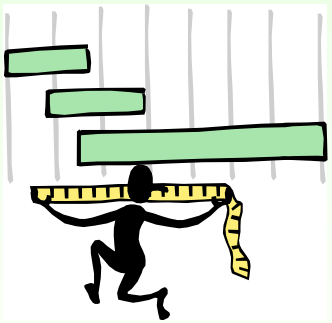
Eco-efficiency For Products

-Establishment of Eco-efficiency Indicators for Sustainable Products

Chie Nakaniwa (nakaniwa@jemai.or.jp)
Japan Environmental Management Association for Industry
-JEMAI-



Overview of Presentations

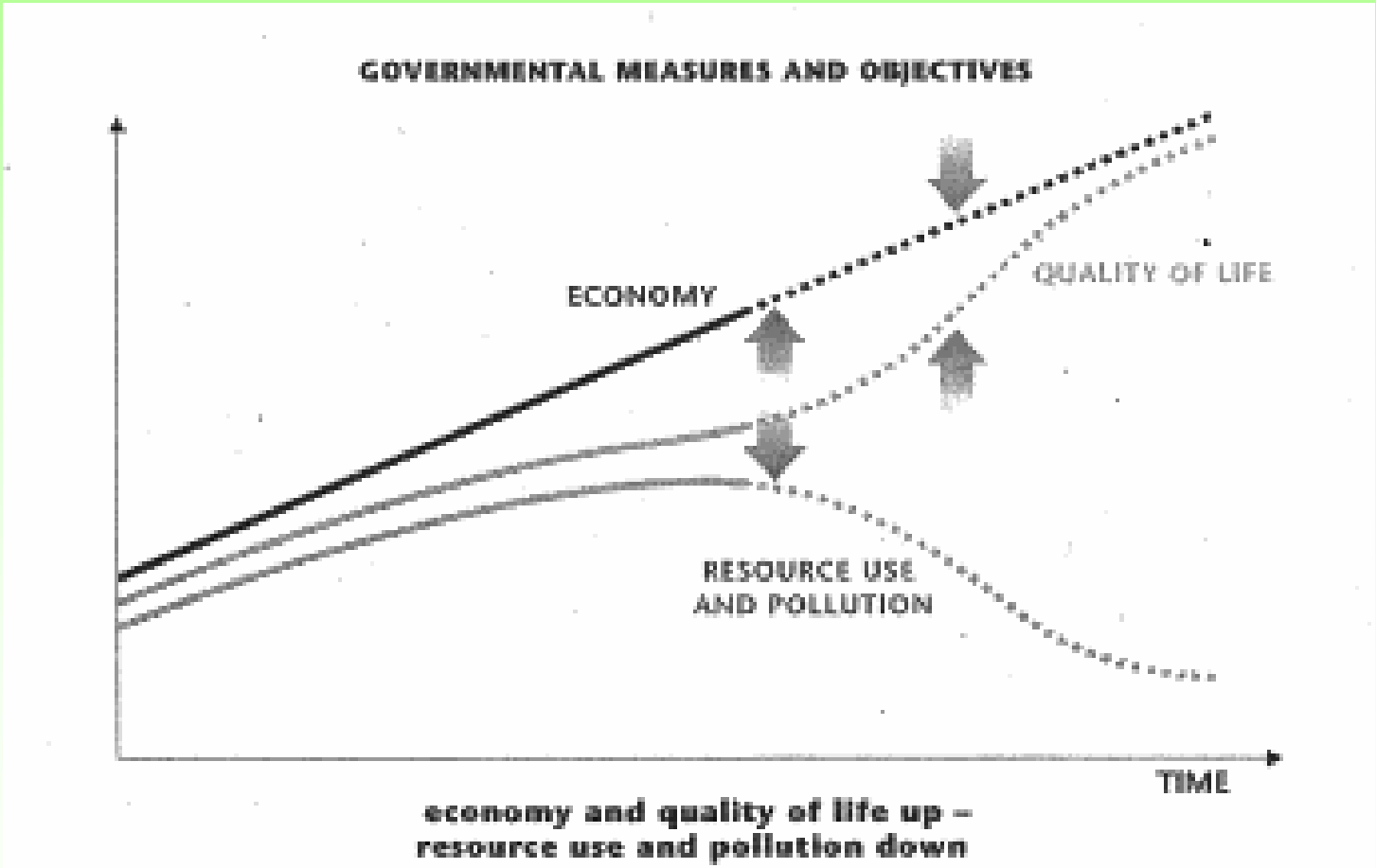
1. The need for sustainability indicators
   - -Introduction of Factor X project
2. Emerging eco-efficiency indicators
   - -Evaluation of environmental performance and value
     - -Definition and calculation principles
   - -Case studies
3. Development of eco-efficiency indicators
   - -Environmental product information

1. The need for sustainability indicators

Introduction of Factor X project

Decoupling economic growth from the environmental burden

Decoupling is a very important theme for business



Factor 4

- The idea that resource productivity should be quadrupled so that wealth is doubled, and resource use is halved. The concept has been summed up as "doing more with less". It is argued that this would result in substantial macro-economic gains.

Factor 10

- The idea that per capita material flows caused by OECD countries should be reduced by a factor of ten. Globally, claim proponents, material turnover should be reduced by 50 percent, but because OECD countries are responsible for material flows five times as high as developing countries, and world population is inevitably increasing, the OECD has to set long-term targets well beyond the more conservative Factor Four target.

Green Sustainable Development Strategy for North-eastern NB Draft Strategy

Definition of Eco-efficiency

Product or service value

Environmental influence

"Creating more value with less impact"

"Economic and environmental efficiency in parallel"

Here, eco-efficiency indicators are defined as a ratio ex. $/T

Source:eco-efficiency creating more value with less impact by WBCSD

The Needs for Eco-efficiency Indicators

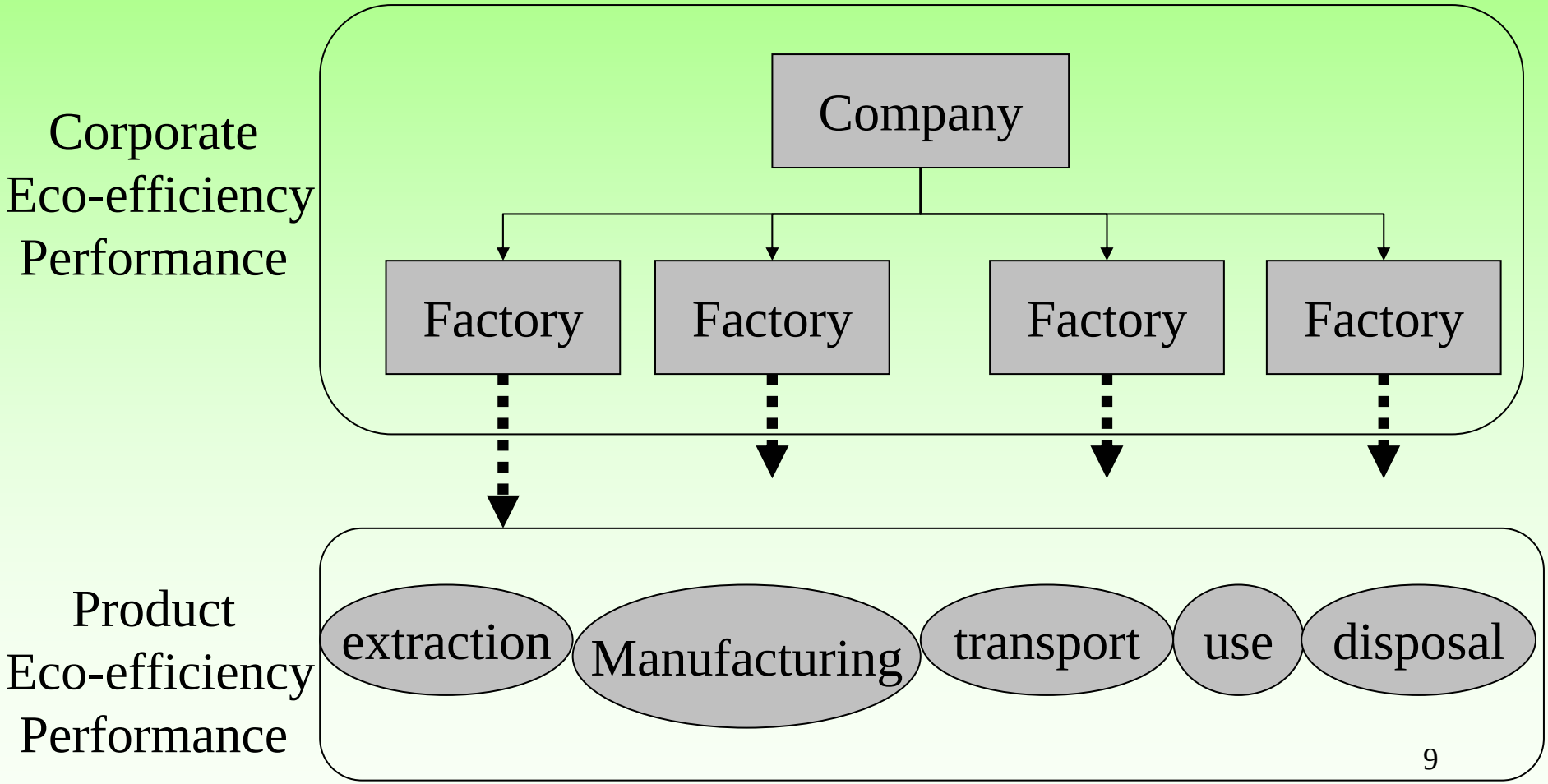
- to track continuous improvement
- to set goals for improvement
- to promote efficient inputs and outputs
- to report to stakeholders

Corporate;
* Executives
* Managers
* Employees

Stakeholders;
* Users
* Financiers
* The public
* Media

Government;
* Regulators

Eco-efficiency, Measuring Level



Factor X Project in Japan

Eco-efficiency indicators for Product Environmental Performance

Project Goal and Scope

Create Factor (indicator / index) for products and services:

1. To provide quantified environmental information as a single or several integrated numbers
2. To provide comparability across a wide range of industry sectors, companies, and products
3. To accelerate sustainability development of business segments
4. To serve analytical foundation as political tools
5. To link quantified evaluation provided by the factor with Design for Environment and Eco label, or other environmental management tools, and promote them

First Year Target (1/2)

1) Survey for current status in Japan

- Identifying types of innovating manufacturing technology, process
- Identifying historical trends of industry sectors about productivity, improvement

2) Identifying the problems, potentials for the future

- Identifying structural problems across sectors, barriers, and technological limitation, and other issues

First Year Target (2/2)

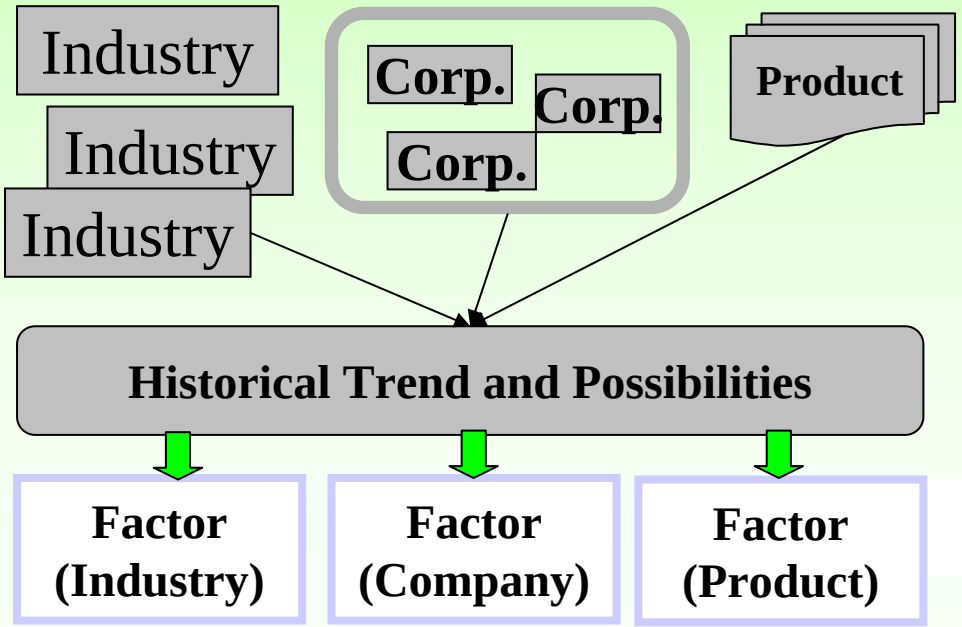
3) Reviewing concepts, existing models about resource productivity, eco-efficiency, or other methodology

- What is the ratio? What are the denominator and numerator?
- What could be selected as service/value? What could be selected as environmental impacts?
- *Existing model;* Factor 4 and 10, WBCSD eco-efficiency, Ecological footprint, LCA, Dow Jones Sustainability Index, and others

Project Scheme

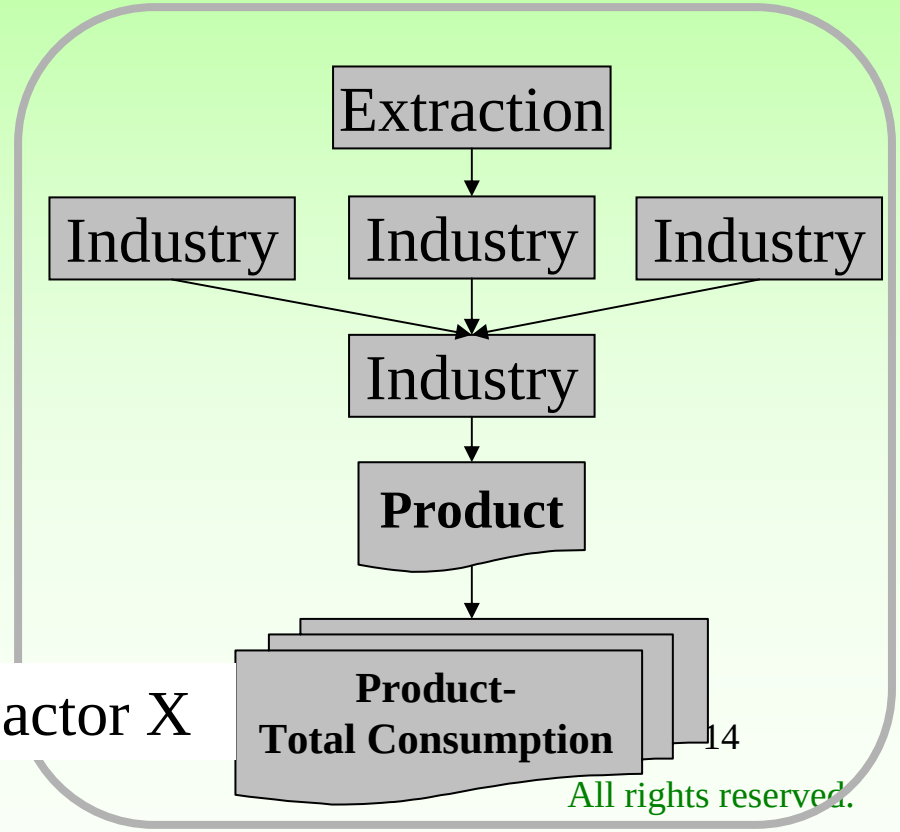
Bottom Up Approach (WG 1)

- Empirical approach
- Considering sectoral factor improvement
- NO TARGET
  Expecting self-improvement by applying
  Factor evaluation methods



Top Down Approach (WG 2)

- Theoretical approach
- Considering supply chain
- Assuming potential target



Two Kinds of Factors Examined

1. Resource Productivity(RP)

   RP=S/RC
   S=Service(product or service value),
   RC=Resource Consumption
   Here, energy substitutes for RC
   ex. Factor=RP_{Y2000} /RP_{Y1970}

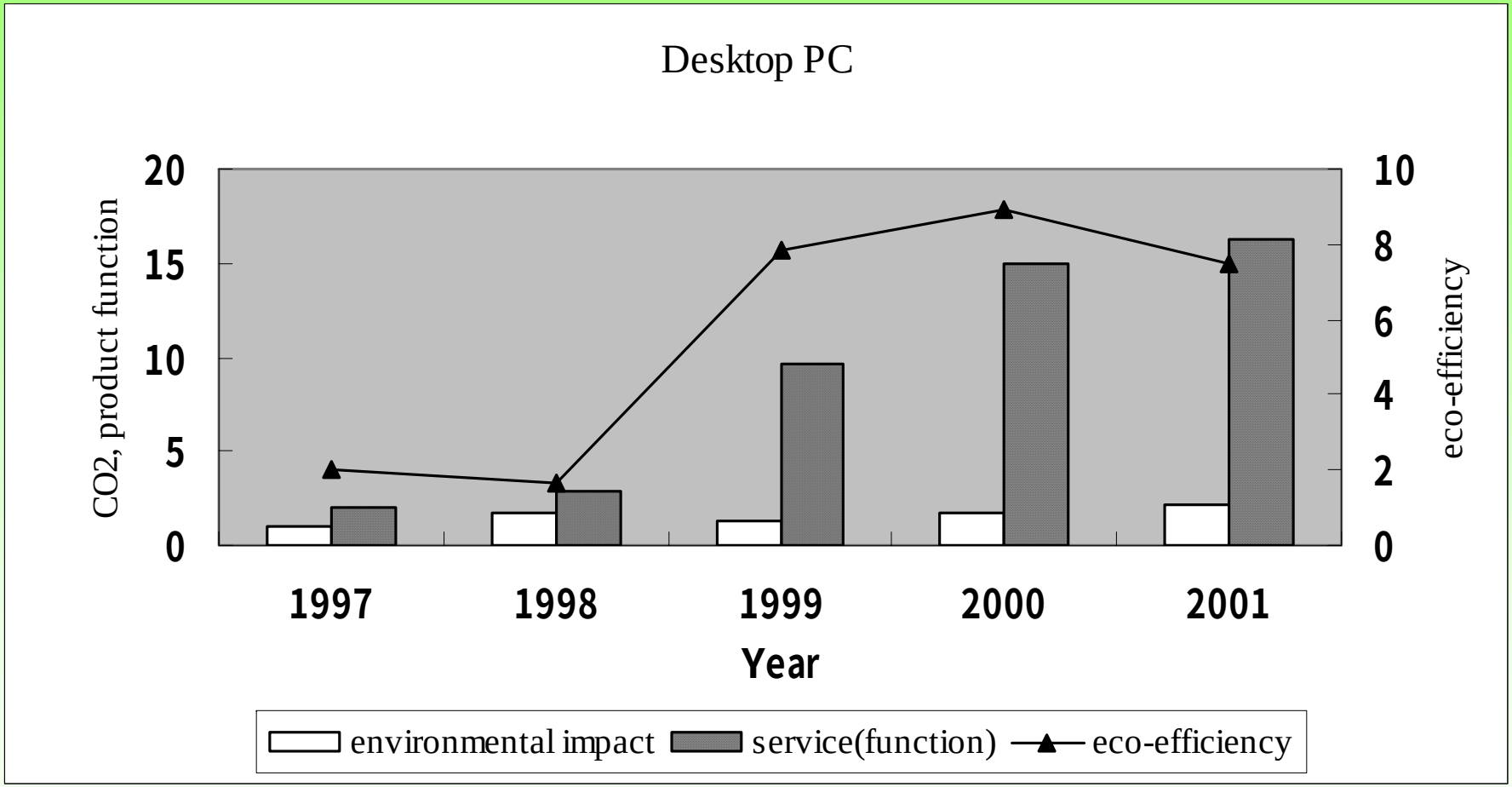
2. Environmental Efficiency(EE)
   EE=S/EL
   S=Service(product or service value),
   EL=Environmental Load
   Here, CO_2 substitutes for EL
   ex. Factor=$EE_{A\ type}$ /$EE_{B\ type}$

Two Kinds of Indicators Examined

Resource productivity			
Numerator	Product or service value	Optional	Economic value, physical amount, specific function
Denominator	Environmental impact	Mandatory	**Energy consumption**
Environmental efficiency			
Numerator	Product or service value	Optional	Economic value, physical amount, specific function
Denominator	Environmental impact	Mandatory	**CO_2**

Product specific indicators (numerator=product performance value)				
Product	PC	refrigerator	Washing machine	TV
Indicators	HDD, CPU	Freezing speed	Washing capacity	Brightness

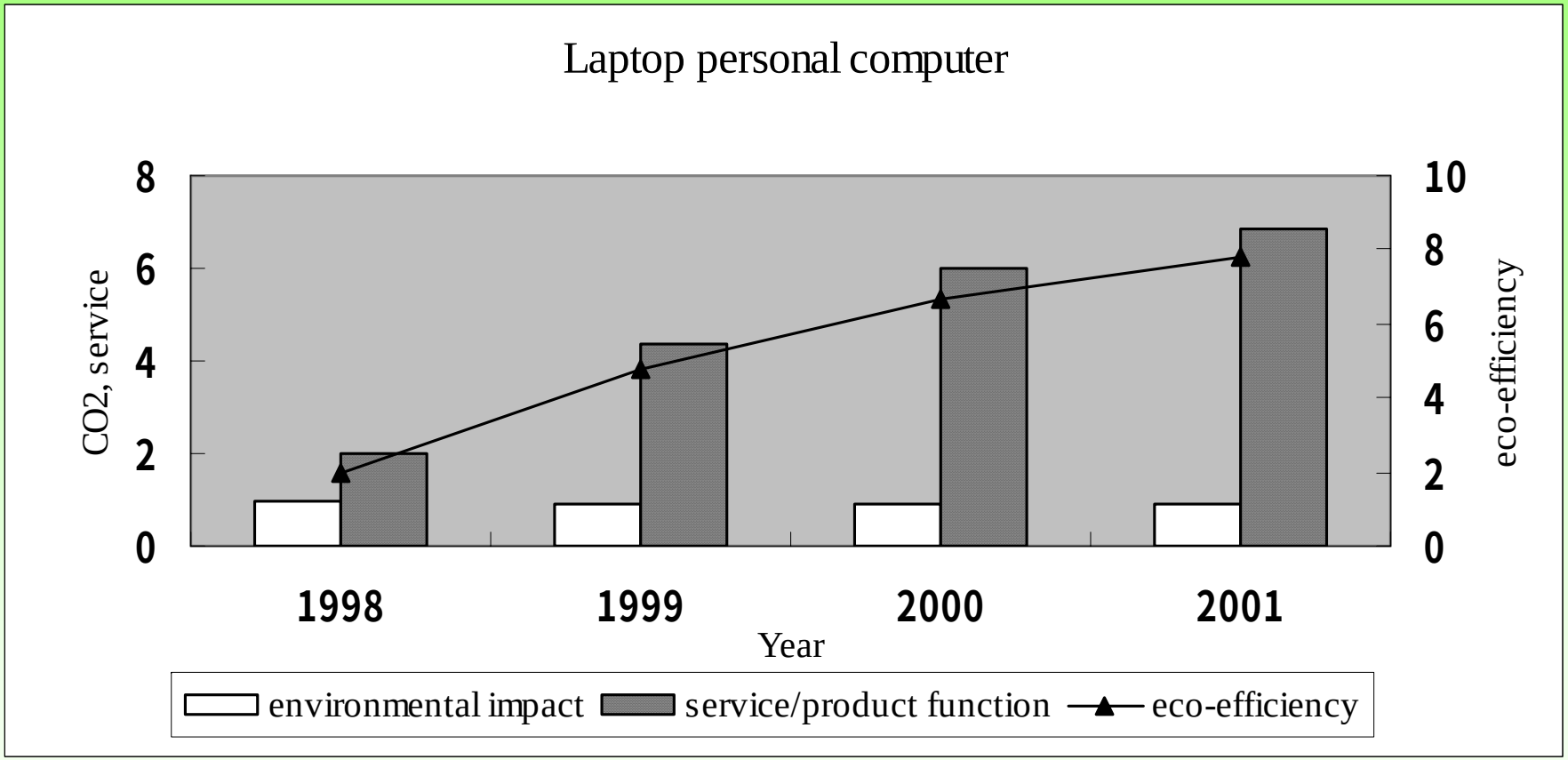
Example of Product Eco-efficiency (1)



Denominator-Environmental impact;CO_2 during life cycle

Numerator-Product function;CPU, HDD capacity **Factor per a product*

Example of Product Eco-efficiency (2)



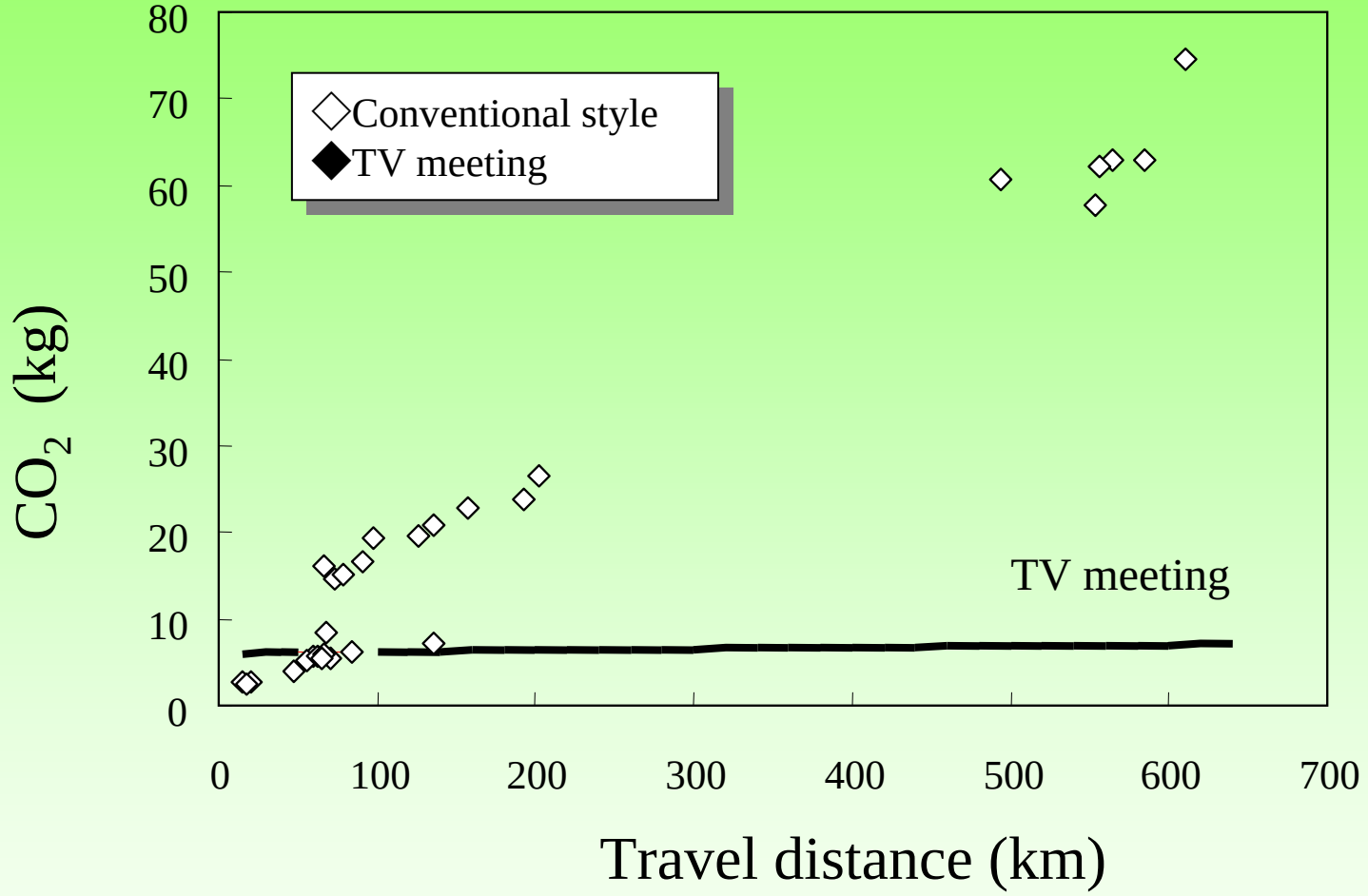
Denominator-Environmental impact;CO_2 during life cycle

Numerator-Product function;CPU, HDD capacity **Factor per a product*

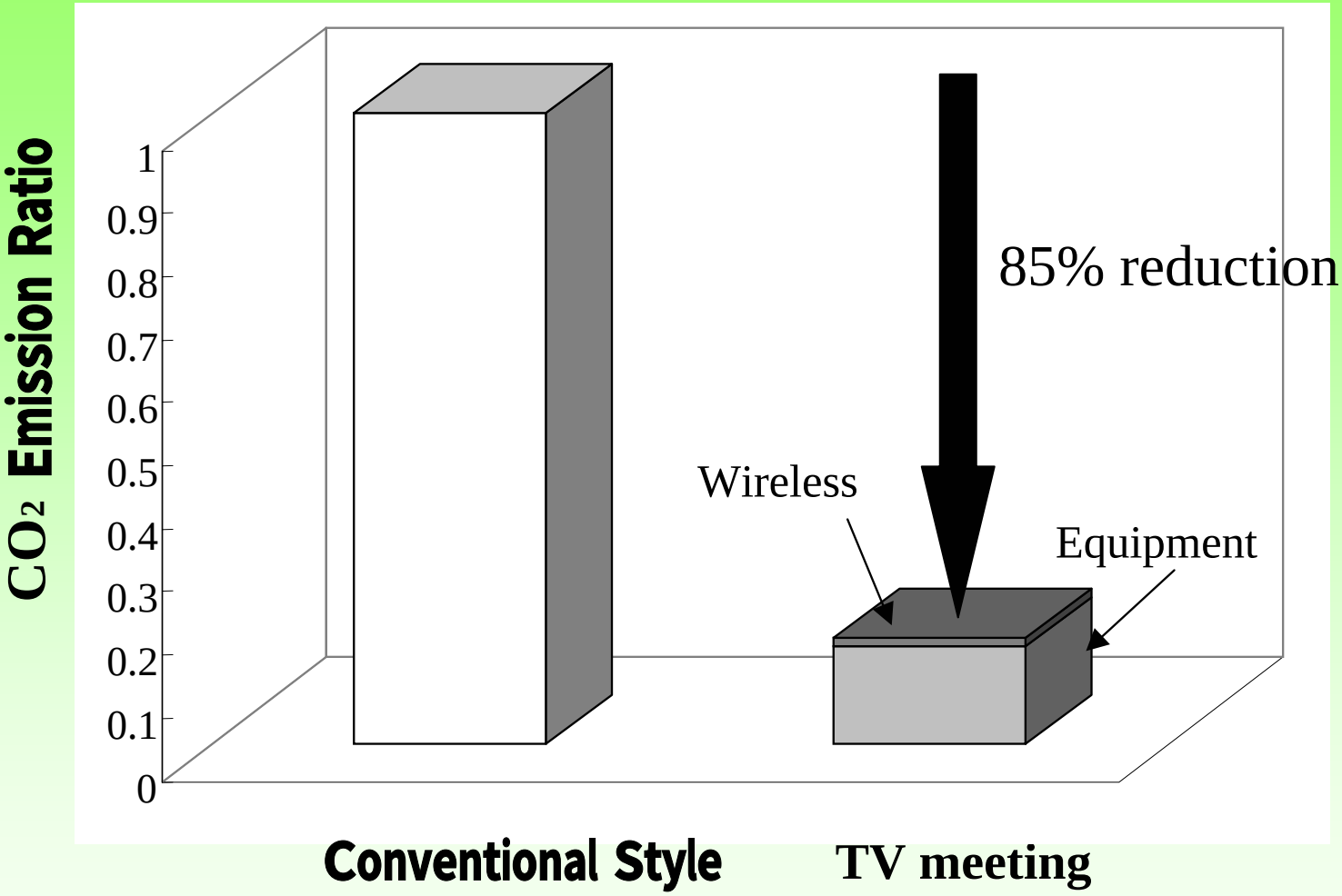
Findings of FY 2001(3)
Facts of a Service System

	CO_2 (Environmental Efficiency)	Energy Consumption (Resource Productivity)
TV meeting (A)	8.5kg (P/8.5)	200MJ (P/200)
Conventional-style meeting (B)	58kg(P/58)	770MJ (P/770)
Factor (A/B)	6.8	3.9

P is outcome of meetings



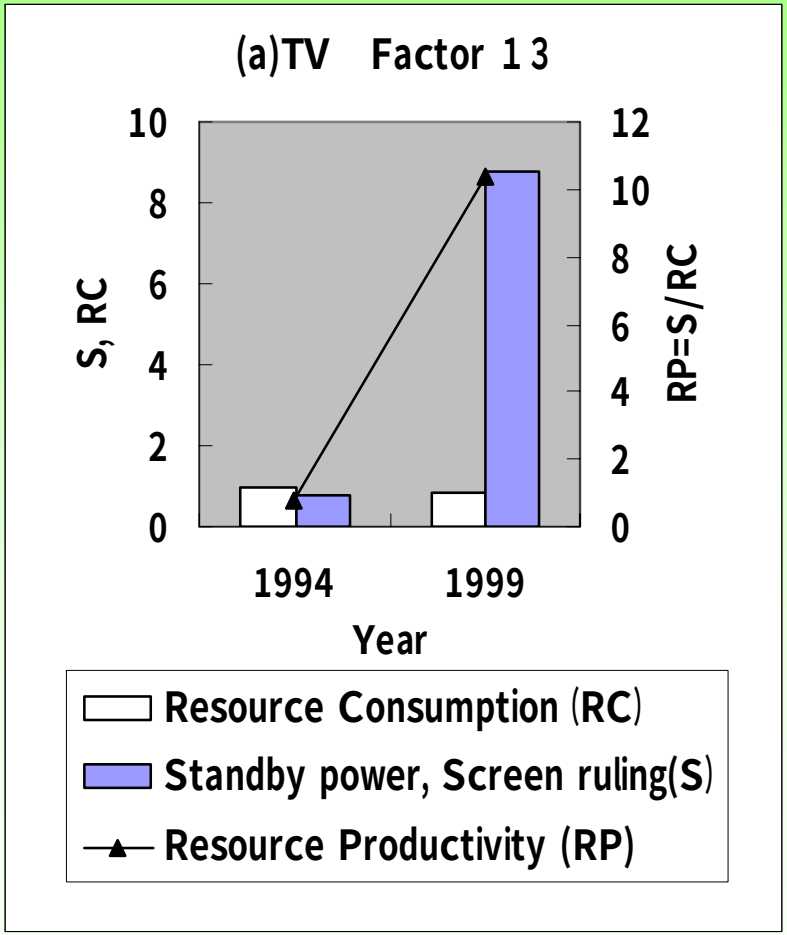
Correlation Between Travel Distance and CO_2

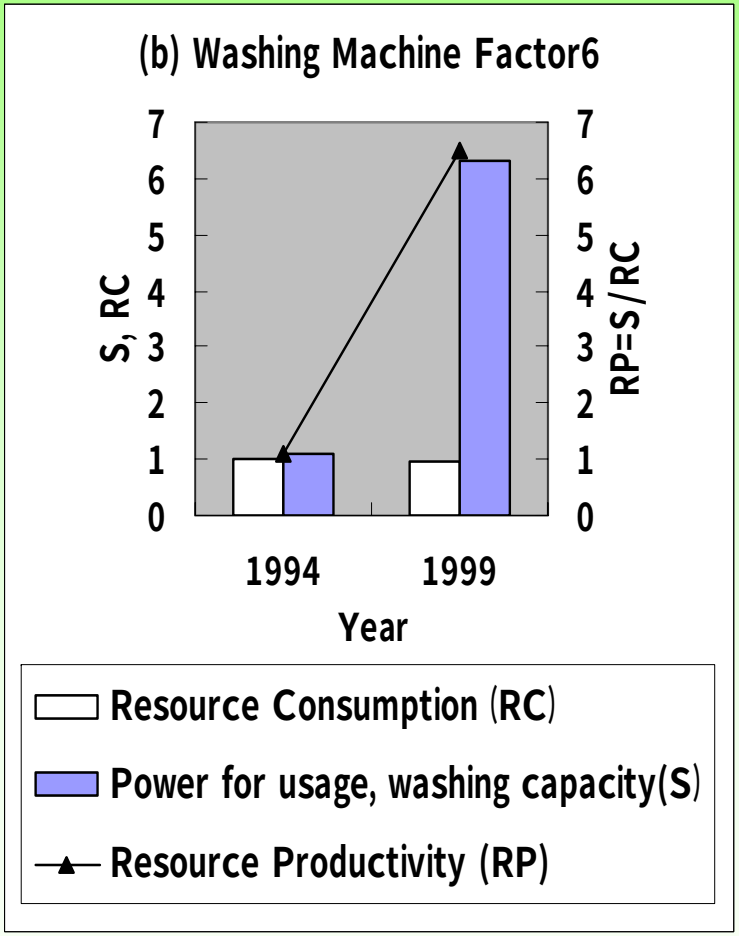


CO_2 Reduction Effects of TV Meeting Technology

Findings of FY 2001(4)

Facts of a Product

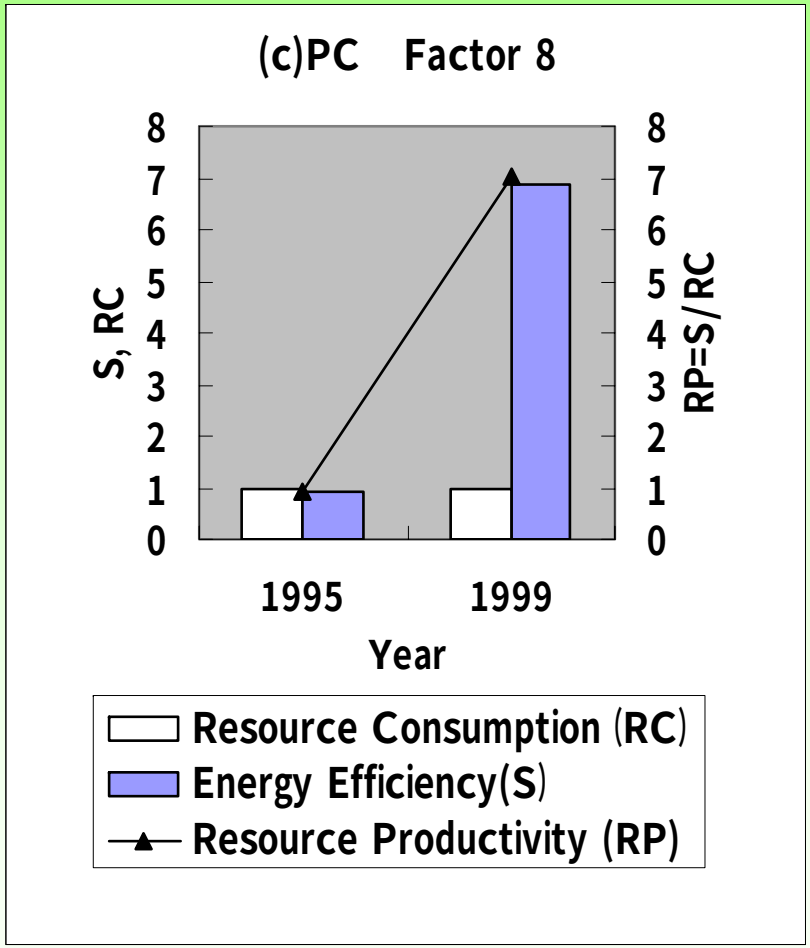


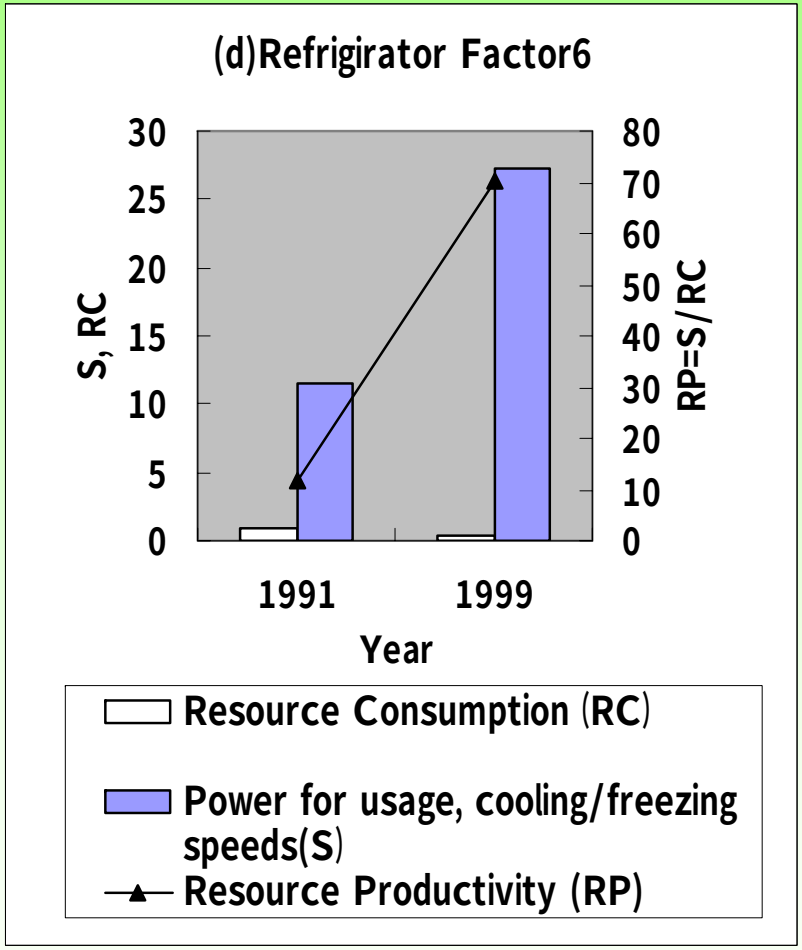


**Factor per a product*

Findings of FY 2001(5)

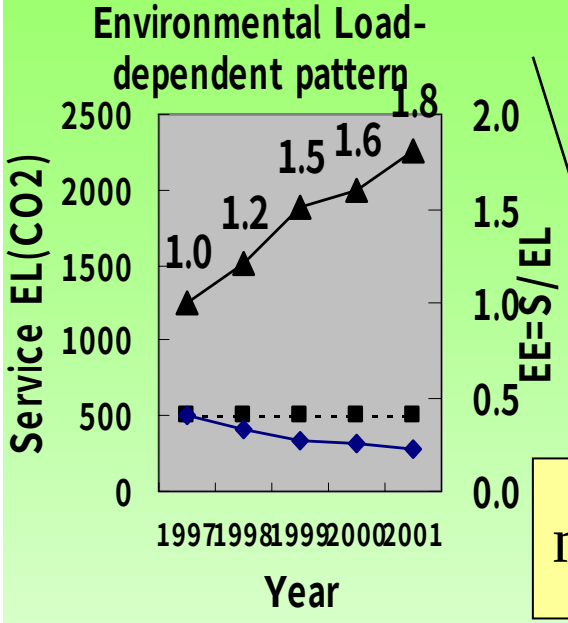
Facts of a Product





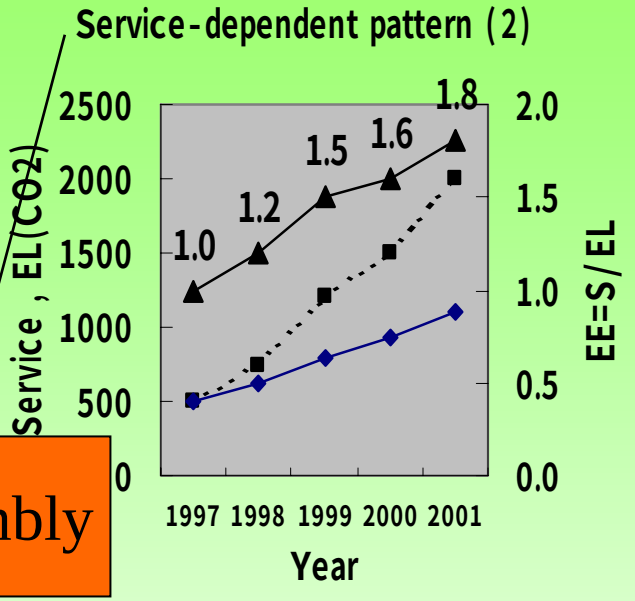
**Factor per a product*

Fundamental Patterns by Product Categories



Manufacturing stage

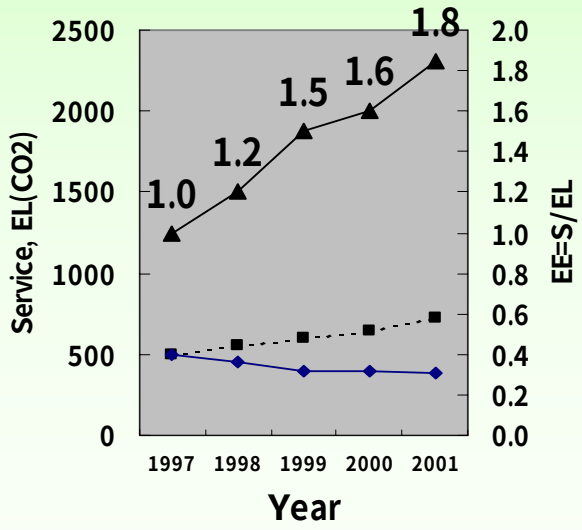
material → parts → assembly

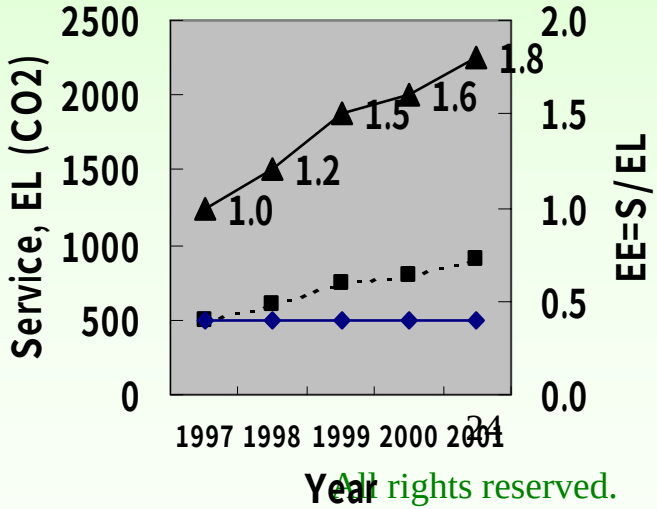


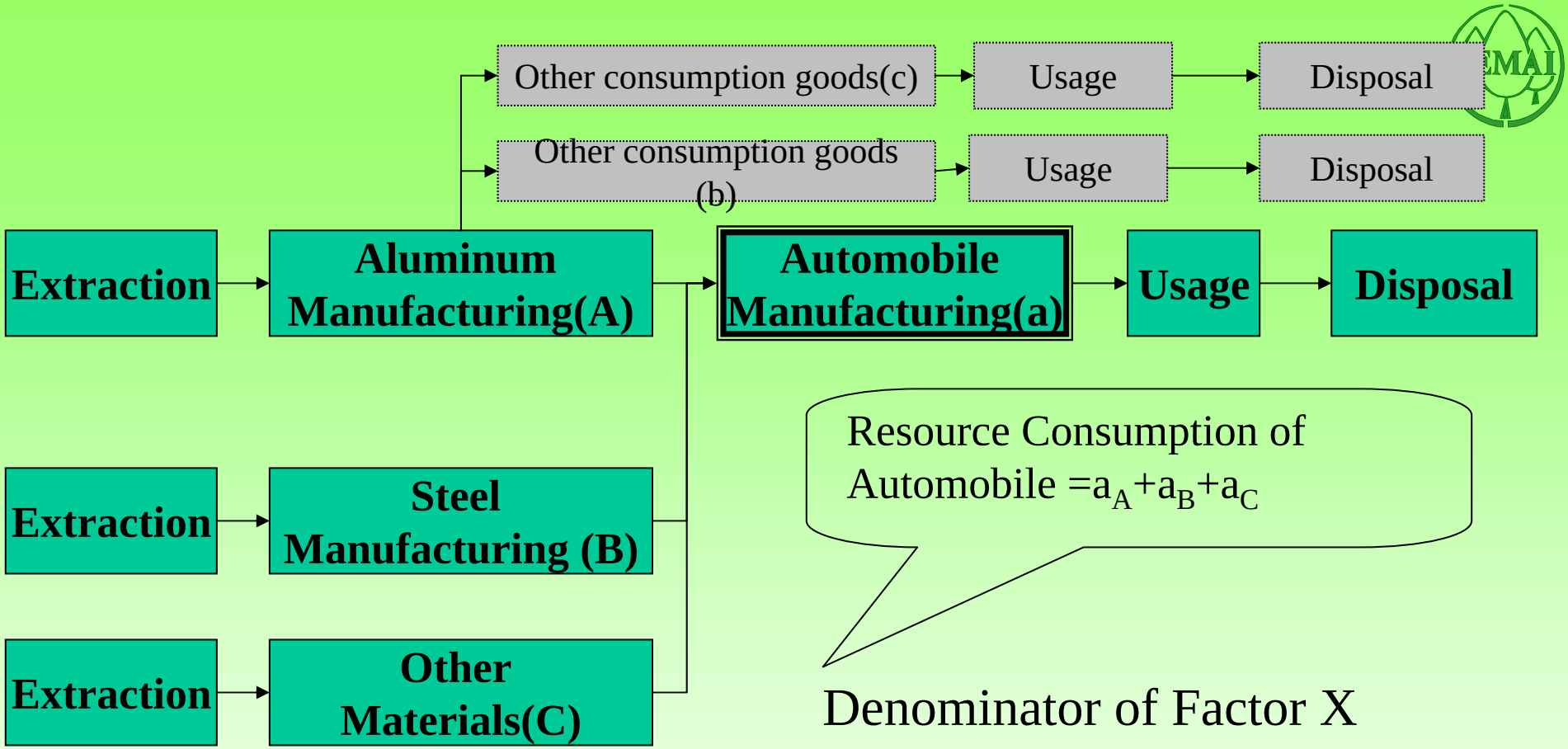
▲;eco-efficiency

■;numerator (value)

◆;denominator (environmental impact)



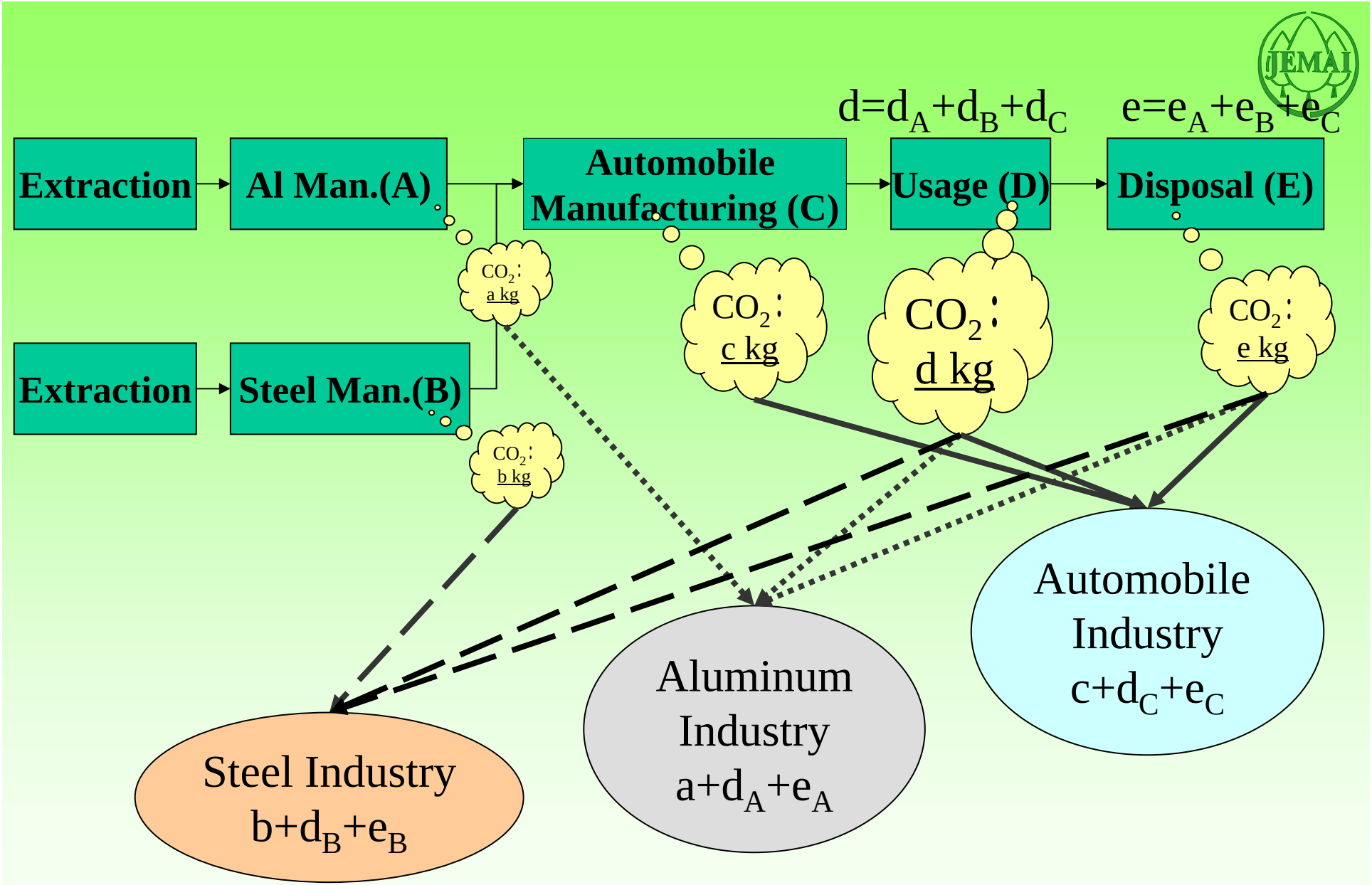




- ONLY resource productivity of consumable goods should be measured
- Consumer goods industries should be measured rather than semi-manufactured/material industries.

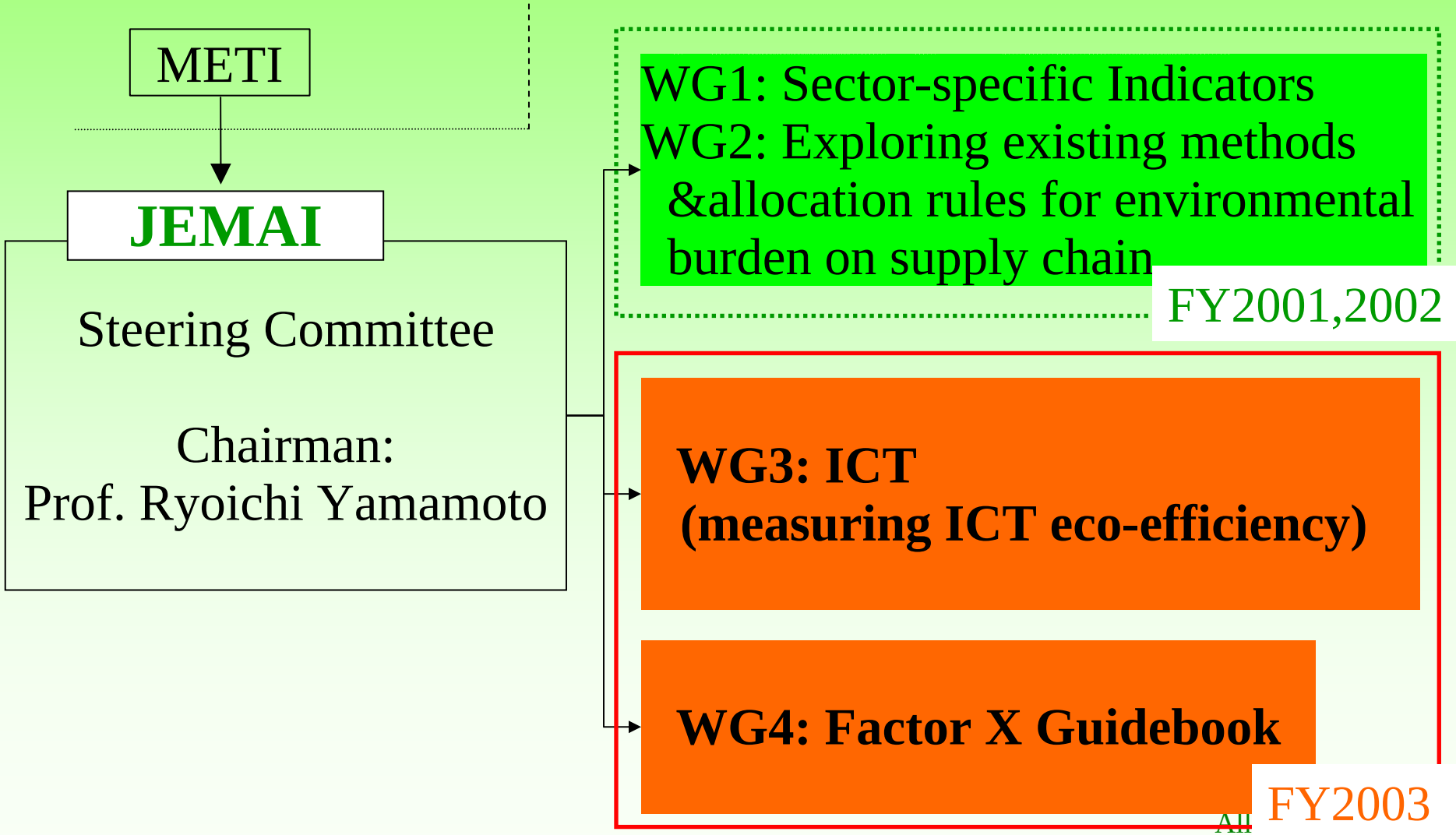
How should we define the boundary of environmental impact?

-Resource Productivity (ex. Metal)



Environmental Efficiency (ex:CO_2)

Factor X Project of 2003



Questions and Discussions

1. What are eco-efficiency indicators working for?
   Market needs? Ranking?
   Promoting incentives of sustainability?

2. What is the future work?
   Comparability?
   –common rule for benchmarking
   Harmonization?
   –for business specific indicators

- The amount of environmental product information are increasing.

2. Emerging eco-efficiency indicators

Evaluation of environmental performance and value
-Definition and calculation principles

Eco-efficiency, Factor X
State of the Art in Japan

1. Eco-efficiency (Factor) indicators for company (factory) performance

   eco-efficiency for company=
   sales amount/environmental impacts

2. Eco-efficiency (Factor) indicators for product performance

   eco-efficiency for product=
   service/environmental impacts

The Application of Eco-Efficiency Concept

Unit：Company

	No. of companies to issue environmental report	No. of companies to practice the concept of eco-efficiency	
		Product	Corporate
Manufacturing	220	4	18
Non-manufacturing	65	2	4
Total	285	6	22

Source: FY2002 METI study

Issues to Be Discussed

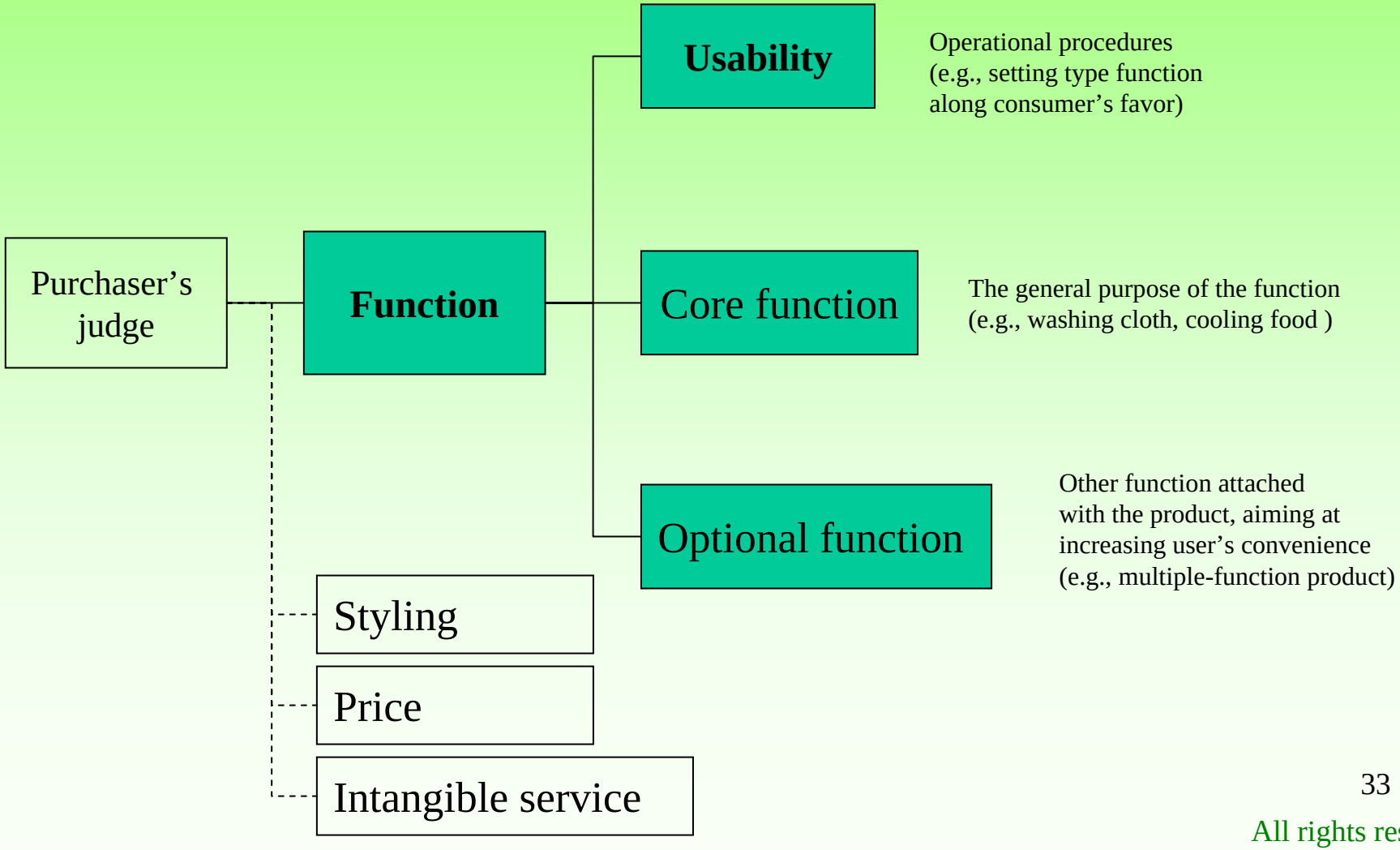
Methodological issues;

- What is a definition of value (numerator)?
- Which is better, single index or multiple indicators?
  -Integrating various environmental aspects and product performance
- How could we weight those parameters?
- Selection of reporting period

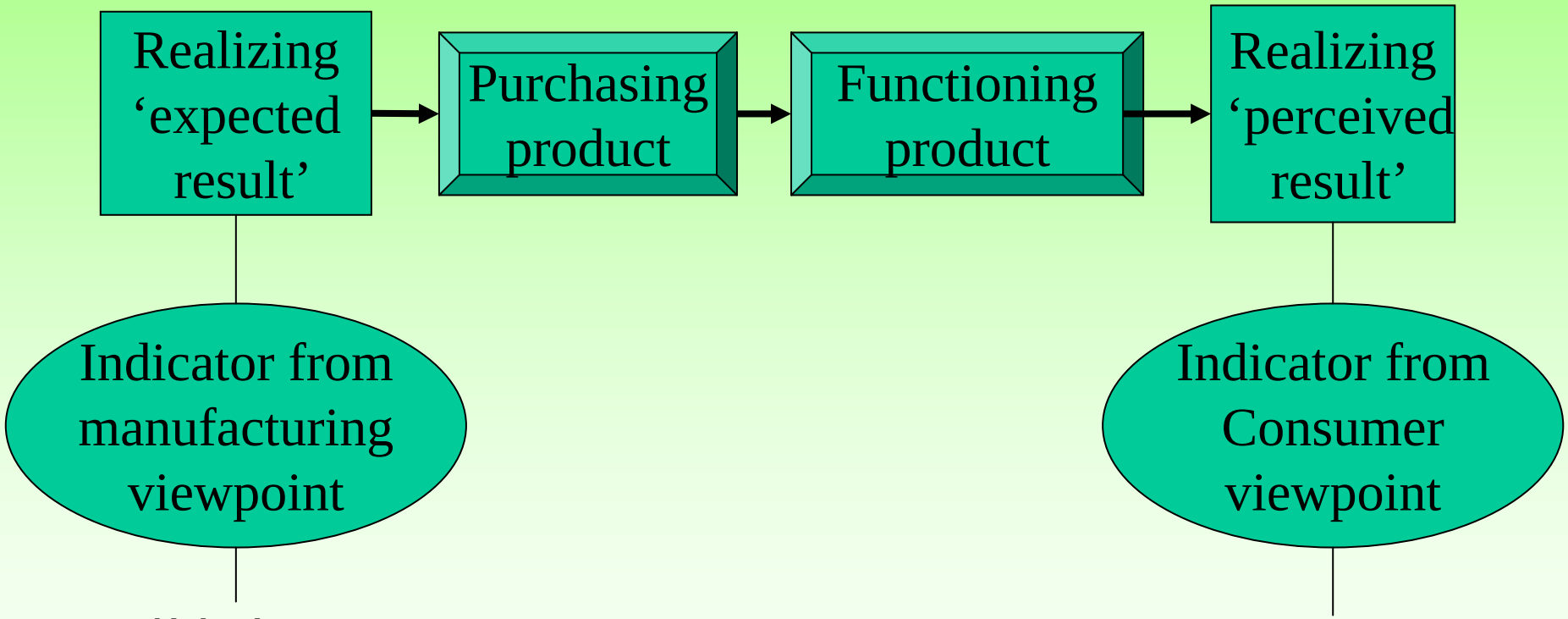
Operational issues;

- What is a main purpose of using eco-efficiency?
- What is a driving force to start eco-efficiency indicators?

A Classification of Product Function



A Model of Value Indicator Establishment



2. Emerging eco-efficiency indicators

Case studies

Example of Matsushita "3 GP(green products) Indicators"

- Index for the prevention of global warming

  $$= \frac{\text{product function} * \text{product life}}{\text{greenhouse gas emission over the entire life cycle}}$$

- Resource use index

  $$= \frac{\text{product function} * \text{product life}}{\text{(newly supplied resources+discarded resources) over the entire life cycle}}$$

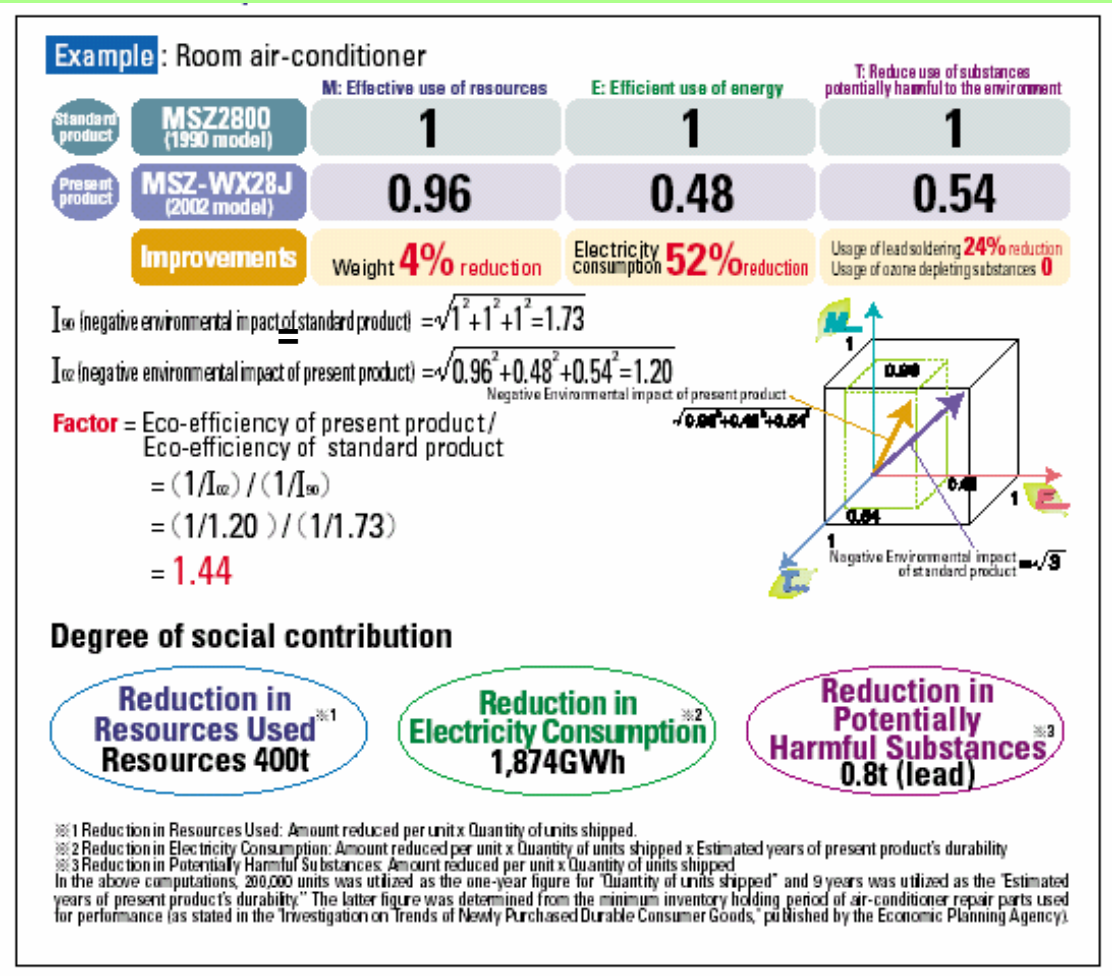
- Use of nontoxic materials

Example of Mitsubishi "Factor X"

■**Basic Factor Computation**

- **Comparison is made with standard product (as a rule, manufactured in 1990).**
- **Do not take performance improvements into account.**
- **The negative environmental impact which consists of each element of following MET was integrated as length of a vector.**
  - **(1) Products weight**
  - **(2) Products energy consumption**
  - **(3) Quantity of Toxic substances contained in Products**

(Note)
M: Effective use of Material,
E: Efficient use of Energy,
T: Reduce use of Toxic substances



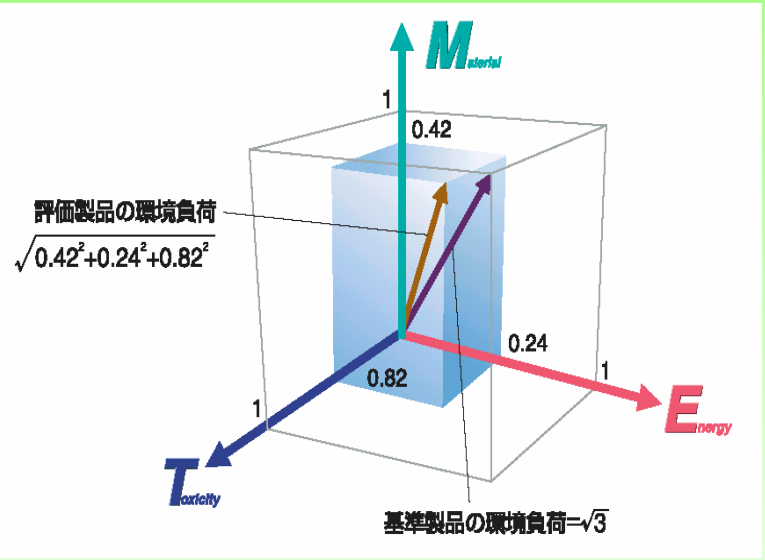
Calculation of multiple environmental aspects

Product eco-efficiency

$$\frac{1}{\text{Negative environmental impact}}$$

Factor

$$\frac{\text{Eco-efficiency of present product}}{\text{Eco-efficiency of standard product}}$$



$$\sqrt{\left(M^2 + E^2 + T^2\right)}$$

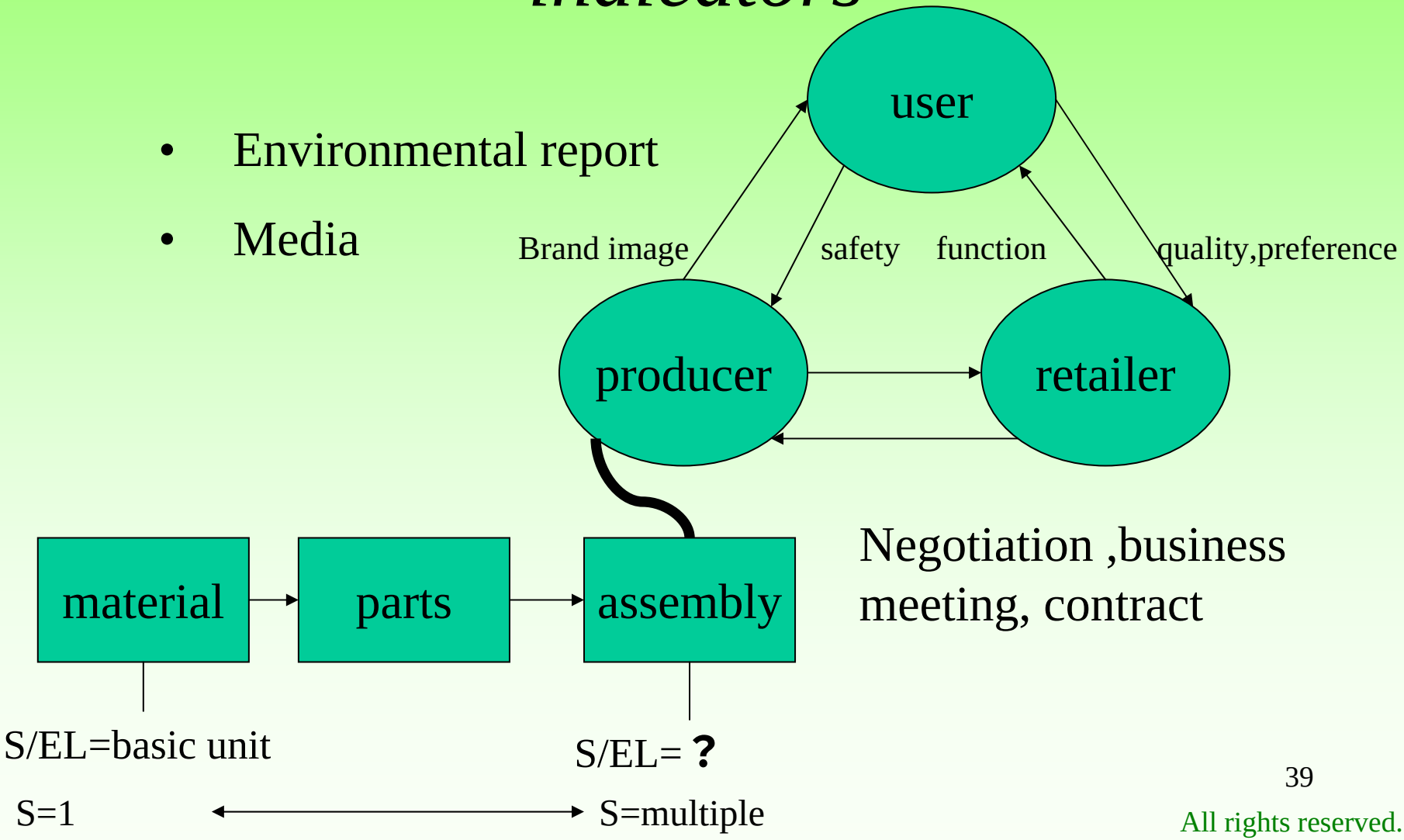
Environmental impact of 'old' $= \sqrt{1^2 + 1^2 + 1^2} = 1.73$

Environmental impact 'new' $= \sqrt{0.42^2 + 0.24^2 + 0.82^2} = 0.95$

Purpose of using eco-efficiency indicators

At shop

- Environmental report
- Media

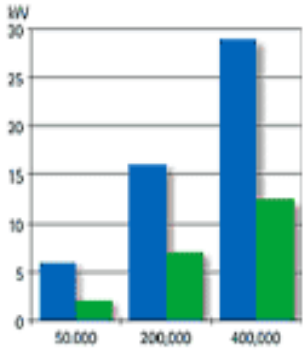


Nokia's eco-efficiency

Product Eco-efficiency

Networks

Lower power consumption
Due to highly intergrated components



Dematerialization

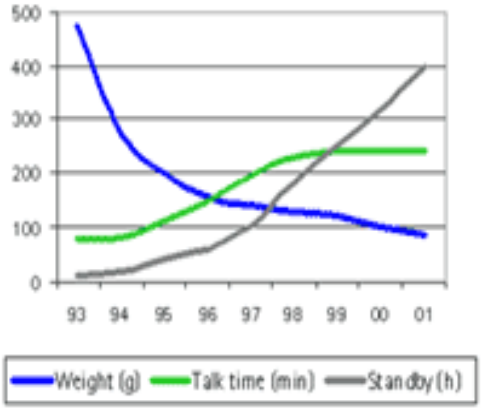
-Minimizing energy intensity

-Minimizing of material intensity of goods and services

-Product optimization
-Enhancement of recyclability
-Maximizing of the use of renewable resources

Immaterialization

Products



Home products-Mitsubishi Factor X

Lighting Fixtures
High efficiency, high output and continued light adjustment capability, as well as high energy conservation through the use of solar energy stored in the automatic control system.

Factor 2.44

Automatic washing machines
Significant decrease of electricity consumption through the implementation of water atomization technology and revision of operation control.

Factor 2.00

Laptop PCs
Considerable reduction in electricity consumption through the use of high-end CPUs.

Factor 1.99

http://global.mitsubishielectric.com/company/environ/pepfxsp_b.html

Society Products-Mitsubishi Factor X

Semiconductor/Memory
Reduction in electricity consumption through lower power voltage of the operating voltage, reduction in use of materials such as mold resin and soldering material.

Factor 73.1

Mobile handsets
Further miniaturization through the use of high energy density batteries. Substantial reduction in the use of resin.

Factor 2.97

Motors
Reduction in power loss. We became the first Japanese manufacturer to acquire an EPAct certification number (CCO12A) from the US Department of Energy.

Factor 1.17

Factor Evaluation of Products

Microwave Oven

Factor 1.27

Social contribution
Resource reduction 66.4t,
Energy reduction 15.9GWh

Air Conditioner

Factor 1.44

Social contribution
Resource reduction 400t,
Energy reduction 1,874GWh
Lead reduction 0.8t

Washing Machine

Factor 2.00

Social contribution
Resource reduction 5,700t,
Water reduction 230 M litters
Lead reduction 3t

Mobile Telephone

Factor 2.97

Social contribution
Resource reduction 68.9t,
Energy reduction 266GWh
Lead reduction 0.33t

Transformer

Factor 1.34

Social contribution
Resource reduction 2,400t,
Energy reduction 246GWh
Toluene/Xylene reduction 3.7t

Semiconductors

Factor 8.07

Social contribution
Resource reduction 61.2t,
Energy reduction 106GWh
Lead reduction 0.36t

Example of Fujitsu(1/2)

Method of environmental efficiency factor calculation

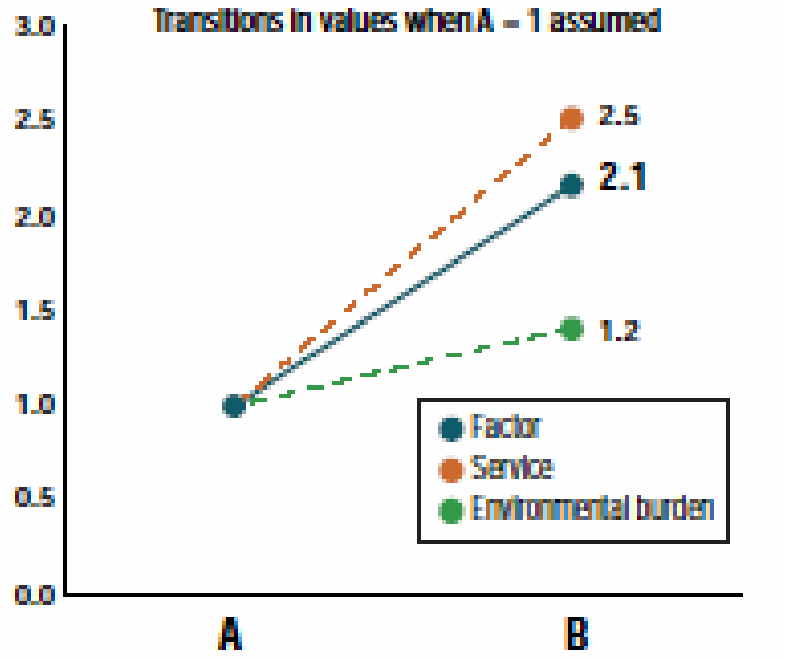
Environmental efficiency factor=

Service
(ratio of new to old products)

Environmental burden
(ratio of new to old products)

Example: Application of environmental efficiency factor to scanners

The environmental efficiency factor of product B, launched in spring 2002, increased 2.1 times compared with that of product A, launched in spring 1999. (Both models are compact A4 two-sided color document scanners weighing under 4 kg.)



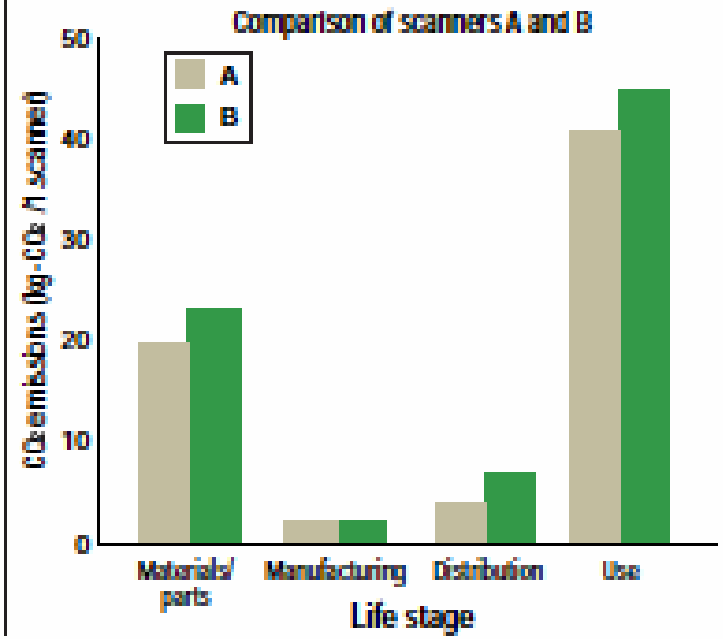
Numerator: Quantification of scanner services

Function/performance		Old/new ratio for function/performance	
Large items	Small items	S= (B) / (A)	={1/n*ΣS^2}^0.5
Optical performance	Evaluation item 1	2.000	3.808
	Evaluation item 2	5.000	
Media-processing performance	Evaluation item 1	1	1.240
	Evaluation item 2	1.440	
Data-processing performance	Evaluation item 1	1.500	1.500

2.47

For calculating services, functions such as optical performance, media-processing performance and data-processing performance were digitalized. The values of the sums of the items were calculated by the square-sum average method.

Denominator: Environmental burden emissions by scanners



A scanner

(B) / (A) = 1.16

The volume of CO_2 emitted throughout the product life cycle is treated as the environmental burden. The manufacturing stage covers the period through the final assembly and the distribution stage the period from final assembly to delivery to the user. Calculation of the use stage assumed operation 2 hours/day, 6 hours/day standby, 240 days/year for five years.

Calculation of Fujitsu indicators

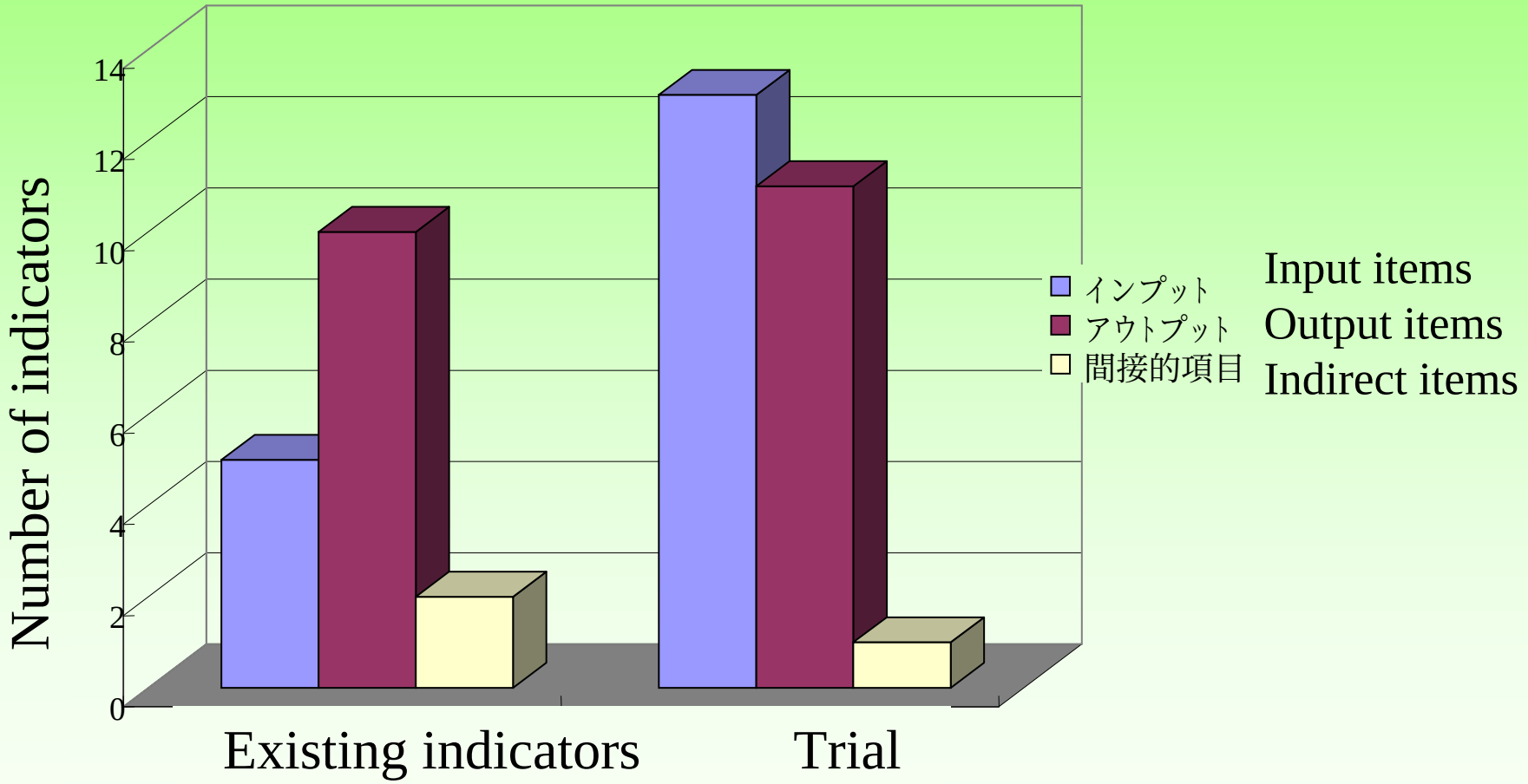
Optical performance $3.808 = \sqrt{\frac{1}{2}\left(2^2 + 5^2\right)}$

Media processing performance $1.240 = \sqrt{\frac{1}{2}\left(1^2 + 1.44^2\right)}$

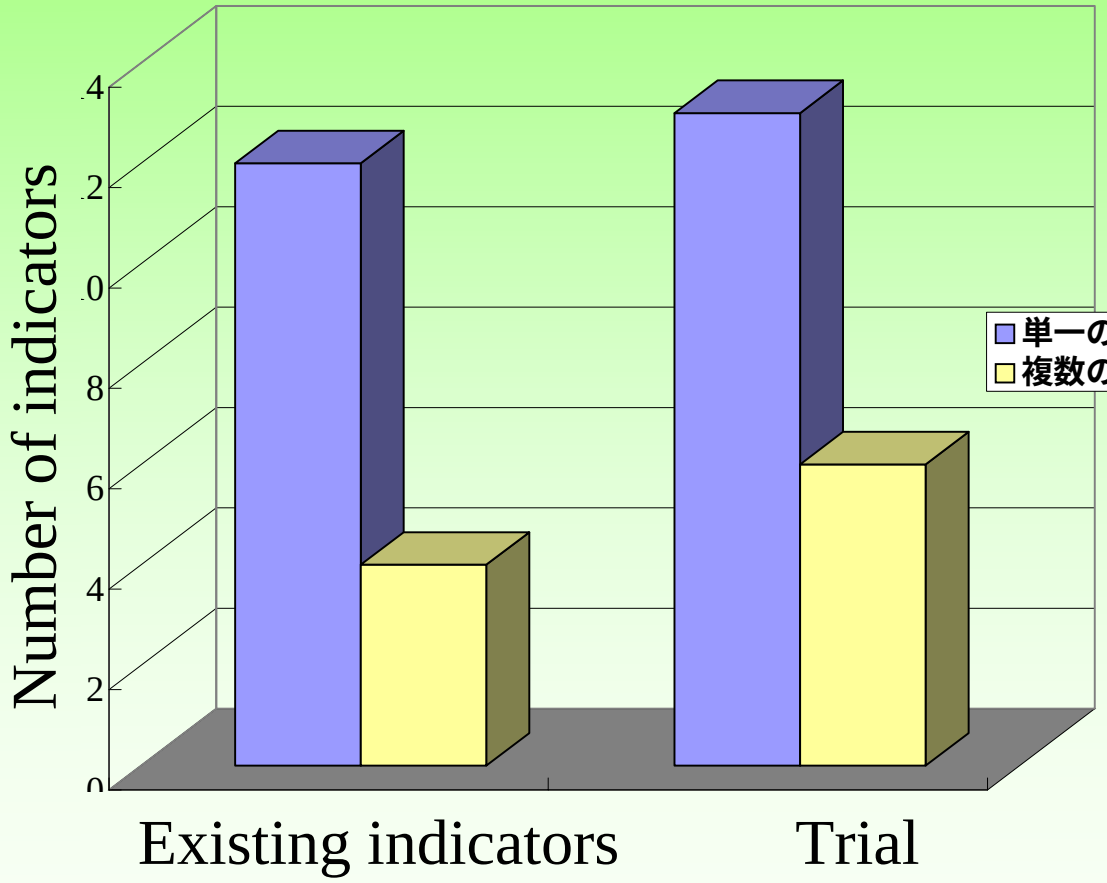
Data processing performance $1.500 = \sqrt{\frac{1}{1}\left(1.50^2\right)}$

Value= $2.469 = \sqrt{\frac{1}{3}\left(3.808^2 + 1.240^2 + 1.500^2\right)}$

Feasibility Study of setting up Factor X (1/3)

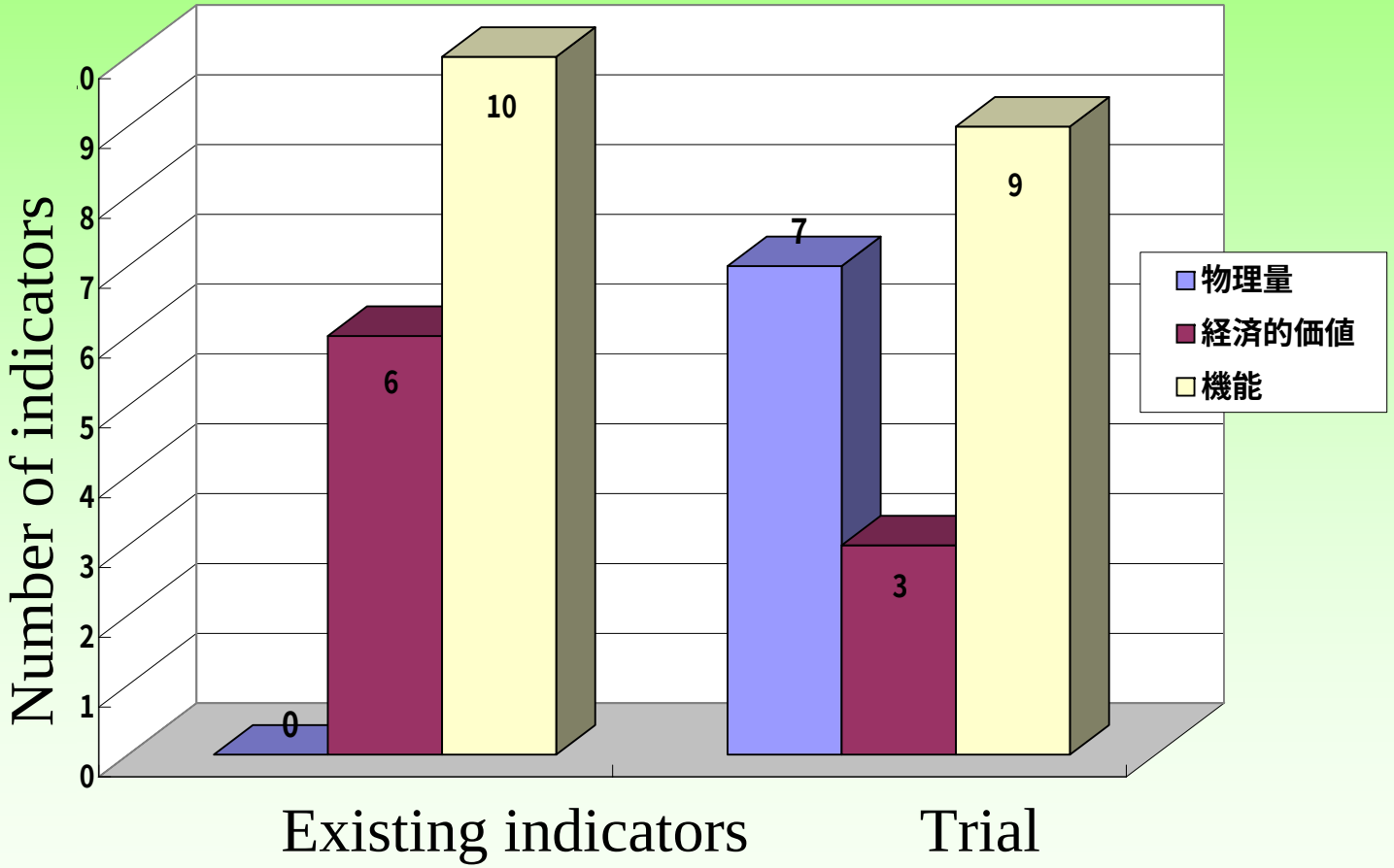


Feasibility Study of setting up Factor X (2/3)



Single indicator
Integrated indicator

Feasibility Study of setting up Factor X (3/3)



Physical items
Economic items
Functional items

Strategy of Implementing Product Eco-efficiency Indicators

- To provide information that the company is committed to evaluating both “product or service performances” and “the environmental impact”
- To describe the company’s efforts to make its products, environmental and performance more efficient
- To indicate the degree of product performances by consulting user priorities for product function
- To differentiate its own products from other company’s competitive products

Current Trends and Development of Eco-efficiency Indicators

The first step

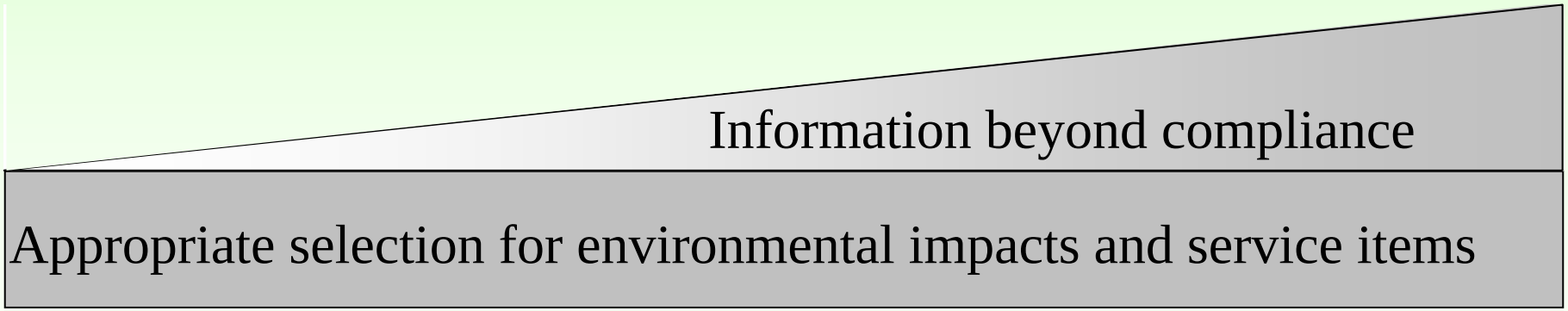
***Positive screening**
***Expressing in ratio**
***Valuable tools for corporate management**
***Internal tools within companies**

The second step

***Information disclosure**
***Effective tools to show good performance**
***External and communication tools to catch attention of stakeholders**

The third step

***Standard-like indicators**
***Comparativeness**
***Expanding market share of high eco-efficiency products**



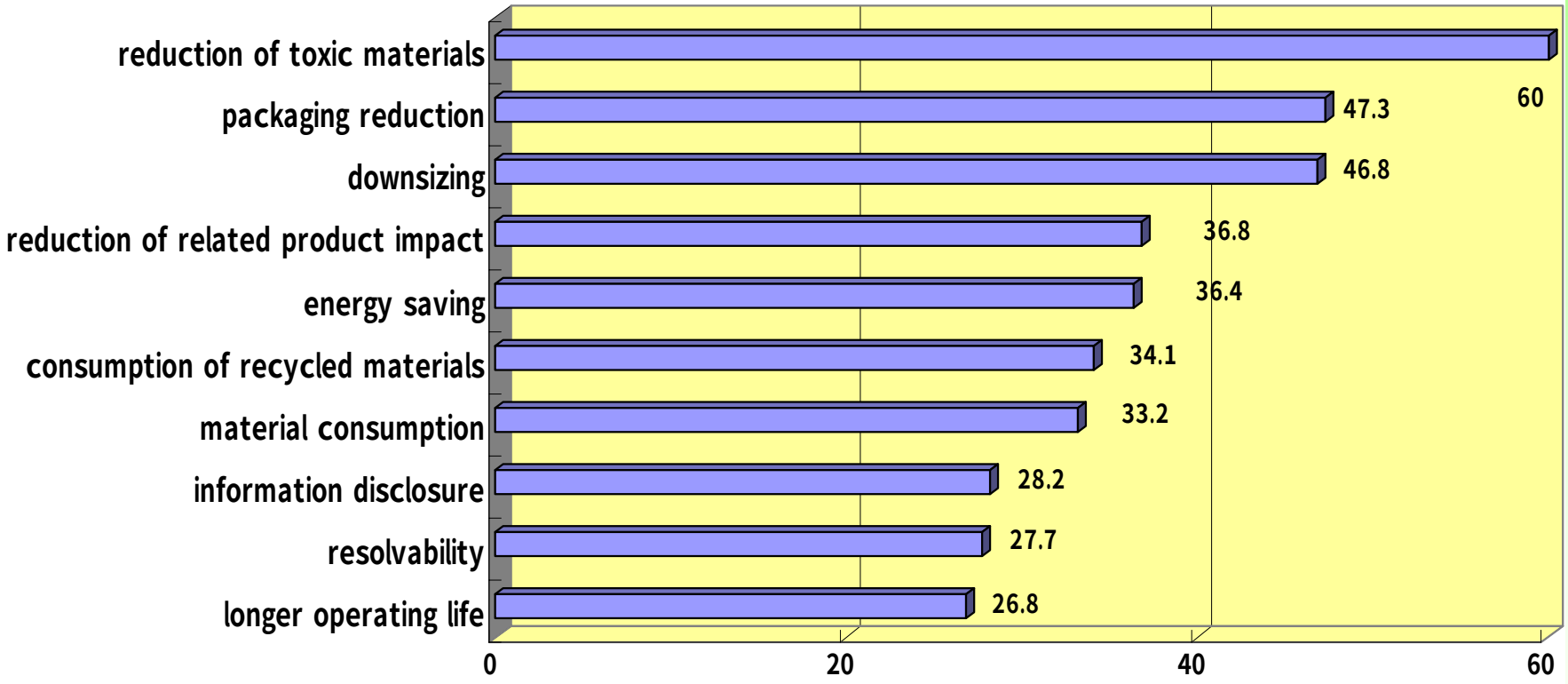
Some Observations

- The environmental performance ratio can be used for both internal and external information.
- A consensus needs to be reached by the business sectors on core eco-efficiency indicators.
- Reporting eco-efficiency indicators could become as standard as reporting indicators of financial performance.
- The distinction between various industries (or products) and stakeholders needs to reflect the importance of proper identification of indicators as practical business instruments.

3. Development of eco-efficiency indicators

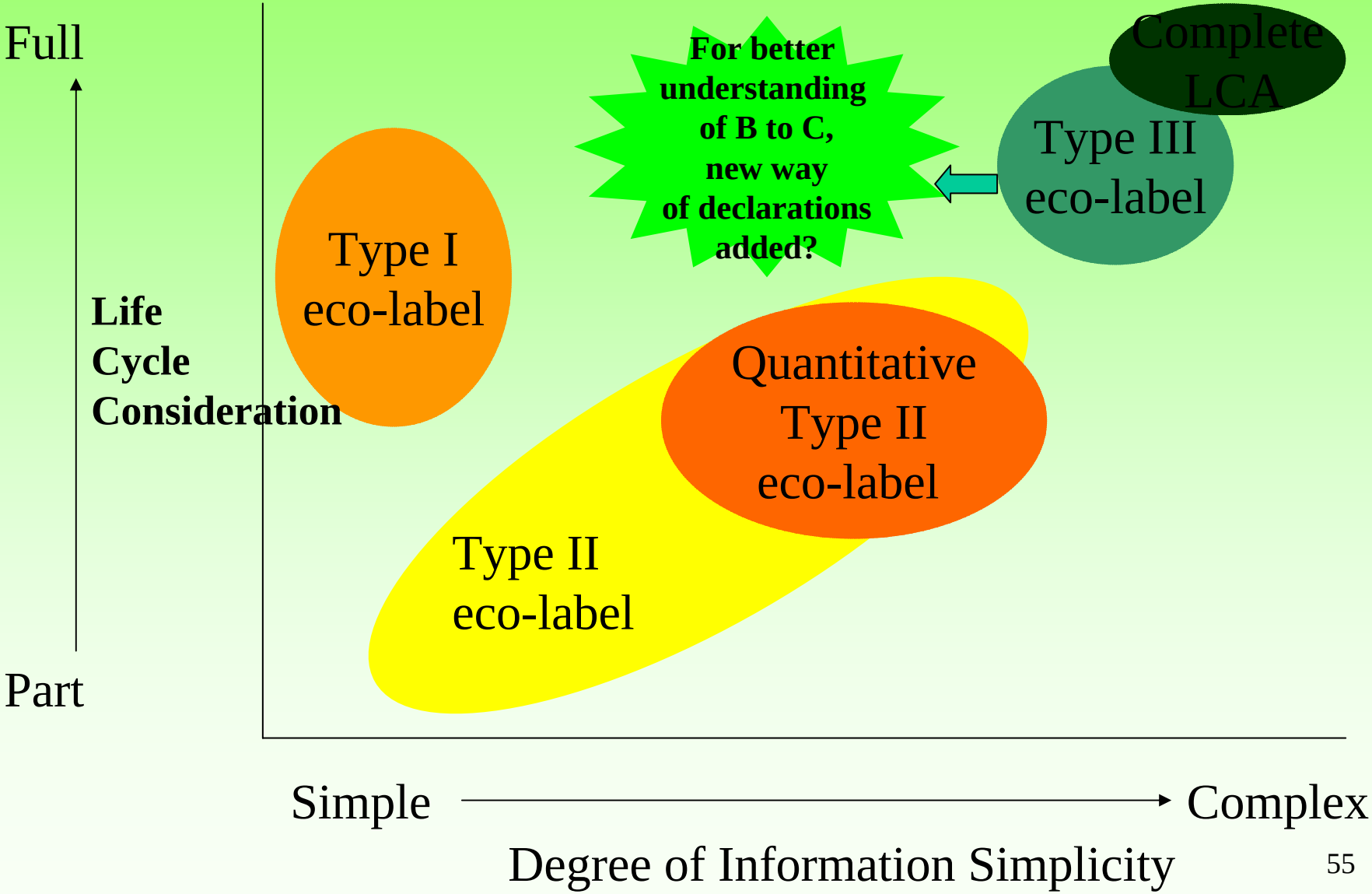
-Environmental product information

Disclosure of Environmental Product Information

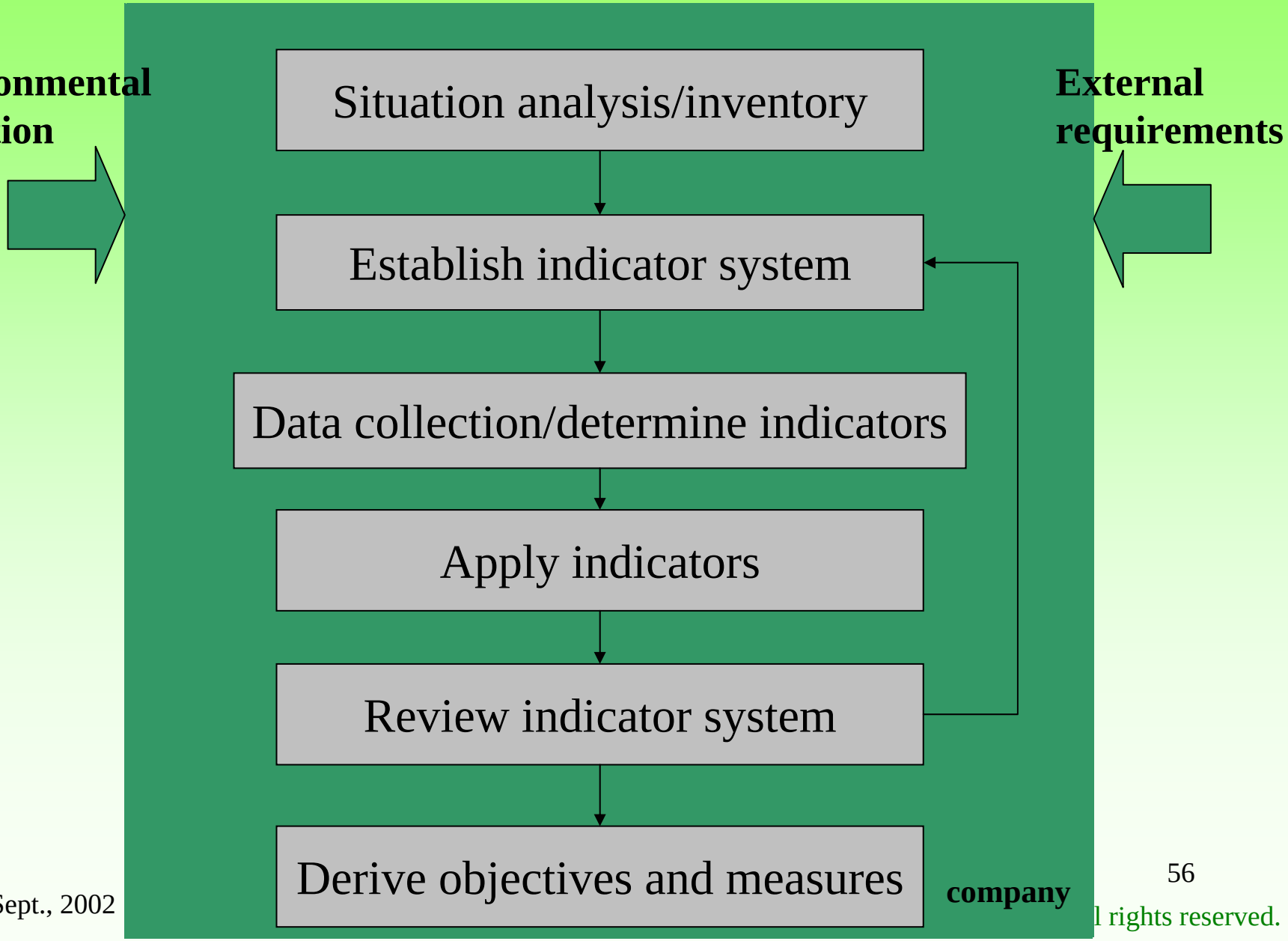


Source: FY2002 Environmental Reporting

Several Types of Product Environmental Information

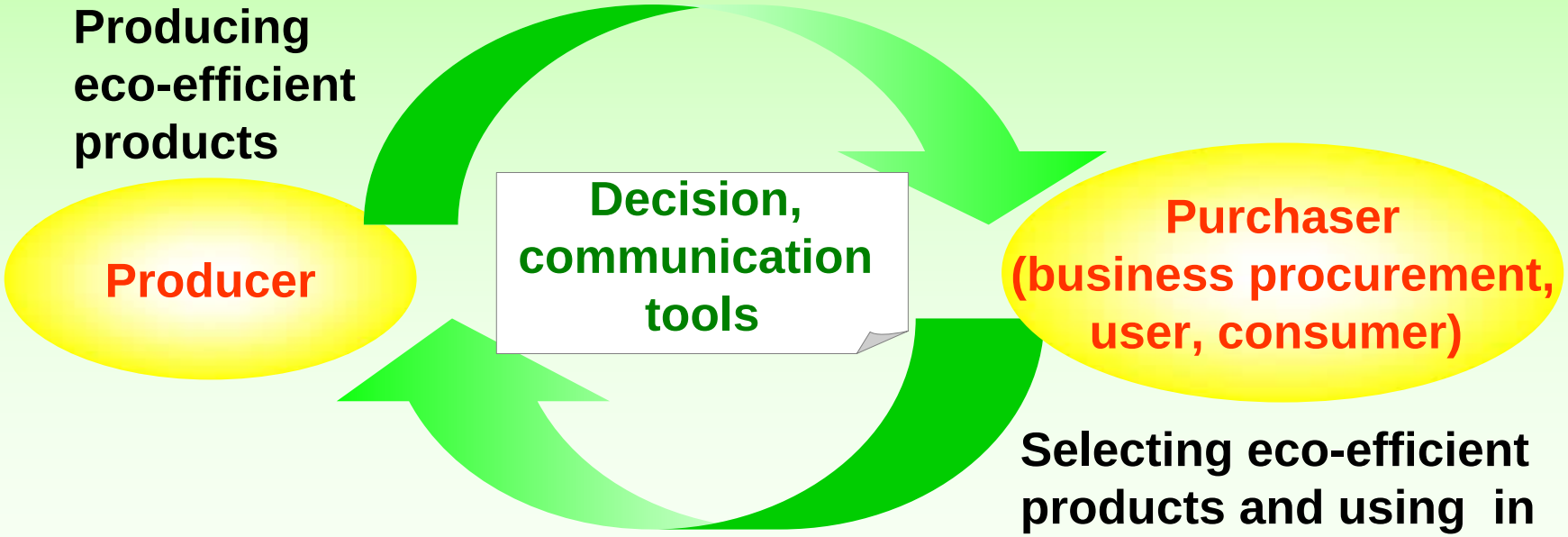


The Path for Establishing Eco-efficiency Indicators



Environmental Product Information Could Be a Key Tool for Sustainable Development

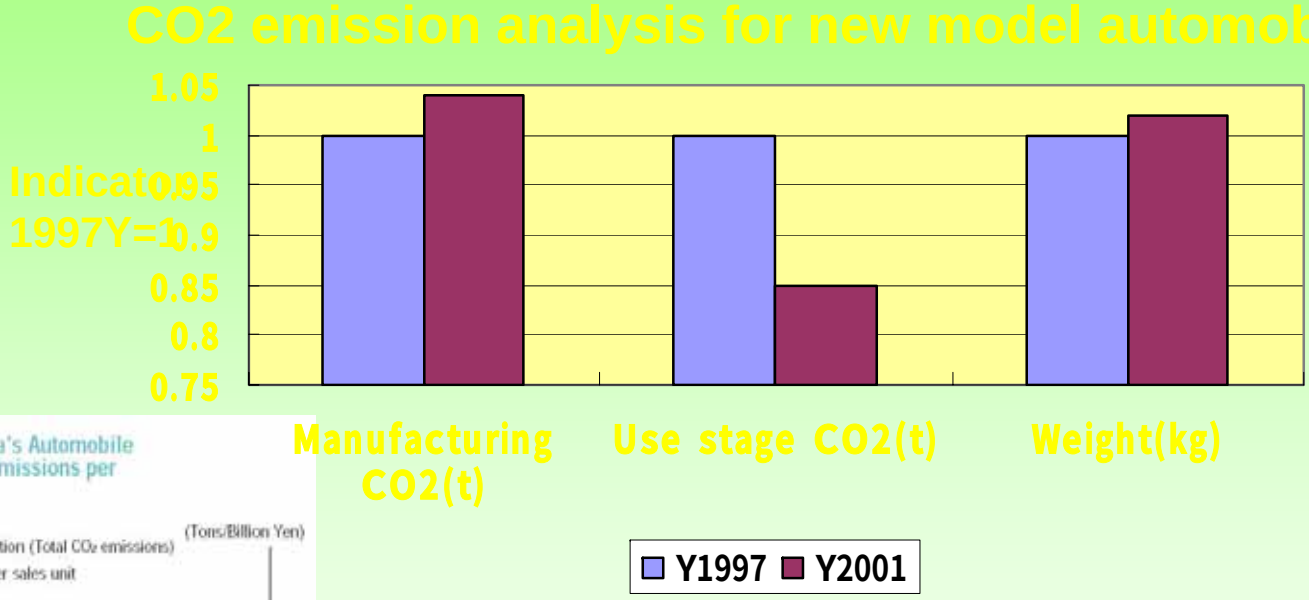
-to raise awareness, to establish priorities, and to motivate activities.

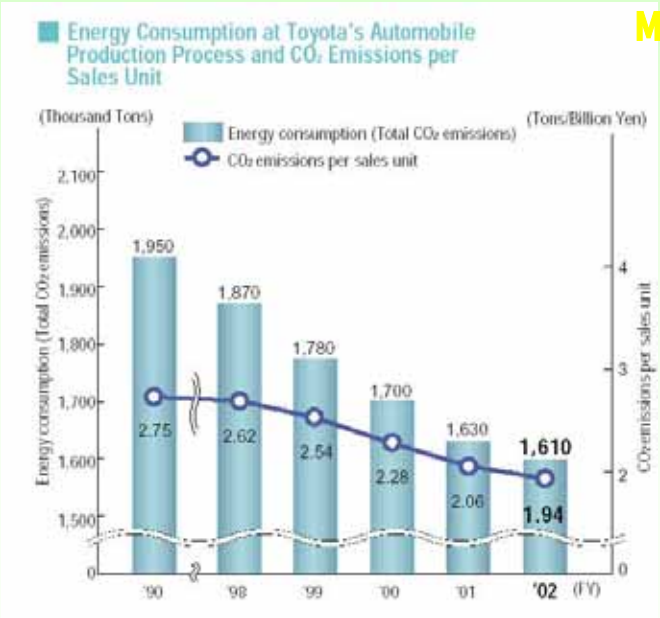


Impacts on the Market

- Data on the market impact of environmental information is difficult to obtain.
- It is difficult to separate the effectiveness of providing environmental information from other factors which influence product's market share.
- However, producers continue to apply for environmental information, *expecting some market value*.

How Could Environmental Product Information Encourage Producers?





- **The effort in shifting from incremental to systematic change should be encouraged.**

Shift From Particular Interest to Whole Life Cycle

- Concerns are increasingly based on life cycle analysis rather than specific stage(production, usage, and disposal).

- Rather than single attribute, multi-aspects of environmental information are expected.

Could EPI Stimulate Product Innovation If There Were Benchmarks?

- Goal is outcomes rather than applied technologies
- Improvements/innovations should be recognized by the market, then rewarded
- Benchmarks would raise corporate targets and increase competition

What Kind of Regulatory Requirements Could Promote These Strategies?

- Government task = prescribe each stage of product design
- Government task = set clear target from life-cycle basis
- Implementations
  - Explore the best combination: standard, competition, cooperative harmonization.
  - Disseminate information and experiences.
  - Develop institutional scheme; e.g., evaluation system

Current Status of Policy Approaches to Trigger Product Innovation

- EU
  - IPP (Integrated Product Policy)
- Japan
  - Integration of tools in future policy
    - **The LCA National project**
    - **Factor 8 committee~product eco-efficiency indicators**
    - **Eco-Leaf Program Environmental product declaration (ISO/CD 14025)**
    - **Green procurement**

The tools are ready to be used…But, where do these things go?

Possible Approaches Based on Life-cycle Information to Product Innovation

- To enhance product supply chain management
  - Green public and private procurement
  - Synergies of existing environmental management systems/tools
  - Information flow and cooperation in product chains
- To enhance awareness
  - Capacity building
- To create market
  - Coordination and information in a critical mass

What Could Be Driving Forces To Enhance Awareness?

- Obtaining credibility endorsement by stakeholders?
- Stimulating supplier by economic incentives, improved availability to LCA inventory data, training, critical review process?
  - Considering how to deal with data from developing countries
- Stimulating demand by enhancing public procurement, promotion and training?

How Could We Show Environmental Product Performance to Users?

Effective Approach to Enhance Acceptability of Environmental Information

- Improving declaration format and visibility?
- Offering consumer education

  (e.g. simple concept about life cycle thinking)?
- Providing other incentives?
- Analyzing consumer behavior/preference?

Concluding Remarks

Success Factors

- Establishment of priorities and targets
- Dialogue
  - Among producers
  - Between producers and consumers
- Case studies