**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

　　　　The first great step to prevent global warming was taken by Kyoto Protocol which came into effect on Feb.16, 2005. But it is necessary to reduce GHG (Greenhouse gases) emissions drastically to stabilize climate change. According to the existing research, to limit the global mean temperature increase at 2　from pre-industrial level, the GHG reduction target in 2050 is required to be 50% of 1990 emission level. It implies that reduction rate for Japan will be around 60-80%. 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

　　　　Primary aim of this sub project is to develop narrative and quantitative socio-economic scenarios for Japan and to judge the effectiveness of countermeasures to realize low-carbon society. We will address the following questions;

1) How to develop the image of 2020/2050 society?
2) How to develop demand scenarios and intervention scenarios consistently?
3) How to identify and develop technology, institution, and management options for GHG reduction?
4) How to develop consistent and continuous roadmap towards 2050?

　　　　In the current year of our work, we focused on scenario development and evaluation of countermeasures for the year 2020.

## 3. Research Method

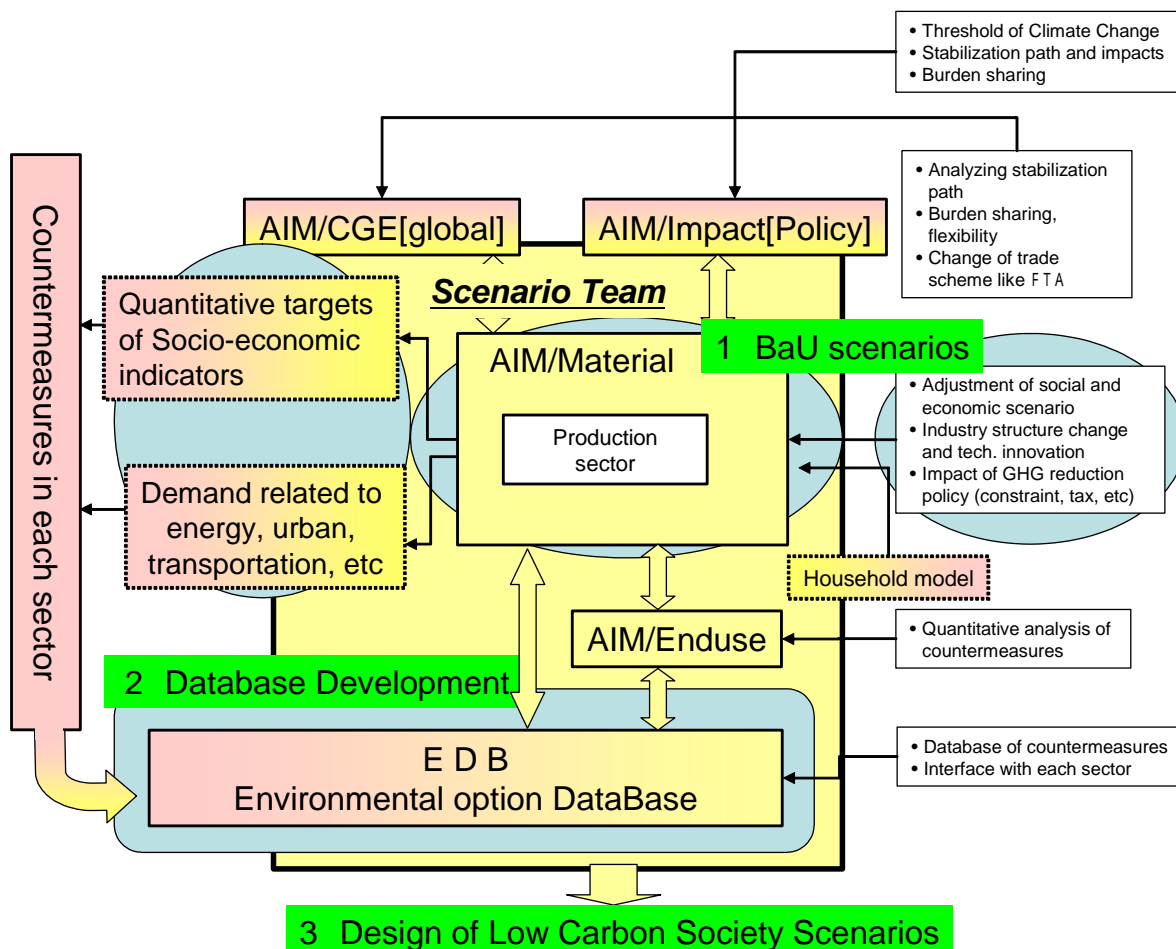Fig. 1 shows the framework of this study and its linkages with other sub-projects.



Fig.1 Research framework of this sub-project (scenario team)

We have developed narrative and quantitative scenarios for year 2020 as per the following process;

1    Develop narrative storylines
2    Develop quantitative BaU scenarios
    - Identify scenario driving forces
    - Carry out analysis using quantitative models (Economic Top-down model for Japan)
3    Develop 2020 Intervention scenarios
    - Collect environmental options (EDB)
    - Assume diffusion rate of each environmental option

4. Results

In the current year, we mainly focused on scenario development for the year 2020 to establish the research framework for low-carbon society scenario assessment in 2050.

1) We visited research organizations in UK, Germany, France, Netherlands where they have already started developing long-term low-carbon scenarios for each country and European commission. It was recognized that the work on rationale for GHG reduction target, identification of countermeasures and developing logic for their combination will have to be carried out. The linkages with environmental problems other than global warming are also to be established for our project.

2) We analyzed the rate of improvement needed to achieve drastic GHG reduction for 2050. Our analysis indicated that the extension of current policies will allow us to achieve at most 40% reductions compared to 1990 level. It is necessary to improve the sum of energy intensity change rate and carbon intensity rate by 4% per year to realize 80% reduction (Fig.2).
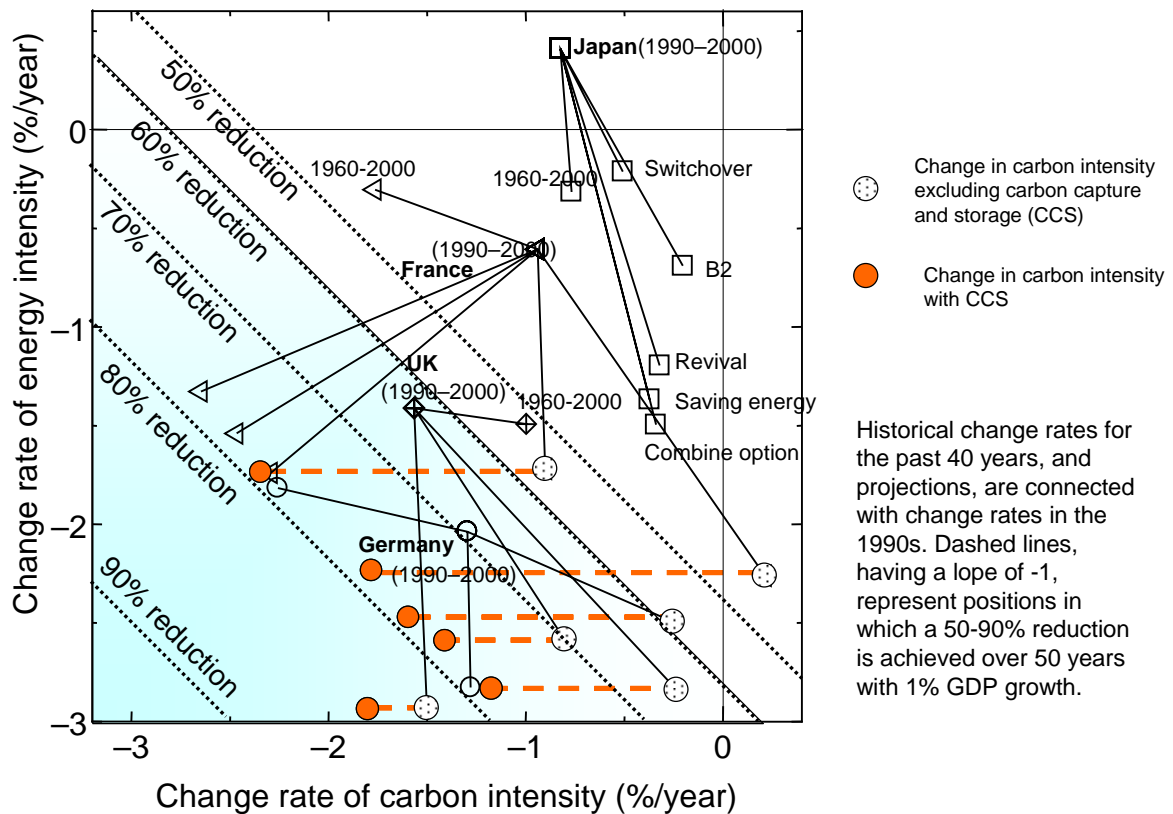


Fig.2 Change rates of energy/carbon intensity and GHG reduction toward 2050

3) We investigated the existing middle-long term national GHG emission scenarios and developed our own two socio-economic scenarios for year 2020 (Table1).

Table1 Develop Storyline of BaU scenario

| Driving forces | BaU A | BaU B |
|---|---|---|
| Population | Slight decrease | Slight decrease |
| GDP growth | Rather high | Rather low |
| Productivity factor improvement | High improvement | Keep current situation |
| Industry structure | High value-added industry | Service industry |
| Consumption | High consumption | Less consumption |
| Land use | Urban centralized | Decentralized |
| IT society | Enhance time convenience | Enhance distance convenience |
| Energy supply | Fossil fuel driven + Nuclear energy | Less energy demand, less nuclear energy |
| GHG emission | Large | Medium |

4) Qualitative scenarios have been developed by the economic model consistently. Indicators, such as GDP, sectoral production amount, $CO_2$ emissions, energy supply and demand, were calculated.

5) EDB (Environmental option DataBase) has been developed to assess countermeasure scenarios and to collect environmental options in collaboration with other sub projects. Possible reduction amount were calculated assuming diffusion rate for each option (Table2). The combination of all options will allow reduction of GHG emissions at the level of 85% of 1990 level.

Table2 Countermeasures and assumed diffusion rate for transportation sector

| Countermeasure | Content | Diffusion (2020) | Effect (MtC) | Team |
|---|---|---|---|---|
| Biofuel | 10% of gasoline and diesel | 100% | 3.6 | - |
| Hybrid vehicle | 40% reduction of energy consumption | 40% | 4.3 | Tr |
| Improvement of reciprocal engine | 10% reduction of energy consumption | 100% | 4.0 | Tr |
| Electric vehicle | Substitution of mini-size private vehicle | 10% | 0.5 | Tr |
| Eco-driving navigation | 10% reduction of energy consumption of passenger vehicle and freight vehicle | 100% | 2.9 | IT Tr |
| Eco-driving license | | 100% | | IT Tr |
| Low rolling resistance | 3% reduction of energy consumption | 100% | 0.9 | - |
| Supply chain management | 2% reduction of freight transportation | | | IT |
| Modal shift | Shift vehicle to ship : 9300 million t-km | | 0.4 | - |
| Real time security transportation system | Shift vehicle to bus : 15% of commuting a short distance | | 0.5 | IT |
| Distributed / Sharing office | | | | IT |

6) We have coordinated the whole research activity in collaboration with other sub projects and have setup an advisory board consisting of several prominent researchers, to review our research activity.

7) Econometric trend analysis of gasoline consumption in Japan showed that consumer did not

change their consumption pattern for gasoline regardless of the facts that Kyoto protocol was adopted in 1997, Japanese government is strengthening its global warming policy, and public awareness for global warming is increasing. It is suggested that regulatory countermeasures are also required to achieve drastic energy saving and $CO_2$ reduction.

8) We need to prudently assess, whether induced technology development will allow realizing 80% $CO_2$ reduction by 2050.

9) We held Open International Symposium on "Low-Carbon Society Scenario towards 2050: Scenario Development and its Implication for Policy Measures" at Tokyo which had more than 250 participants. We have developed our research homepage; http://2050.nies.go.jp. These activities will attract more attention from stakeholders, public and others.

5. Discussion

In the current year, we have developed narrative and quantitative scenarios for the year 2020 using simulation models and database, and also came up with a research framework for low-carbon scenario development. We will utilize and modify it to analyze drastic GHG reduction scenarios for the year 2050. Our initial research suggests that we also need to consider new scenario development approach for this problem, such as back-casting method. We will have more challenging and fruitful research in the next year.