JLCA News English Edition No.1

JLCA NEWS LETTER

LIFE CYCLE ASSESSMENT SOCIETY OF JAPAN

NEWS LINE

Preface: The Spread of LCA in Japan

Chairman of Planning & Information Sub-Committee of JLCA
(Kiyoshi Ueno: Mitsubishi Electric Corporation)

The Life Cycle Assessment Society of Japan (JLCA) was formed on October 25, 1995 in order to provide a forum for those in industry, academia and public research agencies involved in life cycle assessment (LCA) in Japan to discuss data, problems and future trends, as well as to share and exchange information. The secretariat is established in the Japan Environmental Management Association for Industry (JEMAI). In December that same year the JLCA Newsletter Issue No. 1 was published to provide information on the forum's activities and the LCA projects implemented in industries. At present, the newsletter has already reached Issue No. 38. The newsletters (in Japanese), including back issues, are available for public viewing on the JEMAI web site. The JLCA Planning & Information Sub-Committee has decided to re-edit the most recent contents of these newsletters and issue an English version in order to make the latest information on LCA in Japan available to the global community.

LCA in Japan started from the research stage in the 1970s, and universities and government research agencies have continued to advance scientific research on LCA. At universities there has been a rapid increase in specialized fields of study related to the environment, but since LCA researchers come from a wide range of backgrounds, including materials, electrical, mechanical and economics, at the 700 universities and 1700 colleges in the country, the number of students majoring in LCA is increasing, even in fields other than the environment. According to my estimates, there are more than 1000 students majoring in LCA. LCA appeared on the 2001 University Testing Center Examination. This means that high school students are required to be aware of LCA before entering college. Today, at many high schools the significance of LCA is being taught.

Since 1992 many Japanese businesses have established "Environmental Enhancement" departments. At that time in Japan, a search for information would only yield about 1,000 documents referring to "LCA". Today, searching on the Web in Japan using the keyword "LCA" produces 3,600,000 references. LCA seems to have spread thoroughly throughout Japan in just a little over 10 years. In the social environment reports released by many companies each year it is impossible to find a report that does not mention LCA. This probably means that companies not engaging in LCA are unable to gain high reputation. Surely it is no exaggeration to say that LCA has become part of the vocabulary of the people of Japan.

The advanced electrical and electronics industry, automotive industry and materials industries in Japan are greatly concerned about the environment. Early on, these industries focused on LCA as a tool to assess environmental burden. At many large companies there is training and development of LCA engineers. The application to actual products is progressing and these activities are spreading to a wide range of industries, including the food industry, housing industry, and even recycling industries.

JEMAI works hard to promote LCA throughout the industrial world through maintenance and management of the Japan LCA database, as well as seminars, symposia, training and education, and consulting.

It is hoped that this English Edition of the JLCA Newsletter will generate feedback from many readers abroad on the research results and specific case studies of LCA in Japan.

Recent Activities of the JLCA

The Life Cycle Assessment Society of Japan (JLCA) was established in October 1995 as a network to distribute information on LCA to interested parties in industry, academia and government. The JLCA has promoted discussions on the future progress of LCA in Japan, and released a JLCA report and LCA Policy Statement in June 1997 proposing the construction of an LCA background database as well as the development of impact assessment methods that are most suitable for the circumstances in Japan. Subsequently, in FY1998 the Ministry of Economy, Trade and Industry began a 5-year LCA Project, which was completed at the end of March 2002 with the construction of an LCA database. In consideration of the circumstances of the project and the provision of data for inclusion in the database from more than 50 industry organizations, the Ministry of Economy, Trade and Industry decided that it would be appropriate for this database to be managed and operated by the JLCA, since the group brings together industry, academia and government.

As a result, since 2003 the JLCA has rebuilt their organization to focus on the primary function of operating and managing the database, and is proceeding with new activities to start a commendation system.

At present, the JLCA conducts activities in the following three main areas.

(1) Activities related to the operation, management and promotion of utilization of the LCA database

JLCA maintains the security system to manage and maintain the data provided by the industry organizations, as well as editing, updating and posting data. At the same time, background data is researched and created. Through the continuous posting of the latest information the most recent LCA data is provided to members who have obtained an ID and password.

The contents of the offered data include:

1. Representative product inventory data (gate-to-gate) provided by industry organizations
2. Project survey inventory data (mining process, disposal process, etc.)
3. Lists of characterization factors for impact categories, damage factors for end-point and weighting factors to derive a single index for a Japanese version of the Life Cycle Impact Assessment Method based on Endpoint Modeling (LIME)
4. LCA reference literature extract data

(2) Information services

The latest LCA information in the JLCA Newsletter as well as information on various types of events is published periodically four times a year and distributed via mail magazine and mail services. In addition, LCA-related seminars are held (some in conjunction with the Institute of Life Cycle Assessment Japan (ILCAJ)) and efforts are made to provide LCA-related information to the members.

The 1st seminar in April 2005 focused on “EuP Directive (proposal) Trends” and “Dealing with Globalization in Environmental Concerns and Plannings, such as RoHS and EuP,” offering information related to environmental concerns associated with LCA in Europe. At the second seminar in September there were reports on the progress of the second phase of the LCA Project (FY2003 ~ FY2005), including “Product LCA,” “Recycling LCA,” “Regional LCA” and “Impact Assessment”. At the third seminar in December the LCA award recipients made presentations and the superior LCA activities being implemented at various companies, etc., were introduced.

During this time in November lectures were co-sponsored with the Institute of Life Cycle Assessment Japan on the theme of “LCA in Daily Life: From the perspective of lifestyle, consumer electrical products and housing,” including discussions on “Lifestyle and Energy Consumption – Results of a national survey of 4000 households,” “Industry-related Optimization Models and Applications to Housing Policy,” “Whole Household Factor X – Factor for energy-consuming products in the home,” and “LCA for Housing / Labeling Tools.” Each session was attended by about 150 participants.

In addition, an English version website presenting the LCA activities of member organizations and businesses is being offered.

(3) Commendation activities

In 2004 the JLCA Awards system was started in order to publicly recognize superior LCA activities and methods of member organizations. The awards are announced in December at the Eco-Products Exhibition.

The 1st JLCA Awards (2004)

■ JLCA Award

Toyota Motor Corporation, Environmental Department

"Introduction of LCA activities to the vehicle development process (Eco-VAS (Eco Vehicle Assessment System))"

■ Incentive Award

Dai Nippon Printing Co., Ltd., Packaging Development Center

"Development of beverage stopper systems and PET bottles to reduce environmental burdens based on LCA"

Fujitsu Corporation, Environmental Headquarters

"LCA communication activities through the Fujitsu group ecology leaflets and environment efficiency indexes"

Plastic Waste Management Institute

"Collection of LCI data on plastic products and disposal processes for used plastics, and education / dissemination of LCA methods"

SHINKO Electric Industries Co., Ltd., General Development Department

"LCA promotion activities in university education and in industry, government and academia, and introduction of LCA case studies on IC packages"

National Institute of Advanced Industrial Science and Technology, Lifecycle Assessment Center

"Comprehensive research and development related to LCA"

Architectural Institute of Japan, LCA Guidelines Sub-Committee

"Development of LCA methods for buildings and release of calculation software"

■ Service Award

Nobuhiko Takamatsu (International Iron and Steel Institute / Nippon Steel Corp.)

The 2nd JLCA Awards (2005)

■ METI Industrial Science & Technology Policy and Environment Bureau Director-General's Award

Canon Inc., Global Environment Promotion Headquarters

"LCA practices for business activities and all Canon product genres, and release of environmental information"

■ Chairman's Award

Industrial Research Institute of Shiga Prefecture

"LCA promotion activities in Shiga prefecture"

■ Incentive Award

Mitsubishi Electric Corp., Advanced Technology R&D Center, Materials Technology Group

"Development and standardization of LCA assessment technology for the Mitsubishi Electric group"

Fuji Electric Retail Systems Co. Ltd.

"Development of vending machines applying LCA"

Nikkei BP Eco Management Forum

"Nikkei BP Eco Management Forum LCA Special Research Group"

Hitachi Ltd., IMS Project EFSOT

"Life cycle impact assessment for lead-free solder"

■ Service Award

Yasuo Hosoya (Tokyo Electric Power Co., Consultant)

Isao Iwabuchi (Furukawa-Sky Aluminum Corp., Executive Director)

(4) Member information

Currently, the JLCA is operated with member support, including 42 industry associations, 6 other societies, 188 businesses, 61 individuals, and 62 university research organizations. There are about 1000 registered users with the ability to access the database.

Focusing on the activities described above, the JLCA has successfully spread and promoted the use of LCA methods, particularly in industries.

Case Study

Canon's Approach to the LCA Method

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Environment Control/Technical Center
Canon Inc.

1: Introduction and Objective Thereof

Japanese manufacturers specializing in the production of office machines, mainly copying machines, began to address environmental problems at a relatively early stage, while the related industrial associations have also been following up on Life Cycle Assessment (LCA) evaluations. In such context, Canon Inc., had previously formulated its own "philosophy of coexistence," and since then, as part of that philosophy, Canon has been actively working on environmental problems, from the standpoint of harmonizing its business activities in the context of environmental improvement.

In 1982, Canon adopted new, compact toner-cartridges with photosensitive drums, and toners that could be used for copying machines and printers, which have since been introduced in personal-use copying machines. Hence, Canon made it possible to practically realize "maintenance-free" copying, enabling every user to readily copy any document or photograph anywhere. Since then, Canon has successfully increased its share dramatically in the field of copying machines and printers in Japan and overseas.

Canon recycles used toner-cartridges in its factory in Dalian, China, and puts them back into actual use. In 1993, when there was a debate within Canon concerning the effectiveness of recycling toner-cartridges for saving resources and energy, Canon formally introduced LCA, for the first time in its history, as a practical means for quantitatively evaluating the environmental load (the amount of discharge of CO_2).

2: Actual Effect from Disclosure of Information on the Environmental Load (Disclosure of Type III Environmental Labeling)

Canon has been developing programs on Type III Environmental Labeling, a new international Eco-labeling system based on LCA, and has begun to disclose information on the environmental load obtained via LCA. Canon judged that it was highly necessary to do so in order to create new and genuine value by promoting dialogue with the market by quantitatively and directly disclosing the environmental load of products to general consumers and users. Canon initially began to disclose Type III Environmental Labeling in 1999 for the first time in Japan, jointly with the Japan Environmental Management Association for Industry (JEMAI), the promotion organization for LCA in Japan. Canon drew much attention when it announced this at the ISO-TC207 Rally in Seoul, Korea. Further, after completing trials on Versions 1 and 2 of the JEMAI program, for the first time in the world, Canon successfully acquired an accreditation for system consistency, ranging from data collection to verification and disclosure of "Ecoleaf Environmental Labeling," corresponding to the program of Type III Environmental Labeling promoted by JEMAI in Japan. As of the end of January 2005, information for a total of 91 Canon products (17 copying machines, 6 laser printers, 63 ink jet printers and 5 still cameras) had been disclosed via Type III Environmental Labeling including Ecoleaf Environmental Labeling. The products that had been disclosed via such Labeling included the following:

Note that Ecoleaf Environmental Labeling has been disclosed via the websites of JEMAI and Canon.

Table 1 Serial processes for the introduction of the LCA method and Type III Environmental Labeling achieved by Canon.

JEMAI	Date	Canon
	1993	Canon formally adopted the LCA method for assessing toner- cartridges.
The JEMAI began to develop programs of Type III Environmental Labeling. (September, 1998)	October 1998	Canon participated in the innovative Label Council.
	January 1999	Canon defined its basic business plan and established the LCA promotion organization.
	May	Canon Demonstrated practical examples of the JEMAI programs at the ISO-TC20 Rally held in Seoul.
The JEMAI carried out the first trial. (June, 1999)	July	Canon released innovative copying machines and bubble jet printers onto the market.
	December 2000	Canon released innovative electrostatic printers onto the market.
	January 2001	Canon released innovative color copying machines onto the market.
The JEMAI carried out the second trial. (April, 2001)	May 2001	Canon released innovative copying machines conforming to Version 2 of the JEMAI program onto the market.
The JEMAI launched operative programs of EcoLeaf Environmental Labeling. (April, 2002)	July 2002	Canon duly acquired accreditation for the EcoLeaf Environmental Labeling System and made the EcoLeaf Environmental Labeling available for its own copying machines and EP printers.
	January 2003	Canon duly acquired accreditation for the EcoLeaf Environmental Labeling System and made EcoLeaf Environmental Labeling available for its own bubble jet printers.
	December 2003	Canon duly acquired accreditation for the EcoLeaf Environmental Labeling System and made the EcoLeaf Environmental Labeling available for its own still cameras.

3: Formation of a scheme for implementing the LCA method and related issues:

The steps and organized scheme required for execution of the LCA method adopted by Canon are described below.

Step 1:

In regard to the raw materials used for manufacturing products, there was no actual system for determining the actual data, required for practicing the LCA method, on the type and mass of raw materialse, and thus, it was necessary to collect data on the component materials for each part in order to collect the required data. The best method for determining the mass per component material was to disassemble the individual products. In the main production processes, including molding, pressing, and plating, the actual amount of energy consumed per process was determined so as to establish a rule for estimating the actual environmental load.

When using the above method, it was imperative to solve a variety of problems as described below.

To collect various data on raw materials used for manufacturing individual products, it was necessary to spend considerable labor and time to disassemble each product. A good example is a copying machine comprising thousands of component parts.

Although it was possible to precisely determine various data for processing products by calculating the actual amount of energy transmitted at the site of product manufacturing, it was not possible to obtain sufficient data on various industries other than Canon.

Step 2:

Based on the above data, in order to use the LCA calculation for Type III Environmental Labeling, by developing automatic tallying software, LCA calculation was automated (the portion denoted as the LCA computing program shown in Fig. 1). In terms of the database after the JEMAI program Version 2, it was possible to apply the original process-integration type unit prepared by the Industrial Environment Control Association as background data. As a result, it was possible to form a complete system capable of implementing the LCA-based assessment via a database different from the "industry-related table" made available for executing step 1.

Step 3:

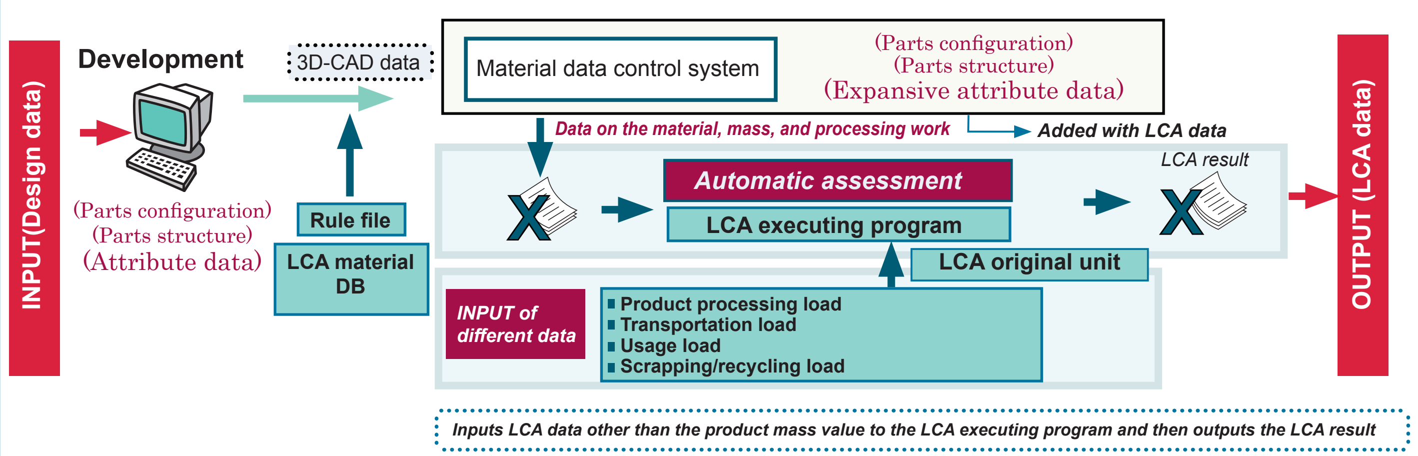
Due to the development of software for automatically feeding design data to be input to the automatic tallying software, it became possible to collect data linked with the design data. This arrangement is essential due to the needs for dealing with problems in data collection and the needs for determining the required data in the design stage, so as to be able to incorporate concrete actions for minimizing environmental load, rather than merely aiming at determining the result of the LCA-based assessment. In Fig. 1, this system deals with the portion for introducing "3D-CAD data" via the development.

Systemized arrangement has thus been achieved based on the above described steps. However, as an issue to be resolved from now on, in order to implement a more comprehensive LCA method, it is necessary to develop the database further, along the following lines.

1: Diversification of the kinds of raw materials and processing
2: Enhancement of the precision of available data
3: Timely maintenance of the database
4: Overseas data

Original units prepared for Ecoleaf Environmental Labeling by the JEMAI are useful as a database for readily implementing the LCA method. However, from the viewpoint of pursuing "comparative possibility" of environmental load data among products, in order to specifically apply the original units as Type III Environmental Labeling, amid a wide variety of quantitative data expected to increase in the future, it is anticipated that the precision of the database will be enhanced and the scope of the database will be expanded further.

Fig. 1 Sequential procedure of the LCA assessment system



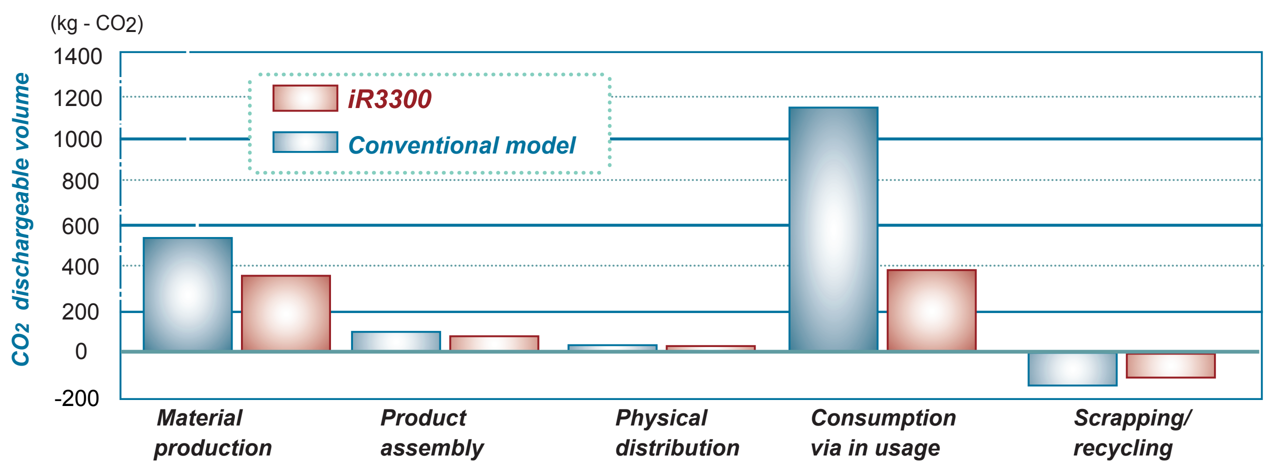
4: Result of LCA Execution

Using copying machines as examples, details and features of the environmental load generated in Canon products are described below.

Canon mainly manufactures precision products requiring step-by-step processing and assembly. Hence, unlike material producers, in regard to the dischargeable volume of CO_2, it was identified that the maximum environmental load among life stages was not caused by the manufacturing of products in Canon's factories, but was mostly generated in the usage stage followed by the environmental load generated during the material processing stage before completing products.

The items in the usage stage are the load accompanying the electric power consumed at the time of use, and the consumption goods (in the case of a copying machine, toner components and the photosensitive drum) consumed during use. Hence, reduction of the load during the usage stage is most effective for minimizing the environmental load. As shown in Fig. 2, in the case of the innovative product model "iR3300", by reducing the power consumption, the load generated during the usage stage was drastically reduced to a level equal to the load generated during the material processing stage. Note that the load in the physical distribution stage shown in Fig. 2 merely refers to the load generated by domestic physical distribution. Although the ratio of this load against the total load is quite negligible, in the case of globally distributed products, it is acknowledged that the international physical distribution load stands at a substantial level that cannot be ignored.

Fig. 2 Comparison of environmental load between an innovative model and a conventional model of Canon copying machines



5: Development into an Innovative Business Vision

In conformity with the basic "coexisting philosophy" described earlier, Canon has established its own principle to maximize productive use of resources so as to deal with environmental issues. As a concrete index based on the above principle, Canon positively urges the practical realization of a scheme for promoting factors of environmental efficiency at twice the current level throughout the Canon group companies. This factor, applying environmental efficiency, is defined below.

$$\text{Factor} = \frac{\text{Eco efficiency (Target year)}}{\text{Eco efficiency (Bench mark year)}}$$

Object: Based on the year 2000, environmental efficiency in 2010 must be enhanced by more than double.

$$\text{Eco} = \frac{\text{Value}}{\text{Environmental load}} = \frac{\text{Gross sales}^{*1}}{CO_2 \text{ emissions during through life cycle}^{*2}}$$

**1: Gross sales according to the audit of all Canon group companies:*

**2: CO_2 emissions through life cycle*

CO_2 emissions through a full life cycles from the mining of resourcesto the scrapping/recycling of entire products of the Canon group companies included in the audit.

As an applied form for developing the LCA method per product, individual environmental loads corresponding to the dischargeable volume of CO_2 expressed as a denominator from the Canon group companies was arithmetically measured. The reasons for citing the dischargeable volume of CO_2 of the environmental load are described below.

1: The dischargeable volume of CO_2 suitably meets the needs for accommodating the environment in the life cycle of individual products.

2: Not only energy consumption, but also dischargeable volume of CO_2 can be designated as an index, including the consumption of resources and recycling.

3: The dischargeable volume of CO_2 is compatible with any business model.

4: Since assessment of specific chemical materials has fundamentally been promoted aiming at eventual abolition, these chemical materials have been excepted as targets for reduction.

At present, generally, it appears that there are many factors involved for targeting a product unit. However, in the case of Canon, while studying factors for individual product units, we conceived that these factors could be used as indexes based on managerial viewpoints, and in accordance with the above definition, we calculated factors by including the whole of Canon group companies as the target. As a feature of this factor, business activities and the environmental load of the entire set of Canon group companies are designated by an integrated index at which the target value is set. Not only is there disclosure of the environmental load reduction target aimed at by Canon by numeric values, but the above factor also breaks down individual target values per operational sector and product unit of Canon against external sources, and further applies the break-down values as the index and the target value for designating the internal activities to deal with environmental issues inside Canon.

As forthcoming issues related to factors, we intend to seek a way to standardize and unify factors into an index (comparative evaluation between individual companies), and at the same time compile not only CO_2, but also other environmental load factors with various characteristics to a unified index, e.g., for costs, from the viewpoint of integration. Also from the managerial viewpoint, we perceive that the LCA method will further increase in importance as one of the tools for achieving that goal.

Case Study

Practical Application of a New Standard of Value - "Factor X (Eco-Efficiency)"

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Factor X and Elvis Presley

Factor X was introduced by the Matsushita Group almost 3 years ago. It was first announced in 2001 at the Panasonic Environment Forum held in Tokyo (Japan) and Freiburg (Germany), and has been actively used by the Matsushita Group as a green products criterion since fiscal year 2002. Within the company, it has been used as an indicator for business performance evaluation, and outside the company as a Type II environmental label to promote and diffuse green products. In addition, Factor X brochures have been published in order to spread the Factor X concept (the pink brochure in which a girl and a boy character appeared started a small boom in popularity for the issue of this type of pamphlet). Fig. 1 introduces the "Factor X" proposed by the Matsushita Group. We use LCA in the environmental impact assessment of this global warming prevention factor. We believe we are the first in the world to consider Factor X and LCA as the criteria for green products, and to practically apply these concepts in the everyday operations at the development sites, not in the research departments, but in the engineering departments. Since the introduction of this indicator, I have spoken about "Factor X" to the engineers and environmental personnel within our company group as well as people in business, research organizations and even to students from junior high schools to universities. About one month ago I had an opportunity to talk to business people, researchers and our engineers, consecutively, and I noticed a change at that time. There wasn't anything different in the manner of the business people and researchers, but there was a clear change in the reactions of our company engineers. I felt convinced from their reactions that the "environment" concepts were becoming securely integrated at the design and development sites. — Maybe it could be called the "Factor X Effect," but rather than "Factor X" itself, it seems that the "environment" has become an integral part of design and development as a result of "Factor X." — When I told this to a director who helped with the Factor X brochure, let's just call him "Mr. Dandy," that director mentioned Elvis Presley, saying that, "When black people sang black music, the world was not aware of black music. The world (meaning society in general) learned about black music when Elvis Presley sang it. Factor X, which not only involves the environmental aspect, but both the life activity value aspect and the environmental aspect, may be having an effect like that of Elvis Presley in incorporating environmental values into business activities." Elvis Presley has been significant to society, and the impact of his musical activities has been described as a "social phenomenon" in published books and articles. In any case, the interest shown by operations and planning departments, R&D departments and advertising departments is ever-increasing. Whether it is "reducing the environmental impact" or "increasing the product/service value while reducing environmental impact," ultimately the goal of reducing environmental impact is the same, but the reactions are rather different. I also began to notice that not just the concept, but also quantification is required.

Fig. 1 "Factor X" Proposed by the Matsushita Group

"Factor X" = Increasing the " product / service value" ↗ / Reducing " environmental impact" ↘

Global warming — Global warming prevention factor = The improvement of the "Product performance x Product life cycle" / The reduction of "Greenhouse gas through the life cycle"

Resource — Resource factor = The improvement of the "Product performance x Product life cycle" / The reduction of the volume of resources not recycled*2 during through the life cycle

*2: Volume of resources not recycled = volume of freshly extracted resources + volume of waste resources

Chemical substances — Phase out of substances designated as hazardous
(lead, cadmium, mercury, hexavalent chromium, bromic flame retardant, and vinyl chloride resin)

Not Just a Concept, Quantification is Also Required

Before this indicator was introduced, a green product was defined by the [basic product quality/performance + environmental quality/performance], and both aspects of the product/service value and the environment were indicated in the concept. However, there was nothing quantified and numerical targets were only established for the environmental side. After the introduction of "Factor X," the concept of "unification of the life activity value (product/service value) and the global environment" was presented. Currently, quantitative assessments of both the life activity value (product/service value) and the environmental aspects are made and target values are set. In other words, the difference before and after the introduction of "Factor X" is not the concept, but the inclusion of a quantitative assessment. As a result of this quantitative assessment, the "Factor X" concept was easy to understand and it became easy to incorporate the "environment" into design and development sites. Rather than a diffusion of the concept itself, it seems that the idea of "measuring" is easier to understand and has spread more easily.

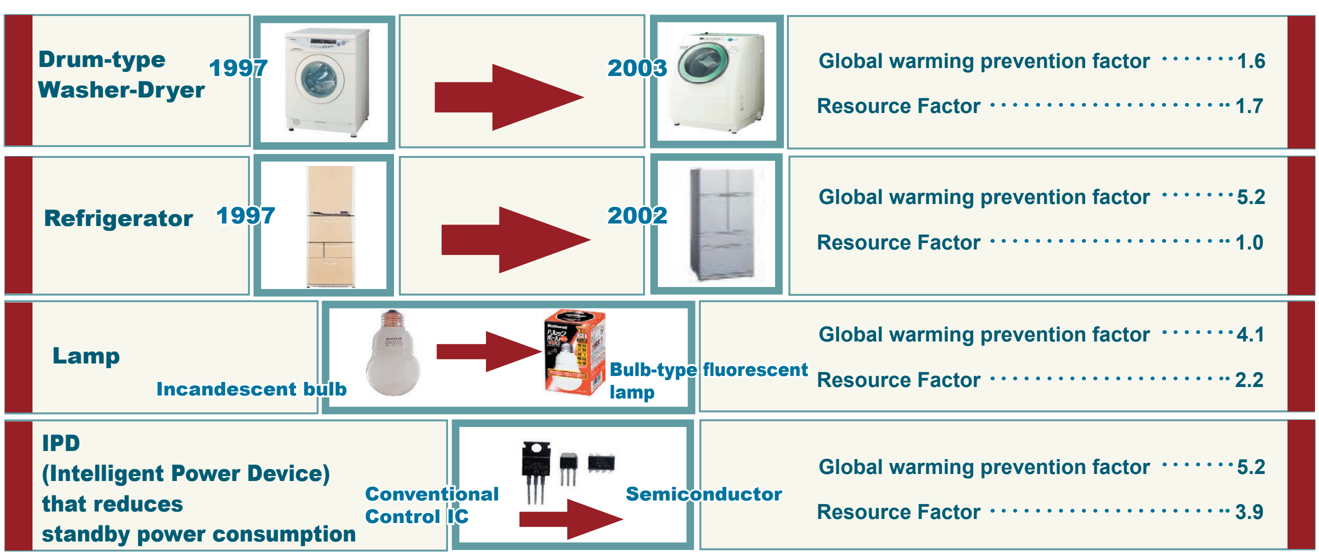
The Inside Story on "Factor X" Development

This indicator was developed based on the discussions of a "Product Assessment Committee," which includes the heads of the engineering departments and the engineering section chiefs among the members. I was the sole representative from the Environmental Department on the committee. As I was showered with "kind comments" (pent-up frustration at the environmental policies?) such as, "You want to conserve energy? – maybe we should make 3-inch TVs," "How about a washing machine that doesn't use water or electricity? – of course it wouldn't get the clothes clean either," and "You environmental department people don't consider the business side at all," I thought about the idea of this indicator with hope that it will lead to good technology and product development, and proposed it to the committee. We developed the indicator into one that can help evaluate matters including product performance in the process of quantifying the "Matsushita Product Assessment Ver. 5" conducted by the company at the time, with the aim of assessing and promoting technology advances. In effect, the indicator coincided with the concept of the Factor X, and resulted in more effective implementation of this concept. We also received the benefit of guidance from Professor Yamamoto of Tokyo University.

A "Factor X" Calculation Example

Due to print limitations, only a brief introduction can be made, but Fig. 2 shows Factor X of Individual Products, and Fig. 3 shows a calculation example for a Household Factor X. The Household Factor X was first introduced at the Panasonic Environmental Forum held in Tokyo in 2003, and it is the world's first-ever calculation model of its kind. The 2004 version is presented here, and it is planned to continue the calculations in the future.

Fig. 2 Factor X of Individual Products

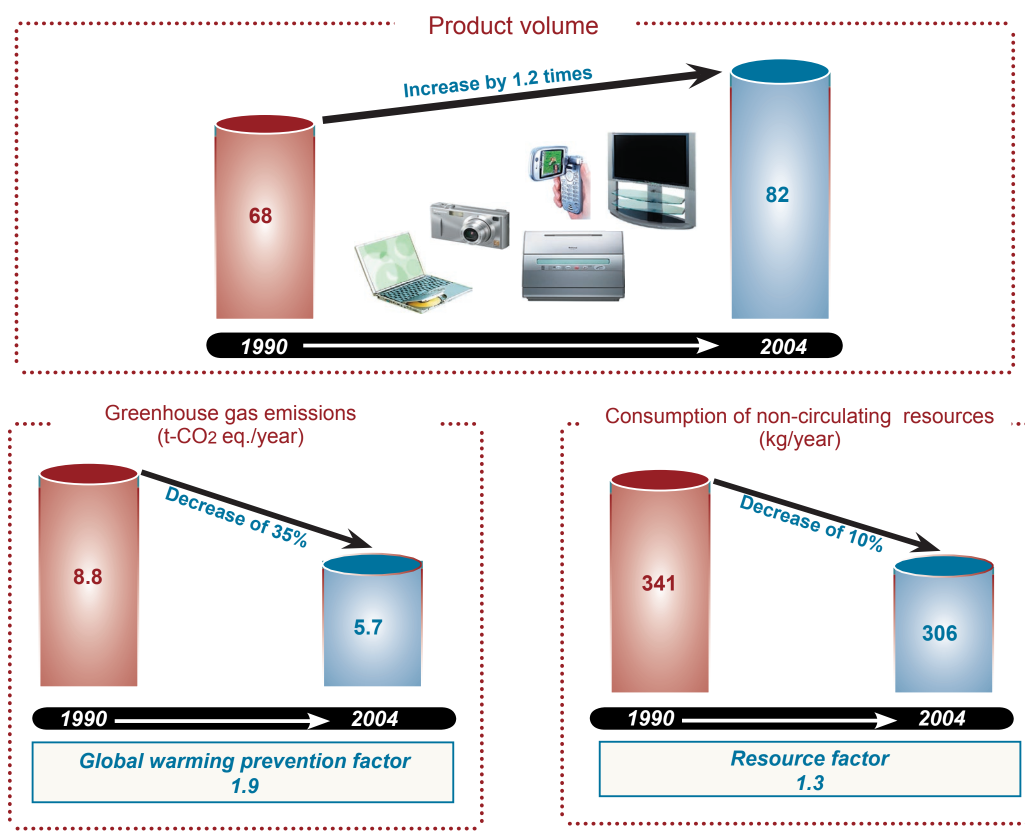


Conclusion

There are many problems that still need to be solved, but steady progress is being made, including the establishment of new guidelines based on actual results. With the introduction of these indicators, it became possible to clearly specify targets and manage the efforts to reach them. We have also been able to create feedback loops to identify issues and reflect results in the guidelines and policies. Looking at the result of practical use for 3 years, I learned that the value cannot be understood without trying it, and there are also issues you will understand for the first time if you try it. Although there are differences in the level between work sites, at advanced worksites, Factor X and LCA are actively used for design improvements, and they even make proposals for specific indicator improvements. There is a perception that researchers are engrossed in their study, and that business does not use them or their results at the work sites. As a result of the development and application of eco-design products and social systems utilizing Factor X and LCA by the company design and development personnel, problems would be identified. Then, these problems would be solved by the researchers, improving precision and operability. After that, the designers/developers would use the improved Factor X and LCA to develop better eco-design products, social systems, and so on... creating a positive cycle of improvement. This is why Factor X is being implemented at the work sites in the Matsushita group today.

Last but not least, the two gentlemen in the photo with me on page 32 of the Panasonic Report for Sustainability 2004 are the sources of some of those "kind comments" (complaints?) mentioned earlier. Today they are colleagues who are always ready to collaborate no matter how busy they are with other matters.

Fig. 3 Household Factor X in 2004



Case Study

ICT Service LCA

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Information Sharing Laboratory Group
Nippon Telegraph & Telephone Corporation

Introduction

Since the latter half of the 1990s there has been rapid development in information communications technology (ICT), with a transition from conventional fixed phone lines to mobile phones, and the widespread use of the Internet. One of the features of ICT services is that it overcomes time and distance. Tasks performed using ICT can be accomplished from remote locations at any time. A second characteristic is that it not only enables easy access to enormous volumes of data, but it also permits information to be shared between users. This facilitates evaluation, decision-making, and communication, contributing to greater efficiency in activities such as manufacturing and distribution. A third feature is that the digitalization of information and use of electronics reduces the need to record information on media such as paper. Thus far, LCA has commonly been implemented for ICT devices like personal computers and telephones. Recently, however, LCA is being performed with regard to ICT services as well as ICT devices. This will be a presentation of video conference service inventory analysis as a representative example of such ICT service.

Video Conference Service Assessment

We made the following hypothetical assessment. Video conferencing was conducted between Tokyo and Nagoya using Phoenix F and 25-inch monitors as the video conferencing equipment at both sites. Transmissions were made using business type B FLET'S. The carbon dioxide emissions for a one-year period were assessed for the case of one 60-minute conference each week. The assessment results are shown in the figure on page 12. The video conference equipment used here is a widely used model, but these are specialty products that are only used for video conferences, so the load at the manufacturing stage is large, accounting for 84% of the total. On the other hand, the amount of electricity consumed by the video conferencing equipment is comparatively low, accounting for about 5% of the load during use. The load at the time of disposal is extremely low in comparison to the manufacturing and usage stages. The total amount of carbon dioxide emissions is 220 kg, with the television equipment being the source of about 53% of this amount. With regard to the communications facilities, since the B FLET'S was evaluated as being exclusively for the video conferencing, the environmental load was larger.

Factors that will change the environmental load when using the same video conferencing equipment are the frequency of the conferences, conference time and conference locations. Of course, the loads at the manufacturing and disposal stages remain the same, since these are assessed as one-year units. In the following part, assessments are made on cases where one of the three factors (the frequency of the conferences, conference time, and the conference locations) is changed.

Firstly, an assessment is made when the frequency of the video conferences between Tokyo and Nagoya is changed from once per week to once per month. The results are shown in the figure on the following page. The electricity consumption of the video conferencing equipment drops to 1/4 of the previous level. The environmental load during use for the communications equipment is composed of a portion from the continuous operation of the subscriber (fixed portion) and a portion that is calculated according to the amount of data or time of use (variable portion). Therefore, even if the video conferences are reduced from once per week to once per month, the load during use does not drop to 1/4, but only to about 47%.

Next, an assessment is made for a conference frequency of once per week, but with a change in the length of time of the video conference from one hour to two hours each time. The results are shown in the figure on the following page. For the reasons explained above, the environmental load from the communications equipment does not simply double. Accordingly, the environmental load during use does not become twice as large. For the two-hour sessions there is only a 69% increase in comparison to the environmental load for one hour of use.

This figure shows the results of an assessment with the video conference site changed from Nagoya to Fukuoka. Since a national average was used for the carbon dioxide emissions equivalents for the electricity, there is no regional difference. Since the B FLET'S system is used, the network environment load has almost no distance-dependence, so the environmental load during use is nearly identical. If the communication method were switched from B FLET'S to ISDN or to analog circuit switching, the environmental load would vary according to the distance. However, in the case of circuit switching, since the access system environmental load is much larger than the relay system environmental load, the distance-dependence of the environmental load is fairly small.

Comparable Service Evaluation

For the purpose of comparison of the video conference service a change in the video conferencing equipment is considered. If a large-screen TV (video conferencing system for about 30 people) is used instead of the Phoenix F, the load at the manufacturing stage for the video conferencing equipment increases by a factor of 50, and the electricity consumption increases by a factor of 20. For one-hour video conferences conducted on a weekly basis between Tokyo and Nagoya, the annual carbon dioxide emissions equivalent is 6,300 kg, which is a 28-times larger environmental load. Since the environmental load of the communications is not changed, the television equipment in this case accounts for 98% of the total environmental load.

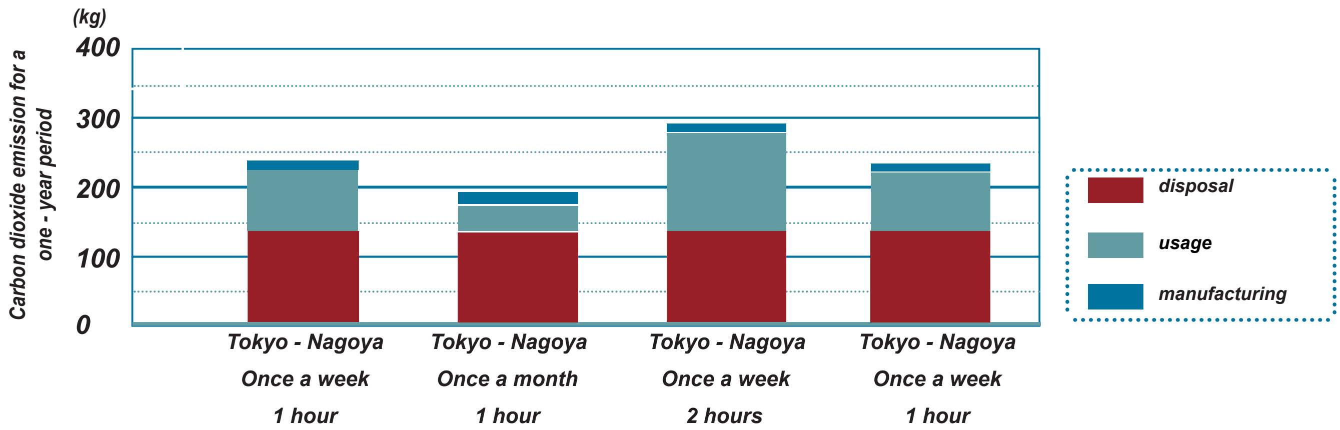
Another comparison service is to send people to meet face-to-face instead of holding video conferences. Although the "depth of understanding" and "verbal interactions" are not exactly the same for face-to-face meetings and video conferences, these are assumed to be equivalent for this calculation. In this case, the environmental load is considered to be generated from the transportation means used to bring the meeting participants together. For example, for a meeting between Tokyo and Nagoya, we consider a model of travel by train from Nagoya to Tokyo and a 2 km bus ride to the final destination. Assuming that one person travels once per week, the annual carbon dioxide emission equivalent is 1,500 kg, which is 6.7 times larger than the video conferencing scenario. For cases involving movement of people, the environmental load varies in direct proportion to the frequency of the conferences and the number of people. Furthermore, if travel is from Fukuoka to Tokyo, travel will be by airplane, further increasing the environmental load. If one person flies once per week, the annual carbon dioxide emission equivalent will be 29 tons. This is 130 times greater than the environmental load from a video conference.

Conclusion

For the impact of ICT services on the environment there is more than simply the assessment of the comparable services to consider. Ripple effects, such as rebound effects, also need to be evaluated. Takahashi et al., collected questionnaires on activities during transit and activities during the time saved by using video conferencing, and calculated the environmental load (1). For details, refer to the reference document. The environmental loadof ICT services varies not only in terms of the content of the services themselves, but also a great deal according to the behavior of the beneficiaries of the services. There are many issues related to LCA of ICT services. An IT solutions research group has been started in the Japan Eco-Efficiency Forum, and has begun investigation of common assessment methods.

References:

(1) Takahashi et al, Proc. 2004 IEEE Int. Symp. Electron Env. P 13 (2004)



Case Study

LCA Activity at Mitsubishi Materials

Yasunari Amami
Management Center
Mitsubishi Materials Corporation Environment

1: Introduction

Mitsubishi Materials Corporation operates a variety of businesses as a comprehensive materials manufacturer. Products cover a wide range, including cement, non-ferrous metals (e.g. copper, precious metals), aluminum cans, tools, and electronic materials, etc.

Our company strives to preserve the environment in our business activities. Through efforts to ensure effective use of resources, our goal is to contribute to the construction of recycling-oriented social systems in harmony with the environment. To achieve this goal, we are implementing “Green Productivity Management (GPM) activities”.

LCA is one of the themes of the GPM activities, and efforts are being made to reduce the environmental burden related to both production and the products themselves.

2: LCA Activities at Our Company

(1) Activities to Date

Our company has been conducting LCA activities since the latter half of the 1990s. The R&D department and various sections have been evaluating individual products (railway contact wires, etc.) and the recycling processes for household appliances, based on our own surveys as well as requests from both inside and outside the company.

Since 2002, assessments of environmental burden reduction effects have been implemented by the “Mitsubishi Materials Group Environmental Recycling Project”.

Our corporate group has long been conducting environmental and recycling projects using the cement and smelting infrastructure. For example, in the cement and copper smelting businesses a lot of waste and many by-products are accepted for recycling in the production processes. In addition to recycling used aluminum cans, the reclaimed metal from recycling processes is used as a raw material in the production process for aluminum cans. We also operate household appliance recycling plants. The materials collected from the recycling plants are ultimately processed to reclaim materials such as iron, copper and aluminum.

The four divisions of cement, copper smelting, aluminum cans and household appliance recycling were selected and evaluated using LCA methods in the areas of “resource consumption reduction effect (mineral resources, energy resources),” “final waste disposal reduction effect,” and “CO_2 emissions reduction effect”. The main wastes and materials for recycling obtained in each of the four divisions are shown in Table 1.

Table 1 Main wastes and materials for recycling from the target divisions – received and processed quantities.quantities.

Division	Received wastes / materials for recycling	Received quantity (*1) / Processed quantity (*2)
Copper production (smelting)	Copper scraps, shredder dust, recycled oils	Approx. 220,000 t (*1)
Cement production	Soot (coal ash and the like), mineral slag (iron & steel, nonferrous), sludge, waste plastics	Approx. 3,620,000 t (*1)
Aluminum can production / recycling	Used aluminum cans	Approx. 42,000 t (*2)
Household appliances recycling	Four kind of used electric appliances (TV sets, refrigerators, washing machines, air conditioners)	Approx. 1,190,000 units (*2)

**Received quantity and processed quantity values are from FY 2003.*

Fig. 1 shows the concepts for the assessment of the environmental burden reduction effects. LCA assessments are performed for the [current process], which consists of the current production processes accepting the recycled materials and wastes materials, and the recycling process of the household appliances and aluminum cans, and for a [comparison process (hypothetical process)], which consists of the production processes using only natural materials and resources, without utilizing waste or recycled materials, and the final disposal of wastes. The difference between these two is evaluated as the environmental burden reduction effect.

Thus far, assessments for a three-year period have been made, starting from the 2001 fiscal year. Table 2 shows the assessment results for the 2003 fiscal year. It can be said that our group companies' environment recycling project is contributing to the reduction of the burden on the environment, through measures including resource saving and reduction of wastes. These results are published externally in the company Environmental Reports, etc.

Fig. 1 Concepts for assessment of the environmental burden reduction effect

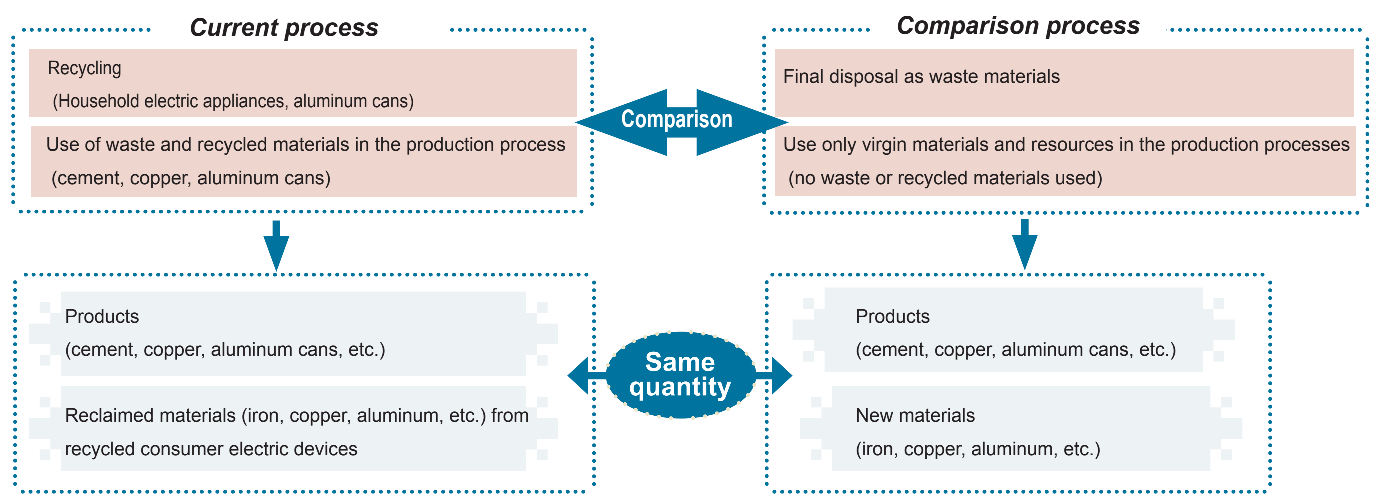


Table 2 Environmental burden reduction effect from group companies' Environment Recycling Project (FY 2003)

Item	Unit	Smelting	Cement	Aluminum	Home appliance recycling	Total
Mineral resources saving effect	1000 t / yr	116	3,819	147	20	4,102
Energy resources saving effect	1000 t crude oil / yr	56	132	116	5	309
Mineral resources saving effect	1000 t / yr	70	1,439	42	19	1,570
CO_2 emissions reduction	1000 t CO_2 / yr	59	1,158	322	13	1,552
Production or processing	1000 t/yr 1000 units / yr	334	11,300	54	560	

(Note) For the group companies, the investment ratio is multiplied to compute the assessment result
**1 Items for calculations of the mineral resource conservation effect: Iron ore, copper concentrate, bauxite ore, limestone, clay, silica (only main items evaluated)*
**2 Produced quantity / processed quantity (product / processing target product) for each division*
** Smelting: Electrolytic copper production quantity (1000 t /yr)*
** Cement: Cement and clinker of other uses production quantity (1000 t / yr)*
** Aluminum:Aluminum beverage cans production quantity (1000 t / yr)*
** Home appliance recycling: Number of 4 item processes (1000 units / year)*

(2) Future activities

At present, LCA activities are being promoted as one of the action items for the GPM activities in order to quantitatively grasp the environmental burden of our products. In the future, in addition to the social contribution of the environment recycling project, we are investigating the use of LCA to focus on reducing the environmental burden of our group companies' business operations themselves.

However, our company encompasses a broad range of products and activities, and the circumstances of each of the various divisions is different. It may not be effective to promote a single set of standard activities on a corporate-wide basis. We intend to consider the effects of implementing LCA and to investigate specific assessment methods, implementation systems and applications corresponding to the characteristics of each business.

Currently, LCA is assumed to be focused on applications within the company, but we are considering the disclosure of environmental information externally according to the product. In fact, for aluminum cans, the certification for the Eco Leaf and EPD Type III environmental labels has been obtained, and the product environmental burden information is being disclosed to users and consumers.

3: Conclusion

In the future, efforts for environment-oriented business management will be made, not by a single company, but by the entire supply chain. In light of such trends in society, we, as a company, believe that it is necessary to continue to conduct business activities that take the environment into consideration.

LCA is one of the tools for assessing and understanding environmental information and lessening the environmental burden. We would like to continue to devise ways to utilize it effectively.

Case Study

Eco-Efficiency Activities Assessment Conducted by the Tokyo Electric Power Company

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1: Tokyo Electric's Concept of the Eco-Efficiency Index

Pursuing efficiency in both aspects of environment and economy is necessary in aiming for sustainable development in the energy industry. For that purpose, we at Tokyo Electric are carrying out various activities, including the evaluation of internal economic effect associated with the costs of environmental measures, and environmental measures for the establishment and utilization of an environmental accounting technique.

Eco-Efficiency established by the World Business Council for Sustainable Development (WBCSD) describes the link between business activities and environmental impact using the following equation. It aims to help businesses understand the specific values, make use of them in managing their performance and decision-making, help businesses on a worldwide basis calculate the index based on a uniform definition, and present them in environmental reports.

$$\text{Eco-Efficiency} = \frac{\text{Quantity \& price of product or service}}{\text{Environmental Load}}$$

At Tokyo Electric, we have been working on assessments from the perspective of Eco-Efficiency such as this since 2000, and we have presented our own estimate of the "Eco-Efficiency Index" through our Sustainability Report.

$$\text{Tokyo Electric's Eco-Efficiency Index} = \frac{\text{Sales}}{\text{Environmental Load that accompanies business activities}}$$

2: Results of Estimating Environmental Load and the Eco-Efficiency Index

The trends in the main environmental load and net system energy demand at Tokyo Electric are indicated in Fig. 1. SOx and NOx have decreased from the 1970's as a result of end-of-pipe fuel and pollution-abatement measures. On the other hand, CO_2 emissions without a cost effective removal measure have increased with the increase of thermal power volume. However, they have been suppressed to a slow rate of increase compared to the growth of the net system energy demand through the promotion of nuclear power, the improvement of thermal power energy efficiency, and the decrease of power transmission and distribution loss rate.

The trends of the Eco-Efficiency Index since 1990 are shown in Fig. 2. As for the environmental load and fossil fuel load (consumption) associated with the power generation business, substances that have a significant impact have been selected, and the Life-cycle Impact Assessment Method based on End-point Modeling (LIME) has been used to consolidate figures as a single index.

By 2001, the Eco-Efficiency Index showed a rising trend, and an improvement of over 30% compared to 1990. In 2002 and 2003, as a result of compensating, with thermal energy, for decreased power due to the shutdown of a nuclear power station, the CO_2, SOx, and NOx emissions and fossil fuel consumption increased, and the Eco-Efficiency Index dropped to 60% of that of 2001. In 2004, while sales increased by 1.9% compared to 2003, the environmental load and fossil fuel consumption both decreased due to the rise of the nuclear power plant usage rate from 26.3% to 61.7%, and the Eco-Efficiency Index increased by 28% (a 24% increase when environmental load alone is considered), resulting in the same level as 1990. For Tokyo Electric, the results indicated the significance of the impact of nuclear power plants on the Eco-Efficiency Index.

Fig. 1 *Trends of major environmental load and net system energy demand (1973 as 1)*

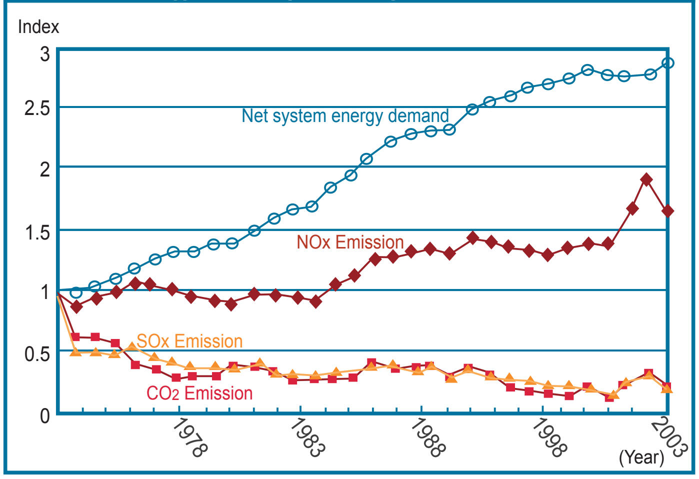
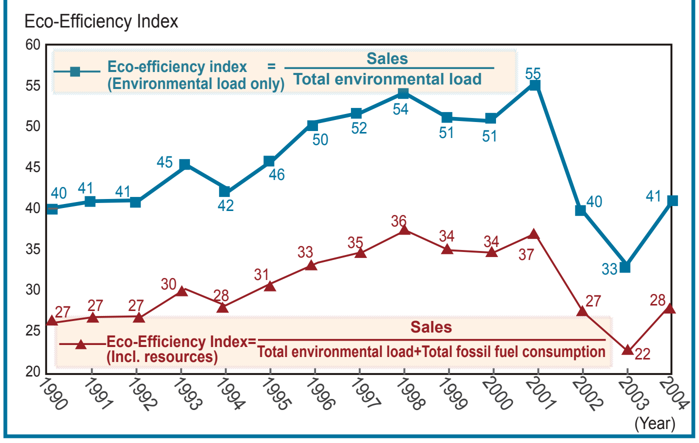


Fig. 2 *Trends of the Eco-Efficiency Index*



Case Study

Kyowa Hakko's Life Cycle Assessment Activities

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Environment and Safety Department
Kyowa Hakko Kogyo Co., Ltd.

1: Background to the Introduction of LCA

At Kyowa Hakko Kogyo, we have introduced LCA in carrying out ISO14001 from 1999 to 2001. In 2001, we carried out assessments on the material balance and life cycle of shochu products, which at that time accounted for a significant amount of end products, and presented the results in the Kyowa Hakko Health, Safety, and the Environment 2001 Report (*We transferred our alcoholic drinks business to Asahi Breweries Ltd., in 2002).

We have studied energy usage and environmental emissions in the production, manufacturing and distribution of the raw materials of shochu products. Ninety-two percent of total carbon dioxide output was emitted in the production, manufacturing and transportation of raw materials, and the remaining 8 percent was used in product distribution (Table 1). When we compared these findings to with beer, partly due to the difference in alcohol concentration (shochu: about 25%; beer: about 5%), the carbon dioxide output per pure alcohol for a plastic bottle of shochu was estimated to be approximately half of that for a glass bottle of beer (Table 2).

Table 1 Energy Usage and Environmental Emission of Shochu Products (Fossil fuels)

Process	Energy 1,000 Mcal	CO_2 ton	SOx ton	NOx ton
Raw Material Production, Manufacturing, Transportation(Overseas + Japan)	79,899	24,144	133.4	37.3
Product distribution	6,988	2,045	3.5	5.6
Total	86,887	26,190	136.9	42.9

Table 2 Assessment of product contents, including product container

Environmental emission of product contents, and containers (Fossil fuels)			Shochu		Beer
			One-way glass	Plastic Bottle	Bottle 20 times Recycle
Product content	CO_2	g/l-Product	400	400	255
	SOx	g/l-Product	2.21	2.21	0.35
	NOx	g/l-Product	0.62	0.62	0.48
Total incl. container	CO_2	g/l-Product	655	589	303
	SOx	g/l-Product	2.73	2.63	0.46
	NOx	g/l-Product	0.84	0.83	0.54
	CO_2	g/l-Pure alcoholSox	2600	2400	6700
	SOx	g/l-Pure alcoholSox	10.9	10.5	10.2
	NOx	g/l-Pure alcoholSox	3.4	3.3	12.0

2: Comparison of the Environmental Impact Index utilizing the Life-cycle Impact Assessment Method based on Endpoint modeling (LIME)

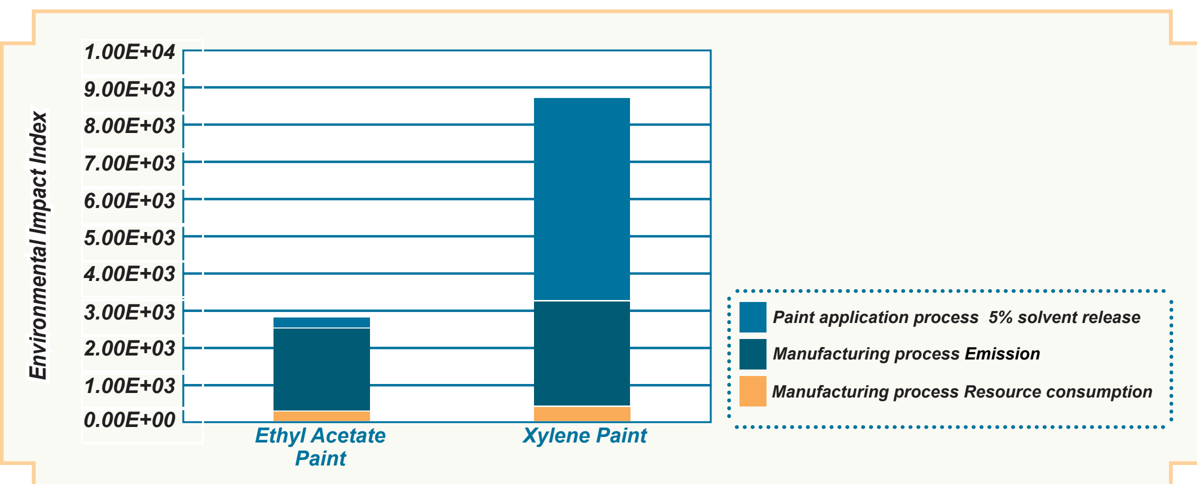
The Kyowa Hakko Chemical Co., Ltd., within the Kyowa Hakko Group produces various solvents as its main products. As part of responsible care practices, quantitatively assessing the various environmental impacts, from manufacturing to disposal of products, is an important element of being a chemical company. In 2003, we estimated the environmental impact of solvents with the support of the Research Center for Life Cycle Assessment, Advanced Industrial Science and Technology (AIST). Typical solvents used in paints, ethyl acetate and xylene, were analyzed and the overall environmental impact load was estimated in the manufacturing and transporting of solvents, and in the manufacturing, transporting and use of paints (environmental discharge), the internal and external costs were also compared. Furthermore, we used various suppositions, such as assuming the solvent usage in paint as 364kg/ton of product in the trial calculation. Please note that the results of the estimation were provisional values for our company's environmental impact assessment.

In addition, volatile organic compounds, such as solvents that are released into the air, affect human health by changing into photochemical oxidants or suspended particulate matter due to photoreaction. In the comparisons made with protected subjects of LIME, human health and primary production were the key ingredients occupying 40 percent of the total environmental impact respectively. When we see the result of a comprehensive environmental impact assessment, we can see as shown below that the environmental impact is almost the same for both xylene and ethyl acetate when they are used as solvents in the process of manufacturing paint; assuming the release of solvent during paint application as 5 percent, it was found that there is a significant difference in the environmental impact index (external costs). This means that ethyl acetate paint has overall lower environmental costs if the solvent collection ratio is low at the time of paint application.

3: Future challenges

As demonstrated above, at Kyowa Hakko, we have just launched collecting data on life cycle assessment, and assessing the environmental impact based on that data. We were able to analyze the comparisons of solvents, even though we are a newly established company, due to the disclosure and use of the LCA database of the LCA Japan Forum, to which we are very grateful.

As well as providing further LCA data on various products mainly for our users, at Kyowa Hakko, we are working toward an understanding of the overall environmental load including the LCA data of raw fuel supply, while grasping the entire picture of Kyowa Hakko's environmental burden, as stated in our 2005 Sustainability Report. When accomplished for the first time, we hope it can lead to assessment of chemical products in every process from development to manufacturing, distribution, usage, end consumption and disposal of chemical products, as advocated by Responsible Care.



Event Information

2nd International Conference on Quantified Eco-Efficiency Analysis for Sustainability	Jun. 28 - 30, 2006 Egmond aan Zee, Netherlands	Ebara Corporation / CML, Leiden University	http://www.eco-efficiency-conf.org/
Third World Congress of Environmental and Resource Economists	Jul 3 - 7, 2006 Kyoto, Japan	Society of Environmental Economics and Policy Studies (SEEPS) Association of Environmental and Resource Economists (AERE) European Association of Environmental and Resource Economists (EAERE)	http://www.worldcongress3.org/
Renewable Energy 2006	Oct. 9 - 13, 2006 Chiba, Japan	Renewable Energy 2006 Organizing Committee	http://www.re2006.org/
7th International Conference on EcoBalance	Nov. 14 - 16, 2006 Tsukuba, Japan	The Institute of Life Cycle Assessment, Japan, The Society of Non-Traditional Technology/ECOMATERIALS Forum National Institute for Agro-Environmental Sciences Japan Environmental Management Association for Industry/ Life Cycle Assessment Society of Japan Institute for Building Environment and Energy Conservation Center for Environmental Information Science	http://www.sntt.or.jp/ecobalance7/

JLCA

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