An Expansion of Input-Output Model Focusing on the Demand-side Structural Changes (Vol. 1): Changes of Input-Output Coefficients and Capital Formation Coefficients and Model Development

Summary

It is widely recognized that effecting a shift from a “low-carbon society” to a “zero-emission society” requires not only replacing the existing equipment with more energy-saving and emission-reduction equipment, but societal changes, which involve the participation of consumers enhancing the use of information and communication technologies (ICTs). A wider application of ICTs in industrial and household sectors, the deployment of electric vehicles (EVs) and other new types of automobiles as well as the development of associated infrastructure, are examples that are expected to contribute to low carbonization. In this proposal, we constructed an extended input-output analysis model imposing information technology and energy demand changes in the household sector. Capital formation structure changes are also included. We then calculated the preliminary overall assessment of the industry in 2030. Whereas the results show the zero-emission scenarios for individual industries, it was suggested the necessity of in-depth investigation of zero-emission in the process systems of petroleum products, chemical industry, and others, and then incorporation into the context of the input-output table for the establishing of a socio-economic scenario.

Proposals for Policy Development

- The necessity of various options of new technologies spread in society is recognized, but two further problems are raised.
- The first is the change in the stock of existing equipment and the speed of introducing new equipment. When the introduction of new equipment is hastened, incentives for this need to be provided in the system.
- The second involves spillover effects due to the introduction of new products. This time, the input of petroleum products as raw material was on an increasing trend. Although the introduction of petroleum products does not directly contribute to CO_2 emissions, some sort of measures will be needed before the stage of final disposal.

1. Incorporation of new technology options into the input-output analysis

The information necessary for the evaluation of incorporation of each technological issue given in Table 1 was assigned to the process, which is currently underway at LCS, creating a quantitative socio-economic scenario for achieving a zero-emission society. Focusing on an intermediary stage in 2030, data required were estimated, and incorporated into the input-output analysis model.

Table 1 Information used for linking technological options to the input-output analysis model

	Input-output coefficient	Capital formation coefficient	Final consumption	Stock for future	Others
① Information service for consumer			○		
② Information service for enterprise					(＊)
③ Transport service (MaaS)	○	○	○		
④ New types of automobiles like EV and PHEV	○	○	◎	○	
⑤ Zero energy housing (ZEH)	△	○	◎	○	
⑥ Trucks	○	○	◎	○	
⑦ Final consumption of fossil fuel in the industrial sector	○				

2. Construction and estimation of input-output Models

An input-output analysis model was created for quantitative evaluation of a total industrial picture, which was composed from the information of input-output coefficients, capital stock prediction, capital coefficients, final consumption of each technological elements. According to the simulation results for the growth of Scn-1 through Scn-5 shown in the Fig. 1, scenarios of Scn-1 and Scn-2, in which productivity improvement is absent until 2030 and industrial growth is made only through capital accumulation, stayed in an annual rate of from 0.4% to 0.5%. For the scenarios of Scn-3, Scn-4, and Scn-5, which include labor productivity improvement due to ICTs such as SaaS, based on a survey conducted by the Ministry of Internal Affairs and Communications, the increase of about 28% over 15 years was observed. In addition to the rise in the output value of the passenger car sector due to the introduction of new automobiles with high unit prices, general-purpose machinery, production machinery, and industrial electric equipment, in which Japan has a competitive edge, are growing. In terms of electricity consumption, there was an overall increase due to electrification, but there was significant growth in the chemical industry and rather a decline in the electronics industry. In the above preliminary study, it can be said that the characteristics of the input-output analysis were utilized as the zero-emission scenario for each industry was presented, although there are still issues to be addressed in the process industries.

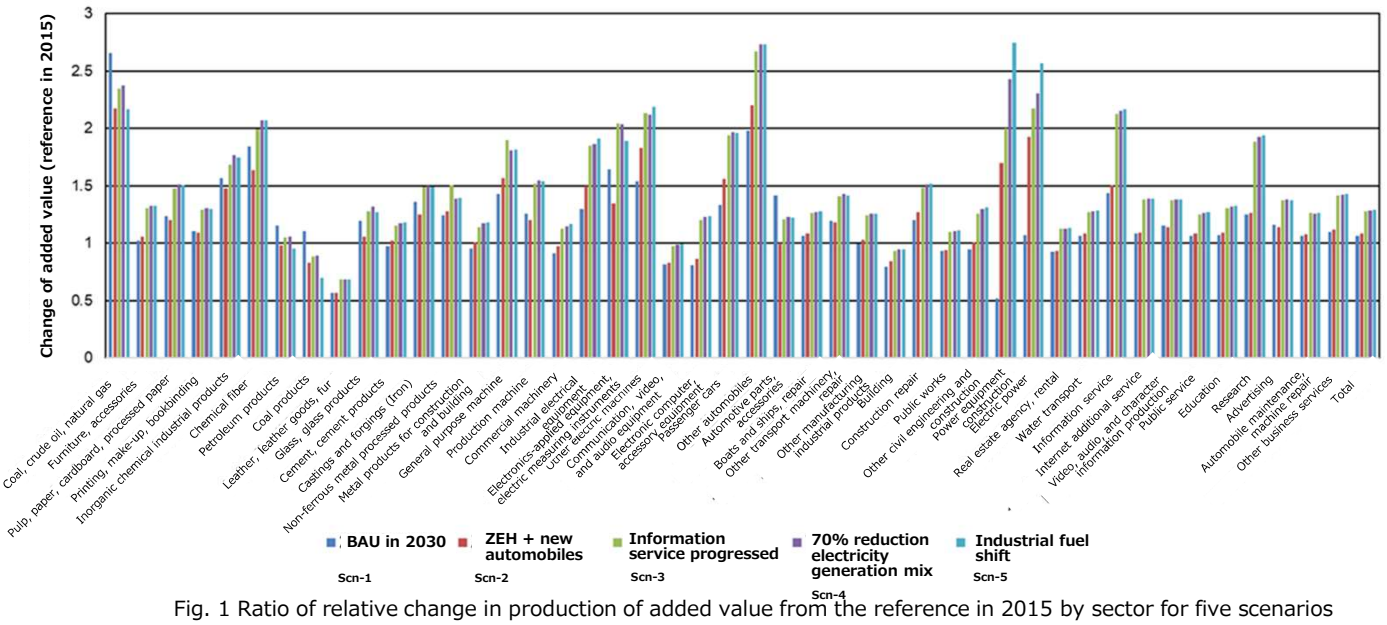

Fig. 1 Ratio of relative change in production of added value from the reference in 2015 by sector for five scenarios