Chapter 15

# THE JEPIX INITIATIVE IN JAPAN

*A New Ecological Accounting System for a Better Measurement of Eco-Efficiency*

Nobuyuki Miyazaki
*International Christian University (ICU), Tokyo, Japan, miyazaki@icu.ac.jp*

**Abstract**: Currently in Japan, in addition to some officially or publicly authorized environmental accounting methods recommended by governmental agencies, a newly advocated and privately developed Japan Environmental Policy Priorities Index (JEPIX) is attracting attention. Many of Japan's leading companies, eager to introduce and develop ecological and eco-efficiency accounting systems, are introducing JEPIX in order to obtain data with relevance, reliability and comparability. JEPIX is a set of indices which makes different types of environmental interventions and impacts (originally measured in physical units) fully comparable in a common measurement unit of the Environmental Impact Point (EIP). The calculation is based on the Swiss eco-scarcity method, a Distance to Target approach which has been developed mainly by Ahbe and Braunschweig over the last ten years, conceptually based on the ecological bookkeeping (ökologische Buchhaltung) method advocated by Müller-Wenk (1978). Since 1991, the eco-scarcity concept has been applied in several European countries. Since 2003, 12 Japanese companies have voluntarily formed the JEPIX Forum initiative group, which aims to establish democratically a comprehensive standard of eco-efficiency accounting in Japan by introducing JEPIX into their own environmental management and environmental reporting systems, and by exchanging opinions with each other based on their experience. In this paper, some basic methodological and theoretical features of the JEPIX method will be introduced (in Section 2) followed by an elaborated explanation of the motivations and present activities of the JEPIX Forum as well as a characterization of the participating companies (in Section 3). Thereafter, a typical and practical benchmark application of JEPIX in an actual environmental report by Komatsu – a Japanese manufacturer of construction machinery – will be discussed (in Section 4). We address the fundamental reasons for why JEPIX is so appealing to Japanese companies (in Section 5) before, in Section 6, we finally present perspectives for future improvements of the method and its application.



*S. Schaltegger, M. Bennett and R. Burritt (Eds.), Sustainability Accounting and Reporting*, 339-354.

## 1. INTRODUCTION: ESTABLISHING A PRACTICAL ECOLOGICAL ACCOUNTING STSTEM IN JAPAN

Currently some environmental accounting methods, which are related to monetarily measured environmental costs and benefits (so-called *environmentally differentiated accounting*, Schaltegger and Burritt 2000, or *monetary environmental accounting,* Burritt et al. 2002) as well as to physically calculated environmental impacts (so-called *ecological accounting*, Schaltegger and Burritt 2000, or *physical environmental accounting,* Burritt et al. 2002), are strongly recommended by governmental agencies such as Japan's Ministry of Environment (MoE) and Ministry of Economy, Trade and Industry (METI). It is already a common phenomenon for a leading Japanese company to adopt a few of these officially recommended methods for its environmental management, even simultaneously, and to provide some kinds of eco-efficiency data (sometimes with sustainability data including on corporate social responsibility) in its annually published environmental report (Miyazaki 2000:721ff.).

In this situation today, a newly advocated, privately and democratically developed environmental accounting method, the *Japan Environmental Policy Priorities Index (JEPIX)* system is attracting the attention of many Japanese leading companies which are eager to introduce and develop ecological and eco-efficiency accounting systems in their own companies in order to obtain data with relevance, reliability and comparability.

In the following sections, some basic features of JEPIX and the related activity of the JEPIX voluntary initiative group, *JEPIX-Forum*, will be described, and the fundamental reasons for the remarkable progress of this private accounting initiative will be analyzed.

## 2. FUNDAMENTAL FEATURES OF JEPIX SYSTEM

JEPIX is a set of indices which make different types of environmental impacts comparable and make it possible to express with a single figure of EIP (environmental impact point) the environmental impact caused by the activities of a company. Some basic features of JEPIX are as follows.

Firstly, the JEPIX project was inspired by the eco-scarcity concept originally founded and advocated by Müller-Wenk (1978, 1980) with his unique name of *ecological bookkeeping* (or *ecological accounting: ökologische Buchhaltung* in German). The theory has been developed further in the publication of Braunschweig (1990) which deals with the environmental policies of several Swiss cities, and also in some publications of the Swiss Environmental

Agency (Bundesamt für Umwelt, Wald und Landschaft: BUWAL) (Ahbe et al. 1990, BUWAL 1998). The fundamental idea of eco-scarcity theory is expressed in the Equation:

$$\text{Ecofactor} = F/Fk*1/Fk \quad (1)$$

Here the numerator F stands for "*actual* flow" of one category of environmental intervention or impact (for example: $CO_2$, NOx, SOx, etc.), whereas the denominator Fk stands for "*critical* flow" (or means rather "target flow", Goedkoop 1995) of this category of environmental intervention or impact. As the actual flow F gradually approaches the critical flow Fk and even exceeds Fk (the latter case is the essential situation for which JEPIX indicators are actually calculated), the environmental condition will become worse, which means that environmental scarcity increases.

The second most important feature of JEPIX is the establishment of a *single-score index, Environmental Impact Point (EIP)* which will clearly indicate the priorities of action in an alternative situation because the alternative environmental measures, production processes or new products can be evaluated from an environmental standpoint in comparable EIP figures.

Thirdly, JEPIX reflects *Japanese environmental policies*, which means that the priorities derived from applying JEPIX will correspond with the (democratically legitimised) environmental policies of the government of Japan (in Table 15-1) and with international treaties such as the United Nations Climate Convention or the Montreal Protocol.

*Table 15-1.* Environmental categories covered by JEPIX.

| 12 categories covered by JEPIX | Laws and measures covered by JEPIX |
|---|---|
| • Greenhouse gases<br>• Ozone-depleting gases<br>• Toxic substances including dioxin<br>• Photochemical oxidants<br>• NOx<br>• SPM10<br>• BOD<br>• COD<br>• N<br>• P<br>• Land reclamation<br>• Road noise | • IPCC guidelines<br>• Montreal protocol<br>• Ozone Layer Protection Law<br>• PRTR law<br>• Voluntary control plan of toxic air pollutants<br>• Automobile NOx Law<br>• Air Pollution Control Law<br>• Water Pollution Control Law<br>• Environmental guidelines set by the Ministry of the Environment, etc. |

The indices, as described above, are basically calculated as a ratio between the actual and the target flow of emissions which indicates the distance to the target, and the estimation of the target flow reflects the environmental policies of the government of Japan. A list of the main data sources for

calculating the actual and target flows of JEPIX Indicators is shown in Table 15-2.

As a result, the priorities which are set by the government will automatically be the priorities of each company which adopts JEPIX for its environmental management because if a governmental environmental target becomes stricter (i.e., if the target flow figure is estimated to be lower), the corresponding eco-factor of JEPIX will rise and hence result in a higher score for the environmental intervention or impact under consideration. In such a situation, a reasonable decision of management would be to increase attention on this particular environmental policy priority subject.

*Table 15-2.* List of main data sources for calculating the JEPIX indicators.

| | Actual flow | Target flow | Main data sources and remarks |
|---|---|---|---|
| Greenhouse gases (GHG) | Japan's Third Report on the Framework Convention on Climate Change, by the MoE | IPCC Third Report on Global Warming | Calculates GHG other than $CO_2$, on a GWP100 basis (greenhouse warmth potential for hundred years). |
| Ozone-depleting potential (ODP) | National CFC Phase-out Plan (July 2001) | National CFC Phase-out Plan (July 2001). Amount of foaming agent stock | Calculates substances other than R11, on an ODP basis (ozone depletion potential). |
| Photochemical oxidants | METI's voluntary control plan of toxic air pollutants (OECD). | Calculated based on differences from environmental guidelines | Numerical environmental databases of the Environmental Information Center, National Institute for Environmental Studies |
| Dioxin and other toxic substances | 12 substances are listed in METI's voluntary control plan of toxic air pollutants. | 12 substances are listed in METI's voluntary control plan of toxic air pollutants. | Materials of the 5th meeting of the WG on toxic air pollutants under the Risk Management Subcommittee, Chemicals and Bio-industry Committee, Industrial Structure Council, METI<br>Third report on PRTR research by the Japan Federation of Economic Organizations |
| Biochemical oxygen demand (BOD) | Estimates based on household emission data from the White Paper on the Envi–ronment and data from experts in Japan | Estimated from environmental guidelines | Lake research data and chronological tables of flow by the Ministry of Land, Infrastructure and Transport |

*continued on next page*

*Table 15-2.* Continued.

| | Actual flow | Target flow | Main data sources and remarks |
|---|---|---|---|
| Chemical oxygen demand (COD) | Estimates virtual flows based on the actual flows of Tokyo Bay, Ise Bay, and the Seto Inland Sea | Same as the left | Office of Environmental Management of Enclosed Coastal Seas, Water Environment Management Division, Water Environment Department, MoE |
| Total nitrogen, total phosphorus | Report to the Japanese government and the secretariat of the UNFCCC | Calculated based on the target values of 6 prefectures | Automobile NOx Law, reports of the Investigative Committee on Reduction of Total Automobile NOx Emissions |
| NOx | Estimates based on the composition ratio of PM emissions | Calculated by comparing data in observatories that do not meet environmental guidelines against average concentrations in prefectures that do meet the guidelines | Investigation of fixed sources of air pollution in 1999 by the MoE<br>Numerical environmental databases of the Environmental Information Center, National Institute for Environmental Studies |
| SPM10 | Materials published by the MoE (OECD). | Materials published by the MoE (OECD) | Environmental Performance Review |
| Emission control, landfill capacity | Total travel distance of regular cars and large-size cars. | Calculated based on the achievement ratio of the environmental guidelines on noise. | Hearing from the Ministry of Land, Infrastructure and Transport; HP of the MoE. |

Fourthly, JEPIX is based on a private "*bottom-up approach*" in contrast to the *Ministry Guideline*. The Guideline was stimulated and published by the MoE, and is therefore close to a "top-down approach". In contrast, the JEPIX project was stimulated by the strong and enduring initiative of Siegenthaler and has been developed by the JEPIX research team (co-leaders: Siegenthaler and Miyazaki; members: Kumagai, Shinozuka, Nagayama, Schoenbaum, Azuma and Nakamura (Miyazaki et al. 2003:1f.)), which can be characterized as a voluntary and private organization. Financial support was provided by the Japan Science and Technology Corporation (National Agency of Science and Technology) as a part of the Eco-Rating Project for the fiscal years 2001-2003.

## 3. JEPIX FORUM: PRACTICING ECO-CONTROLLING WITH JEPIX-ECOBALANCES

In the autumn of 2003, 12 large Japanese industrial companies (TEPCO, Canon, Suntory, J-Power, and others) voluntarily organized the JEPIX Forum on the initiative of the JEPIX development team (co-leaders: Miyazaki and Siegenthaler; now comprising 27 companies, including 15 companies which belong to the 2nd enlarged JEPIX Forum). The 12 pioneering companies (the names and some related data are shown in Table 15-3) have been preparing for the application of JEPIX based on their experience with Eco-Balances and eco-efficiency measures, discussing the strengths and shortcomings of JEPIX, and improving the relevance and utility of JEPIX by exchanging their own experiences gathered within their companies.

*Table 15-3.* Participating companies in JEPIX Forum 2003.

| Company name | Sales amount | Type of industry |
|---|---|---|
| Canon | ¥3,198 billion | Copying machines, Digital cameras, Video Camcorders, Printers |
| Sekisui Chemical | ¥845 billion | Housing, High Performance Plastics, Urban Infrastructure |
| Bosch in Japan | ¥192 billion | Automotive Technology, Power Tools, Industrial Technology |
| Alps Electronic company | ¥602 billion | Magnetic devices, Automotive products, Peripheral products |
| Mitsubishi Estate | ¥681 billion | Building Business, Residential Development, Urban Development |
| Railway Technical Research Institute | ¥17 billion | Research Institute |
| Fujifilm | ¥795 billion | Copying machines, Film, Digital cameras, Information media |
| J-Power | ¥546 billion | Power supply |
| KAO | ¥900 billion | Fabric and Home Care, Personal care, Chemical Products, Health care |
| Suntory | ¥1383 billion | Alcohol (Whisky, Beer, Wine), Soft drinks, Food |
| Tepco | ¥4,919 billion | Power supply |
| Komatsu | ¥1,089 billion | Lift Trucks, Outdoor Power Equipment & Hobby Engines, Diesel Engines & Hydraulic Equipment, Industrial Machinery |
| Yamatake | ¥50 billion | Industrial automation systems, Building automation systems |

The JEPIX Forum is financially supported by the *Ministry of Education, Culture, Science and Technology, Japan* as a part of the *'21st Century Center of Excellence (COE) Program'* of the International Christian University (ICU) for the fiscal years 2003-2007. In addition, the development of the JEPIX method has been endorsed by many institutions of world authority.

# 4. CASE STUDY: AN EXAMPLE OF JEPIX APPLICATION IN KOMATSU

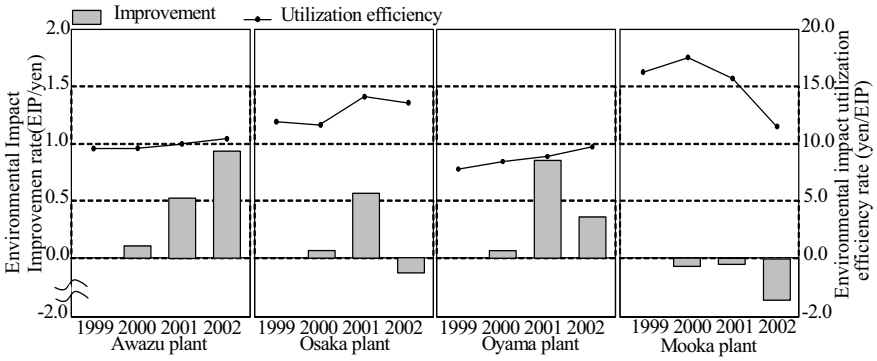
## 4.1 Application of Environmental Accounting Guideline

Komatsu, one of the largest manufacturers in Japan, manufactures and sells construction and mining equipment, electronics products, industrial machinery and vehicles, and environment-related systems. To achieve more efficient environmental management, Komatsu has adopted the *Environmental Accounting Guideline* (JEA 1999, JME 2002) and has been disclosing its results through its environmental reports since 1999, now including its subsidiaries abroad.

Although the financial and economic situation of environmental conservation can be made fairly clear by application of the Guideline, there are still many physical figures which as a whole can be interpreted in various ways and lead to different conclusions. Most importantly, the impacts on the environment take place in many different ways and are measured in different units, such as the emissions of greenhouse gases, contamination of water, and production of solid waste. This makes it impossible to compare the different environmental impacts rationally.

## 4.2 Application of JEPIX

To eliminate or mitigate the difficulty above, Komatsu decided to apply JEPIX from 2003, which has made it possible to compare and assess different types of environmental impacts with a consistent unit in a holistic way (JEPIX Forum 2004:175ff.). Komatsu applied JEPIX to four of its domestic factories. By using two types of eco-efficiency index, it became possible to compare their efficiency and effectiveness in environmental conservation, based on a single unit of EIP. The results are shown in Figure 15-1, which shows the recent trends and comparison of two types of eco-efficiency figures of Komatsu's four manufacturing plants.




Improvement rate:
*Effect of environmental impact reduction in relation to cost (EIP/yen) for environmental conservation activities, enabling us to measure the extent of environmental impact reduction for each monetary unit of 1 yen for environmental conservation activities.
*This enables us to assess the effectiveness of environmental conservation activities.

Utilization efficiency rate:
*Added value of manufacturing in relation to the degree of environmental impact (yen/EIP), enabling us to measure the amount of monetary value added (added value) in relation to the degree of environmental impact
*This enables us to assess the environmental impact utilization efficiency rate directly related to business activities.

Cost of environmental conservation activities: costs + investment amounts – depreciation

EIP: Environmental Impact Points

*Figure 15-1.* Comparison of utilization efficiency and recent trends for environmental impact (source: Komatsu Environmental Report 2003:8f.).

## 4.3 Summary of Case Study

The results show that the *Awazu* plant has recorded the highest "improvement rate" for the fiscal year of 2002, which means the efficiency of its environmental conservation activities. The *Osaka* plant achieved the best "utilization efficiency rate", meaning the equivalent value added with the least environmental impact. In conclusion, *Awazu* plant has carried out the most efficient environmental conservation, while *Osaka* plant has been the most environmentally friendly plant when expressed in quantitative terms. In addition, *Oyama* plant has been steadily reducing its environmental impact year by year.

The adoption of JEPIX has made it feasible for top management to judge easily which factory has created the least/most environmental impact, based

on a single unit of EIP. Combination of these EIP data with monetary environmental costs and economical value added has enabled further comparison and evaluation from the point of eco-efficiency. Komatsu plans to apply this method also to Komatsu Group manufacturing facilities (including overseas manufacturing facilities) in order to practice ecological business administration on a consolidated basis.

# 5. ATTRACTIVENESS OF JEPIX FOR JAPANESE COMPANIES: BUSINESS PERSPECTIVE WITH AN OVERALL ECO-EFFICIENCY FIGURE

The last part of this short paper will argue about the reason why JEPIX prevails among Japanese leading companies today. It is mainly because JEPIX enables company management, especially top management, to make it possible to calculate *overall eco-efficiency indicators* by providing *aggregate ecological figures* in a single unit of EIP, which will be described below.

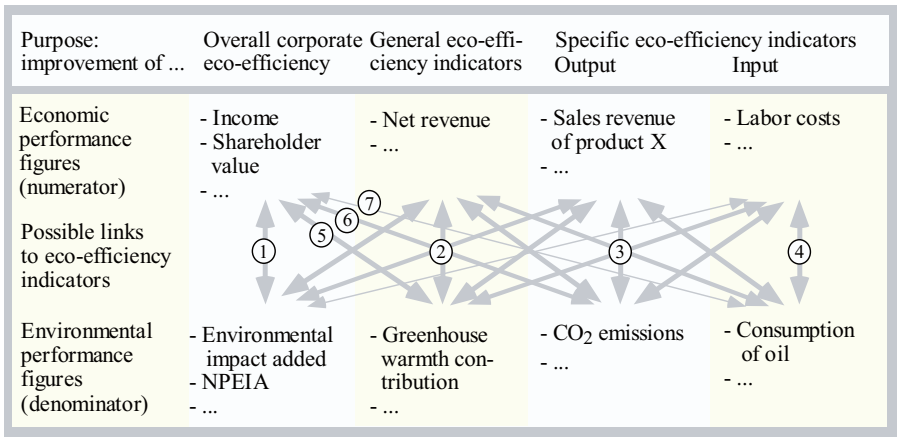
## 5.1 Eco-Efficiency as Relevant Management Guide

In the present economy, where companies pursue more profit for themselves while reducing impact on the environment in a continuous business effort, consistent pursuit of the principles of economy and ecology is vitally necessary for rational and sustainable management (Schaltegger and Sturm 1990: 282ff.). Ecological consciousness is today not only a necessary condition of sustainability but also an inevitable foundation of a company's legitimacy in society, which should be firmly established in corporate business strategy, taking precedence over other business purposes. In this double-track situation, the most practical strategy for companies is not the absolute reduction of environmental impact, but the relative reduction of environmental impact compared with their business performances (e.g. sales, value added, net profit etc.).

Therefore, eco-efficiency indicators measured through the transformation or integration of a set of economic and ecological indices/indicators (one from economic/monetary accounting and the other from ecological/physical accounting, where the former is usually the numerator, and the latter the denominator) are theoretically one of the most relevant management guides for companies (Schaltegger and Burritt 2000:361).

## 5.2 Overall Eco-Efficiency Indicators have Vital Importance for Management

What is important here is that theoretically (as well as practically, Kawamura 2003:54), a vast number of combinations of economic and ecological figures are possible, reflecting the multi-dimensional character of the eco-efficiency concept, which generates many links for deriving overall, general and specific eco-efficiency indicators as seen in Figure 15-2 (Schaltegger and Burritt 2000:362f.).




*NPEIA = net present environmental impact added

*Figure 15-2.* Systematic collection of eco-efficiency information (source: Schaltegger and Burritt 2000:362).

Among these many links, overall (and general) eco-efficiency links have vital importance for management decision-making (especially for that of top management) because of their ability to provide a comprehensive view of the economic and ecological situations actually faced by the company.

The importance of aggregate numbers cannot be stressed too much, because not many eco-efficiency calculations can be thought of without aggregate figures. In case of only using detail figures, there would be as many categories of eco-efficiency data as the numbers of individual environmental interventions, and these vast numbers of eco-efficiency figures might bring about only a chaotic situation without any holistic perspective to correspond to the view taken by top management.

Although various methods (e.g. Centrum for Milieukunde, CML) do exist to assess and trace specific environmental impacts such as global warming, acidification, smog, etc., such methods leave decision-makers with a series of indices. However, these methods have not yet seen a comprehensive

uptake by managers. Their application seems more appropriate for engineers, for example in product development, but they leave the evaluation of priorities to the users who then have to decide what relevance each impact has for them.

In contrast, aggregate indices aim for comprehensive evaluation and reproducible priorities, which will ensure the accountability of eco-efficiency monitoring and communication, and thereby serve the concept of Corporate Social Responsibility. In the case of a policy-based method such as JEPIX, the results can be seen as an early warning indicator of the future environmental costs that might result from more stringent legal regulation to cope with the gap between actual flows and political targets, so that it can support the company's risk management where top management has the main responsibility to take quick action (and without fatal delay), and for whose rapid and relevant decision-making JEPIX single unit indicators can be very useful.

## 5.3 Necessary Aggregated Ecological Data are Not Available

In the eco-efficiency schema (Figure 15-2), aggregate figures of economic performance, such as net income, value added, free cash flow, sales, net revenue, etc., are not difficult to acquire because most of these financial figures are currently prepared in the process of a company's (internal) management accounting and (external) financial reporting.

Compared with such high availability of aggregated data in a single (comparable) monetary unit (or in some monetary units), aggregated ecological figures in a common unit (or some equivalent units) such as (net present) environmental impact added, etc., are usually very difficult or even impossible to acquire, although they will enable overall decision-making and provide a foundation for rational environmental management (Braunschweig and Müller-Wenk 1993:43, Schaltegger and Burritt 2000:364).

Using the language of Life Cycle Assessment (LCA), company decision-makers need a practical approach to impact assessment in order to assess environmental interventions from an ecological standpoint, i.e. through reducing the numerous available environmental measures to just a few units, or even only a single unit of measurement, after the aggregation of each physically identified intervention.

## 5.4 Why are Aggregate Ecological Figures Not Available in Japan?

The main reason for the absence of widely-accepted aggregate ecological data of relevance in Japan is the lack of an acknowledged ecological accounting system (meaning in Japan substantially *life cycle assessment (LCA) + environmental performance evaluation (EPE) + eco-labelling (EL)*) because of the lack of an acknowledged ecological accounting standard-setting committee or body so far (Schaltegger and Burritt 2000:276).

In Japan, to break through this difficult situation, many attempts at integrating different environmental impacts into aggregated, comparable numbers (including those with a top-down approach by the government) have been made for about ten years. They have not, however, proven to be very successful because many of the leading Japanese companies have not introduced them, in spite of the efforts of various governmental bodies such as ministries and agencies as well as research institutions and universities.

Therefore, generally accepted weighting factors (GAWF) for environmental impacts (the principles, methods and results for them) which will enable comprehensive and fair ecological valuation (pricing) have not yet been developed and are not yet publicly available, because these early attempts have not been successful in gaining substantial support and participation from industry. Considering the importance of generally accepted accounting principles (GAAP) as the basis for the availability of comprehensive and fair accounting information, especially in American accounting practices and international accounting standards setting, this immature situation has been far from satisfactory, or even frustrating, for all stakeholder groups. But why are GAWF lacking?

Though the importance and much experience of the preceding attempts for determining relevant valuation factors cannot be denied, it must be pointed out that they have usually lacked (1) *established principles* (e.g. the eco-scarcity principle for JEPIX) *with high practicability* as a basic foundation of developing any methods, (2) *enduring and consistent scientific study with international and interdisciplinary cooperation* (e.g. JEPIX international research team), and (3) supporting sufficiently large *company organizations with eagerness and experience* (e.g. JEPIX Forum). Regarding (3), it is worth mentioning here that with a top-down approach by the government, many participating Japanese companies had never seriously committed themselves with real and positive motivation to the developing work, which seems quite different from the developing work of JEPIX with its bottom-up approach based on a voluntary initiative.

## 5.5 JEPIX as the Basis of a Standard Ecological Accounting System

JEPIX (the Japan Environmental Policy Priorities Index) is the most recent result of the efforts which have been dedicated to breaking through these difficult situations by establishing a set of generally accepted weighting factors (GAWF) for environmental interventions and impacts (which are closely related with environmental priorities for management), a de facto standard of ecological accounting system with a bottom-up approach. JEPIX has until now been given the voluntary support of many kinds of public and private organizations including about 30 leading large Japanese industrial companies, which have enabled full and explicit comparison of their aggregate environmental impact figures and overall eco-efficiency indicators between participating companies of JEPIX-Forum fairly well.

# 6. FUTURE PERSPECTIVES

Even now, there are some critical opinions about the so-called arbitrary nature of JEPIX because it is fundamentally based on political target figures, which cannot practically avoid all the (undesirable) subjective elements (for the historical list of important critics including Callenbach et al. 1990:26, see Miyazaki 2000:418ff.). Hence, logical consistency and a scientific attitude are always required for determining the JEPIX index figures.

In order to determine JEPIX more scientifically and objectively, consideration of the following points will be of essential importance in the near future: (1) examination of the appropriateness and reasonability of *categorization in 12 fundamental environmental themes* by up-to-date knowledge of environmental sciences, especially LCA studies, (2) precise and objective determination of *target figures*, especially the choice of environmental laws and regulations, (3) inquiry into the legislation process of environmental policy law, not excluding the possible large influence of *economic powers and political pressure groups* on environmental laws, (4) correct determination of *periodical and geographic boundaries* for calculating indicators as well as for their application, (5) periodic correct and reasonable *matching* of EIP data with economic data (Miyazaki and Azuma 2003), (6) comparison with *other impact assessment methods*, especially the Life Cycle Impact Assessment Method based on Endpoint Modeling (LIME) (RCLCA 2001-2003) and Eco-Indicator 99 (Goedkoop and Spriensma 2000), (7) introduction of Excel Sheet for easy and comfortable use for *environmental reporting* with JEPIX and (8) *accreditation or certification* of JEPIX figures by authoritative third parties.

From an accounting point of view, (1) *completeness*, (2) *alternativeness* and (8) *verifiability* are certainly the most important elements to consider for the list of points above.

Concerning the *completeness of categories* (1), it is probable that there are some further additional important environmental categories to consider. So long as such possibilities cannot be eliminated theoretically, periodic re-examination of the advance of scientific knowledge in environmental sciences and of actual significant environmental issues are necessary for securing the scientific neutrality of categorization. For example, the inclusion in JEPIX of scarcity of non-renewable resources (energy and materials) might be considered in the near future.

There are today, both theoretically and practically, often *alternative* domestic and international *laws and regulations* (2) to adopt as a target value for JEPIX, which is comparable to that of traditional, financial accounting with numerous alternative accounting methods. There is no rational best solution, but at least, as in the case of BUWAL SR 297 (BUWAL 1998), the *binding power* of each law ought to be considered and described clearly. Generally speaking, laws with greater binding power possess priority compared with those of small binding power.

Thirdly, the importance of *verifiability* (8) of the Ecofactors will grow with its application by the many companies. In order to enhance the reliability and comparability of data, the participation of many companies from various industrial fields is not sufficient. Most desirably, a formal, established certification procedure by professional experts of neutral institutions (environmental experts, certified accountants, etc.) should be taken to both JEPIX determination procedures and the application of JEPIX figures to the corresponding inventory data of each company.

As of now, the activity of the JEPIX-Forum is still in the beginning stage. Further efforts to ensure the *relevance, reliability* and *comparability* of JEPIX figures are needed in order to make them a more useful accounting tool for stakeholders. More than 100 participating companies and groups in the JEPIX-Forum are needed in practice to make the environmental performance evaluated by JEPIX fully comparable in many industrial fields, including service industries such as banking and insurance, and also non-profit organizations such as universities, municipalities and Non Governmental Organizations (NGOs).

Finally, it will be important to cooperate with other domestic and foreign organizations, including legislative bodies and LCA research institutes. At the same time, critical opinions from both the academic and the practical fields will be extremely important for the enhancement of the interdisciplinary methodology of JEPIX.

## ACKNOWLEDGEMENTS

I appreciate the continuous support of Stefan Schaltegger for the development of JEPIX, and am very grateful to Claude Patrick Siegenthaler and Kentaro Azuma for their valuable advice on this paper. This paper has been written with the financial support of the Japanese Ministry of Education, Culture, Science and Technology in the framework of the 21st Century Centre of Excellence (COE) Program.

## REFERENCES

Ahbe S, Braunschweig A und Müller-Wenk R (1990) *Methodik für Ökobilanzen: auf der Basis ökologischer Optimierung* (BUWAL Schriftenreihe Umwelt Nr. 133) Bern, BUWAL (available only in German and Japanese)

Burritt R, Hahn T and Schaltegger S (2002) Towards a Comprehensive Framework for Environmental Management Accounting. Links Between Business Actors and Environmental Management Accounting Tools, *Australian Accounting Review* Vol. 12, No. 2, 39-50.

BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (1998) *Bewertung in Ökobilanzen mit der Methode der ökologischen Knappheit Ökofactoren 1997* (BUWAL Schriftenreihe Umwelt Nr. 297) Bern, BUWAL (available only in German and partly in Japanese)

Callenbach E, Capra F and Marburg S (1990) *The Elmwood Guide to Eco-Auditing and Ecologically Conscious Management* (Global File Report No. 5) Berkeley

Goedkoop A (1995) *Eco-Indicator 95 Weighting Method for Environmental Effects That Damage Ecosystems or Human Health on a European Scale: Contains 100 Indicators for Important Material and Processes* Amersfoort, National Institute of Public Health and Environmental Protection

Goedkoop MJ and Spriensma R (2000) *The Eco-indicator 99, A Second Edition: A Damage Oriented Method for Life Cycle Impact Assessment, Methodology Draft 2000* Amersfoort, Pre-Consultants

JEA (Japan Environmental Agency) (1999) *Guideline for Recognition and Reporting of Environmental Protection Costs: Toward the Establishment of Environmental Accounting* (interim report) Tokyo

JEPIX Forum (2004) *JEPIX Forum Annual Report 2003* Tokyo, Yamatake Co., International Christian University

JME (Japan Ministry of Environment) (2002) *Environmental Accounting Guideline: Toward the Establishment of Environmental Accounting* (revised version 2002) Tokyo

Kawamura M (2003) Age of Environmental Management Indicators: Environmental Management in the Balance of Environmental Impact and Economic Value *Quarterly Report* Vol. 26, 37-67 (available only in Japanese)

Komatsu (2003) *Environmental Report 2003* Tokyo, Komatsu

Miyazaki N (2000) *Integrated Environmental Accounting* Tokyo, Soseisha Publishing (available only in Japanese)

Miyazaki N and Azuma K (2003) Theoretische Grundlage der ökologischen Buchhaltung: Rechnung der Umweltbelastungen durch die doppelte Ökobilanzierung *in* Miyazaki N, Siegenthaler C, Schoenbaum T and Azuma K (2003) *Japan Environmental Policy Priorities Index 2003 (JEPIX)* (21st Century COE Monograph Series 7) Tokyo, Social Science

Research Institute of International Christian University 60-77 (available only in German, with a summary in English)

Miyazaki N, Siegenthaler C, Schoenbaum T and Azuma K (2003) *Japan Environmental Policy Priorities Index 2003 (JEPIX)* (21st Century COE Monograph Series 7) Tokyo, Social Science Research Institute of International Christian University (Japanese translation also available from Internet URL <:http://www.jepix.org> <:http://subsite.icu.ac.jp/coe/>)

Müller-Wenk R (1978) *Die ökologische Buchhaltung. Ein Informations- und Steuerungsinstrument für umweltkonforme Unternehmenspolitik* Frankfurt, Campus Verlag (available only in German and Japanese)

Müller-Wenk R (1980) Ökologische Buchhaltung: eine Einführung *in* Simonis UE *Ökonomie und Ökologie: Auswege aus einem Konflikt* Heidelberg, Verlag C. F. Müller (available only in German and Japanese)

RCLCA (Research Center for Life Cycle Assessment) National Institute of Advanced Industrial Science and Technology (2001-2003) Life Cycle Impact Assessment Method Based on Endpoint Modelling (LIME) *Workshop Proceedings* No. 1-5 (available only in Japanese)

Schaltegger S and Burritt RL (2000) *Contemporary Environmental Accounting: Issues, Concepts and Practice* Sheffield, Greenleaf Publishing (Japanese and Chinese translations also available)

Schaltegger S und Sturm A (1990) *Ökologieorientierte Entscheidungen im Unternehmen: Ökologisches Rechnungswesen statt Ökobilanzierung: Notwendigkeit, Kriterien, Konzepte* Bern, Haupt Verlag

Schaltegger S and Sturm A (1990) Ökologische Rationalität: Ansatzpunkt zur Ausgestaltung von ökologieorientierten Managementinstrumenten *Die Unternehmung* Nr. 4, 273-290