S-3 Low-Carbon Society Scenario toward 2050: Scenario Development and its Implication for Policy Measures

4. Integrated Measures of Technologies and Lifestyles against Global Warming - Ecodesign of ICT (Information and Communication Technology) Society -

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Key Words Information and communication technology, Eco-designed movement model, Eco-navigation system, Supply chain management, Future industries

1. Introduction

With the development and diffusion of information and communication technologies (ICT), various benefits may be gained in all aspects of society. In industry, we have obtained efficiency improvements in materials supply, physical distribution, and office work, and also achieved the globalization of business. In daily life, we have obtained many benefits from novel approaches to communication with other people, information acquisition for hobbies and entertainment, and the purchase of commodities. These changes are expected to accelerate with increasing communication capacity and simplified access to networks in the future, leading to great structural changes in society. (i.e. an ICT revolution). As the consumption of resources depends on social structure, an ICT revolution will make it possible to apply a large influence on the environmental load of society. As we start moving towards an ICT revolution, adding environmental consciousness will lead to the causal treatment of environmental problems, which will in turn reform industrial activities and lifestyles into more sustainable approaches. This is our research perspective.

2. Research Objective

We have been studying the influence of ICT diffusion on environmental problems. From previous study's results, we selected three important ICT applications. These are a "SCM (Supply Chain Management) system", which reduces resources used in the industry sector, "advanced traffic utilization system & teleworking", which increases energy use efficiency and decreases the frequency of traffic use, and "Eco-life guidance system", which changes people's actions to a more environmentally conscious one. We investigated these effects on environmental loads in more detail. In addition to these, we drew a clear vision of a networked society, which many people desire strongly, under the condition of achieving low carbon emissions in the year 2050.

3. Results & Discussion

(1) Embodiment and Empirical Verification of Integrated Measures of Technologies and Lifestyles against Global Warming by the Medium of Information Technologies

We verified that the offer of the information about the energy-saving was effective to the reduction of CO_2 emission derived from electricity and gas in the home using the environment household account book data and the questionnaire answer. Our questionnaire was designed on a basis of Ito's research findings[1)] and our experimental results in FY2005. The multiple regression equation which comprised of CO_2 emission as a dependent variable and psychological factors and demographic factors as independent variables was created from collected data. As a result, the negative correlation was observed in the knowledge of energy-saving at statistical significance level (p-value) of 6.4 %. This result shows that the energy consumption decreases as knowledge about the effect of the energy-saving action increases. We estimated the CO_2 emission reduction potential which derived from the use of the electricity and gas in the home by eco-navigation system technology in the assumption that the whole CO_2 emission in the home is about 130Mt-CO_2/year and all consumers have the knowledge about the effect of the energy-saving. Consequently, CO_2 reduction of 45kg-CO_2/month in the home was estimated. It is equivalent to 18 % of total CO_2 emission (248.2kg-CO_2/month) derived from electricity and gas use in the home. When assuming that the degree of the effect is equal through a year and the rate of diffusion to the home is 100 %, the CO_2 reduction potential is estimated to be 23Mt-CO_2/year.

(2) Eco-Design movement model to achieve a low-carbon society

We propose a real-time secure traffic system that would automatically generate and adjust an individual's mode of transportation and schedule based on their personal schedule and the traffic situation (fig.1)[2) 3)]. Through a real-time secure traffic system and a distributed satellite office system, our ICT eco-designed movement model helps give shape to regional community, which is the basic sphere of everyday life. Based on fluctuations in transportation demand in the community, our model facilitates the expansion of public transportation infrastructure and the use of different types of car sharing and pooling.

From our web survey results, we assess the substitutability of movement using ICT for each type of lifestyle scene and then the potential CO_2 reduction by 2050. For people who commute by private automobile, we estimate a modal shift rate of 25.1%, which results in a CO_2 emission reduction of 5.21 million tons per year. In addition, we estimate a teleworking rate of 43.9% of the working population, which results in a CO_2 emission reduction of 8.66 million tons per year. Finally, if 48% of all daily shopping by automobile is made over the Internet, it is possible to reduce CO_2 emissions originating from automobile exhaust by 31.2 million tons per year.

With a data of the web survey, we estimate an environmental emission form the packaging materials of the Internet shopping, which results in a CO_2 emission of 1.29 kg per a package.

Then we estimate a CO_2 emission reduction rate of 30%, which results in a CO_2 emission reduction of 15.8 million tons per year.

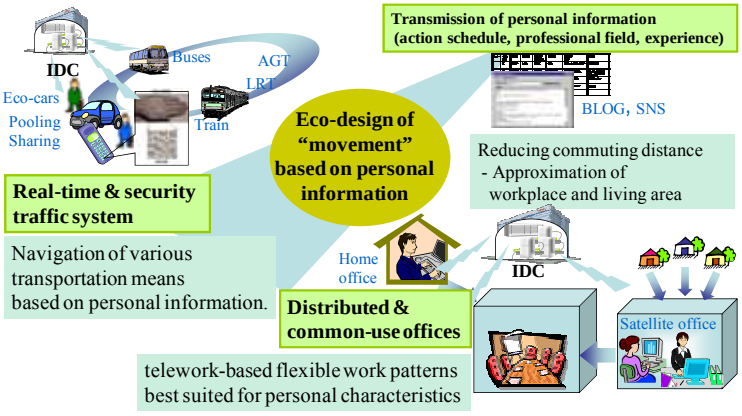

Fig.1 Eco-designed movement model by ICT

(3) The effect of reducing CO_2 emissions by optimizing industrial procedures through the introduction of ICT

In FY2004, we investigated the effect of reducing CO_2 emissions caused by using ICT in production and distribution management systems such as SCM, in the food, textile, medicine, and cosmetics industries. In FY2005, we used that knowledge to reduce the stock in hand (inventory) of the manufacturing industry. We also designed a methodology of estimating the effect of reducing CO_2 emissions that would be caused by reducing the amount of dead stock by the application of ICT systems such as the SCM technique, thus suppressing unnecessary production[4), 5)].

This year (FY2006), we developed the above estimation methods further not only with respect to SCM but also with respect to the use of direct-from-factory and build-to-order (BTO) systems in net retail, as in the Dell model, and the computerization of goods distribution. Items of optimizing industry efficiency by the application of these ICT are described below.

a. Effects due to application of SCM

- Suppression of unnecessary production by reduction of inventories in the manufacturing industry
- Reduction in number of factory buildings due to suppression of unnecessary production in the manufacturing industry
- Reduction of storage space due to inventory reduction in wholesalers
- Suppression of unnecessary production due to inventory reduction in wholesalers
- Wholesalers made unnecessary due to direct transactions between manufacturers and retail stores

Table 1 Results of calculations of CO_2 reduction effect due to application of ICT

(units: 1,000t-CO_2)

Items			2010	2020	2030	2050
a. SCM	Manufacturing industry	Suppression of unnecessary production	16,221	16,221	35,960	41,461
		Reduction in number of factory buildings	84	124	178	202
	Wholesalers	Reduction of storage space	7,777	11,497	16,140	17,875
		Suppression of unnecessary production	443	660	943	1,065
		Wholesalers made unnecessary	2,274	4,724	6,477	8,630
	Retail stores	Reduction of storage space	3,326	4,830	6,848	7,382
		Suppression of unnecessary production	329	480	692	755
	Reduction in warehouse building		2,275	3,308	4,496	4,933
	Reduced distribution of returned goods		1,943	2,819	3,541	4,600
	Optimization of accounting work		1,429	2,382	3,334	4,763
Subtotal			36,100	47,044	78,609	91,665
b. Direct-from-factory and BTO		Wholesalers made unnecessary	2,722	4,084	5,445	8,167
		Retail stores made unnecessary	2,380	3,571	4,761	7,141
		Increase in inventory space in net-retailers	▲ 1,328	▲ 1,992	▲ 2,657	▲ 3,985
		Suppression of unnecessary production	215	323	431	646
		Increase in retail goods distribution	▲ 808	▲ 1,211	▲ 1,615	▲ 2,423
		Reduction in returned goods distribution	28	42	56	84
		Reduction in movements of customers	426	639	852	1,278
Subtotal			3,636	5,455	7,273	10,909
c. Application of ICT to goods distribution		Journey management system	1,588	3,970	6,352	7,940
		Logisitic (distribution) management system	1,295	3,238	5,181	6,476
Subtotal			2,883	7,208	11,533	14,416
Total			**42,619**	**59,707**	**97,415**	**116,991**

- Reduction of storage space due to inventory reduction at retailers
- Suppression of unnecessary production by reduction of inventories at retailers
- Reduction in warehouse building due to inventory reduction
- Reduction in goods distribution due to reduction in returned goods
- Optimization of accounting work

b. Effects due to direct-from-factory and BTO systems

- Wholesalers made unnecessary by direct-from-factory system
- Retail stores made unnecessary by direct-from-factory system
- Increase in inventory space in net-retailers
- Suppression of unnecessary production
- Increase in goods distribution by parcel-delivery services
- Reduction in returned goods distribution
- Reduction in movements of customers because visiting stores is not necessary

c. Effects due to computerization of distribution

- Eco-drive effect due to journey management system
- Improvement in carrying efficiency due to logistic (distribution) management system

The results of these estimations are shown in Table 1. The largest factor in the effect of reducing CO_2 emissions is the suppression of unnecessary production as inventories contract within the manufacturing industry due to the application of SCM. Optimization of the manufacturing industry is likely to have a greater direct effect on CO_2 emission reduction. The next largest factor is the reduction of storage space as the amount of inventories contract within the wholesalers of goods due to the application of SCM. By their very nature, companies involved with the wholesale distribution of goods easily

accumulate inventory, so clearly, any inventory reduction here will be effective in reducing CO_2 emissions. These estimations suggested that these applications of ICT, such as SCM, direct-from-factory and BTO systems and the computerization of goods distribution will have the effect of reducing approximately 11.6 millions t-CO_2 in 2050, including indirect effects. This is equivalent to approximately 10% of the CO_2 emission throughout Japan in 1990. However, we should note that the numerical values obtained by totaling values for each item overlap to a certain extent.

(4) Future strength industries

We extracted some information regarding Japan's future strength industries from relevant literature. They are classified into three categories; new industries which would be created by i) advanced services for social needs and ii) technological innovations, and iii) current frontrunner industries. Keywords/concepts regarding typical industries in individual categories were collected by interviewing seven experts. Using these keywords/concepts, the image of Japan's future industries are presented in three daily-life scenes in 2050.

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