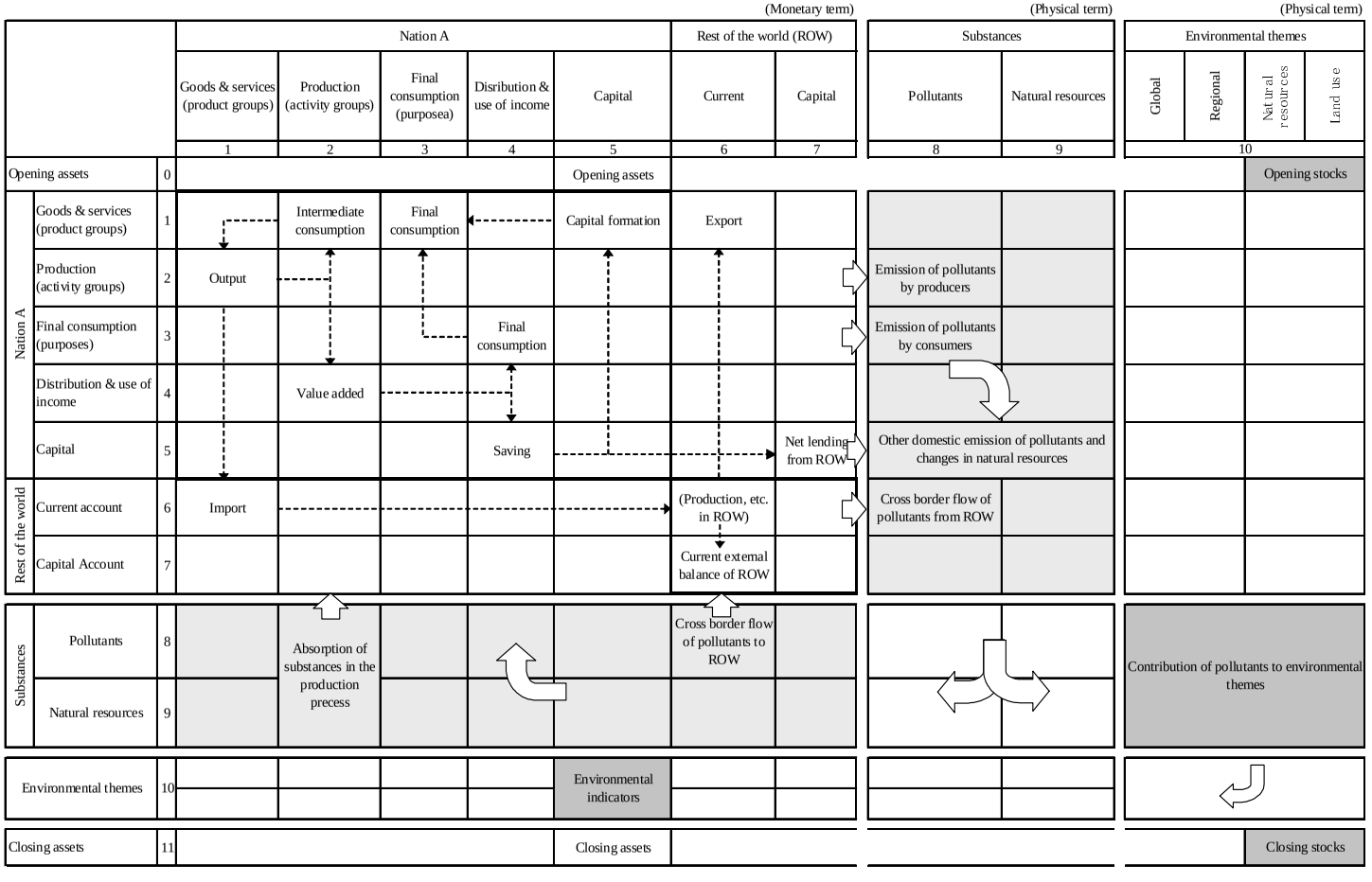


Table 6b. First Trial Estimate of the Japanese NAMEA (1995) *(The top left of the J-NAMEA)*

Monetary flows ⇦ Material flows : Cells for environmental flow data : Cells for nvironmental indicator

Account (classification)			Goods and services (product groups)	Production (kind of economic activity)	Final consump-tion purposes)	Generation of income (value added categories)	Distribution and use of income (sectors)	Taxes (tax categories)	Capital (sectors)	Non-financial assets (types)			Rest of the world	
										Environmental protection facilities (types)	Social capital (types)	Others	Current	Capital
			1	2	3	4	5	6	7	8a	8b	8c	9	10
Opening stocks	OA									Opening stocks				
										42,678.4	601,149.3	2,475,490.6		
Goods and services (product groups)	1			Intermediate consump. 430,940.5	Final consump. 351,564.2					Gross capital formation			Exports 45,230.1	
										6,105.6	38,907.1	95,337.6		
Production (kind of economic activity)	2		Output 924,849.6											
Final consumption purposes)	3						Final consump. 351,564.2	National economy						
Generation of income (value added categories)	4			Gross value added 460,552.7						Consumption of fixed capital (-)			Compensation of employees from ROW 108.7	
										-204.2	0.0	-88,745.4		
Distribution and use of income (sectors)	5					Net national income 371,540.0		Taxes, receivable 82,589.9					Property income and current transfers from ROW 19,372.2	
Taxes (tax categories)	6		Taxes on imports 990.8	Taxes on production 33,356.5			Current tax on income, wealth etc. 48,242.6							
Capital (sectors)	7		Statistical discrepancy 3,972.3				Net saving 57,814.6							Capital transfers from ROW, net -214.4
Non-financial assets	Environmental protection facilities (types)	8a							Net capital formation 5,901.4					
	Social capital (types)	8b							38,907.1					
	Others	8c							6,592.2					
Rest of the world (ROW)	Current	9	Imports 38,272.4			Compensation of employees to ROW 171.8	Property income and current transfers to ROW 15,880.6						ROW	
	Capital	10							Changes in claims to ROW 10,171.8				Current external balance -10,386.2	

Substances										
Pollutants										
Air										
Grenhouse effects							Ozon layer	Acidification		
CO2	N2O	CH4	HFCs	PFCs	SF6	CFC	NOX	SO2	NH3
11a	11b	11c	11d	11e	11f	11g	11h	11i	11j
Emission of pollutants by producers										
969,670	61	1,208	19,611	10,671	16,533	-	1,300	782	-
Emission of pollutants by consumers										
248,094	10	36	0	0	0	-	708	123	-
Other domestic emission of pollutants										
0	0	160	433	762	197	-	0	0	-
							Cross border flow of pollutants from ROW			
							-	-	-	

(The bottom left of the J-NAMEA)

Substances			Item	Code	Supply of purchaser's price	Input of basic price	Final consumption	Destination of generated income	Current expenditures	Tax receipts, net	Capital expenditure	Non-financial assets	Current receipts from ROW	Capital receipts from ROW
Pollutants	Air	Greenhouse effects	CO2	11a										
			N2O	11b	Absorption of substances in the production process									
			CH4	11c										
			HFCs	11d										
			PFCs	11e										
			SF6	11f										
		Ozon layer	CFC	11g								Cross border flow of pollutants to ROW		
		Acidifi-cation	NOX	11h									-	
			SO2	11i									-	
			NH3	11j									-	
	Quality of water		T-P	11k		0								
			T-N	11l		0								
			Wastewater	11m		0								
	Waste		Final disposal	11n		212,310								
			Reuse	11o		149,782								
Natural resources	Energy resources		Natural gas	11p		92							2,375	
			Crude oil	11q		34						Depletion of ROW's natural resources caused by import	10,261	
			Coal	11r		153							3,610	
	Forests (volume)			11s		22,915							89,015	
	Waters			11t		88,900							0	
	Fish			11u		6,768							6,755	
Land uses	Agricultural land			11v										
	Forests etc.			11w										
	Water of rivers etc.			11x										
	Roads			11y										
	Land for housing etc.			11z										
	Other land			11aa										
Hidden material flows				11ab		Domestic hidden flows 1,218							Hidden flows caused by import 2,520	

		Supply of purchaser's price	Input of basic price	Final consumption	Destination of generated income	Current expenditures	Tax receipts, net	Capital expenditure	Non-financial assets			Current receipts from ROW	Capital receipts from ROW
Total		968,085.1	924,849.7	351,564.2	371,711.8	473,502.0	82,589.9	61,572.5	5,901.4	38,907.1	6,592.2	54,324.8	-214.4
									Other changes and revaluation				
Reconciliation accounts	R								-4,019.4	-3,237.4	-117,852.8		
									Closing stocks				
Closing stocks	CA								44,560.4	636,818.9	2,364,737.4		
Unit		Billion Yen											

Origin of substances										
1,217,764	70	1,404	20,044	11,433	16,730	-	2,008	906	-	
Unit: 1000 t										

(The top right of the J-NAMEA)

	Substances																				Environmental themes																	
	Pollutants					Natural resources						Land uses									Global		Regional				Changes in natural resources				Changes in land uses							
	Quality of water			Waste		Energy																																
	T-P	T-N	Wastewater	Finaldisposal	Reuse	Natural gas	Grude oil	Coal	Forests (volume)	Water	Fish	Agricultural lamd	Forests etc.	Water of rivers etc	Road	Land for housing	Other land	Hidden material flows	Accumulation of substances to the environment	Changes of natural resources in ROW caused by import	Greenhonse effects	Ozone layer depletion	Acidification	Eutrophication	Wastewater	Waste	Energy resources	Forests	Water	Fish	Agricultural land	Forests etc.	Water of river etc.	Road	Land for housing	Other land	Hidden material flows	Total
	11k	11l	11m	11n	11o	11p	11q	11r	11s	11t	11u	11v	11w	11x	11y	11z	11aa	11ab	X1	X2	12a	12b	12c	12d	12e	12f	12g	12h	12i	12j	12k	12l	12m	12n	12o	12p	12q	
Opening stocks																					-	-	-	-	-	-	22,597	-	-	-	5,170	25,420	1,320	1,190	1,680	3,000	-	Opening stocks 3,119,318.3
																																						Use at purchaser's prices 968,085.1
Emission of pollutants by producers	31	503	391	247,000	147,000																																	Output an basic prices 924,849.6
Emission of pollutants by consumers	26	321	468	47,912	2,782																																	Final consump. 351,564.2
																																						Origin of generated income 371,711.8
																																						Current receipts 473,502.1
																																						Tax payments, net 82,589.9
Changes in Land use												-40	-20	0	20	20	30																					Capital receipts 61,572.5
Other domestic emission of pollutants / Changes in natural resources																																						Capital formation 5,901.4
																																						38,907.1
	-	-	-	-	-	0	0	0	73,658	0	0																											6,592.2
Restoration of ROWs natural resources by national economy									-	-	-																											Current payments to ROW 54,324.8
																																						Capital payments to ROW -214.4

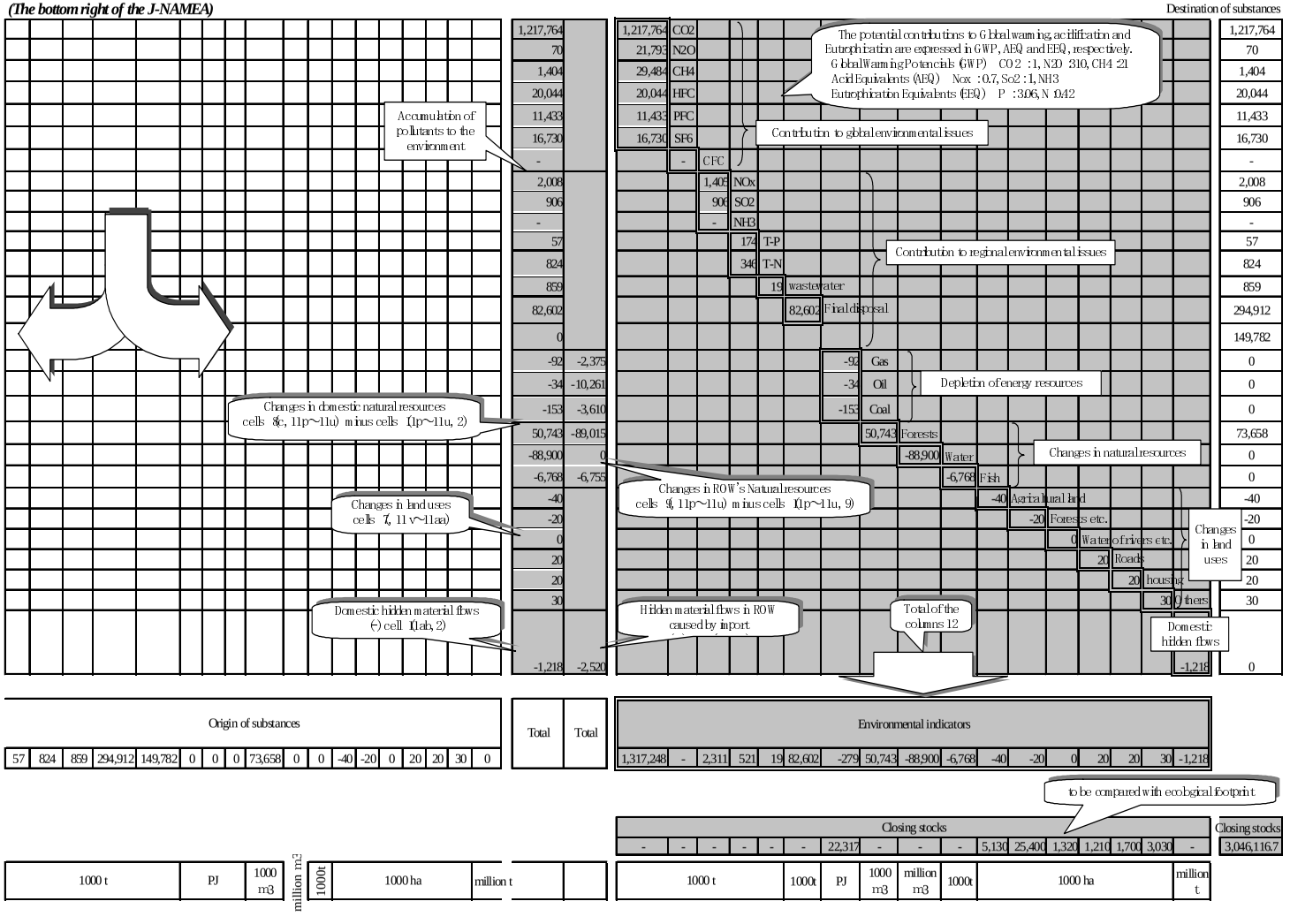

(The bottom right of the J-NAMEA)
Destination of substances
The potential contributions to Global warming, acidification and Eutrophication are expressed in GWP, AEQ and EEQ, respectively.
Global Warming Potencials (GWP) CO2 :1, N2O 310, CH4 21
Acid Equivalents (AEQ) Nox :0.7, So2 :1, NH3
Eutrophication Equivalents (EEQ) P :3.06, N 0.42
Accumulation of pollutants to the environment
Contribution to global environmental issues
Contribution to regional environmental issues
Depletion of energy resources
Changes in natural resources
Changes in land uses
Changes in domestic natural resources cells (8c, 11p~11u) minus cells (1p~11u, 2)
Changes in ROW's Natural resources cells (9, 11p~11u) minus cells (0p~11u, 9)
Domestic hidden material flows (-) cell (1ab, 2)
Hidden material flows in ROW caused by import
Total of the columns 12
Domestic hidden flows
CO2
N2O
CH4
HFC
PFC
SF6
CFC
NOx
SO2
NH3
T-P
T-N
wastewater
Final disposal
Gas
Oil
Coal
Forests
Water
Fish
Agricultural land
Forests etc.
Water of rivers etc.
Roads
housing
others
Origin of substances
Total
Total
Environmental indicators
Closing stocks
Closing stocks
to be compared with ecological footprint
1000 t
PJ
1000 m3
million m3
1000t
1000 ha
million t
1000 t
1000t
PJ
1000 m3
million m3
1000t
1000 ha
million t

Table 7. Basic structure of the PAFEE (Physical Accounting Framework for Environment and Economy)

(Physical term)

				Nation A						Rest of the world (ROW)		
				Goods & services (product groups)	Production (activity groups)	Disribution & use of income (sectors)	Capital		Material balance in A	Current account	Capital account	Material balance
							Sectors	Natural assets (types)				
				1	2	3	4	5	8	9	11	14
Opening assets			0					Opening assets				
Nation A	Goods & services (product groups)		1		Intermediate consumption	Final consumption		Capital formation		Export		
	Production (activity groups)		2	Output								
	Distribution & use of income (sectors)		3		(Value added)				Final consumption			
	Capital	Sectors	4			(Saving)					(Net lending from ROW)	
		Natural Assets (types)	5				(Capital formation)		Capital formation, Total use of resources(-) & total discharge of residuals(+)			
	Pressure on environment	Use of natural resorces (types)	6		Use of resources(+)	Use of resources(+)		Total use of resources(-)				
		Discharge of residuals (types)	7		Discharge of residuals(-)	Discharge of residuals(-)		Total discharge of residuals(+)		Discharge of residuals(-)		
	Material balamce in A		8									Material balamce in A
Rest of the world (ROW)	Current account		9	Import						(Production etc. in ROW)	(Capital formation in ROW)	Final consumption
	Capital	Sectors	10							(Current external balance of ROW)		
		Natural Assets (types)	11									Capital formation, Total use of resources(-) & total discharge of residuals(+)
	Pressure on environment	Use of natural resorces (types)	12							Use of resources(+)	Total use of resources(-)	
		Discharge of residuals (types)	13		Discharge of residuals(-)	Discharge of residuals(-)				Discharge of residuals(-)	Total discharge of residuals(+)	
	Material balamce		14									
Closibg assets			15					Closing assets				

→ : Physical flows

▭ : Cells for environmental flow data

Table 8. Basic structure of the MDPIOT (Multi-dimensional physical input-output tables)

Resource total

Sheets for resource type as 3rd dimension

Resource B

Resource A

Use (output) / Supply(input)				Nation A									Nation B (Major trade partners)									The rest of the world (ROW)	Other resources
				Production				Consump-tion	Accumulation		Environment		Production				Consump-tion	Accumulation		Environment			
				Base material	Manufac turing	Service	Waste man-agement		Capital formation	Waste storage	Env. as source	Env. as sink	Base material	Manufact uring	Service	Waste man-agement		Capital formation	Waste storage	Env. as source	Env. as sink		
	Lev.1	Level 2		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Nation A	Production	Base material	1	(-,+)*	Flow of intermediate products (+)		Interm. inputs for waste manag (+)	Material flows to final demand sectors (+)					Exports from A to B (+)									Exports from A to ROW (+)	
		Manufacturing	2	Flow of intermediate products (+)	(-,+)*																		
		Service	3			(-,+)*																	
		Waste management	4	Material flows other than wastes accompanied by waste management activities (+)																			
	Recovery	Recovered material	5	Recovery of by-products(-) and outputs to recycle/treatment/disposal(+)				Recovery of materials (-)		(-)													
	Accumu-lation	Intermediate products	6	Apparent intermediate flows				Stock (+)															
		Waste storage	7				Final disposal (-)			Stock (+)													
	Environ-ment	Environment as source	8	Resource extraction, oxygen input for combustion , etc (+)							Extractio n total (-)												
		Environmnet as sink	9	Direct emission of substances (CO2, etc.) from economic activities to the environment (-)					Erosion (-,+)			Emission total (+)											
Nation B (Major trade partners)	Production	Base material	10	Imports into A from B (+)									Flows of intermediate products				Material flows to final demand sectors (+)					Exports from B to ROW (+)	
		Manufacturing	11																				
		Service	12																				
		Waste management	13																				
	Recovery	Recovered material	14										Recovery of by-products(-) and outputs to recycle/treatment/disposal (+)				Recovery of materials (-)		(-)				
	Accumu-lation	Intermediate products	15										Apparent intermediate flow				Stock (+)						
		Waste storage	16													Final disposal (-)			Stock (+)				
	Environ-ment	Environment as source	17										Resource extraction, oxygen input for combustion , etc (+)							Extractio n total (-)			
		Environmnet as sink	18										Direct emission of substances (CO2, etc.) from economic activities to the environment (-)					Erosion (-,+)			Emission total (+)		
The rest of the world (ROW)			19	Imports into A from ROW (+)									Imports into B from ROW (+)									(ROW)	
Internal transformation			20	Internal transformation across type of resources (-,+)									Internal transformation across type of resources (-,+)										Balance (+,-)

*) For diagonal elements in production activities, gross production should be indicated with negative sign and self-consumption should be indicated with positive sign.

: Cells for environmental flow data

: In the short term, these cells will be filled by incomplete accounts to record the material flows induced by imports into A

References

Feeney, Patricia (2001),
"The Trust Business," OECD O*bserver*, No. 225, March 2001.

Oldenziel, Joris (2000),
"The 2000 Review of the OECD Guidelines for Multinational Enterprises: A New Code of Conduct?", SOMO, Amsterdam.

Organisation for Economic Co-operation and Development (2001a),
"The OECD Guidelines for Multinational Enterprises and Global Instruments for Corporate Responsibility", Background and Issues Paper, May 16, 2001, Paris.

Organisation for Economic Co-operation and Development (2001b),
"OECD Roundtable on Global Instruments for Corporate Responsibility", Summary Report of the Roundtable Discussion, June 19, 2001, Paris.

Organisation for Economic Co-operation and Development (2001c),
"The OECD Guidelines for Multinational Enterprises – First Annual Meeting of the National Contact Points", Summary Report of the Chair, September 21, 2001, Paris.

Sabel, Charles, Dara O'Rourke and Archon Fung (2000),
"Ratcheting Labour Standards: Regulation for Continuous Improvement in the Global Workplace", Washington, DC: The World Bank, Social Protection Discussion Paper No. 0011.

Trade Union Advisory Committee (2001a),
"TUAC Survey of the Functioning of National Contact Points", Paris.

Trade Union Advisory Committee (2001b),
"The OECD Guidelines on Multinational Enterprises: A User's Guide", Paris.

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