

Evaluation of Notebook and Desktop Personal Computer through the EcoLeaf Type III Environmental Label

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1. Introduction

EcoLeaf is a Japanese version of Type III environmental labeling program launched in June 2002 promoted by the Japan Environmental Management Association for Industry. Fujitsu joined EcoLeaf program from its trial stage and became Japan's first personal computer (PC) manufacture to receive EcoLeaf environmental label certification. So far, Fujitsu has acquired thirty one labels for PCs and two for magneto-optic disc drives as of Aug 2005. In this study, notebook and desktop PC, which EcoLeaf Type III labels are certified, are analyzed and the potentials for effective environmental loads reduction are discussed.

2. LCA through EcoLeaf Program

In EcoLeaf program, there are a set of standards called Product Specification Criteria (PSC) for each product categories in order to ensure the objectivity and consistency of declared information. PSC, for instance, defines the definition of products assessed, requirements and rules of the Life Cycle Assessment (LCA) calculation, scenarios of product use and disposal, method of data collection, processing and use, and data to be disclosed [1].

The first PSC for notebook PCs was formulated in 2003 and later modified to include the evaluations of desktop PCs and monitors. All PSCs are available at a Website [2]. Some of the key elements of PCs PSC are as below:

- 1) Product stages are divided into five: material production, product production, transportation, use, and disposal and recycle stages.
- 2) Functional unit is set as one unit of product. Manuals and packaging materials are included in the assessment.
- 3) Both raw materials acquisition and material manufacturing are calculated at the materials production stage.
- 4) LCD panel manufacturing, mounting of the main board, and product assembly are considered as

foreground data source and reported at product production stage.

5) The distribution stage is modeled as the transportation between the product assembly site to Japanese domestic customers.

6) Three modes are considered for the product use phase: active/standby, energy saving, and off mode. Products are assumed to be in use 240 days a year for 4 years.

7) In the disposal and recycle stage, the product collection rate is set to 100% and a deduction is made for product reuse, component reuse, and material recycling. There are two elements in this stage: direct and indirect effects. Open recycle is considered in the value of indirect effect while only closed recycle is considered in direct effect.

3. Results of EcoLeaf Label

Based on PSC of personal computer, Life Cycle Inventory (LCI) of notebook and desktop PCs are computed and the results are shown in Table 1. Notebook PC FMV- C6200 (EcoLeaf registration No. BJ-05-015) released in 2005 is selected while FMV-C5200 (EcoLeaf registration No. BJ-05-006) and VL-171SE (EcoLeaf registration No. BJ-05-007) released in 2005 are selected as desktop PCs. It is noted that FMV-C5200 is a computer itself while VL-171SE is a display and the sum of two machines are considered as a desktop PC in this study.

Table 1 Summary of Inventory Analysis

(IN)	Unit: kg		(OUT)	Unit: kg	
	FMV-C5200 VL-171SE	FMV-C6200		FMV-C5200 VL-171SE	FMV-C6200
Coal	44.2	14.8	CO ₂	341	115
Crude oil (fuel)	53.6	18.2	SO _x	0.300	0.105
LNG	18.3	6.15	NO _x	0.316	0.113
Crude oil (ingredients)	3.60	1.26	N ₂ O	0.0149	0.00551
Iron ore	5.76	1.39	CH ₄	0.00611	0.00204
Copper ore	0.318	0.0728	Dust	0.0261	0.0097
Bauxite	1.09	0.262	Solid waste	1.03	0.278
Nikkel	0.0325	0.0333	Slag	4.29	1.69
Wood	4.01	2.33			
etc...			etc...		

*Indirect effect (open recycle) is excluded

4. Comparison and Analysis of Notebook and Desktop PCs

Figure 1 shows the life cycle CO₂ emissions of notebook and desktop PCs. Total CO₂ emissions of desktop computer excluding indirect effect is 341 kg-CO₂ which is about three times higher than that of notebook PC of 115 kg-CO₂. Beyond that, CO₂ emissions per unit mass of desktop and notebook PCs are 23.3 kg-CO₂/kg and 23.4 kg-CO₂/kg respectively and that explains base unit of desktop and notebook PCs are the almost same in this case.

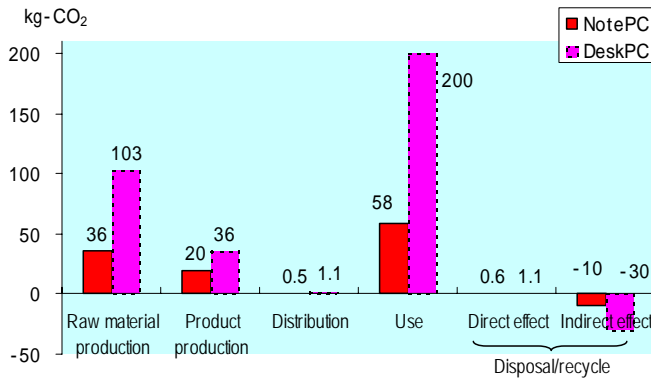


Figure 1 Comparison of CO₂ emissions

4.1. Details of Notebook PC

Life cycle CO₂ emissions of notebook PC are indicated in Figure 2. It is noted that material production and product production stages are combined into one stage and shown as production stage for this analysis.

Both production and use stages are the significant stages for notebook PC. In general, use phase is by far the highest stage of environmental burdens for electronic products; however, notebook computer is not one of them. This is due to the low electricity consumption during the operation and standby mode at the use stage as well as the short replacement cycle of PCs. There are potentials to reduce the environmental loads in the production stage. Application of environmentally benign manufacturing processes for semiconductor and LCD panel will contribute to reduce the total CO₂ emission of notebook PC. In addition, the electricity reduction during OFF mode is another challenge for further reduction.

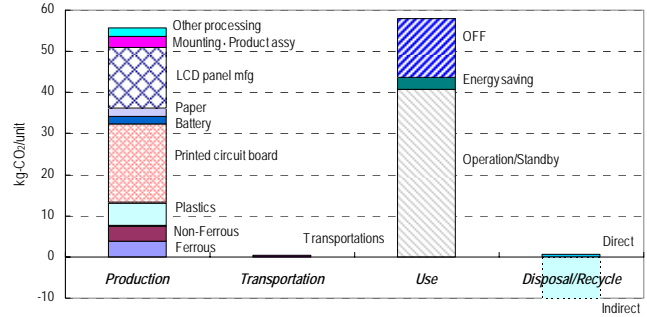


Figure 2 CO₂ Emissions of Notebook Personal Computer

4.1. Details of Desktop PC

CO₂ emission of desktop PC is the highest at the use stage as shown in Figure 3; it contributes more than 60% of the total emission. Also the production of printed circuit board which includes both semiconductors and substrate emits a large amount of CO₂ which consists of 18% of total emission. Transportation and disposal/recycle stage are not significant elements like notebook PCs. More efforts can be made to reduce the electricity consumption especially in the operation/standby mode.

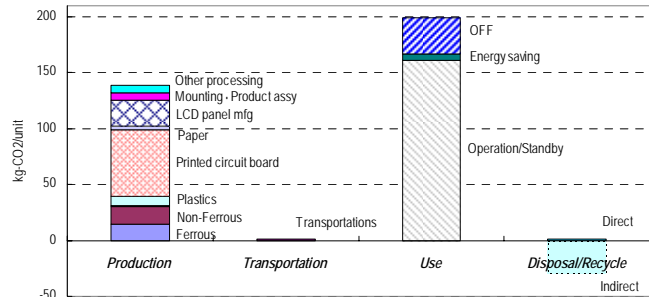


Figure 3 CO₂ Emissions of Desktop Personal Computer

5. Conclusion

From the life cycle inventory analysis of EcoLeaf label, both production and use stages are the dominant sources of CO₂ emissions on the other hand distribution and disposal/recycle stages are not significant to the whole. Manufacturing of LCD panel and printed circuit board and electric consumptions during operation/standby and off mode are the key factors to reduce environmental loads of PCs.

References

- [1] Ecoleaf: Japan Environmental Management Association for Industry. <http://www.jemai.or.jp/english/ecoleaf>
- [2] PSC for for notebook personal computer. http://www.jemai.or.jp/english/ecoleaf/pub_psc.cfm