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Contents

Special Article

Summary of LIME2 Working Group Activity Result

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1. Introduction

LIME2[1] was developed through the 2nd National LCA Project (2003 to 2006 with the Ministry of Economy, Trade and Industry (METI), NEDO, Japan Environmental Management Association for Industry (JEMAI), and Advanced Industrial Science and Technology (AIST)). LIME2 is the newer version of LIME1 (Itsubo and Inaba, 2005) which can conduct LCIA on 11 areas of environmental impact and 1,000 types of substances based on the Japanese environmental conditions. A large number of LCIA implementers are expected to use LIME2 once the LIME2 coefficient list is released.

For this updated version, the visual presentation of the assessment coefficients, scope of assessment, and coefficient list have been changed. A new function has also been added so that uncertainty analysis can be carried out. Features of LIME1 and LIME2 or important points to remember when using them, however, have not been sufficiently communicated to users. It is therefore desirable that technical instructions be provided to the implementers such that they can appropriately and easily use the new functions of LIME2.

With LIME2, LCIA method developers can examine the validity of new methods by studying case examples and also can discuss research topics that receive much public attention such as the sick building issue and the waste material issue. It is also expected that they can identify future research topics from the case example study results.

If these case example study results are released as the LIME Users Guide, those who wish to start using LIME can learn appropriate use and interpretation methods in advance. As for general consumers, they can obtain useful information for environmental communication based on a simple index.

Based on the background described above, corporate LCA implementers and LIME developers formed a working group to carry out joint research under the control of the LCA Japan Forum. This article reports the results of the LIME2 working group activity.

2. Description of the Activity

The LIME2 working group was organized in order to achieve the following:

• Accumulation of case example study findings using LIME2 and effective dissemination thereof to society

• Promotion of operators' understanding of the LIME2 methodology by providing explanation

• Interpretation and discussion of case example study results, and improvement of assessment efficiency through critical review by developers

• Creation of the LIME2 Users Guide Book and distribution of information to society through publication of the guide book.

Figure 1 shows the working group activity. Corporate members independently set the assessment target and defined the scope of investigation, and conducted inventory analysis based on this setting. LIME developers disclosed the LIME coefficient list, and at the same time, distributed a tool to support LIME-based environmental impact assessment (LIME calculation sheet). They also provided advice regarding how to review the assessment result as well as how to interpret and discuss the result.

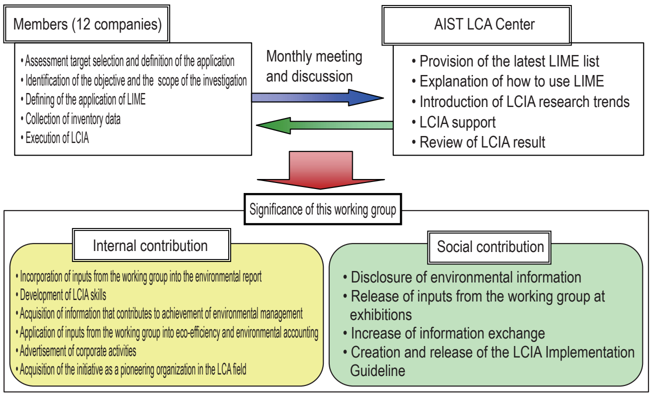

Figure 1: Structure and significance of the LIME2 working group

Table 1 shows the major processes that take place at the working group. The assessment target and the scope of investigation were decided in the beginning (the 1st working group meeting). Then, each member collected data and carried out inventory analysis. Their results were reviewed at the 2nd working group meeting. There, the results were inputted in the LIME2 calculation sheet for environmental impact assessment. The LIME2 calculation sheet is an environmental impact assessment tool developed by AIST. It contains the LIME2 coefficient list, and inputting of inventory data allows automatic assessment following the characterization, damage assessment, and integration steps (Figure 2)[2].

[Task for individual members] Selection of the assessment target (e.g. particular product, corporate activity, and so on) and setting of the assessment goal (e.g. environmental report)		
September, 2007	Kick-off meeting Finalization of the assessment target and the scope of investigation	[Discussion] • Selection of the assessment target • How the special seminar should be run
[Task for individual members] Inventory analysis and examination of environmental burden data		
November, 2007	Organization of inventory analysis result	[Lecture] How to use the LIME sheet
[Individual discussion] Inventory discussion (product level or corporate level) [Individual discussion] Consultation regarding integration [Task for individual members] Execution of integration		
December, 2007	Organization of calculation result	• Report and review of the result • Discussion regarding future study themes

Table 1: LIME2 working group schedule (1 of 2)

[Individual discussion] Review of characterization and damage assessment result [Task for individual members] Execution of integration		
January, 2008	Organization of calculation result	• Organization of information that can be learned from the result • Important points to remember when creating a report • Discussion regarding report creation
[Individual discussion] Review of the integration result [Individual discussion] Consultation regarding interpretation of the life cycle [Task for individual members] Interpretation of the life cycle		
February, 2008	Discussion of the report	• Review of the report content
[Task for individual members] Creation of a document to describe the result		
March, 2008	Summarization of the result	• Internal report on the calculation result using PowerPoint • Use of the calculation result
External presentation meeting (hosted by the LCA Japan Forum) Voluntary presentation (environmental report and website)		

Table 1: LIME2 working group schedule (2 of 2)

- Spreadsheet software allows easy and simple calculation.
- Calculation results can be automatically displayed as graphs.
- Uncertainty analysis can be carried out.

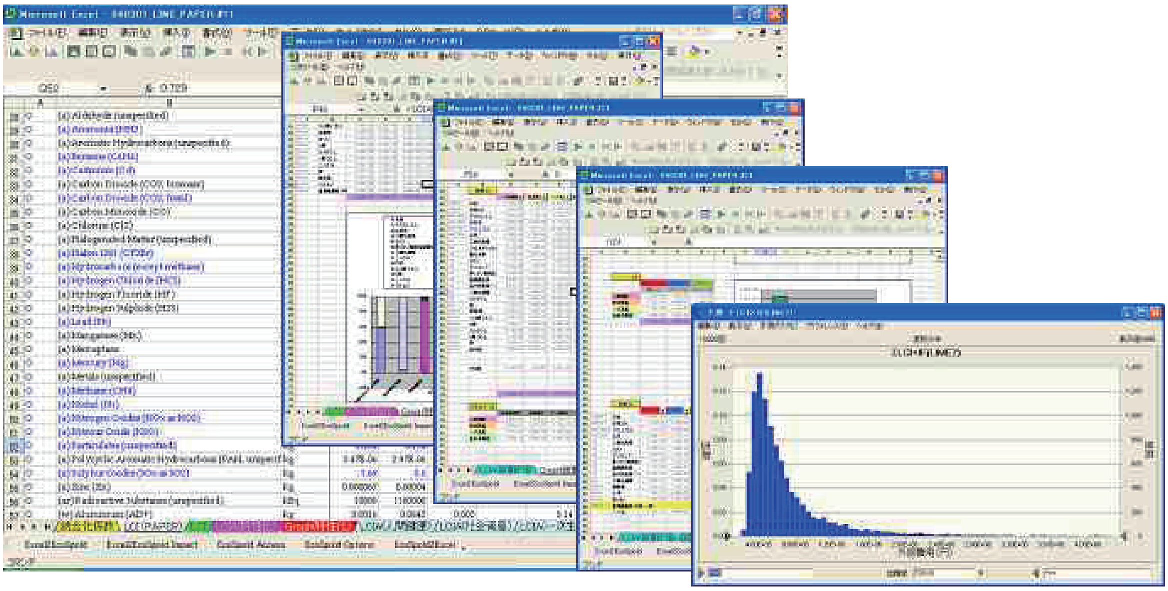

Figure 2: Image of a LIME calculation sheet

The LIME2 working group explained how to use the tool and provide practice sessions using specific inventory data in order to avoid incorrect use of the tool as much as possible. For the obtained environmental impact result, the method developers carried out critical review (the 3rd working group meeting). They also interpreted the result with the implementers, and as necessary, the developers provided advice on how to disclose the assessment result or how to establish an eco-design policy. The implementers actively exchanged opinions about interpretation of the result and how to use the tool (the 4th working group meeting).

At the end, each member created a report on the study achievements (the 5th working group meeting). The report was created based on a standardized format, and the members tried to create an easy-to-read report for the recipients.

Through these activity processes, the implementers experienced a series of flows including preparation for the use of LIME2, assessment using the tool, interpretation of the result, and disclosure of the result.

We then reviewed the activity processes from October, 2007, to March, 2008 (6 months).

The achievement of this working group was presented at the FY2008 LCA Japan Forum Seminar (June 3rd, 2008). Detailed information on the presentation is available on the LCA Japan Forum website (www.jemai.or.jp/lcaforum/seminar/02_01.cfm). Also a poster summarizing the evaluation result was also created at the same time as the creation of the study achievement report. This report and the poster will also be published on the LCA Japan Forum website in the near future.

3. Assessment Target

Table 2 shows the companies that participated in the working group and their assessment target. This working group was able to cover a wider range of business fields than originally expected such as building materials, automobiles, electric products, office equipment, containers and packages, heath-related products, electricity, and services. The implementers were responsible for selecting the area of environmental impact to be assessed. Environmental impacts such as global warming, consumption of fossil fuels, air pollution in city areas, and acidification were included in almost all case examples. Some included indoor air pollution, noise, waste material, and toxic chemical material, depending on the assessment purpose or target.

Company	Target	Company	Target
Toshiba	Air conditioners and electric devices	Fuji Electric Systems	Distribution boards and switching devices
Ricoh	Copy machines made with recycled material	UniCharm	Automatic urine collector
Nissan Motors	Corporate activities	Chubu Electric Power Company	Power generating facilities (thermal power generation and nuclear power generation)
Mitsubishi Motors	Rear-end trim using natural materials	Tostem	Interior materials having a volatile organic compound (VOC) absorption and degradation mechanism
Sekisui Chemical	Adhesives and building materials	Toyo Seikan Kaisha	Steel can TULC
Hitachi	Liquid-crystal projectors	Fujitsu Laboratories	IT solutions

Table 2: LIME2 working group participants and assessment targets

4. Major Results

This section introduces an overview of some of the case examples of assessment conducted by the working group. Assessment was carried out for all the characterization, damage, and integration steps, but this section introduces the result for the integration step.

Figure 3 shows the result of assessment of a wall material called MOISS conducted by Tostem. MOISS has a mechanism for absorbing and degrading VOC that is dispersed inside a room. When adhesives using formaldehyde as a solvent are used, an extremely small amount of chemical is released for a long period of time and causes the sick building syndrome. When MOISS is used, however, it has been found that formaldehyde is degraded and the indoor air pollution can be dramatically reduced. It has also been found that degradation of formaldehyde involves the generation of CO_2. The assessment result has indicated that the reduction of indoor air pollution was greater than the environmental impact caused by warming. Due to the size of the waste material, the assessment result has also indicated that the future issues to be focused on will be stages other than the product use stage, such as processing of waste materials produced in construction and recycling.

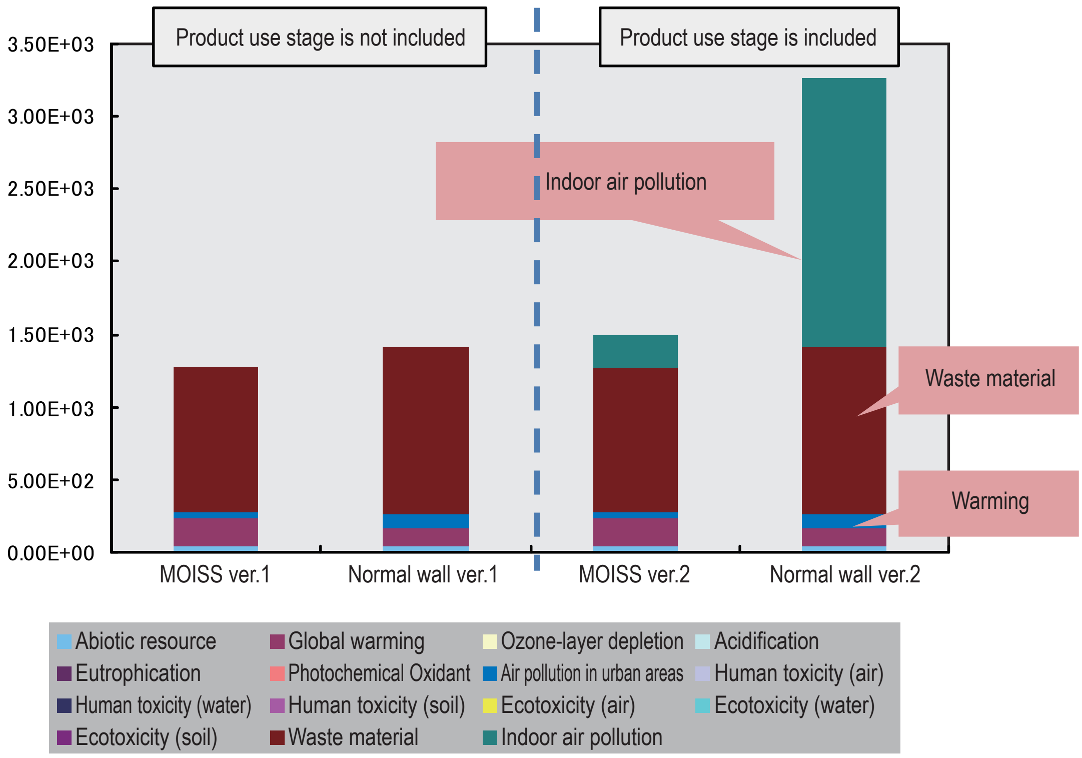

Figure 3: Result of environmental impact assessment of a VOC absorbing and degrading wall material (Tostem) (the unit for the vertical axis is yen); the left half of the graph is the assessment result when the product use stage is not included; the right half of the graph is the assessment result when the product use stage is included. MOISS is the VOC absorbing and degrading wall material.

Figure 4 shows the result of automatic urine collector assessment conducted by UniCharm. An automatic urine collector pumps urine; therefore, the frequency of changing diapers can be reduced (when using paper diapers: 2 diapers and 6 pads, and when using an automatic urine collector: 2 diapers and 2 pads[3]). Here, the environmental impact of not only the urine collector but also the paper diapers that are used together with the urine collector were assessed. Although manufacturing and use of the automatic urine collector caused an increase in CO_2 emission, the environmental impact associated with production and disposal (warming and waste material in particular) was reduced due to the decreased consumption of diaper pads. Therefore, the assessment result indicated that the environmental impact was greatly reduced.

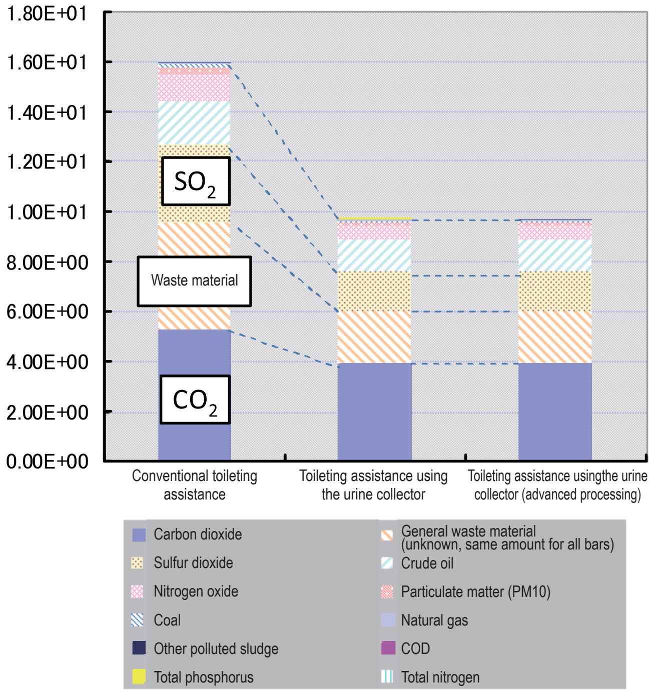

Figure 4: Result of environmental impact assessment of an automatic urine collector (UniCharm). The left bar shows the case where the automatic urine collector was not used. The center bar shows the case where the automatic urine collector was used. The right bar shows the case where the assessment included the urine treatment process. The unit for the vertical axis is yen.

Chubu Electric Power Company assessed the environmental impact of power generation. The assessment result is shown in Figure 5. The result indicated that thermal power generation using coal, oil, or LNG greatly influences CO_2 emission. Among these three above, LNG had low CO_2 emission strength and also had low air pollutant emission; therefore, LNG had a small environmental impact. Coal is in general collected through open-pit mining, and it uses more land area for collection than oil or natural gas. The reason why the environmental impact of coal is larger than oil or natural gas is that it influences biodiversity or primary production due to the land use during resource collection. Nuclear power generation has a low environmental impact overall compared to thermal power generation, but it must be noted that the risk of accidents or radiation was not within the scope of assessment. Furthermore, Japan has good environmental equipment such as desulphurization equipment and denitration equipment, and the volume of air pollutant emission is much smaller than other countries[4]. For this reason, when the same type of assessment is carried out in other countries, it is necessary to focus not only on warming and but also on air pollution.

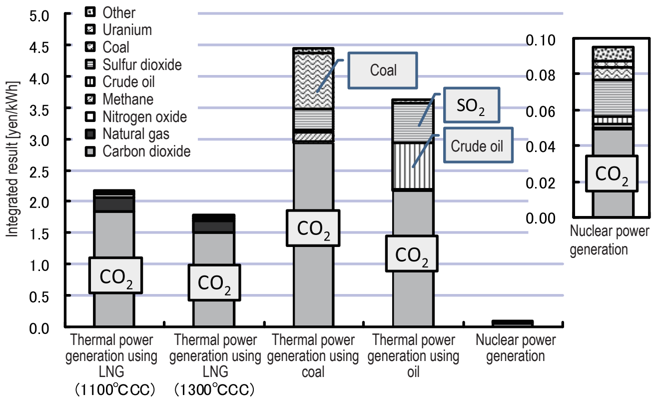

Figure 5: Result of environmental impact of power generation (Chubu Electric Power Company). The unit for the vertical axis is yen. The partial graph presentation in the small window is an enlarged image of the result of nuclear power generation assessment.

Toshiba proposed the originally developed environmental index "Factor T." Environmental impact assessment was included as a part of Factor T, and LIME was used for it. The most distinctive characteristic of Toshiba's assessment was that the factor calculation was used in all products. Figure 6 shows the summary of factor calculations. Although the environmental impact of each product largely varies with the type of product, a consistency tendency was observed in the life cycle stage breakdown. High-performance products with a relatively short life such as mobile phones or notebook PCs had a large environmental impact in production of their constituent materials. On the other hand, products with a long service life and large power consumption such as air-conditioners, lighting fixtures, and washers tended to have a large environmental impact in the product use stage. Toshiba now uses LIME not only to assess their products but also to assess the environmental performance of the entire company and also to set a long-term eco-efficiency target.

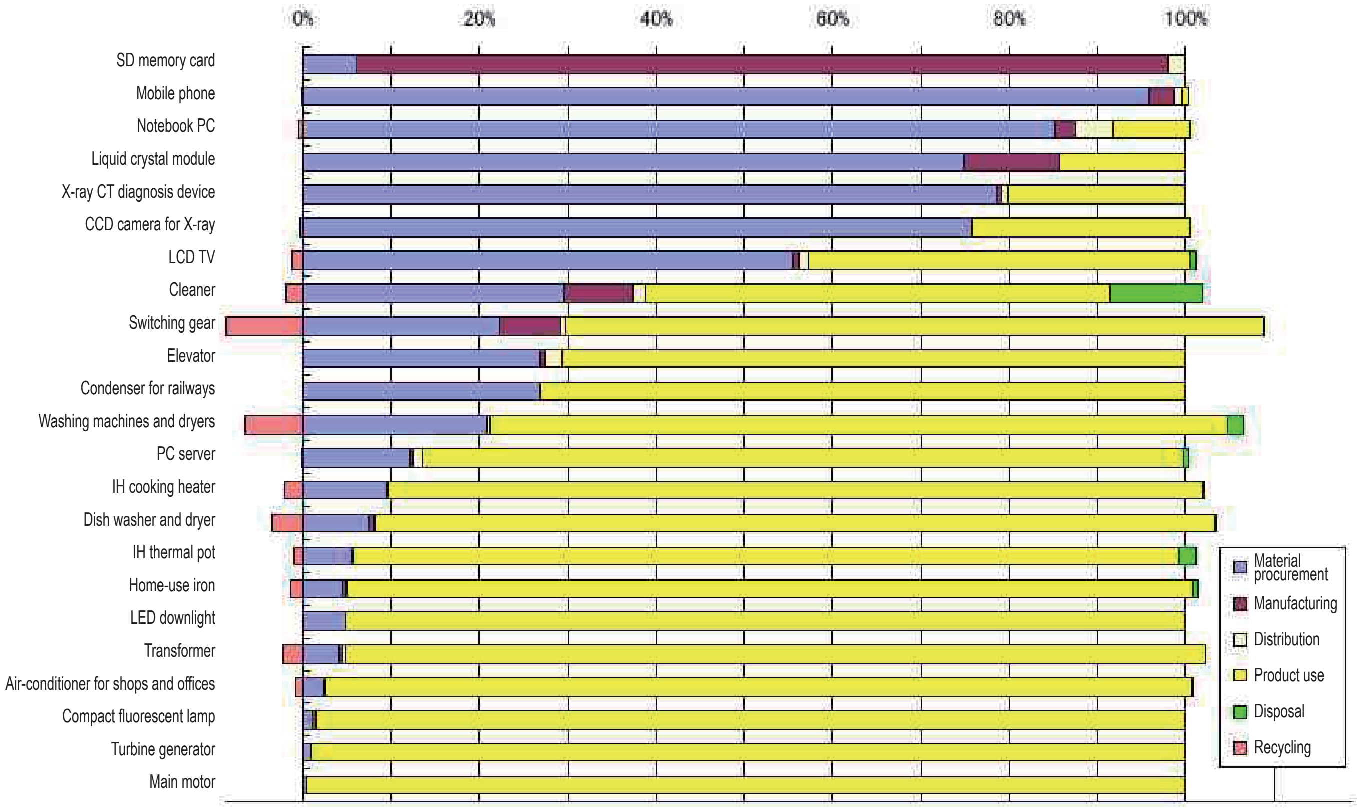

Figure 6: List of electric product Factor T calculation results (Toshiba): breakdown of the environmental impact integration result

5. Conclusion and the Future Vision

This article has reported what the LIME2 working group studied. In summary, Table 3 shows the breakdown of the environmental impact area from the assessed product and assessed result perspective. Through the study activity, we were able to conduct assessment on a wide variety of products, and the result indicated that these products had large environmental impacts on global warming, fossil fuel consumption, and urban air pollution compared to the other impact areas. At the same time, some assessment results directly reflected product characteristics. For example, the assessment result for containers, packages, and building materials showed that the impact on waste material had to be focused on. The assessment result for high performance

	O	G	A	U	P	Eu	T	Ec	I	N	M	F	B	L	W
Paper diaper		30〜50%		10〜30%								10〜30%			30〜50%
Plaster board									30〜50%				10〜30%		30〜50%
VOC degrading building material		10〜30%													50% or higher
Adhesive		50% or higher		10〜30%											
Natural adhesive		30〜50%		30〜50%											
Steel can		30〜50%		10〜30%							10〜30%				30〜50%
Car parts		30〜50%		30〜50%								10〜30%			
GV		30〜50%		30〜50%	10〜30%					10〜30%		10〜30%			
DV		30〜50%		50% or higher						10〜30%		10〜30%			
Car		30〜50%		30〜50%							10〜30%	10〜30%			
Thermal power generation using LNG		50% or higher										10〜30%			
Thermal power generation using coal		50% or higher		10〜30%								10〜30%			
Thermal power generation using oil		50% or higher		10〜30%								10〜30%			
High-voltage panel		30〜50%		10〜30%							10〜30%	10〜30%			10〜30%
Urine collector		30〜50%		10〜30%								10〜30%			10〜30%
Liquid crystal projector		30〜50%		10〜30%			10〜30%					10〜30%			10〜30%
Copy machine		30〜50%		10〜30%			10〜30%					10〜30%			
Air conditioner		50% or higher		10〜30%								10〜30%			

50% or higher　30〜50%　10〜30%

O: Ozone-layer depletion G: Global warming A: Acidification U: Urban area air pollution P: Photochemical oxidant Eu: Eutrophication T: Toxic chemical substance Ec : Ecotoxicity
I: Indoor air pollution N: Noise M: Mineral resource consumption F: Fossil fuel consumption B: Biological resource consumption L: Land use W: Waste material

Table 3: List of important environmental impact areas for each product type

electric products such as liquid crystal projectors and copy machines indicated that energy-saving as well as chemical substance management was important. It was also found that, from the perspective of comprehensive environmental impact control, implementation of measures to deal with indoor air pollution or consumption of biological resources[5)] would be effective for wall materials, and as for automobiles, measures against urban air pollution as well as noise would be effective. The assessment results presented at this time were provided by particular companies with regard to particular products. Therefore, they were not to be regarded as typical assessment results for any product groups. Still, however, we believe that these assessment results have provided useful information for identifying potentially serious environmental impacts.

Joint case example studies in cooperation with companies contributed not only to the sharing of study results and promotion of LIME2 but also clarification of future issues with regard to development of the environmental impact assessment method. The future issues to be addressed are as follows:

• Development of a method to assess overseas environmental impacts: LIME2 reflects Japanese environmental conditions and cannot accurately assess overseas environmental impacts. Currently, environmental burdens generated overseas are assessed based on the assumption that they cause the same environmental impacts as the environmental burdens generated inside Japan. Therefore, development of an assessment method to reflect overseas environmental conditions through collaboration with overseas researchers is desired. Even though global warming is the key when using electric products within Japan, when the same products are used overseas, particularly in areas where environmental equipment at power generation facilities has not been sufficiently installed, air pollution may be a more serious issue than global warming.

• Further expansion of case example study: So far, many case examples of LIME-based assessment are about industrial products such as electric products, cars, and materials, and not enough assessment has been conducted with primary industries such as agriculture, fishery, mining, and forestry. However, it is highly possible that the environmental impact areas to be focused on in these industries are different from those of industrial products such as land use, water, chemical substance, and accidents. Assessment of structures such as civil engineering and construction, ICT, and service has also been insufficient.

• Consistency with inventory: Although LIME2 covers 15 environmental impact areas, at this working group meeting, too, many of the case example studies focused only on a few areas such as warming or urban air pollution. Therefore, the extent of the assessed environmental impact areas has not been checked. Execution of screening assessment using data that fully covers inventory items will be an important requirement for avoiding improper decision making.

• Updating of the assessment method for major environmental impact areas: Global warming and resource consumption have been indicated as the major environmental impact areas for a lot of products. Improvement of the assessment method for these areas should be effective in improvement of the overall LCIA accuracy.

• Construction of a platform to promote sharing of information: The tool to promote the use of LIME was distributed at this working group meeting; however, there were cases where evaluation results that were inconsistent with the facts were outputted due to improper use or misunderstanding or where the results were not properly interpreted. In the future, it is desirable to enhance the function to assist smooth assessment by the implementers by publishing a guidebook that describes the LIME2 methodology or an instruction manual that shows how to use the tool and provides explanation on case examples.

[References]

Norihiro Itsubo and Atsushi Inaba: Lifecycle Environmental Impact Assessment Method. Japan Environmental Management Association for Industry (2005).

Masaharu Motoshita, Ryota Ii, Hironori Nogami, Norihiro Itsubo, and Atsushi Inaba: Spreadsheet Software-Based Impact Assessment Program -LIME Calculation Sheet-. Collection of Presentation Materials at the 3rd Japan LCA Forum, pp. 104-105 (2008).

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1) Life-cycle Impact assessment Method based on Endpoint modeling
2) For the content of the LIME2 calculation sheet, refer to the Collection of Executive Summaries of the Presentation Meeting of the 3rd Japan LCA Forum (Motoshita, et al., 2008).
3) Based on UniCharm's investigation result.
4) Compared to 0.05 g per kWh of SO_2 emission and 0.09 g per kWh of NOx emission (2002) by Chubu Electric Power Company, SO_2 emission was 1.2 g per kWh and NOx emission was 0.7 g per kWh in Germany (1999), and SO_2 emission was 4.8 g pr kWh and NOx emission was 2.1 g per kWh in the United States (1999) (from the Chubu Electric Power Company website)
5) When wood building material is used.

LCA-Based Approach to reduce CO_2 Emissions from Recycling Plants

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Representative Director and CEO
Re-Tem Corporation

1. Introduction

It is believed that, in terms of resource efficiency, a healthy product life cycle consists of a flow of raw material → manufacturing → use → recycling.

There is no such thing like 'waste' , it is 'fortune' in the wrong place; therefore, it is necessary and urgent to establish a resource circulating society where recycling, manufacturing, and consumption are all included to close the loop of material flow.

One of the possible approaches is to apply LCA to identify the most appropriate recycling process for each recycling plant and type of waste material in order to reduce environmental burdens as much as possible. To investigate the environmental burden generated in our Mito Plant during its operation, LCA data for the entire plant were collected for the year 2002 and 2003. Although data was available for individual waste material, i.e. used car or home appliance, system-level LCA data covering entire recycling plant was lacking at that time;

By analyzing the data,a number of solutions were recommended which have contributed to the reduction of energy consumption at the plant. Until now, the company has been constantly applying LCA to further reduce environmental burdens while searching for improving recycling efficiency.

In addition, the company is conducting LCA for recycling plant construction for Re-Tem Tokyo plant - the first attempt in recycling industry.

Since analysis and comparison based on LCA result could effectively assist companies to conduct quantitative assessment of the volume of CO_2 emission, it is necessary that it become a recognized tool to assist reducing CO_2 emission for the industry.

2. Material Flow and Inventory at the Mito Plant

To examine the environmental burden produced in the Mito Plant during its operation, material flow and process-specific inventory data for the Mito Plant were created.

A disposal plant has not only horizontal but also vertical lines, and it takes a large amount of time and effort to conduct measurement at each point. In the material flow, the recycling process in Mito Plant was divided into five sub-processes including P1, P2, IR, NF, and C1, and created charts for the processes at each of these sub-processes.

First, the material balance (= environmental burden) must be visually checked. Materials such as plastic, chlorofluorocarbon (CFC) products, fluorescent lamps, and batteries that can be converted into environmentally-friendly material are first materially sorted and processed by shredders. The output of the process could be inputed as raw material for electric furnaces or non-ferrous metal and is required to provide the products high quality. Because of this material conversion, both of the plants produced "zero" CO_2 emissions. Due to the sophiscation of material flow, its outline is shown in an easy-to-understand manner in Figure 1 Schematic diagram of the flow at the Re-Tem Mito Plant. As for the inventory data, each process at the P1 sub-processs is provided.

The examination result showed that CO_2 emission per ton of processed waste was the largest in the shredding process at the P2 sub-plant followed by the shredding process at the P1 sub-plant and the cutting process at the IR sub-plant. As for the ratio between electricity and fuel consumption and the total CO_2 emission for each process, the electricity and fuel consumption at the P1 sub-plant accounts for almost 80%, and this suggested P1 is the priority area to be improved.

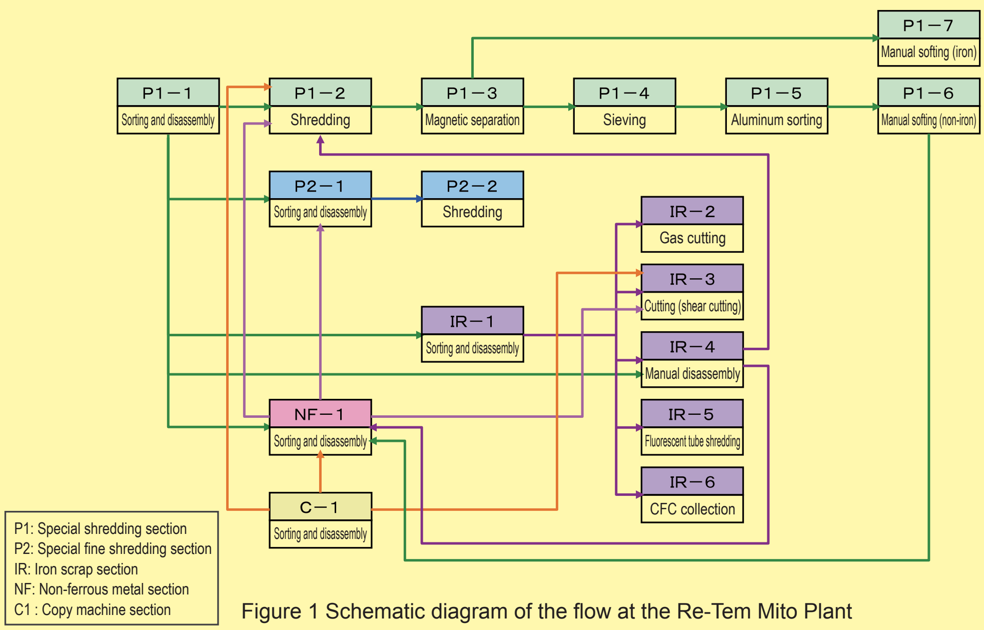


Figure 1 Schematic diagram of the flow at the Re-Tem Mito Plant

[Input]

Used product	11	Waste motor (home appliance)	772.3	t
	12	Waste OA device	2,595.4	t
Total			3,367.7	t

Energy		Electricity	3.4	MWh
		Fuel (light diesel oil)	6.7	kl
		Fuel (gasoline)	0.6	kl
Water		Service water		

Indirect material		Oxygen	395.4	m^3
		Propane	74.4	kg
		Acetylene	4.9	kg
		CO_2	26.8	kg
		Welding rod	29.2	kg
		Packing and transportation material (flexible container bag)	790.6	kg

[Output]

Process output		Process output	2,463.8	t
	23	Aluminum	1.3	t
	24	Non-ferrous composite materials	29.3	t
	25	Copper	0.5	t
	29	Substrate	5.9	t
	30	Monitor and CRT	2.9	t
	31	Paper	1.0	t
	41	Substrate	0.5	t
	52	Iron scrap	21.0	t
	53	Iron composites	15.1	t
	54	Iron	20.4	t
	11	Waste motor and compressor	772.3	t
	32	Lead battery	9.9	t
	34	Recycled waste plastic	1.3	t
	35	Waste plastic (RDF)	6.6	t
	35-1	Waste plastic (land filling)	0.0	t
	36	Paper	10.91	t
	55	Iron	0.5	t
	33	Stainless steel	4.7	t
Total			3,367.7	

Emission		CO_2	20.5	t

[Input]

Used product	11	Waste motor (home appliance)	229.3	kg
	12	Waste OA device	770.7	kg
Total			1,000.0	kg

Energy		Electricity	1.0	kWh
		Fuel (light diesel oil)	2.0	l
		Fuel (gasoline)	0.2	l
Water		Service water		kg

Indirect material		Oxygen	0.1	m^3
		Propane	22.1	g
		Acetylene	1.4	g
		CO_2	8.0	g
		Welding rod	8.7	g
		Packing and transportation material (flexible container bag)	234.7	g

[Output]

Process output		Process output	731.6	kg
	23	Aluminum	0.4	kg
	24	Non-ferrous composite materials	8.7	kg
	25	Copper	0.1	kg
	29	Substrate	1.7	kg
	30	Monitor and CRT	0.9	kg
	31	Paper	0.3	kg
	41	Substrate	0.1	kg
	52	Iron scrap	6.2	kg
	53	Iron composites	4.5	kg
	54	Iron	6.1	kg
	11	Waste motor and compressor	229.3	kg
	32	Lead battery	2.9	kg
	34	Recycled waste plastic	0.4	kg
	35	Waste plastic (RDF)	2.0	kg
	35-1	Waste plastic (land filling)	0.0	kg
	36	Paper	3.2	kg
	55	Iron	0.2	kg
	33	Stainless steel	1.4	kg
Total			1,000.0	kg

Emission		CO_2	6.1	kg

Table 1 P1-1 Sorting and disassembly inventory

[Input]

Used product		In-process input	2,463.8	t
From the IR sub-plant	92	Non-ferrous composite materials	11.3	
From the IR sub-plant	11-1	Waste motor	1.7	
From the Non-ferrous metal section	122	Non-ferrous composite materials	166.2	t
From the Copy machine section	164	Iron composites	205.9	t
	165	Non-ferrous composite materials	945.2	t
From the Game machine section	155	Non-ferrous composite gold materials	36.9	t
Total			3,831.0	t

Energy		Electricity	303.8	MWh
Water		Service water		kl

Indirect material		Tool (damper)	173.5	t
		(rotor cap)	687.1	t
		(hammer)	853.7	t
		Oxygen	449.7	m^3
		Propane	84.7	kg
		Acetylene	5.5	kg
		CO_2	30.5	kg
		Welding rod	33.2	kg
		Packing and transportation material (flexible container bag)	899.3	kg

[Output]

Process output		In-process output	3,479.8	t
	22	Collected powder material	351.2	t
Total			3,831.0	t

Emission		CO_2	117.6	t

[Input]

Used product		In-process input	643.1	kg
From the IR sub-plant	92	Non-ferrous composite materials	3.0	kg
From the IR sub-plant	11-1	Waste motor	0.4	kg
From the Non-ferrous metal section	122	Non-ferrous composite materials	43.4	kg
From the Copy machine section	164	Iron composites	53.8	kg
	165	Non-ferrous composite materials	246.7	kg
From the Game machine section	155	Non-ferrous composite gold materials	9.6	kg
Total			1,000.0	kg

Energy		Electricity	79.3	kWh
Water		Service water		l

Indirect material		Tool (damper)	45.3	kg
		(rotor cap)	179.4	kg
		(hammer)	222.8	kg
		Oxygen	117.4	m^3
		Propane	22.1	g
		Acetylene	1.4	g
		CO_2	8.0	g
		Welding rod	8.7	g
		Packing and transportation material (flexible container bag)	234.7	g

[Output]

Process output		In-process output	908.3	kg
	22	Collected powder material	91.7	kg
Total			1,000.0	kg

Emission		CO_2	30.7	kg

Table 2 P1-2 Shredding inventory

[Input]

Inside the process		In-process input	3, 479. 8	t
Energy		Electricity	9. 0	MWh
Water		Service water		t
Indirect material		Oxyge	563. 6	m^3
		Propane	106. 1	kg
		Acetylene	6. 9	kg
		CO_2	38. 2	kg
		Welding rod	41. 6	kg
		Packing and transportation material (flexible container bag)	1127. 0	kg

[Output]

Process output		Magnetic matter	1, 321. 3	t
	13	Table 4 P1-4 Sieving inventory	2, 158. 5	t
Total			3, 479. 8	t
Emission		CO_2	3. 5	t

[Input]

Inside the process		In-process input	1, 000. 0	kg
Energy		Electricity	2. 6	kWh
Water		Service water		kg
Indirect material		Oxyge	0. 2	m^3
		Propane	30. 5	g
		Acetylene	2. 0	g
		CO_2	11. 0	g
		Welding rod	12. 0	g
		Packing and transportation material (flexible container bag)	323. 9	g

[Output]

Process output		Magnetic matter	379. 7	kg
	13	Table 4 P1-4 Sieving inventory	620. 3	kg
Total			1, 000. 0	kg
Emission		CO_2	1. 0	kg

Table 3 P1-3 Magnetic separation inventory

[Input]

Inside the process		In-process input	1, 321. 3	t
Energy		Electricity	4. 3	MWh
Water		Service water		t
Indirect material		Oxyge	155. 1	m^3
		Propane	29. 2	kg
		Acetylene	1. 9	kg
		CO_2	10. 5	kg
		Welding rod	11. 5	kg
		Packing and transportation material (flexible container bag)	310. 2	kg

[Output]

Process output	15	Plus sieve	834. 0	t
	14	Gold and silver slag	487. 3	t
Total			1321. 3	t
Emission		CO_2	1. 7	t

[Input]

Inside the process		In-process input	1, 000. 0	kg
Energy		Electricity	3. 3	kWh
Water		Service water		kg
Indirect material		Oxyge	0. 1	m^3
		Propane	22. 1	g
		Acetylene	1. 4	g
		CO_2	8. 0	g
		Welding rod	8. 7	g
		Packing and transportation material (flexible container bag)	234. 7	g

[Output]

Process output		Plus sieve	631. 2	kg
		Gold and silver slag	368. 8	kg
Total			1000. 0	kg
Emission		CO_2	1. 3	kg

Table 4 P1-4 Sieving inventory

[Input]

Inside the process	15	Plus sieve	834. 0	t
Energy		Electricity	2. 5	MWh
Water		Service water		t
Indirect material		Oxyge	97. 9	m^3
		Propane	18. 4	kg
		Acetylene	1. 2	kg
		CO_2	6. 6	kg
		Welding rod	7. 2	kg
		Packing and transportation material (flexible container bag)	195. 8	kg

[Output]

Process output	16	Plus sieve	650. 2	t
	17	Aluminum	183. 8	t
Total			834. 0	t
Emission		CO_2	1. 0	t

[Input]

Inside the process	15	Plus sieve	1000. 0	kg
Energy		Electricity	3. 0	kWh
Water		Service water		kg
Indirect material		Oxyge	0. 1	m^3
		Propane	22. 1	g
		Acetylene	1. 4	g
		CO_2	8. 0	g
		Welding rod	8. 7	g
		Packing and transportation material (flexible container bag)	234. 7	g

[Output]

Process output	16	Plus sieve	779. 6	kg
	17	Aluminum	220. 4	kg
Total			1000. 0	kg
Emission		CO_2	1. 2	kg

Table 5 P1-5 Aluminum sorting inventory

[Input]

	16	Plus sieve	650.2	t

Energy		Electricity	0.7	MWh
Water		Service water		t

Indirect material		Oxyge	76.3	m³
		Propane	14.4	kg
		Acetylene	0.9	kg
		CO_2	5.2	kg
		Welding rod	5.6	kg
		Packing and transportation material (flexible container bag)	152.6	kg

[Output]

Process output	20	Stainless steel	11.8	t
	19	Gold and silver slag with plastic	638.4	t
Total			650.2	t

Emission		CO_2	0.3	t

[Input]

	16	Plus sieve	1000.0	kg

Energy		Electricity	1.0	kWh
Water		Service water		kg

Indirect material		Oxyge	0.1	m³
		Propane	22.1	g
		Acetylene	1.4	g
		CO_2	8.0	g
		Welding rod	8.7	g
		Packing and transportation material (flexible container bag)	234.7	g

[Output]

Process output	20	Stainless steel	18.1	kg
	19	Gold and silver slag with plastic	981.9	kg
Total			1000.0	kg

Emission		CO_2	0.4	kg

Table 6 P1-6 Manual sorting inventory

[Input]

Inside the process	13	Magnetic matter	2,158.5	t

Energy		Electricity	2.18	MWh
Water		Service water		t

Indirect material		Oxyge	253.4	m³
		Propane	47.7	kg
		Acetylene	3.1	kg
		CO_2	17.2	kg
		Welding rod	18.7	kg
		Packing and transportation material (flexible container bag)	506.7	kg

[Output]

Process output	18	Iron	2,158.5	t

Emission		CO_2	0.8	t

[Input]

Inside the process	13	Magnetic matter	1,000.0	kg

Energy		Electricity	1.01	kWh
Water		Service water		kg

Indirect material		Oxyge	0.1	m³
		Propane	22.1	g
		Acetylene	1.4	g
		CO_2	8.0	g
		Welding rod	8.7	g
		Packing and transportation material (flexible container bag)	234.7	g

[Output]

Process output	18	Iron	1,000.0	kg

Emission		CO_2	0.4	kg

Table 7 P1-7 manual sorting inventory

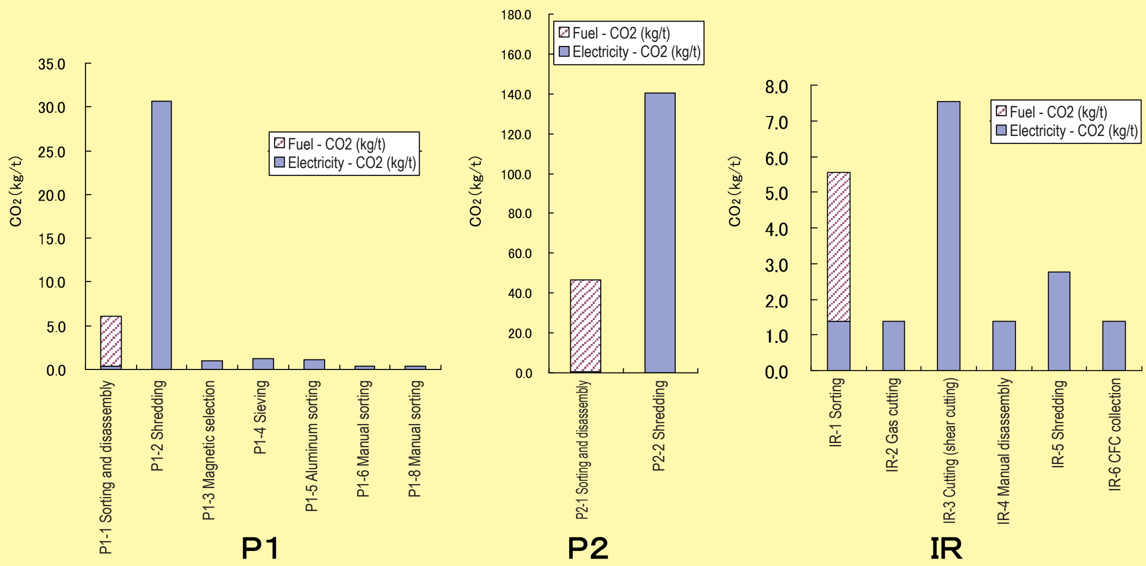


Figure 2 CO2 emission per processing of 1 ton

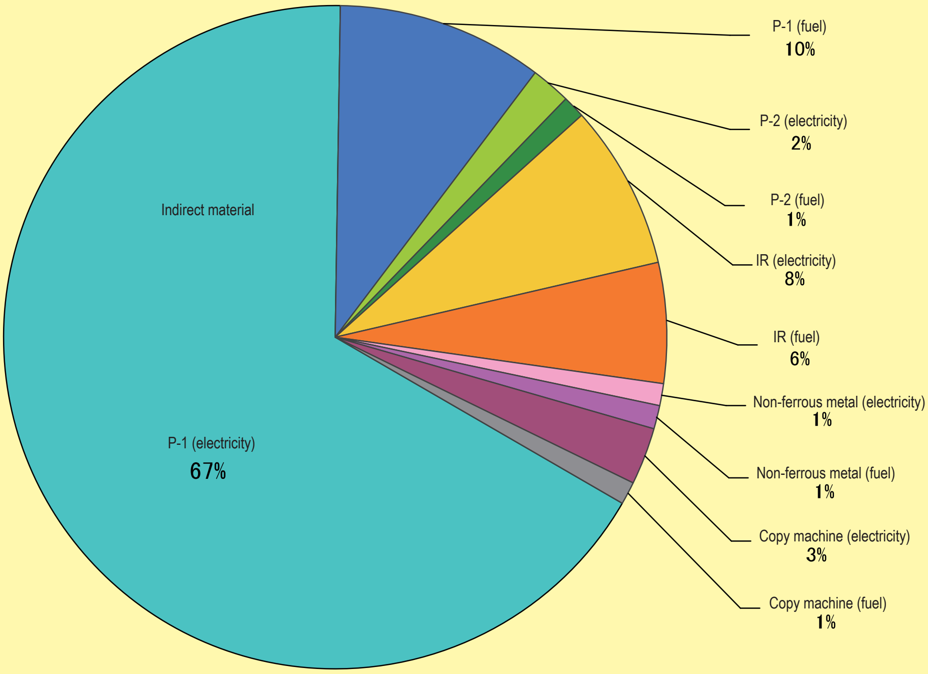


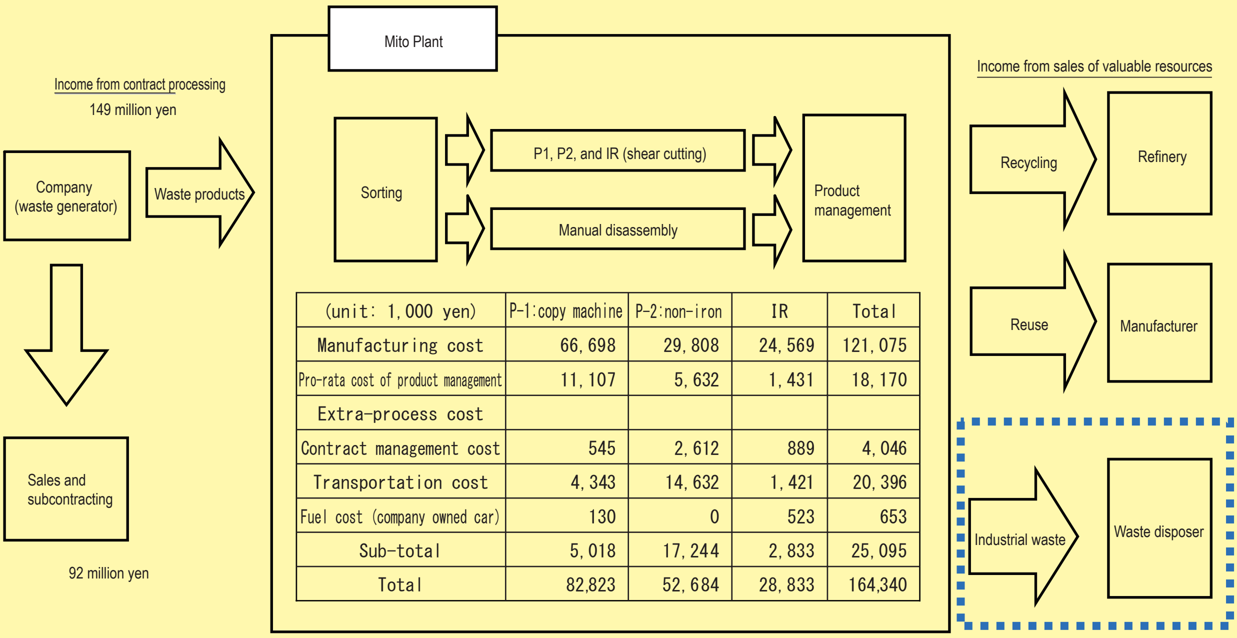
Figure 3 Ratio between electricity and fuel consumption, and the total CO_2 emission for each process

3. Environmental Accounting in Environmental Business

LCA does not cover labor cost. However, manual disassembling is widely used in many recycling methods, especially in developing countries like China and Southeast Asia countires.

Therefore, the company included labor cost for the approach of conducting LCA.

The objective of environmental accounting is to quantify environmental cost based on cost standards of a company for each specific purpose. In environmental business where business is directly related to environment conservation activities however, other costs rather than environmental cost for each specific activity standard, and understanding and classification of environmental effects are also quantified.



(unit: 1,000 yen)	P-1:copy machine	P-2:non-iron	IR	Total
Manufacturing cost	66,698	29,808	24,569	121,075
Pro-rata cost of product management	11,107	5,632	1,431	18,170
Extra-process cost				
Contract management cost	545	2,612	889	4,046
Transportation cost	4,343	14,632	1,421	20,396
Fuel cost (company owned car)	130	0	523	653
Sub-total	5,018	17,244	2,833	25,095
Total	82,823	52,684	28,833	164,340

Figure 4 Approach to environmental accounting

4. CO_2 Emission during Construction period of the Tokyo Plant

Although it is considered time-consuming, the company determined to collect LCA data for the entire life cycle covering construction, operation, and demolition of a recycling plant prior to construction of the Tokyo Plant. By comparing the environmental burden between the scenario when material was recycled and when material was not recycled, the company has attempted to reach a better result using LCA.

First, construction LCA was conducted to measure the amount of energy consumed on construction. Construction was divided into three aspects including construction work, construction material, and installed equipment, and obtained the CO_2 emission for each aspect. As as result, the emission was highest for construction material, accounting for 54.6%, followed by installed equipment accounting for 40.1% and construction work accounting for 5.3%.

By taking the depreciation period into account, the emission was the highest for installed equipment accounting for 71.6% and the construction material accounting comes to the second of 26.1%. This is because, construction material has a long depreciation period of 50 years, comparing to installed equipment, such as machinery or electric equipment, which has a shorter depreciation period of 15 years.

Figure 5 LCCO2 REPORT

CO2 emission in plant construction	CO2 emission		CO2 emission per year	
	t-CO2	%	t-CO2/year	%
Construction work	242.5	5.3	4.0	2.3
Construction material	2517.2	54.6	44.8	26.1
Installation equipment	1847.5	40.1	123.2	71.6
Total	4607.1	100	172.0	100

CO2 emission in construction work (for each process)		CO2 emission			CO2 emission per year		
		t-CO2		%	t-CO2/year		%
Machine operation	Construction by Shimizu	211.9	198.2	81.7	3.5	3.3	81.7
	Distribution by Hitachi		13.7	5.6		0.23	5.6
Soil transportation	Construction by Shimizu	4.3	0.1	0	0.07	0.002	0
	Distribution by Hitachi		–	–		–	–
Material transportation	Construction by Shimizu		3.3	1.4		0.055	1.4
	Distribution by Hitachi		0.9	0.4		0.015	0.4
Utilities		26.3		10.8	0.4		10.8
Total		242.5		100	4.04 1		100

CO2 emission for construction material (for each material)	CO2 emission		CO2 emission per year	
	t-CO2	%	t-CO2/year	%
Concrete	1180.5	46.9	19.9	44.5
Iron	1047.9	41.6	17.7	39.4
Aluminum	77.8	3.1	1.6	3.5
Glass	44.8	1.8	0.9	2.0
Electric wire	39.0	1.6	2.6	5.8
Other	8.7	0.3	0.2	0.4
Lighting	0.0	0.0	0.0	0.0
Planting	0.5	0.0	0.0	0.1
Transportation	118.0	4.7	2.0	4.4
Total	2517.2	100	44.8	100

CO2 emission for construction material (for each building element)	CO2 emission		CO2 emission per year	
	t-CO2	%	t-CO2/year	%
Foundation	1651.5	65.6	27.52	61.4
Foundation pillar	439.0	17.4	7.32	16.3
Aluminum-framed glass wall	122.7	4.9	2.45	5.5
Transportation (other than for planting)	118.0	4.7	1.98	4.4
Building material	104.8	4.2	2.10	4.7
Concrete	39.0	1.6	2.60	5.8
Interior material	35.6	1.4	0.71	1.6
Green roof	4.6	0.2	0.09	0.2
Wall material	1.6	0.1	0.03	0.1
Concrete	0.5	0.0	0.03	0.1
Lighting	0.0	0.0	0.00	0.0
Total	2517.2	100	44.84	100

CO2 emission for installed equipment	CO2 emission		CO2 emission per year	
	t-CO2	%	t-CO2/year	%
Shredder	676.5	36.6	45.1	36.6
Air classifier	240.5	13.0	16.0	13.0
Soundproofing of shredder room	239.2	12.9	15.9	12.9
Wet scrubber + No.1 fan	197.3	10.7	13.2	10.7
Cyclone separator + No.2 fan	178.8	9.7	11.9	9.7
Belt conveyor	76.6	4.1	5.1	4.1
Distribution board	61.8	3.3	4.1	3.3
Vibratory separator + trommel sieve	45.8	2.5	3.1	2.5
Elevator	43.1	2.3	2.9	2.3
Bug filter	36.2	2.0	2.4	2.0
Scale	18.8	1.0	1.3	1.0
Drum magnetic separator	17.3	0.9	1.2	0.9
Radiation detector	8.3	0.5	0.6	0.5
No.3 fan	7.3	0.4	0.5	0.4
Total	1847.5	100	123.2	100

Table 8 CO_2 emission in the Tokyo Plant construction

5. CO_2 Emission from the Tokyo Plant during its Operation

Figures of the "material flow at the Tokyo Plant", "changes in CO_2 emission from the Tokyo Plant in its operation," and "changes in CO_2 emission per 1 ton of processed waste" were created.

CO_2 emission caused by operation of the Tokyo Plant was 7.2 tons per month during initial stage of operation. It then gradually increased to reach its maximum at 21 tons per month in March, 2006. Emission started to decrease from April, 2006, and it was within the range between 7 to 10 tons per month after June. It however went up again to 16 tons per month in March, 2007. This is due to largest amount of waste was processed during the measurement period in March, 2007.

In the first year of plant operation (FY2005), due to various nonrecurring factors, a large amount of electricity and light diesel oil were consumed for the amount of processing, resulting in the increased CO_2 emission. In FY2006, waste processing efficiency improved to realize processing of a larger amount of waste with the minimum amount of electricity and light diesel oil. This resulted in successful reduction of CO_2 emission.

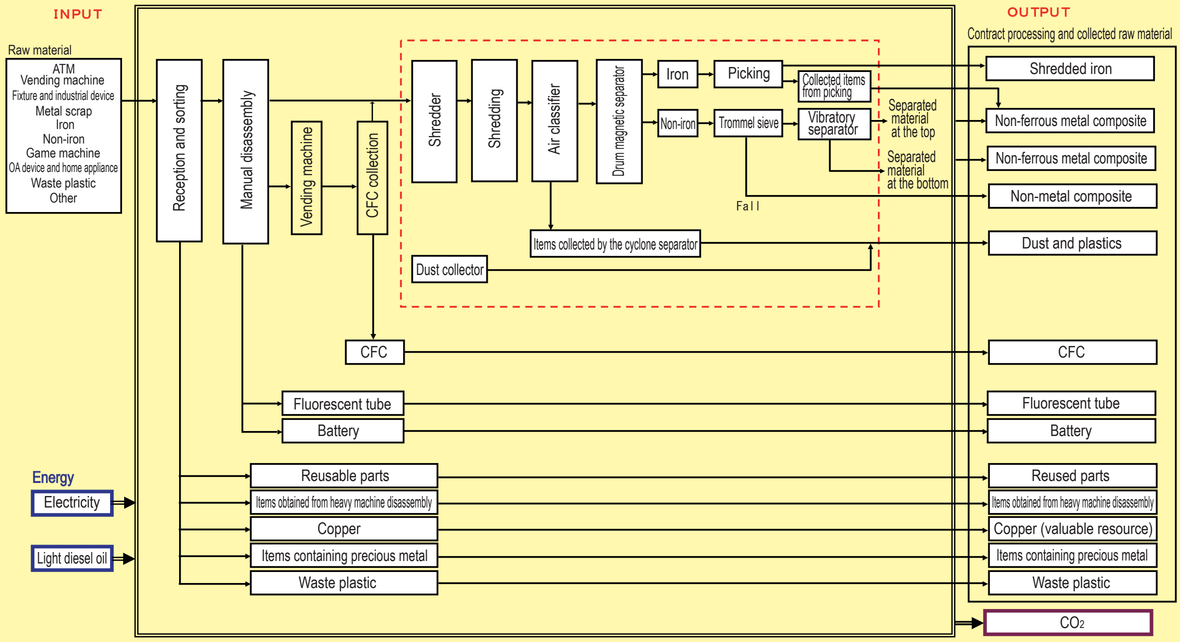


Figure 6 Material flow at the Tokyo Plant

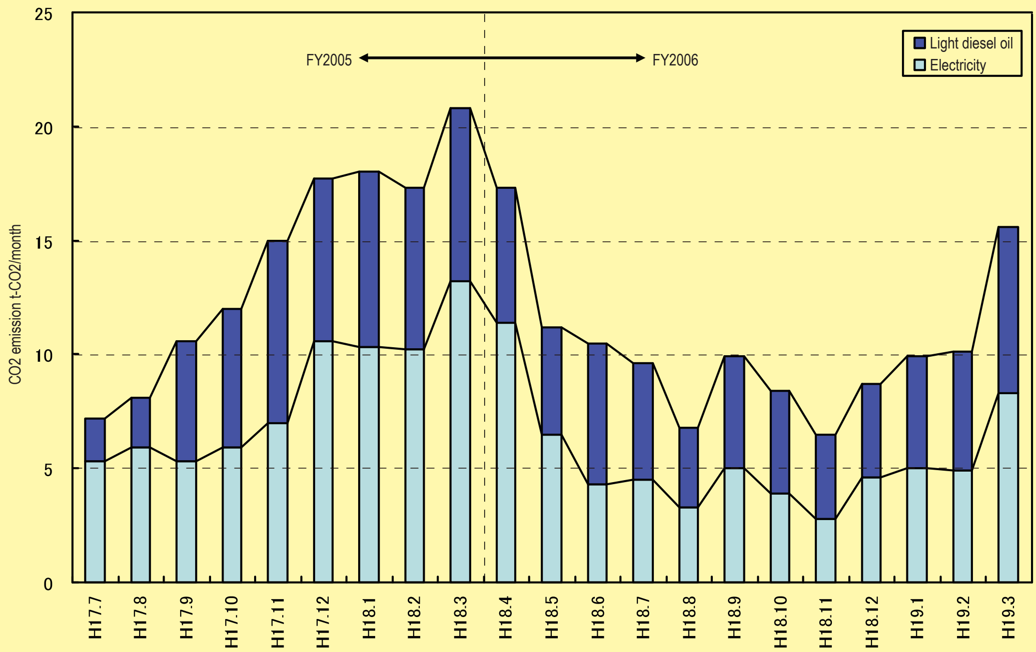


Figure 7 Changes in CO_2 emission from the Tokyo Plant in its operation

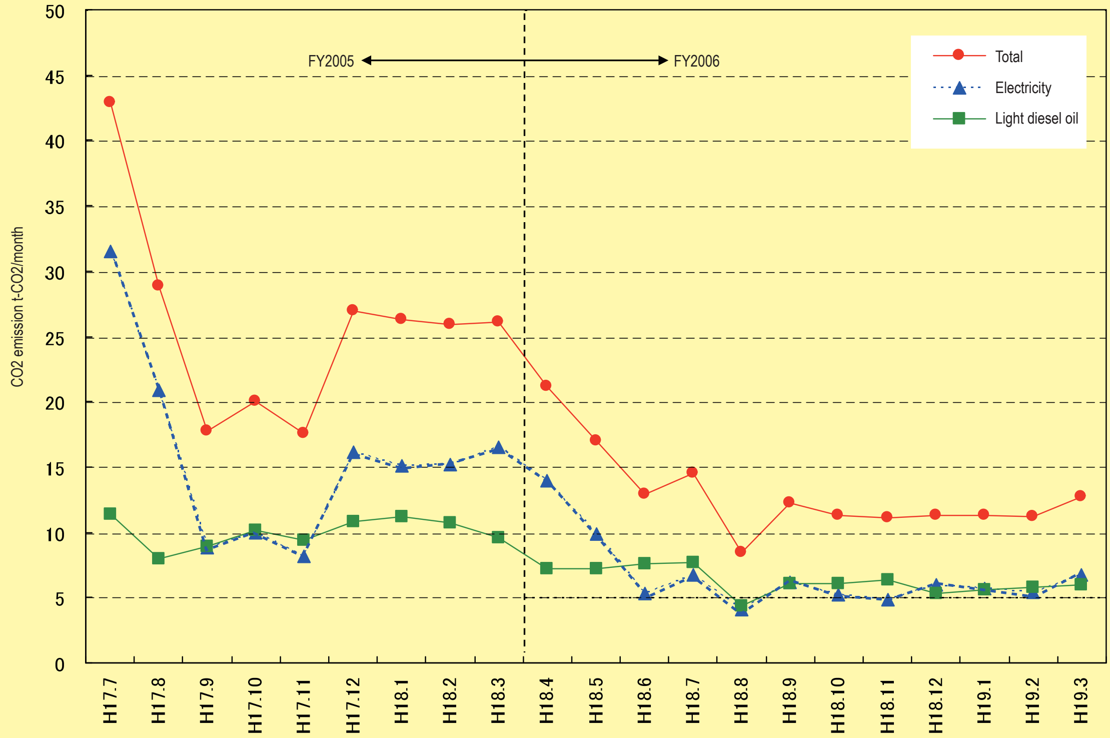


Figure 8 Changes in CO_2 emission per 1 ton of processed waste

6. Green Electricity

Re-Tem purchase green electricity from Japan Natural Energy Company Limited and act as a green electricity recycling plant by replacing all electricity used at Tokyo Plant with natural energy generated through biomass power generation. This allows recycling of waste while maintaining zero CO_2 emission.

Under this concern,Re-Tem provides "green recycle " label to those who want them.

The Green Power Certification System acts as a bridge between companies that wish to use green electricity and power producers. Upon request by Re-Tem, the intermediary, Japan Natural Energy Company Limited (JNE), delegates green electricity generation to power producers. JNE then issues a certificate to Re-Tem, assuring that green electricity was produced and that the volume of electricity currently under contract is green electricity.

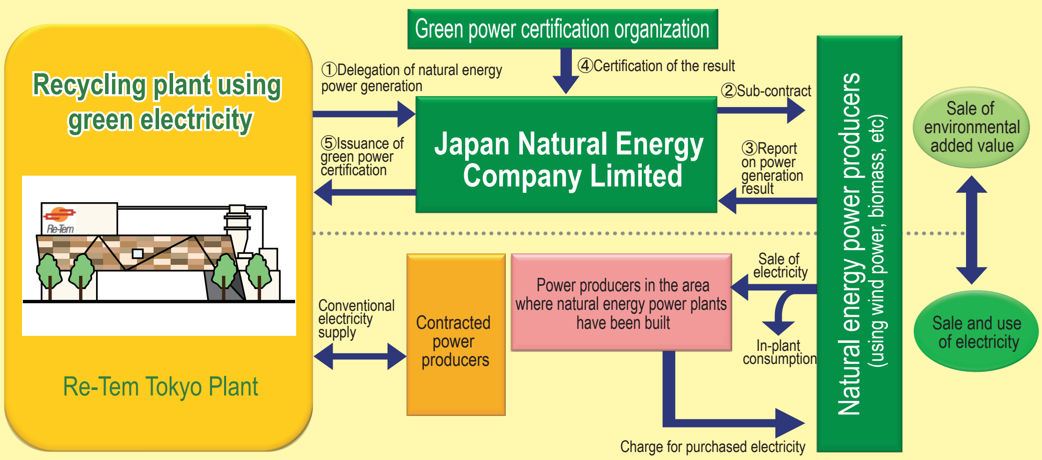


Figure 9 Green Power Certification System

7. Comparison of CO_2 Emissions at the Tokyo and Mito Plants againsting the Previous Year

CO_2 emission at the Tokyo and Mito Plants between FY2005 and FY2006 were compared. Mover, the total CO_2 emissions between the Tokyo Plant and Mito Plant were also compared. The results showed that CO_2 emission per ton of processed material was lower than the previous year at both the Tokyo and Mito Plants. The total emission for both plants was also lower than the previous year by 18%. In other words, the company's priority activity, which was CO_2 emission reduction, produced a positive outcome.

	Tokyo Plant			Mito Plant			Total			
	FY2005 (9 months)	FY2006	Increase /Decrease	FY2005 (9 months)	FY2006	Increase /Decrease	FY2005 (9 months)	FY2006	Increase /Decrease	
Received material (tons)	5,311.0	9,671.9	4,360.9	25,683.9	25,326.4	△ 357.5	30,994.9	34,998.3	4,003.4	
Electricity used (kWh)	182,827	165,930	△ 16,897.0	1,147,670	902,902	△ 244,768	1,330,497	1,068,832	△ 261,665	
Electric power consumption rate (kg/kWh)	0.3886	0.3886		0.3886	0.3886		0.3886	0.3886		
Electricity-based CO_2 emission (kg)	71,046.6	64,480.4	△ 6,566.2	445,984.6	350,867.7	△ 95,116.9	517,031.1	415,348.1	△ 101,683.0	
Light diesel oil used (L)	26,607	47,747	21,140.0	116,833	109,748	△ 7,085	143,440	157,495	14,055	
Light diesel oil consumption rate (kg/L)	2.640	2.640		2.640	2.640		2.640	2.640		
Light diesel oil-based CO_2 emission (kg)	70,242.5	126,052.1	55,809.6	308,439.1	289,734.7	△ 18,704.4	378,681.6	415,786.8	37,105.2	
Total CO_2 emission (kg)	141,289.1	190,532.5	49,243.4	754,423.7	640,602.4	△ 113,821.3	895,712.7	831,134.9	△ 64,577.8	
CO_2 emission per ton of received material	26.6	19.7	△ 6.9	29.4	25.3	△ 4.1	28.9	23.7	△ 5.2	82.0 %
									※2	75.8 %

*1 CO2 emission basic unit

Electricity: 0.3886 kg-CO_2/kWh, based on JLCA-LCA Database FY2005, 2nd Edition, by Japan Environmental Management Association for Industry

Light diesel oil: 2.64 kg-CO_2/L, based on the Ministry of the Environment Enforcement Regulation Emission Coeffi cient List (fuel-specific basic emission unit) in the Ministry of the Environment Greenhouse Gases Emission Calculation Method Examination Committee data from the Greenhouse Gases Emission Calculation Examination Committee Report

*2 Green electricity to be used at the Tokyo Plant from FY2007 will allow CO_2 emission from electricity during recycling to be reduced to zero. The figure for FY2006 incorporates this prediction.

Table 9 Comparison of CO2 emission in FY2005 and FY2006 between the Tokyo and Mito Plants

8. Re-Tem Integrated System of Management (RISM)

It is an attempt to integrate data and systems of the material flow by integrating ISO14001-based EMS, the ISO27001-based ISMS, and the risk management system. By incorporating other tool such as LCA, it is expected material flow management would be improved which would benefit both RISM and LCA.

Figure 10 LCA and Re-Tem integrated system of management (RISM)

9. Conclusion

Environmental issues and global warming are widely discussed in the society. Many people think about environmental issues, talk about CO_2 reduction and global warming, and are concerned about them.

Among a wide variety of environmental issues, Re-Tem handles one of the most immediate problems: waste material and products - which makes Re-Tem obligated to implement practical measures through the business operations.

This provides great incentive for the company to continue applying LCA to further improve the efficiency of recycling operations.

Chairman's Award

Implementation of LCA to Support Environmental Management of the Toshiba Group

Norio Takeyama
Chief Specialist, Corporate Environment Management Division
Toshiba Corporation

1. Introduction

The Toshiba group started using LCA in 1993 and since then has been contributing to internal use and external dissemination of LCA methods by creating a database using input-output tables and also by developing a simplified assessment tool. The above achievements are named as eco-efficiency factors in terms of service life cycle and business process (manufacturing phase) and are effectively used in corporate environmental management. This article provides an overview of LCA in the Toshiba group.

2. Simplified LCA

LCA by designers during the design method of a product is effective in creation of an environment-conscious product, and for LCA of a product containing a large number of parts, development of a simplified LCA was desired. We therefore used statistical data to create a typical life cycle model of a home appliance, and created default values for transportation, disposal, and recycling phases which were difficult to obtain uniquely and for designers to know. We then created a tool using this typical life cycle model to allow designers to calculate environmental burdens in these phases based on design information (Figure 1). Meanwhile, as for raw material procurement, manufacturing, and product use phases, we first created an inventory database for material and energy background data based on the result of input-output analysis, and then installed it in the tool. As a result, designers were able to conduct LCA by inputting only foreground data. The simplified assessment tool so developed was named "Easy-LCA™" and released in 1996. It was widely used inside Toshiba and also was released into the market.

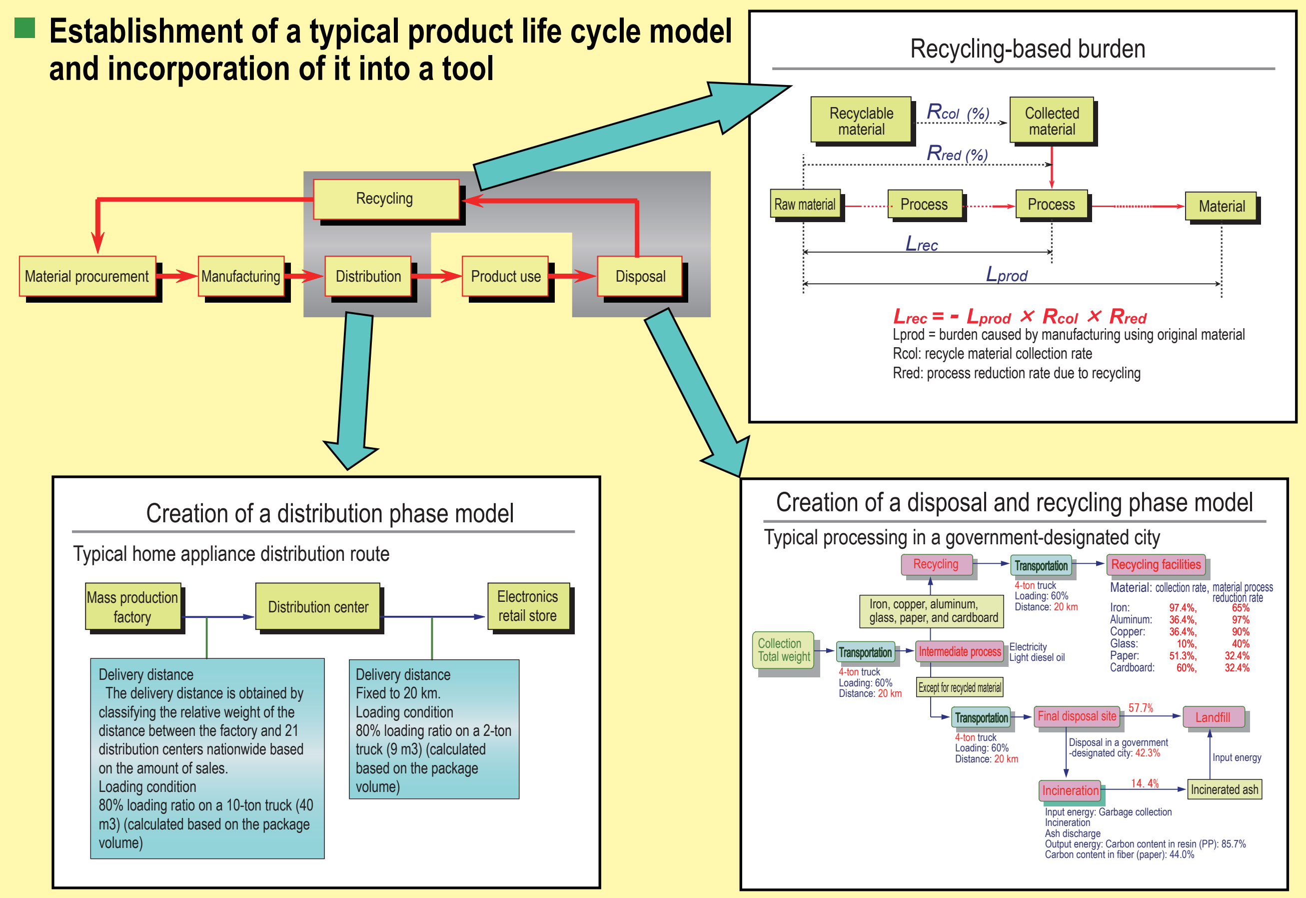


Figure 1 Creation of a product life cycle model to establish a simplified assessment method

3. Uniquely Developed Database

The field of business of the Toshiba group covers consumer products such as home appliances and digital devices, parts such as semiconductors, industrial devices, and social infrastructure products. For successful LCA in this business field, creation of a general-purpose and practical database as background data was necessary. For this reason, Toshiba created the database when LCA was first introduced in 1994. We then focused our attention on inventory analysis using input-output tables. We started creating the database when LCA was first introduced in 1994. The database was updated as the 1985, 1990, 1995, and 2000 editions as statistical data for the input-output tables were updated. Subject inventory was only CO_2 in the beginning, but it gradually expanded to include SOx, NOx, BOD, and COD. In the latest edition of the database, which is the 2000 edition, 30 types of inventory are included. Material classifications also increased from approximately 400 to approximately 4,000 through price allocation based on production statistic data so that the database could provide more detail (Figure 2).

Meanwhile, since the input-output tables only deal with domestic shipment value statistics, environmental burdens attributed to imported material may be underestimated. To address this issue, we used the process method to analyze the overseas processing of 9 major imported materials such as ion-ore, aluminum metal, and crude oil. For other materials, we used the hybrid method where environmental burden obtained from input-output analysis was added to the result of the process method above. As a result, we were able to accurately obtain inventories of imported materials (Figure 3).

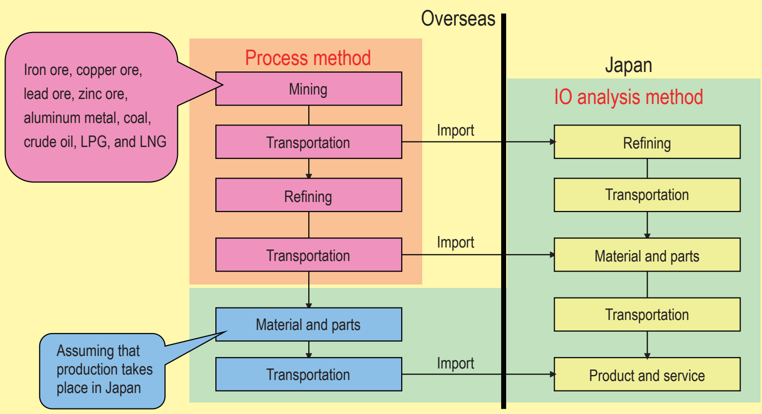
The database was improved every year, and finally, it was used as an optional database in Simapro, the LCA software manufactured by a Dutch company called Pre having a large number of users worldwide (http://www.pre.nl/simapro/Toshiba-IOdata.htm). Together with Easy-LCA™ which has been on the market for 11 years, this database is also used by many domestic as well as overseas users.

Features of the database

- Use of input-output tables (IO tables)
  - The latest Japanese 2000 IO tables are used.
  - Environmental burden basic unit for approximately 400 types of material is estimated.
  - Accuracy of the data has been improved due to further itemization of data in the IO tables.
  - The 400 types of material above have been further broken down into 4,000 types through price allocation.
- Use of the hybrid method
  - Overseas environmental burden is first estimated by the process method and the result is added to the obtained domestic environmental burden.
- Expansion of the range of subject environmental burden
  - Environmental burden of 30 types of material such as CO_2 can be calculated.

Category		Item
Consumption	Fuel	Crude oil (fuel), coal, natural gas
	Resource	Crude oil (raw material), iron, copper, aluminum, lead, zinc, manganese, nickel, chrome, sand, crushed stone, limestone, and wood
Emission	Air	BOD, COD, SS, Total-N, Total-P
	Water	CO_2, SO_x, NO_x, PM, HFC, HFC23, PFC, SF_6
Energy (calorific power)		

Figure 2 Features of LCA Database



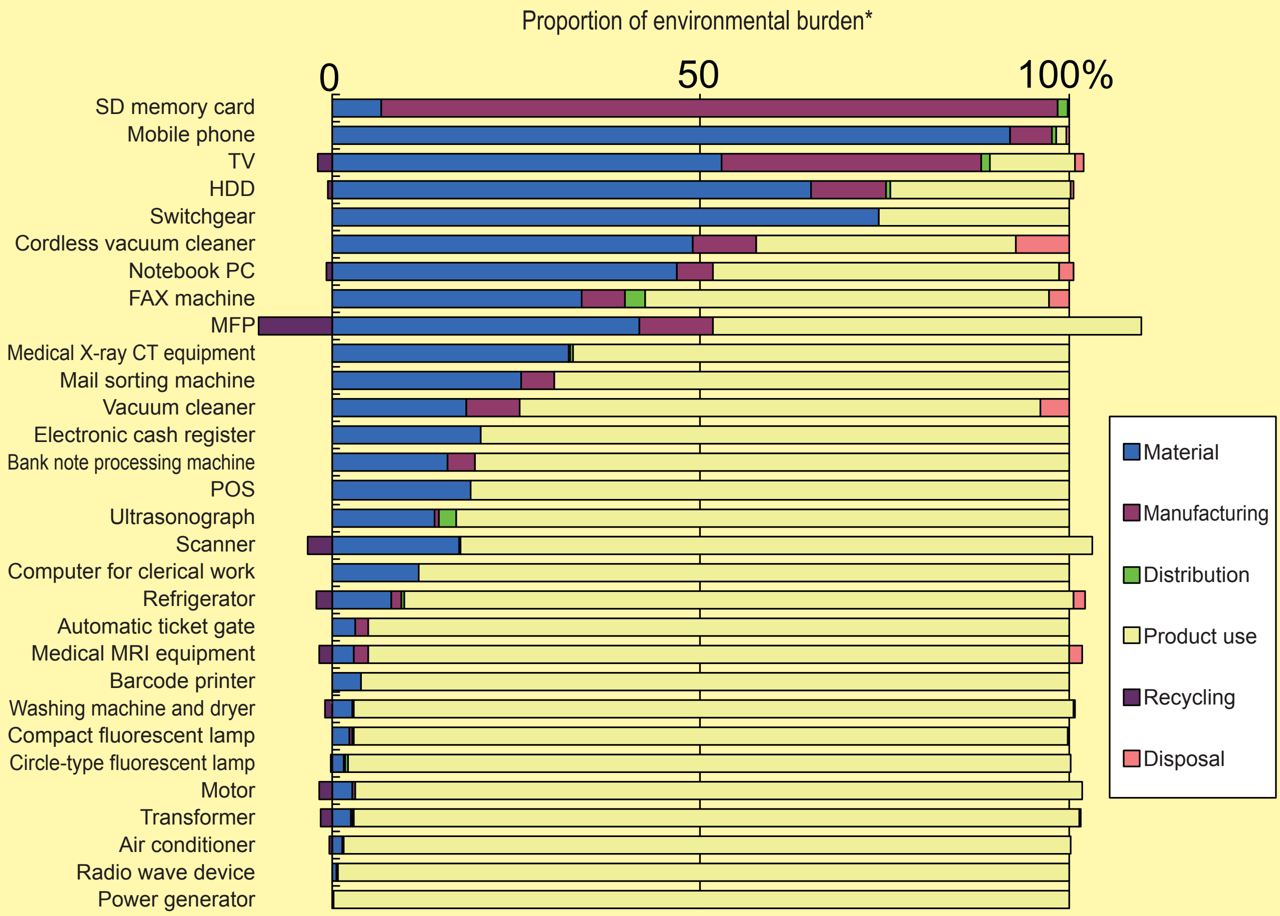
- Overseas processes for 9 major imported materials are analyzed (process method).
- Assuming that other materials are produced in Japan, domestic environmental burdens are obtained and added to the analysis result using the process method (IO analysis method).

Figure 3 Hybrid method incorporating environmental burden of imported materials

4. Execution of LCA

Using the simplified LCA method that we developed as described above, we conducted LCA internally using a large number of case studies or at the site of development. Some of the examples are shown in this section (Figure 4).

The figure shows that the proportion of environmental burdens is different for different parts or characteristics of different products, and suggests that each type of environment-conscious product has different points to pay attention to in development. Recently, LCA has been conducted in many departments in the areas such as ICT solution or heavy electric machinery for which LCA used to be considered difficult to conduct. So far, LCA has been conducted for approximately 80% of Toshiba group product groups, which would account for approximately 360 models in total.



*CO2 emission ratio or the ratio of amount of damage obtained by the LIME method

Figure 4 Example of the result of Toshiba product LCA

5. Environmental Management of the Toshiba Group

The Toshiba group approaches environmental management from the product and service life cycle perspective as well as from the business process (manufacturing phase) perspective, and LCA is used as a basic tool in both aspects. LCA uses an eco-efficiency factor as assessment measurement unit. In Toshiba group's environmental management, 3 types of integration take place in order to comprehensively assess the environmental impact which is a denominator of eco-efficiency and the sales (value) which is the numerator of eco-efficiency. First, as the environmental impact (denominator), environmental burdens are integrated with LIME (*1) and expressed as the amount of environmental damage. Second, as product value, product functions are weighted and integrated by QFD (*2). Third, eco-efficiency of business processes and products are integrated. Figure 5 shows the environmental impact integration process.

*1 LIME (Life cycle Impact assessment Method based on Endpoint modeling) is an LCIA method developed by Advanced Industrial Science and Technology (AIST) through an LCA project.

*2 QFD (Quality Function Deployment) is a systematic process to integrate production functions based on the importance of each function for customers when they choose products.

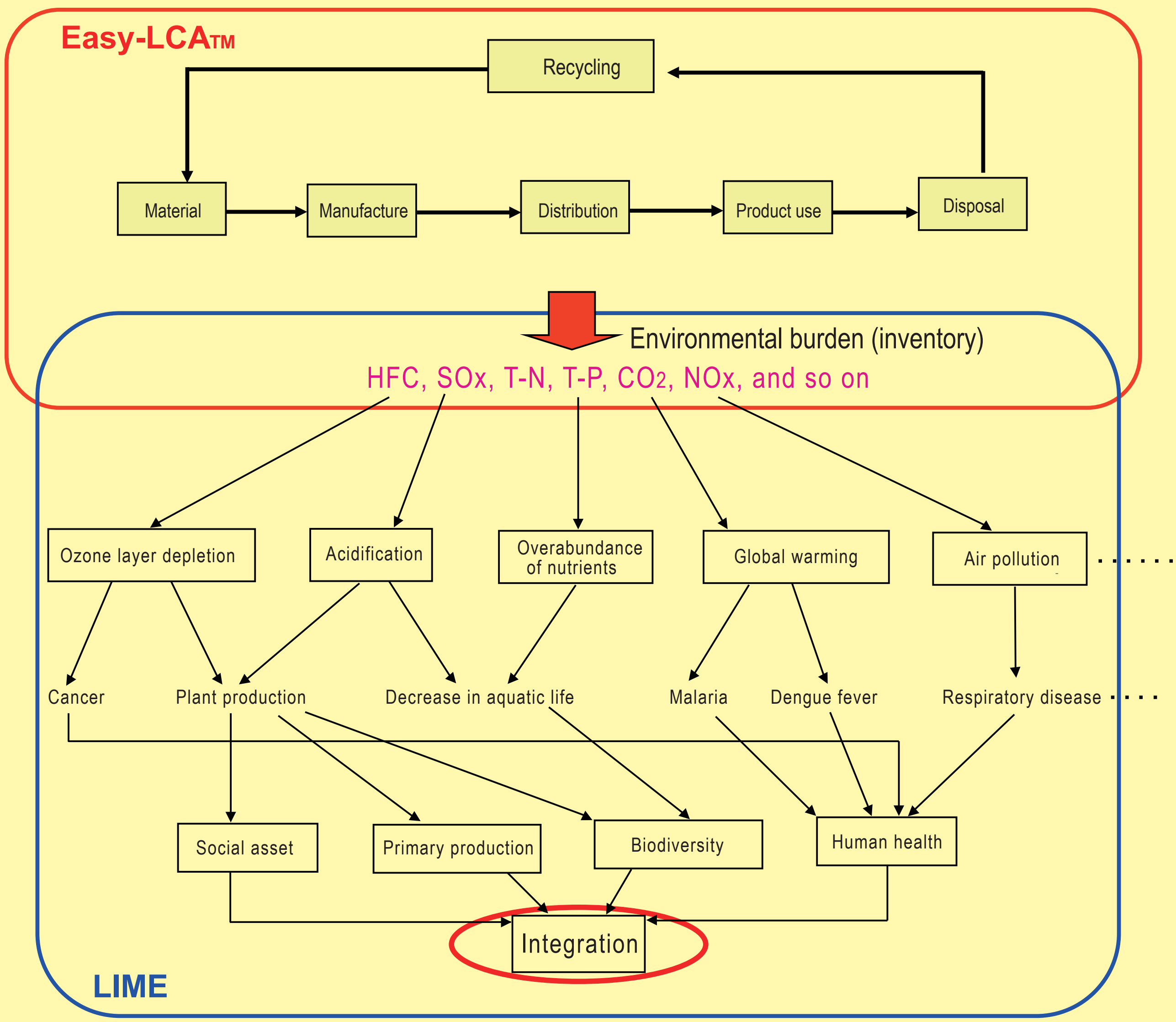


Figure 5 Environmental impact (denominator of eco-efficiency) integration process

The goal of Environmental Vision 2010 of the Toshiba group is to double the comprehensive eco-efficiency in 2010 (as compared to 2000) (Figure 6). Since approximately 20% of a product life cycle has something to do with creation, we made environmental goals for product eco-efficiency and for business product eco-efficiency, and these two types of eco-efficiency combined is expressed as the comprehensive eco-efficiency. So far, our environmental activities have been going well, and in 2006, a value of 1.59 was achieved against the planned value of 1.52 (Figure 7).

6. Conclusion

In order to internally introduce and disseminate LCA, the Toshiba group developed a simplified LCA method and created input-output table-based databases. As a result, we were able to receive a lot of support and comments from inside and outside the group, and based on the support and these comments, we made improvements and conducted a large number of brainstorming sessions on the method and databases. Externally, we believe we contributed to domestic development of LCA by: dispatching employees to serve as committee members for the LCA international standards such as ISO/TC207/SC5; participating in a number of academic conferences such as the International Conference on EcoBalance; presenting academic papers at these conferences; and participating in LCA projects, LCA forums, and LIME-WG. We hope that the scope of LCA will further expand in the future and that LCA will contribute to the international standard as an essential tool for Eco-Design and environmental accounting.

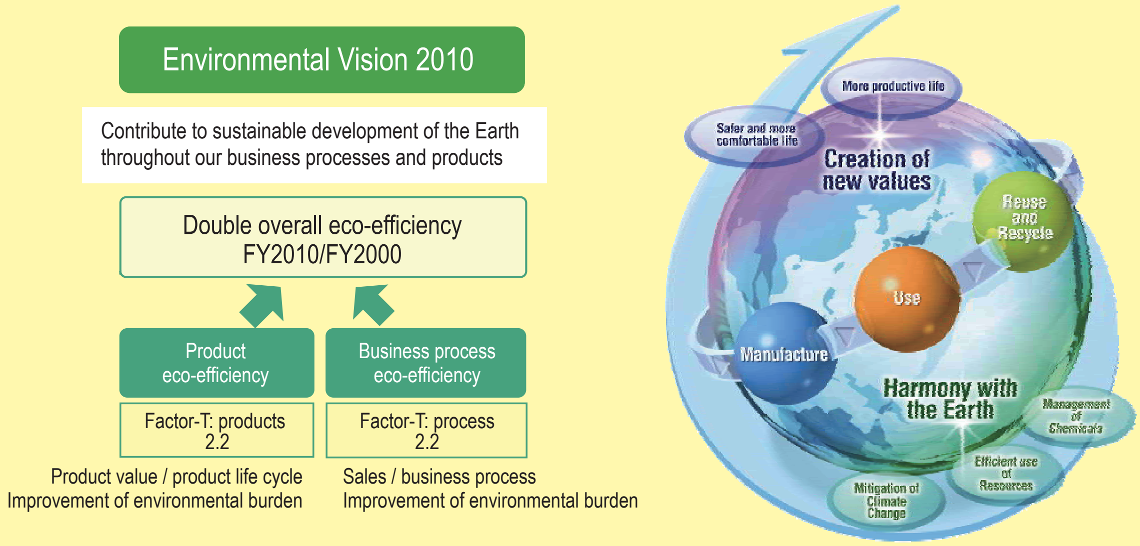


Figure 6 Toshiba group's Environmental Vision 2010

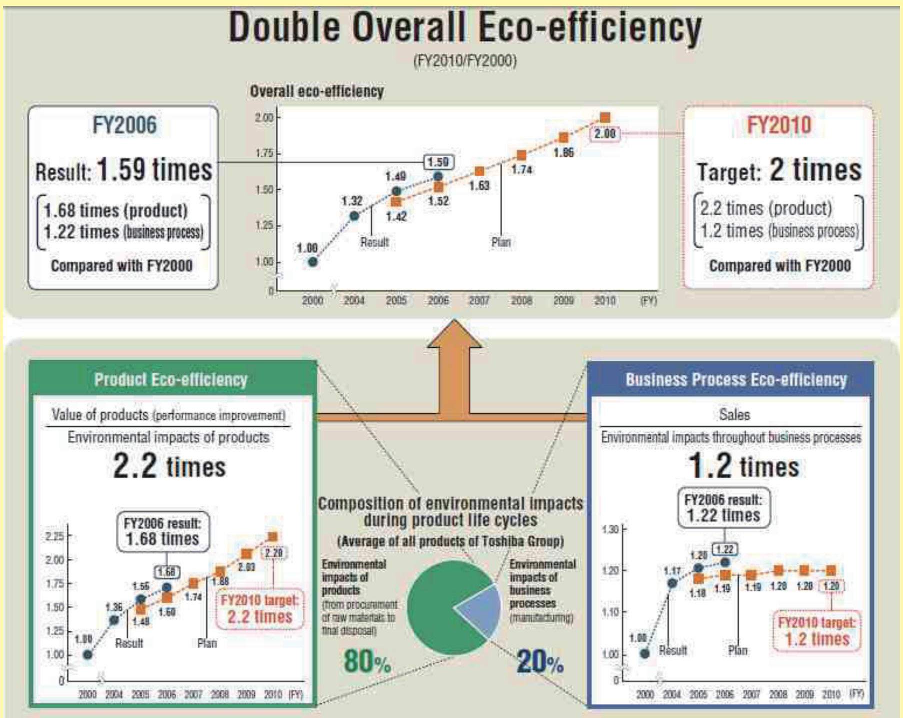


Figure 7 Current status of Toshiba's comprehensive eco-efficiency

Information

Eco-products International Fair 2009	
March 19- 22, 2009 Manila, PHILIPPINES	APO http://www.apo-tokyo.org/index.htm
Third International Conference on Life Cycle Assessment in Latin America, CILCA 2009	
April 27- 29, 2009 Santiago, CHILE	Chilean Research Center for Mining and Metallurgy http://www.cilca2009.cl/web/index.php
16th CIRP International Conference on Life Cycle Engineering (LCE 2009)	
May 4- 6, 2009 Cairo, Egypt	The Intelligent Manufacturing Systems (IMS) http://www.uwindsor.ca/lce2009
SETAC Europe 19th Annual Meeting World under stress: scientific and applied issues.	
May 31- June 4, 2009 Göteborg, SWEDEN	SETAC http://goteborg.setac.eu/?contentid=45
2009 ISIE Conference	
June 21- 24, 2009 Lisbon, PORTUGAL	ISIE http://www.isie2009.com/index.php
The 23rd National Congress for Environmental Studies	
July 9- 11, 2009 Okinawa, JAPAN	The Japan Society of Mechanical Engineers http://www.env-jsme.com/eng/index.html
LCM 2009	
September 6- 9, 2009 Cape Town, SOUTH AFRICA	Univ. of Cape Town / Pre Consultants http://www.lcm2009.org/
Life Cycle Assessment IX	
September 29- October 2, 2009 Boston, USA	American Center for Life Cycle Assessment http://www.lcacenter.org/
Sustainable Innovation 09	
October 26- 27, 2009 Farnham, UK	The Centre for Sustainable Design http://www.cfsd.org.uk/events/tspd14/index.html
3rd International Conference on Eco-Efficiency Modelling and Evaluation for Sustainability: Guiding Eco-Innovation	
November 18- 20, 2009 Egmond aan Zee, the NETHERLANDS	CML, Leiden University http://www.eco-efficiency-conf.org/
SETAC North America 30th Annual Meeting	
November 19- 23, 2009 New Orleans, USA	SETAC http://neworleans.setac.org/
EcoDesign2009	
December 7- 9, 2009 Sapporo, JAPAN	the Union of EcoDesigners and AIST, Japan, http://www.mstc.or.jp/imf/ed/

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Mr. Yasuhiko Morita	The Japan Electrical Manufacturers' Association
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