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

5. Long-term CO_2 reduction strategy of transport sector in view of technological innovation and travel demand change（Abstract of the Interim Report）

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1. Introduction

Only the emissions from transport sector have continued to increase almost proportionally with GDP when we see the trend of CO_2 emissions by sectors during the last 30 years after the first oil crisis. Although transport CO_2 per capita of Japan accounts for 2.0t-CO_2/year, which is lower than OECD's average (3.0t-CO_2/year) but higher than world average (0.8t-CO_2/year), it is still important to take measures to reduce transport CO_2 emissions, for the modal share of automobiles has continued to increase and additional reduction target beyond COP3 is being under discussion.

We have already examined Japanese case study for EST (Environmentally Sustainable Transport) at the "International Conference on Environmentally Sustainable Transport in the Asian Region, 2003 Nagoya". In the case study, we have experienced that the transport model should be revised to be more comprehensive and detailed. And a back-casting approach should be examined more sophisticated way for construction of longer-term strategies.

2. Research Objective

In this study, the EST (Environmentally Sustainable Transport) scenarios are developed which achieve CO_2 reduction targets for both 2020 and 2050 by the combination of technological innovation and demand change.

3. Research Method

Fig. 1 shows the framework of this study across time horizon.

The EST 2020 scenario is constructed relying mainly on technological innovation, for there seems to be little feasibility on the demand change options in the near future. To see the

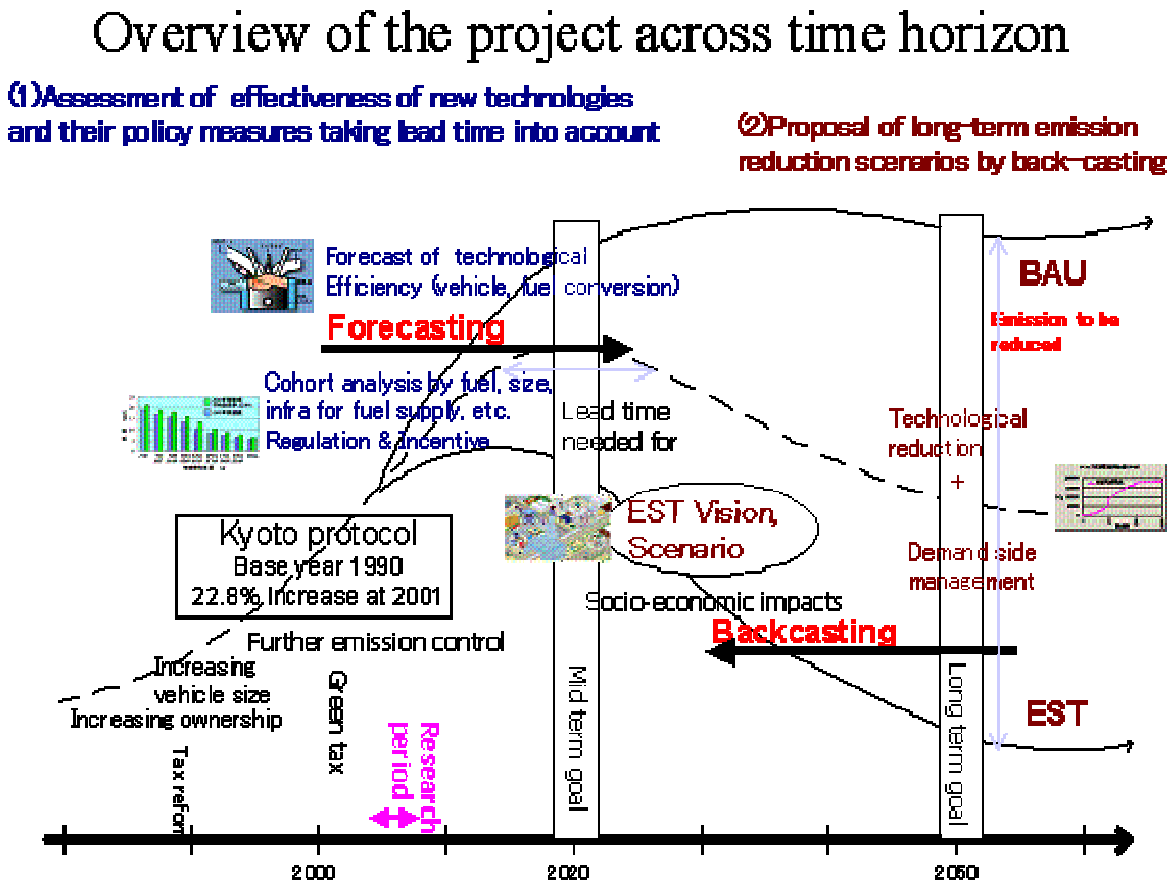

Fig.1 Overview of transport scenario study

trends of technological innovations, the energy consumption and CO_2 emissions of various vehicles and their fuel toward 2020 and 2050 have been estimated from the viewpoint of the Well-to-Wheel analysis, which is a framework to estimate the environmental advantages of alternative fuel vehicles and their fuels over an entire automotive fuel pathway. The traffic demand forecast data is derived from the survey by the Ministry of Land, Infrastructure and Transport, or derived from the revised version of the survey corresponding to the socio-economic trend provided by the Scenario Team of the S-3 research project. The lead-time spent for changes in the production capacity and the purchase behavior is taken into consideration.

The EST 2050 scenario is drawn with a back-casting approach. The required amount of reduction is the gap between the amount of emission of BAU case and EST target. The reduction by the demand change options is thought to cover the shortage of the reduction by the technological innovation options to achieve the reduction target.

4. Results

From the viewpoint of Well-to-Wheel analysis, it can be said that hybrid vehicles should be the most feasible and promising technology to mitigate CO_2 emissions toward 2020. Fuel cell vehicles are thought to emit less CO_2 than hybrid vehicles, but have less feasibility toward 2020. Construction of alternative fuel station is thought to be one of the key issues to prevail

fuel cell vehicles. In order to work out a strategy for optimal allocation of alternative fuel station, a methodology to simulate the travel pattern of all cars for private use in certain area has been developed. The case study was conducted in the southward of Ibaraki Prefecture. Distribution of trip length and trip patterns for commuting and non-commuting trips respectively in a day are analyzed using the data of road traffic census. Distribution of trip length and trip patterns of an individual in a long term (one month) are also analyzed using the data which we had obtained from trial subjects with vehicle driving recorder. A simulation model for travel of cars for private use was constructed by combining the both results. The simulation results suggest that more than 99% of the cars in the case study area should find at least one fuel station during their trips if 10% of petrol stations have changed into alternative fuel stations.

BAU 2020 scenario was developed considering the following forecast of technology:

a) Fuel consumption of hybrid vehicles improves by 40% compared with current conventional gasoline vehicles.
b) Hybrid vehicles substitute for 20% of passenger cars and 10% of LDVs
c) Fuel consumption of conventional vehicles improves by 10%.
d) Traffic volume of passenger cars increase by 66% compared with 1990's (increase by 15% compared with 2002's), and those of LDVs and HDVs decrease by 5% from 1990's & 2002's.
e) Fuel consumption of air, rail and water transport improves by 5% and traffic volume of air transport increase by 20% compared with 1990's.

-- CO_2 emissions from vehicles increase by 18% compared with 1990's (decrease 2% compared with 2002's).

EST 2020 [HV] scenario focused on prevailing Hybrid vehicles. It was developed as follows:

a) Hybrid vehicles substitute for 83% of passenger cars and 50% of LDVs. Battery vehicles substitute for 83 % of light passenger cars.
b) Fuel consumption of gasoline vehicles improves by around 20% with technological innovation and eco-drive.

-- CO_2 from vehicles decrease by 1% compared with 1990's (decrease by 18% compared with 2002's).

To reduce CO_2 emissions in 2020 under 1990’s level, EST 2020 [HV+DM] scenario is developed by adding demand management (DM) to HV scenario.

a) Traffic volume of passenger cars increase by 32% compared with 1990's (decrease by 8% compared with 2002's), and those of LDVs and HDVs decrease by 15% compared with 1990's (decrease by 14% compared with 2002's).

-- CO_2 from vehicles decrease by 14% compared with 1990's (decrease by 28% compared with 2002's).

Fig.2 shows emissions trend of each scenario. Fig.3 shows the required production capacity of hybrid cars for providing enough number of new hybrid cars to replace most of new cars to achieve the EST2020 [HV] scenario. In order to achieve the CO_2 reduction amount,

those that cannot be achieved by the technological innovation options are thought to be covered by the changes in transport demand even in 2020.

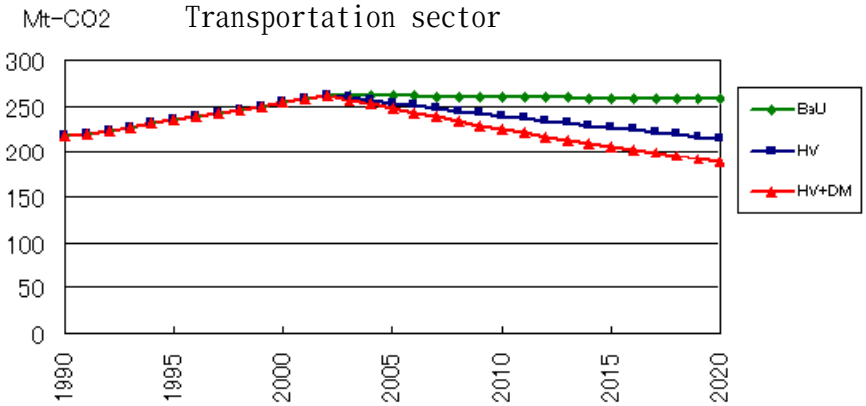

Fig.2 CO_2 Emissions of 2020 scenarios

For developing 2050 scenarios, group interviews have been held to obtain rough sketch of the situations of society, economy, urban form, transport, energy system and environment in 2050. Three groups consist of each 3 or 4 of eminent persons in fields of urban, transport,

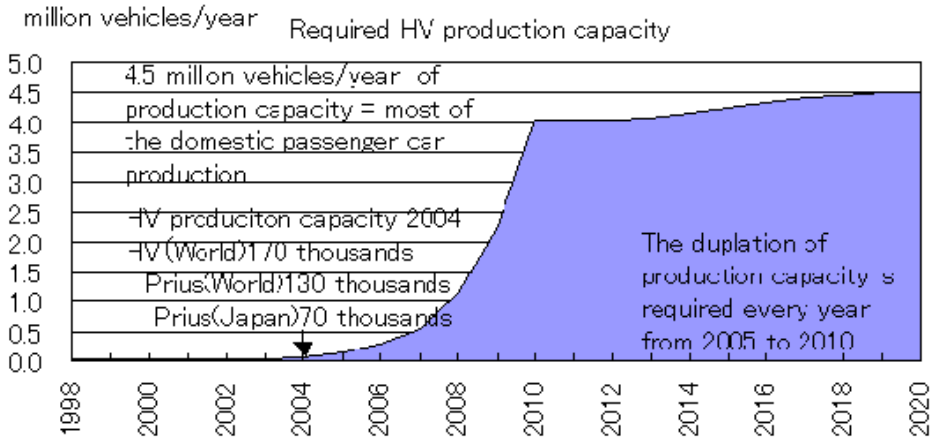

Fig.3 Required production capacity of hybrid car

energy, environment and lifestyles. There are some different opinions on the probabilities of the depletion of oil, dissemination of fuel cell vehicles and possibility of natural/simple lifestyles and so on. These various visions will help to draw the 2050 scenario.

Next, it is important to consider regional characteristics to adopt demand changes of transport as one of the countermeasures for CO_2 reduction, because the feasibilities of inducing countermeasures such as traffic demand management are said to be differ by regional characteristics. The framework has been developed to estimate the national total reduction with the combination of the countermeasures to control travel frequencies, trip length, mode, load factor, fuel economy and carbon intensity which are applicable to each regional categories.

A metropolis of 2 million populations and a local city of 0.1-0.3 million populations are selected as typical examples among the regional classifications. As a fundamental study for these case studies, a framework of a strategic policy package to achieve CO_2 reduction target has been developed. It is a “roadmap”, or a policy time table to implement various measures

including a promotion urban structure and lifestyle, and technological change.

5. Discussion

It can be said that hybrid vehicles should be the most feasible and promising technology to mitigate CO_2 emissions toward 2020. Construction of alternative fuel station is thought to be one of the key issues to prevail fuel cell vehicles. To reduce CO_2 emissions in 2020 under 1990's level, EST 2020 [HV+DM] scenario is developed by adding demand management (DM) to prevailing hybrid vehicles (HV) scenario. It requires making the production capacity double every year from 2005 to 2010 until 4 millions hybrid cars per year covering most of Japanese domestic passenger car demand.

For developing 2050 scenarios, group interviews have been held to obtain a rough sketch of the situations surrounding society, economy, urban form, transport, energy system and environment in 2050. There are various visions on the probabilities of the depletion of oil, dissemination of fuel cell vehicles and possibility of natural/simple lifestyles and so on. As for travel demand change, the feasibilities of such kind of countermeasures were examined in case studies. On the other hand, automobile CO_2 emissions and the populations of all local governments were complied and classified by the belonging metropolitan area, the province level and the population size. Using the framework, the national 60% reduction in 2050 was examined with the combination of applicable countermeasures to each regional category.