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

1. Long-term Scenario Development Study to Integrate Environmental Options using Simulation Models（Abstract of the Interim Report）

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1. Introduction

To avoid serious impact on climate change, there is discussion to limit the global mean temperature increase at 2℃ from pre-industrial level, which would require the GHG reduction target in 2050 can be required to be 50% of 1990 emission level. It implies that reduction rate for Japan would be around 60-80%. We need Japan low-carbon society scenarios to achieve such an ambitious target. A large part of social infrastructure is likely to be replaced by 2050; therefore, it would be possible to propose concrete policy packages including institutional change, technology development, and lifestyle change towards meeting the target of a low-carbon society in 2050.

2. Research Objectives

When we assume GDP growth rate to be 1% per year until 2050, CO2 reduction rate will be 40% at most in 2050 using existing future emission scenarios in Japan and not enough to achieve LCS such as 60-80% reductions in 2050. Results of current researches on Japan emissions scenarios means that “forecasting” method which considers future image as extension of current countermeasures is not likely suit LCS scenario development. We need trend-breaking intervention and investment. Thus we examine the “backcasting” method, which first develops emission target representing favorable LCS visions and then discusses the method in order to achieve the goal (Fig. 1).

GHG emissions are related to all kinds of human activity. To achieve deep cut in GHG emissions, not only mitigation technology development but also service demand change is required by changing social behavior, lifestyles and institutions are required. A large part of social infrastructure is likely to be replaced by 2050. It would be possible to propose concrete policy packages including institutional change, technology development, and lifestyle change toward LCS.

It is also important to consider industrial change to achieve LCS through economic growth. What kind of industry does Japan need to look for?

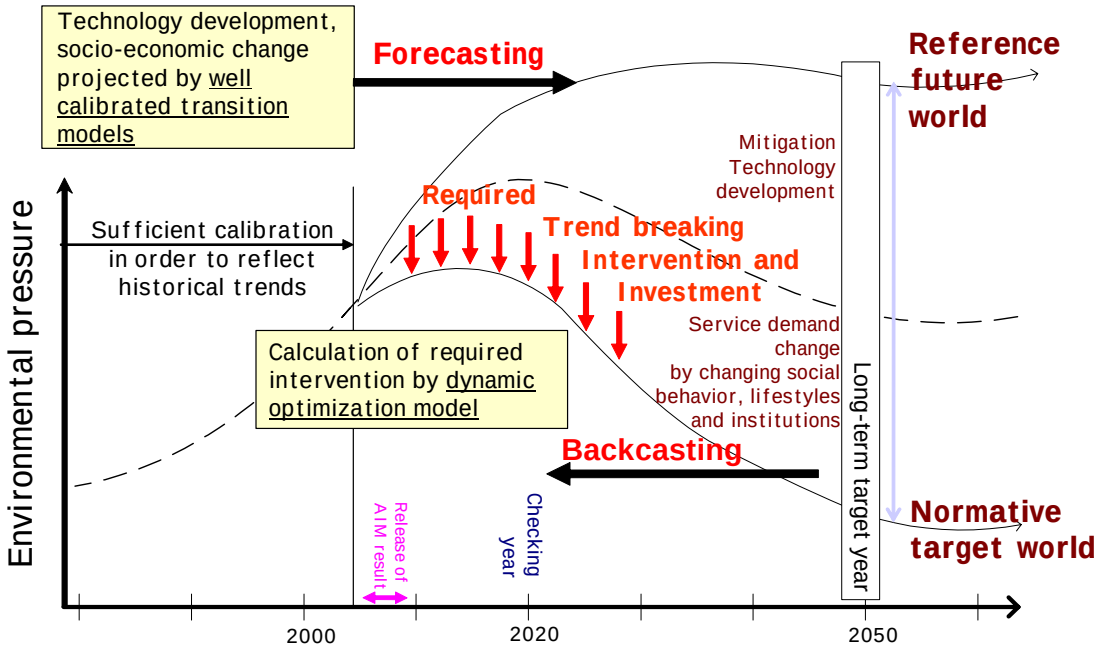

Fig.1 Backcasting to achieve LCS

3. Research Results

1) LCS scenario development

Fig.2 shows the methodology of LCS scenarios. We have developed narrative storylines, their quantitative scenarios, and trend-braking countermeasures in sectors such as residential, service, transportation, industrial, and energy supply. The desired Japan 2050 future images with 60-80% GHG reduction will be set and the path considering economic impact, technological possibility, institutional and lifestyle change will be simulated objectively and consistently using several numerical model analyses.

In order to examine the feasibility of the LCS in 2050, it is important to pay attention to the changes in several social factors. What would be the features of the economy in 2050? One of the most obvious and drastic changes in 2050 would be its population structure. Such a change is mainly caused by the downturn in birthrate over long term. The trends of depopulation and aging will continue until 2050 with high certainty. In addition, progress of globalization of markets and maturation of information society (informatization) would also be the other major trends up till 2050.

In long-term scenarios, many uncertain factors exist, which applies equally to dominant trends as mentioned above. Although we can draw infinite pictures about our future, it is impossible to assess all of them. Meaningful work would be to represent the possibilities of drastic reduction of carbon emission. In order to place future uncertainties into consideration, two different scenarios were developed by focusing on cause-and-effect relationships among

factors. In order to achieve the goals of LCS, innovative trend-breaks must be added on narrative storylines.

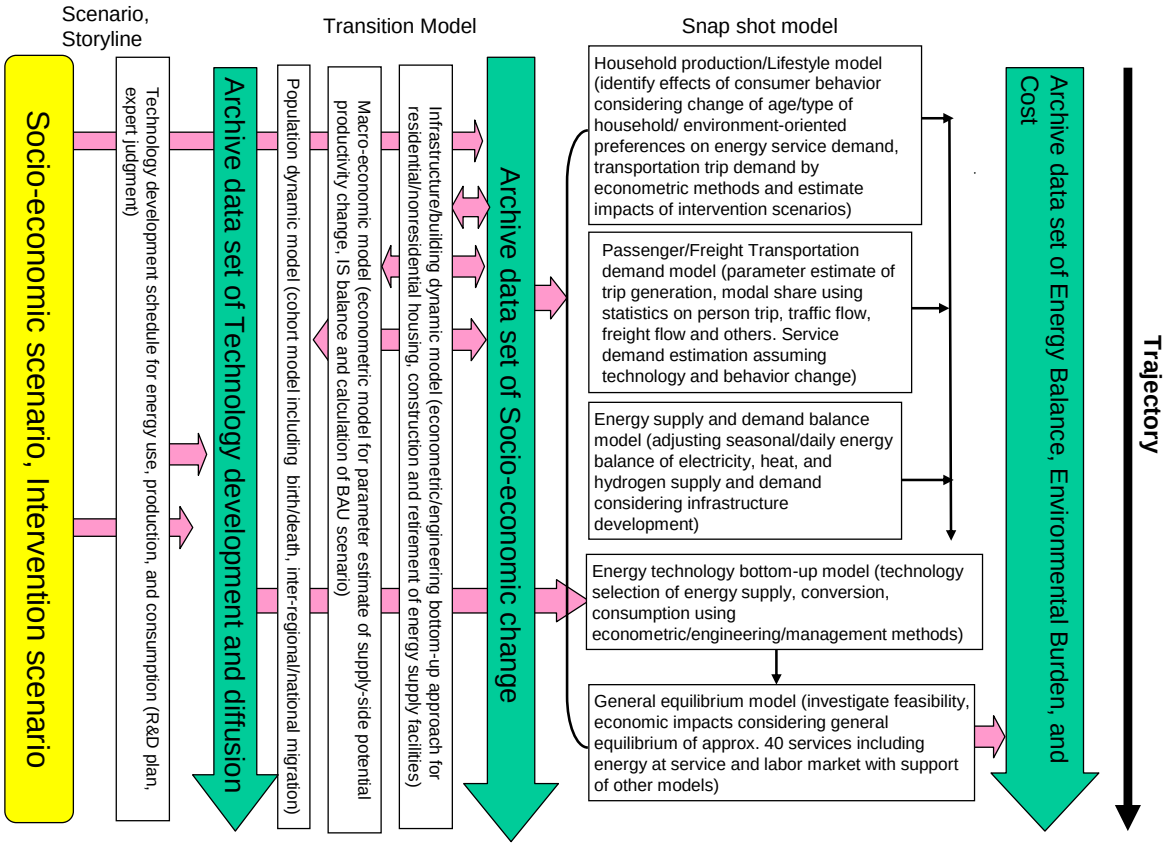

Fig.2 Research framework of LCS scenarios development

To evaluate feasibility and social impacts of the trend-breaking options, driving forces associated with social changes in each sector need to be simulated. In the simulation, characteristics and constraint condition of each sector should be taken into account. It is also important to ensure consistency among the sectors.

We examined 70% CO2 reductions by 2050 as compared to 1990 level. Following is a summary of the findings. (a) There are possibilities to reduce CO2 emissions by 70% in 2050 with several energy demand countermeasures (such as insulation, modal shift, high efficiency vehicles, and clean product technology) and drastic energy supply side changes. CO2 free energy should be delivered for meeting spatially dispersed small-scale demands because it is almost impossible to undertake capture and storage of CO2 from them; (b) in the residential sector there are many feasible countermeasures for drastic reduction of CO2 emissions. However, along with technology development, diffusion is also important for achieving such reduction in the residential sector; (c) Renewable energies may have a significant role to realize low carbon society. It is important to design feasible roadmap to expand their share and use with long term perspectives.

More detailed models need to be developed for verifying consistency of population

dynamics, macro and micro economy, sector-wise material and energy demand and supply. Quantitative verification using simulation models is essential to find consistent and feasible pathways toward achieving the low carbon society.

2) Industrial society scenario development

"Porter hypothesis"[1] shows the dynamic possibility where the innovation offsets the compliance cost to the stringent environmental standard under the well-designed and flexible policy; however, it was severely criticized from the economist. Otes et al.[2] insists that an increase in stringent regulation worsens sales and profits despite adoption of more efficient technology when using a simple general equilibrium model, except in the case where a number of important elements are missing in the model. The elements include: (1) strategic behavior between pollution firms and between these firms and the regulatory agency, (2) the presence of an industry that produces abatement technology and equipment as its output, and (3) the existence of opportunities for profitable innovation in the firm triggered by new and tougher regulations. In this study, the sustainable economy from the end of 1970s to the beginning of 1980s in Japan, following the reduction-first policy in 1970s, is examined in Porter Hypothesis view. And the dynamic process where the firm's action for rent-seeking which is shown as the remarkable elements by Oats, played important rolls in realizing the technological achievement to the regulation. At the same time, such a dynamic process where the success in technological development connected to higher competitiveness could not be realized without higher energy price just coming after the reduction-first policy. This implies the future innovation-offset possibility under the expectation of incremental energy price which can be realized by the treaty after Kyoto Protocol.

In industrial sector, the primary processing industries have a key to realize de-coupling or de-linkage between economic growth and material input of production. Larson showed the material demand per GDP in iron and steel industry in U.S. reached its peak in 1920 and stated that the era of materials already passed. From an ecological modernization point of view, Yánicke[3] led a collaboration study to assess material input in "dirty industries" in Europe, and he concludes that the demands of some basic materials in Europe also shows the penetration in the oil crisis, but neither relocation, nor their general decline and nor ecological modernization has been a strong enough to motor to go beyond the de-linkage after the crisis. In this study, the same kind of analysis is conducted and shows two points as the result. First, historically, a strong penetration in material demand is seen in iron and steel industry and cement industry. In these sectors, decline in social infrastructure formation from budgetary reason and historical perspective, can accelerate its trends. In particular, the demand penetration of the materials and increase in the stocked materials in the society will pressure the use of recycled materials for the future. A simple simulation in iron & steel sector (figure 2) shows that the future potential of de-coupling is not a small.

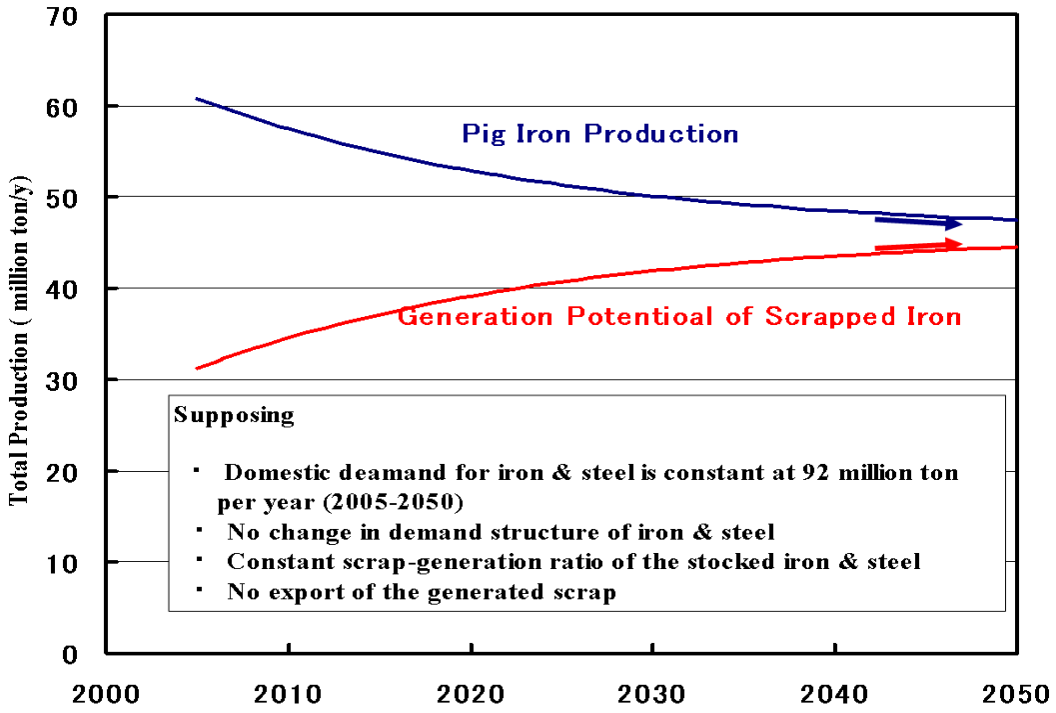

Figure 3 Increases in Recycling Pressure of Scrap Iron

4. Discussion

Currently, we have developed narrative and quantitative scenarios for the year 2050 using backcasting method. Next step is to develop low-carbon society roadmap using narrative storylines including industrial society change and numerical simulation models analysis. We will have more challenging and fruitful research in the next year.

Reference

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3) Jánicke M. 1997. “Dirty Industries: Patterns of Change in Industrial Countries” Environmental and Resource Economics, 9, pp467-491