Environmental Consideration throughout Entire Life Cycle of Products

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The Fujitsu Group is currently engaged in promoting Design for Environment (DfE) in its products and reducing environmental burden throughout the entire life cycle of products. The Group has been implementing product environment assessment since FY1993 with the purpose of reducing energy consumption, saving resources and improving the recycling rate based on power saving and energy conservation technologies, while eliminating harmful substances through chemical substance management. Setting the target of providing customers with high-performance products in addition to reducing environmental burden, the Fujitsu Group has developed Green Products which are DfE products in the Fujitsu Group, developed Super Green Products integrating supreme elements in terms of environmental consideration, and taken approaches to enhance the environmental efficiency of products through introducing the eco-efficiency factor. Further, since FY2013, emphases have been placed particularly on improving the energy efficiency and resource efficiency of products to further promote the development of DfE products. In this paper, the Fujitsu Group's past approaches in the DfE area are outlined and its efforts to improve energy efficiency and resource efficiency of products are introduced in the Fujitsu Group Environmental Action Plan, Stage VII (FY2013–FY2015).

1. Introduction

Resource constraints are expected to become severer around the world in the future, as exemplified by international hikes in the price of resources, a tight supply and demand situation and quality deterioration of mineral resources. The International Resource Panel (IRP), an international organization on sustainable resource management established by the United Nations Environment Programme (UNEP), says that, because of the rapid increase in resource consumption on a global scale, decoupling in two ways is required: people and organizations must use fewer quantities of resources per unit of economic output and reduce the environmental burden of any resources that are used for economic activities that are undertaken.[1)] In addition to responding to global warming, it is becoming more important for people and organizations to take measures to address problems including the destruction of nature due to natural resource depletion and to large-scale resource collection, and to ameliorate the heavy demands placed on disposal plants and environmental pollution because of increased waste. Enterprises are now required by society to take approaches such as helping customers to reduce their energy use by improving product energy efficiency and providing products that thoroughly pursue resource conservation and recyclability.

In consideration of these circumstances, Fujitsu has set new targets of the Fujitsu Group Environmental Action Plan, Stage VII (FY2013–FY2015): improvement of energy efficiency and resource efficiency.

This paper outlines Fujitsu's development of eco-friendly products and presents those products that we should aim at from now on and the approach to take to improve their energy efficiency and resource efficiency. It also describes Design for Environment (DfE) through the entire life cycle of products including managing the chemical substances they contain, recycling used CDs and DVDs into notebook PCs and giving disassembly site tours for designers so that they can incorporate improved recyclability in product development.

2. System of development of eco-friendly products

The whole Fujitsu Group makes a concerted effort to help give new products an eco-design and is striving to reduce environmental burden and improve value through the entire product life cycle (**Table 1**).

We have been implementing our own product environment assessment since FY1993 to carry out checks on various methods of environmental consideration, and thereby promoting the development of eco-friendly products that meet the needs of environment-related regulations, environmental integrity, resource conservation, resource recovery, energy conservation and information disclosure. In FY1998, we introduced the Procedure for Green Product Evaluation for the purpose of strengthening the development of eco-friendly products. These measures were integrated into the Procedure for Product Environmental Green Assessment, which was established in FY2004.

Furthermore, we have been developing Super Green Products, which feature a top-class environmental performance, and visualizing environmental burden by means of the eco-efficiency factor.

In FY2011, we established the Eco Design Standard based on an international standard IEC 62075:2008 "Audio/video, information and communication technology equipment–Environmentally conscious design" to globally promote DfE of products.

The following outlines these approaches.

1) Implementation of product environment assessment

We have been implementing a product environment assessment from the product development/design phase in order to reduce environmental burden and environmental pollution of the entire life cycle until products and their packages have been used and disposed of/recycled. In the product environment assessment, which includes 10 categories, environmental performance is evaluated in terms of 45 items, and products that achieve a grade of 70 points or higher in the comprehensive evaluation are defined as eco-friendly products.

2) Development of Green Products

The requirement for Green Product accreditation is to conform to all of the Green Product Evaluation Standards including energy conservation, 3R's (reduce, reuse and recycle) design/technology and hazardous chemical substance safety and achieve 90 points or higher in the assessment evaluation. Products accredited as Green Products are marked in product catalogs and packages with the Green Policy Innovation logo (**Figure 1**) of the Fujitsu Group.

3) Development of Super Green Products

Super Green Products are defined as products or

Table 1
Fujitsu Group's approach to eco-friendly products.

Action Plan	Targets/Specific Measures	Regulation Formulation
Stage I (FY1993–FY1995)	• Improve product recyclability by 50% compared to FY1992	Guideline for Product Environmental Assessment (1993)
Stage II (FY1996–FY2000)	• Product recycling measures • Advancement of Green Product development	Procedure for Green Product Evaluation, Procedure for LCA (1998)
Stage III (FY2001–FY2003)	• Make all newly developed products Green Products	Procedure for OEM Product Environmental Evaluation (2003)
Stage IV (FY2004–FY2006)	• Offer Super Green products from the main product groups of all business units	Procedure for Product Environmental Green Assessment, Procedure for Super Green Product Operation (2004)
Stage V (FY2007–FY2009)	• From all business units, provide newly developed products 50% or more of which are Super Green • Achieve eco-efficiency factor of 2	Procedure for Eco-Efficiency Factor Evaluation (2007)
Stage VI (FY2010–FY2012)	• From all business units, provide newly developed products 30% or more of which are Super Green • Achieve eco-efficiency factor of 4.0	Eco Design Standard (2011)
Stage VII (FY2013–FY2015)	• Make 50% of all new products top-level performers in terms of energy efficiency • Improve resource efficiency for new products by 20% compared to FY2011	–

Year of formulation in parentheses

Figure 1
Green Policy Innovation logo.

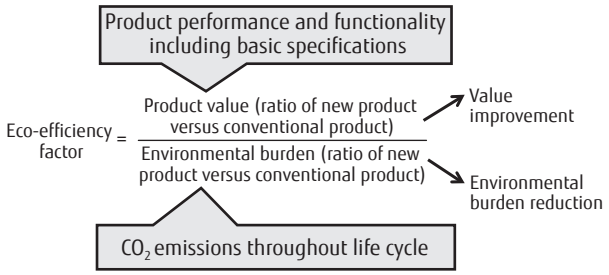

Figure 2
Eco-efficiency factor.

systems that meet the Fujitsu Group's Green Product Standards and have top-class elements in terms of environmental consideration. For the definition and conformance criteria, we have established the "Procedure for Super Green Product Operation" that relates to product operation, in the same way as Green Products. Products accredited and registered as Super Green Products are approved to bear the Green Policy Innovation logo as with Green Products.

4) Improvement of eco-efficiency factor

To accelerate manufacturing that is capable of providing higher value with less environmental burden, the Fujitsu Group introduced the eco-efficiency factor (**Figure 2**) in 2007. The eco-efficiency factor provides a measure for comparing between new and previous products based on quantifying the improvement in environmental burden and value (functionality and performance) through the entire product life cycle.

3. Activities in Environmental Action Plan

3.1 Stage I–Stage V

The Fujitsu Group has been formulating its Environmental Action Plan since 1993 and been working to ensure the environmental consideration of products early on. In Stage I, we intended to improve product recyclability in order to promote the recycling of products. In Stages II and III, we attempted to make products environmentally friendly ones at a faster rate by striving to make all products Green Products. In Stages IV and V, we worked to help reduce environmental burden and develop environmentally conscious products in business units of the Fujitsu Group by developing Super Green products with even higher environmental performance and we have been using the eco-efficiency factor to make environmental burden visible (Table 1).

3.2 Stage VI

In Stage VI from FY2010 to FY2012, we aimed at developing Super Green Products and improving the eco-efficiency factor as in Stage V. In 2010, we revised the definition of Super Green Products into a more stringent standard: products that are in the top group level in terms of both "energy conservation" and "other fields (including resource conservation)." For the eco-efficiency factor, the product value indicator was revised so as to accommodate new products and keep up with the changes in the performance and functionality that are required. The reference year was also made more stringent, and changed from FY2005 to FY2008.

1) Super Green Products

We set a target of developing Super Green Product Series for at least 30% of the Green Product Series newly developed by all business units of the Fujitsu Group. The cumulative percentage of the Super Green Products developed during this period reached 39%. Hence, we successfully achieved the target and made significant contributions to environmental burden reduction, despite the fact that the standard was made stricter.

2) Eco-efficiency factor

At first, we set the FY2012 target of "2.5" and started activities. During this period, we upwardly revised the target to "4.0" based on the actual progress and as a result achieved "4.6" at the end of FY2012. This means that the environmental burden (CO_2 emissions) through the entire product life cycle was reduced by as much as 78% as compared with that of FY2008.

3) CO_2 reduction by Green Policy Innovation project

The Fujitsu Group has been promoting the Green Policy Innovation project, an effort to reduce

environmental burden through provision of green ICT, since FY2007. We have disclosed the amount that products contribute to CO_2 reduction, of which the amount contributed by hardware products has been calculated by using the eco-efficiency factor value, and the result at the end of FY2012 was 3.38 million tons against the target of 3 million tons.

3.3 Review

In Stage VI, we successfully obtained results that exceeded the targets. However, these activities are based on our own standards and do not allow easy objective understanding or comparison with other companies. We are aware that, for this reason, they could have better shown customers the efforts we have been making.

3.4 For Stage VII

In the future, we intend to develop activities that have higher transparency and are globally acceptable by taking measures such as introducing publicly known external standards as much as possible.

In addition, as described in the Introduction, enterprises are required by society not only to reduce CO_2 but also to improve product energy efficiency and resource conservation and the Fujitsu Group is committed to working on the improvement of the "energy efficiency" and "resource efficiency" of products based on the past activities by positioning them as important themes.

The past activities for improving the eco-efficiency factor were intended to comprehensively evaluate and improve environmental efficiency through the entire product life cycle. For energy efficiency and resource efficiency improvement activities, we focus our attention on the use phase and the material manufacturing and disposal/recycling phases respectively, since these have the most impact on the life cycle, and commit ourselves to reducing environmental burden in these phases. In this way, we aim to renew the activities that make use of the eco-efficiency factor as activities for improving energy efficiency and resource efficiency to maximize the activities' effects.

To calculate the amount that hardware products contribute to CO_2 reduction in the Green Policy Innovation, we participate in the Low-Carbon Society Action Plan of the electrical and electronics industries and use their calculation rules.

4. Improvement of energy efficiency of products

The Fujitsu Group has used the eco-efficiency factor up to now to evaluate environmental performance from two perspectives: improvement of product value (performance) and reduction of CO_2 emissions in the product life cycle. Recently, the increase in the volume of data handled in society has caused an issue: an increase in the power consumption of ICT devices. And, for many of the ICT devices dealt with by Fujitsu, CO_2 emissions in the use phase of the entire life cycle account for a large portion of such emissions. Accordingly, we have focused on having energy efficiency during use and decided on a policy that promotes the development of products that offer higher efficiency than ever.

This section describes the improvement of energy efficiency in the Fujitsu Group Environmental Action Plan, Stage VII. With "making 50% of all new products top-level performers[note 1)] in terms of energy efficiency" set as a target for Environmental Action Plan, Stage VII, the Fujitsu Group aims to continuously expand the development of products offering excellent energy efficiency and contribute to reducing environmental burden during use by customers (**Figure 3**).

We have defined the standards for respective product fields that accredit top-level energy efficiency in comparison with others in the market or with conventional products and intend to work on development so that "top-level performers in terms of energy efficiency" that meet the standards will account for 50% or more of the number of product series newly developed in the three years from FY2013 to the end of FY2015. In setting the target standards, we have given weight to ease of comparison and transparency and employed publicly known standards as much as possible.

5. Improvement of resource efficiency of products

The Fujitsu Group has strived to reduce size and weight, use recycled plastic, reduce the number

note 1) Products that meet standards equivalent to the top 25% of the market including leading products in terms of energy efficiency (the world's first, the industry's first, the world's best, the industry's best, etc.).

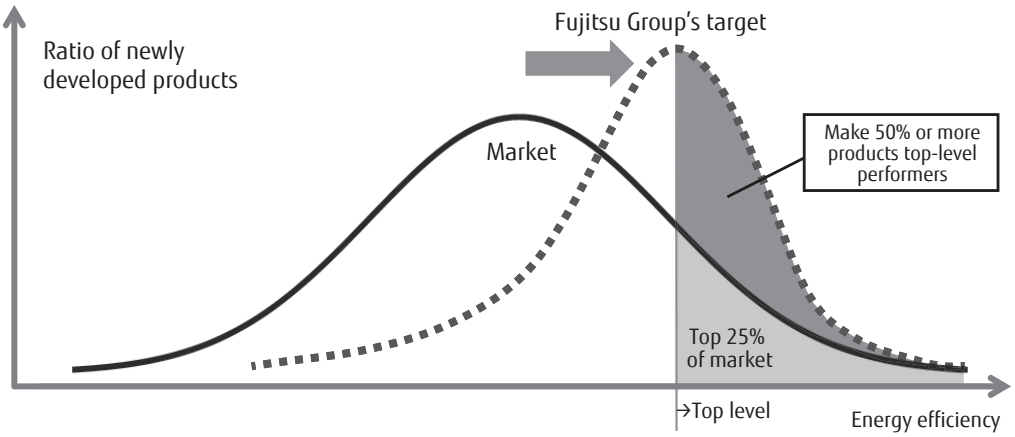

Figure 3
Development of top-level performers in terms of energy efficiency.

of parts, make it easier to disassemble and recycle products, and ensure the material of plastic parts is indicated, as its activities to develop environmentally conscious products. However, there has been no system of comprehensively evaluating the improvement of resource efficiency.

While we believe that assessment by evaluation indicators should preferably be conducted by publicly known standards whenever possible, at present, there are no publicly known indicators capable of objectively evaluating the resource efficiency of products.

Accordingly, we have defined "resource efficiency" as a new indicator for quantitatively evaluating the reduction of environmental burden imposed by products in terms of resource usage and disposal and decided to promote product development aimed at its improvement.

This section describes the improvement of resource efficiency of products in the Fujitsu Group Environmental Action Plan, Stage VII.

5.1 Activity target

The Fujitsu Group has set a target of "increasing resource efficiency of newly developed products by 20% or more as compared with FY2011" for the Environmental Action Plan, Stage VII (FY2013–FY2015). For new products developed by our own design,[note 2)] we intend to work on reducing the environmental burden arising from resource usage and disposal by improving resource efficiency per unit of product and contribute to building a sustainable society. We also aim to provide excellent products that offer benefits to customers with attributes such as a compact size, reduced weight and space efficiency.

5.2 Definition of resource efficiency

The Fujitsu Group has defined resource efficiency of a product, with "environmental burden from usage and disposal" of the individual materials (resources) that constitute products as the denominator and "product value" as the numerator (**Figure 4**, **Table 2**).

We intend to move forward with development that focuses on reducing resource usage while, for the time being, further discussing the "product value," "resource burden coefficient" and "resource disposal volume" in the definition so as to improve the resource efficiency indicator.

6. Other activities

6.1 Chemical substances contained in products

The Fujitsu Group designates substances that are harmful to people and the environment and whose use is either prohibited or regulated by law as "Fujitsu Group Specified Banned Substances" and complies with both Japanese and overseas regulations.

Substances that are not scientifically proven to be harmful but have a possibility of being harmful are designated as either "Fujitsu Group Specified Controlled

note 2) Products with a resource efficiency that is dependent on customer specifications or standards are not included.

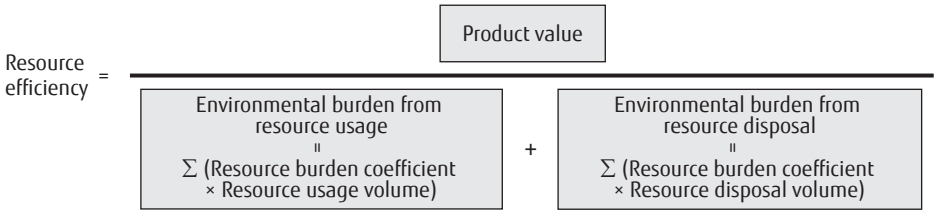

Figure 4
Resource efficiency calculation.

Table 2
Definitions of items in resource efficiency calculation.

Product value	To place emphasis on the valuation of reductions in environmental burden due to resource usage and disposal, product value is limited to that related to resource usage and is set on a per-product basis. (Example of factor not considered: CPU performance improvement.)
Resource burden coefficient	Environmental burden weighting coefficient that is specific to a particular resource and considers factors such as exhaustibility, scarcity and environmental burden from mining and disposal. Activities will begin with this figure set to a value of "1" for all resources.
Resource usage volume	Mass of each resource used in the product (recycled plastic usage volume subtracted).
Resource disposal volume	Mass (design value) of each resource disposed of (not reused) in connection with a post-use product. Activities will begin with this figure set to a value of "0."

Substances" or "Fujitsu Group Specified Reportable Substances." And, based on a precautionary principle, we manage their content so that they can be transferred to banned substances when danger of the relevant substances has been confirmed.

Information about these specified chemical substances and other chemical substances contained in parts and materials purchased from suppliers is centrally managed with a system that covers a range of processes from request for investigation to collection. This system is also used to accumulate the collected data for each product so that the content of the specified chemical substances can be grasped and managed at the product level.

We conduct these activities in order to provide products that can be safely used with a sense of security by preventing any damage to customers' health and reducing environmental pollution risks in their disposal.

We also offer FUJITSU Manufacturing Industry Solution PLEMIA M3/ECODUCE to manage products' environmental information, as a software package that uses this in-house expertise.

6.2 Recycling of used CDs/DVDs for notebook PCs

The Fujitsu Group has become the first in the industry to build a recycling system in which used CDs/DVDs are collected by recycling centers in the Group so that they can be used as recycled plastic for products. This was first used in a model in the summer 2012 lineup of FUJITSU Notebook Personal Computer LIFEBOOK P772/E notebook PC for enterprise customers (**Figure 5**).

Plastic that can be recovered from used products is a mixture of various types, and this fact made it hard to achieve a quality level that allows plastic to be used in products. The risk of contaminants such as heavy metals being mixed in and the difficulty in complying with regulations including the RoHS directive were other factors that hampered the application of plastic. As we sought a means to overcome these issues, we paid attention to the CDs/DVDs, which are made of pure materials, collected in recycling centers in large volumes, and we controlled quality based on a database that manages the risk of chemical substances that was developed by Fujitsu Laboratories. This has made it possible to apply the plastic to notebook PCs.

This recycling system is expected to reduce the

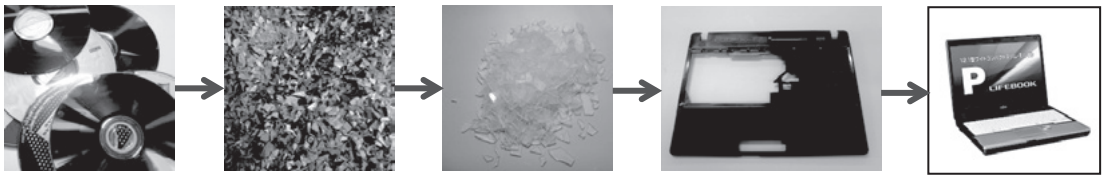

Figure 5
Reusing waste CDs and DVDs.

amount of newly produced plastic that is used by 10 tons or more per year while cutting CO_2 emissions by approximately 15% as compared with the conventional notebook PC manufacturing process. In the future, we plan to build a recycling system for used plastic other than CDs and DVDs to utilize plastic in a wider range of our products, thereby working on resource conservation and environmental burden reduction.

6.3 Recycling center tours for designers

Since 2010, we have held twice-yearly tours of Fujitsu recycling centers for designers of the Fujitsu Group. These tours also show case studies given by recycling professionals that highlight factors which make product disassembly difficult and they offer a chance for the participants to exchange opinions, in addition to having them visit a recycling site and gain hands-on experience of how to disassemble used products (**Figure 6**). These tours serve to provide information to the designers. In this way, we work on improving designers' awareness of recycling and recyclability of products.

6.4 Participation in Low-Carbon Society Action Plan

As described at the end of the "Activities in Environmental Action Plan" section, the Fujitsu Group participates in the Low-Carbon Society Action Plan of the electrical and electronics industries. And, starting with FY2014, we will report every year to the Liaison Group of Japanese Electrical and Electronics Industries for Global Warming Prevention on the amount that our products and services have contributed to reducing CO_2 emissions as calculated based on common rules to calculate CO_2 emission contribution established by industries. We are committed to making contributions

Figure 6
Gaining experience in disassembling.

to the realization of a low-carbon society by providing more energy-efficient products.

7. Conclusion

This paper has presented the Fujitsu Group's in-house framework for promoting the development of environmentally conscious products, activities for improving energy efficiency and resource efficiency of products as two major targets for the future and environmental consideration through the entire product life cycle.

The Environmental Action Plan, Stage VII that is currently under way has made a transition from development of "Super Green Products" and improvement of "eco-efficiency factor," which were targets in Stages IV to VI, to the target of improving "energy efficiency" and "resource efficiency." We intend to further strengthen environmental burden reduction in forms that benefit customers by means such as reducing power consumption during use, ensuring portability as a result of

resource conservation and reducing installation space, and to communicate Fujitsu's activities to customers in an easier-to-understand manner. We will positively disclose information about the results of our activities and meet the demand for environmental burden reduction, and this will lead to the development of a sustainable society.

References

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