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 - （Abstract of the Interim Report）

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

[Abstract]
Discussed here is ICT impact on industrial structure in 2050, using a macroscopic long-term simulation model and microscopic LCA based model. The total energy consumption in Japan reduced 13,376Peta-Joule (PJ), from 15,982PJ in 2000, and the ratio of industry sector reduced to 41% in 2050 from 47% in 2000.These results reveal that ICT impact on Industry in 2050 accelerate economic growth in service sector, which result in reducing energy consumption from industry in Japan. On the contrary, from a global viewpoint, the improvement of ICT means the amount of offshoring will dramatically increase. This leads to the radical increase of China’s and India’s economy, as well as to an increase in global energy consumption.

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 navigation 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.

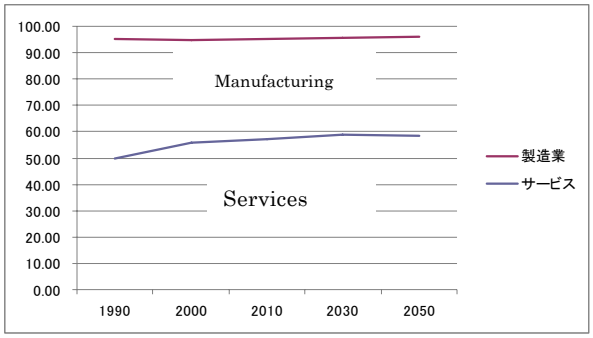
3. Results & Discussion

(1) Macro evaluation of ICT impact on Industrial Structure in 2050

Regarding ICT impact on economy, we have to see the impact both from a domestic viewpoint and a global one. From a global viewpoint, the most significant issue is the phenomena of 'Offshoring'. Generally, 'Offshoring' refers to the relocation of business processes, such as production, manufacturing, or services, from one country to another. 'The Next Industrial Revolution?'. Alan S. Blinder defines 'Offshoring' more specifically as 'the migration of jobs, but not the people who perform them, from rich countries to poor countries.' [1)]. Blinder argues that the process of 'Offshoring' is the most significant economic issue facing today's world, and as ICT improves, the amount of offshoring will dramatically increase, because 'the old assumption that if you cannot put it in a box, you cannot trade it is thus hopelessly obsolete.'

A long-term simulation model, which is composed of macro-economic model, Input-Output tables and energy model, has been developed in order to calculate the economic and energy structure for Japan, USA, China, and India, up to 2050, including macro effect of offshoring caused by ICT revolution. In 2050 Japan, GDP would be737trillion Japanese Yen (JY), and GNP would be 830 trillion JY. This means about 100 trillion JY was acquired from overseas investment. The population of employment would be reduced 34.4million in 2050 comparing with 51.6 million in 2000. The ratio of yield from Industry and population of employment in service sector up to 2050 shows Fig. 1 and 2, respectively. These figures indicate the service sector occupies a major part of Japanese Industry in 2050. Due to this industrial structural change, the total energy consumption in Japan reduced 13,376Peta-Joule (PJ), from 15,982PJ in 2000, and the ratio of industry sector reduced to 41% in 2050 from 47% in 2000.These results reveal that ICT impact on Industry in 2050 accelerate economic growth in service sector, which result in reducing energy consumption from industry in Japan. On the contrary, from a global viewpoint, the economy of individual countries affects multilateral economic situation i.e. Offshoring. Figure 3 shows GDP transition up to 2050 in four countries. Chinese GDP may be larger than USA's GDP in after 2010 and India's GDP will become the similar values with USA's GDP in 2050. The gross GDP in these countries shows a radical increase during this period (2000-2050). The CO2 emission of these countries also indicates radical increase from 2000 to 2050 according to GDP extension. All parts of these changes are not caused by ICT diffusion. However, ICT diffusion partly affects this economic extension. Thereby,

ICT impact on industrial structure, regarding CO2 emission would lead to a positive effect in limited Japan, but from the global viewpoint that may have a negative effect.



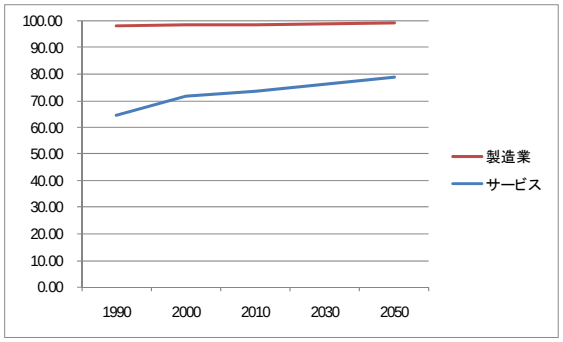
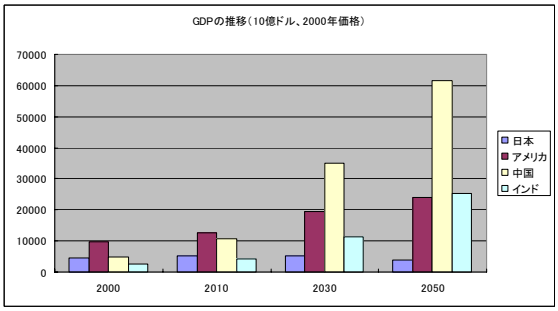


Fig.1 Ratio of yield from Industry

Fig.2 Ratio of population of employment in service sector



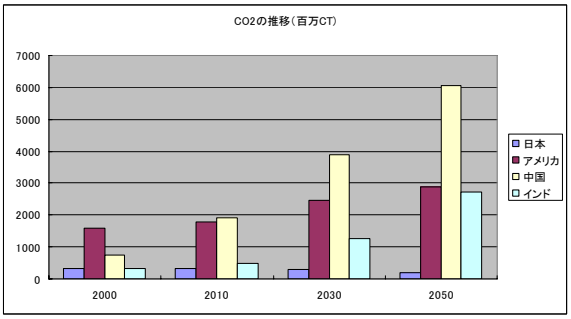


Fig.3 GDP transition up to 2050 (Japan, USA, China, India)

Fig4 CO2 emission in four countries (Japan, USA, China, India)

(2) Concept of Low carbon society (LCS) navigation system

Existing systems that relate to LCS navigation system include the following.

-Mileage meters of automobiles: they display the gas mileage of cars in real time

-Home energy management systems (HEMS): they display energy use in house in real time.

-Carbon labeling in European countries

-Experimental personal carbon allowance in UK

Technological barriers to develop LCS navigation system are not high. LCS navigation system can be developed by integrating and updating the existing systems.

We collected and analyzed the data of diffusion trends of products in the past. Existing related systems such as HEMS are, in most cases, large and expensive (at least a few thousand USD). Such properties prevent fast diffusions. If the future LCS navigation system are handy, low price (a few hundred USD, for example), useful and entertaining --- like, for example, mobile phones, electronic toll collection systems (ETC), DVD players --- they are expected to diffuse in a relatively short term.

CO2 emission abating effects of LCS navigation system are estimated as a few million tons of CO2, which we estimated by referring the estimated effects of HEMS. If LCS navigation system promote not only consumers' energy saving behavior, but also their purchasing of energy-saving products (such as energy-saving cars, energy saving home appliances, etc.), the effects could become a few ten million tons of CO2.

Measures including the following are effective to promote the diffusion of systems.
-Automation (digitalization) of home electricity/gas meter readers
-Standardization of environmental performance of products (home appliances, automobiles, etc.)
-Securing authentication and privacy protection of personnel energy usage information
-Introduction of incentive systems for consumers' saving energy use (e.g. personal carbon allowance systems)

(3) Study of Environmental Impact Evaluation for ICT in Industry

In this Fiscal year 2007, we made policy packages which were based on the result of study in the first 3 years term (from the fiscal year 2004 to the fiscal year 2006), which estimated the effects of reducing CO_2 emissions by optimizing supply chains [or industrial procedures] through the introduction of ICT such as SCM (supply chain management) technique. Furthermore, we started to study environmental impacts and feasibility of "servicizing" by use of ICT in the second 2 years term (from the fiscal year 2007 to the fiscal year 2008). In this fiscal year, we investigated foreign trends of servicizing, and estimated the potential effect of reducing CO_2 emissions for several cases of servicizing.

1) Policy Packages for realizing Low Carbon Industry by use of ICT

The result of the policy packages is shown as follows;

① Optimizing Supply Chains

We indicated from the studies in the fiscal years 2004 and 2005 that the present state of supply chains is not optimized from an inventory standpoint, especially (large) wholesalers and medium and small enterprises is increasing inventories year by year. According to Japanese commercial customs, wholesalers have responsibility for inventory risk and order work not only to inventories of themselves but also to inventories of upstream and downstream. Then inventories placed in upstream and downstream such as retailers are paid little heed because they do not have ownership of the inventories. From this viewpoint of optimizing supply chains, we propose to reconsider the commercial custom that inventory risks should allocate appropriately.

② Spreading ICT to small and medium-sized enterprises (SMEs)

We indicated from the study in the fiscal year 2005 that ICT systems such as SCM, ERP (Enterprise Resource Planning) and CRM (Customer Relationship Management) don't diffuse so much to SMEs because introduction of ICT systems for business are very expensive. We propose that investments and cost for ICT systems should be dispersed by joint ownerships, such as use of SaaS (Software as a Service), packaged software and so on.

③ Innovation of Business Grand Design

The main purpose of introducing ICT systems is for improvements in operation efficiency and profits. We propose that it is necessary to make policies and to change corporate culture, for example, environmental efficiency should make use of one of the operation indicators.

④ Corporate Collaboration [or Partnership] for optimizing supply chains

We propose that it should promote R&D and construct schemes concerning the

optimization of supply chains on national level. It has failed in the introduction of the SCM solution that has been developed in Europe and USA because of different commercial customs between Japan and those countries. For instance, the concept and organizing of ECR (Efficient Consumer Response), which is the scheme of collaborating and optimizing supply chains between manufacture and distribution sectors, has been started from food industry of USA in 1993. Then ECR extended to advanced nations of about 40 countries afterwards. In Japan, however, general remarks that whole supply chains should be optimized were agreed, but details such as standardization and cooperation with the competitor met with opposition. It is only Japan that doesn't have the promotion organization of ECR in an advanced country now.

We propose concretely that we should promote the organization of optimizing supply chains and make collaborations between each enterprise on the domestic level for improving the global competitiveness of Japan.

⑤ R&D of ICT for optimizing supply chains

Nowadays it is developing advanced new grand designs, such as PLM (Product Lifecycle Management) and CPC (Collaborative Product Commerce), and business method, such as CPFR (Collaborative Planning Forecasting and Replenishment) called new generation SCM. We propose that it should develop ICT for optimizing supply chains, adding the view point of environmental protection.

⑥ International Standardization

We propose that it should make a strategic approach to the international standardization bodies such as ITU (International Telecommunication Union) and IEC (International Electrotechnical Commission) for standardizing ICT developed in Japan to maintain and to improve the global competitiveness of Japan. For instance, it is necessary to standardize EDI, which is the interface inside and outside of Japan owing to advance corporate cooperation and to optimize supply chains.

2) Investigation of Oversea Trends to Servicizing

The concept “servicizing” was developed in Europe and USA (In Europe, “servicizing is called to “PSS (product-service system)”. For this reason, we held hearings of persons from Europe and USA who is shown below in order to investigate up-to-date trends to servicizing.

- Prof. Martin Charter (University College for Creative Arts)
- Dr. Arpad Horvath (Department of Civil and Environmental Engineering, University of California, Berkeley)

In these investigations, it was introduced that they have been studying the environmental impacts of video conference by cellular phones, e-newspapers and so on as cases of servicizing.

3) Estimations of CO_2 Reduction Potential for Cases of Servicizing

We estimated CO_2 reduction potentials of following cases;

- Car Sharing and Car Pooling
- e-Library
- e-Newspapers Delivery Service
- e-Music Delivery Service

- Total Management Service of Rechargeable Battery

As estimating CO_2 reduction potential of above cases, we used public data and cases of "Green Servicizing Business" supported by METI (Ministry of Economy, Trade and Industry). The results of these estimations are shown by Table 1.

Table 1 Amount of CO_2 Reduction Potential through spreading of servicizing

Case of Servicizing	Effects	Amount of CO_2 reduction potential [millions t-CO_2]
Car Sharing / Car Pooling	Reducing numbers of cars	44.2
	Reducing frequency in car use	1.21
e-Library	Reducing books, bookstores and libraries	28
e-Newspapers Delivery Service	Reducing newspapers, actual deliveries and stores	0.25
e-Music Delivery service	Reducing medias (CDs) and stores	0.25
Total Management Service of Rechargeable Battery	Efficient materials use by optimizing recycle and reuse	0.22

References

1) Alan S. Blinder, Offshoring: The Next Industrial Revolution?, April 2006, http://elgringocolombiano.blogspot.com/2007/05/alan-binder-article-on-offshoring.html

Major Publications

1) J. Fujimoto, M. Matsumoto, T. Origuchi, S. Nishi, H. Ueda, T. Hashitani, "Contribution to achieving Low Carbon Society utilizing Information Communication Technology", Global Environmental Research, 12(2), 209-218, 2007,
2) M. Matsumoto and J. Fujimoto, "A study on the potential of ICT on realizing environmentally sustainable society", The 4th Asialics International Conference, Kuala Lumpur, Malaysia, 2007
3) T. Origuchi, S. Nishi, and J. Fujimoto, "Estimations of Reducing CO_2 Emissions through Introduction of ICT in Manufacturing and Distribution Sectors," Proceedings of EcoDesign 2007 5th International Symposium, B1-5-1S, Tokyo, Japan, Dec. 2007