S-3-5 **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 Kyoto Protocol 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 trends of technological innovations, the energy consumption and CO_2 emissions of various vehicles and automative fuel toward 2020 and 2050 have been estimated from the viewpoint of the Well-to-Wheel analysis, which is a framework to estimate the

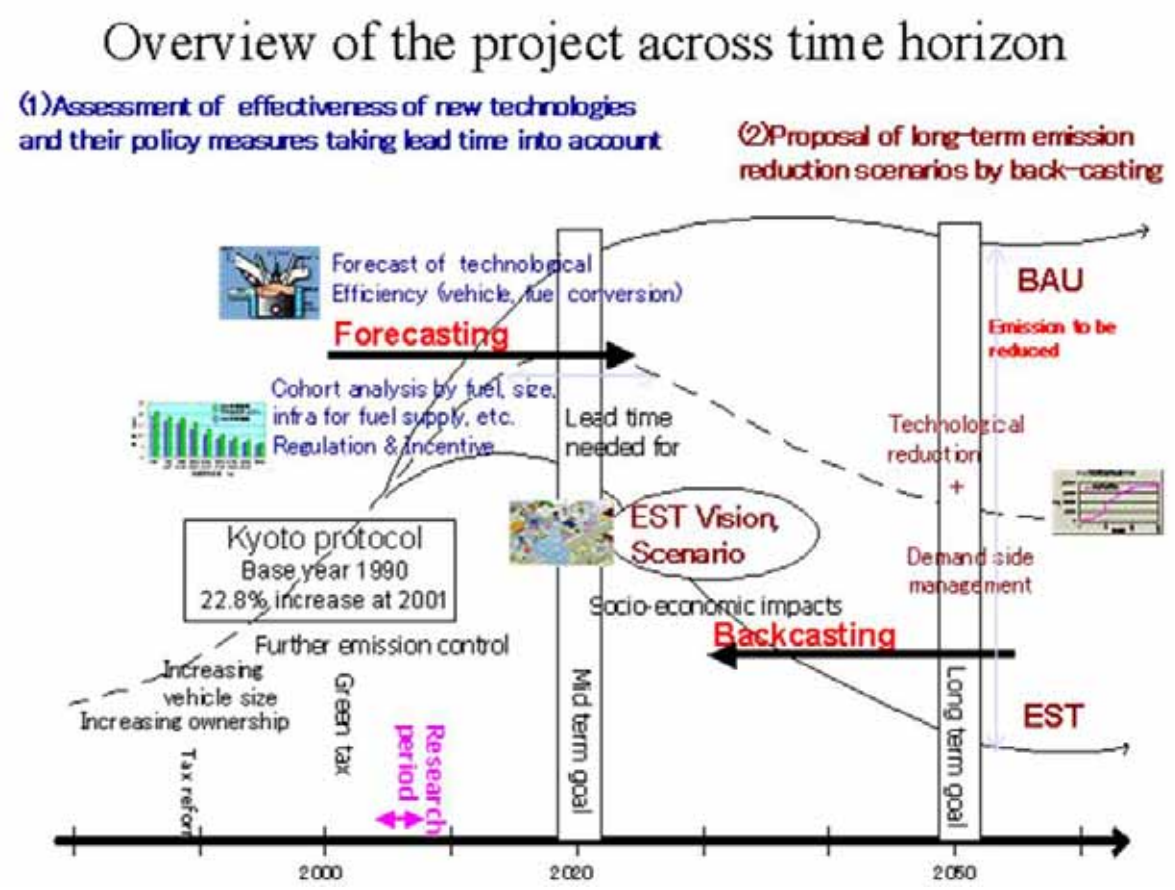


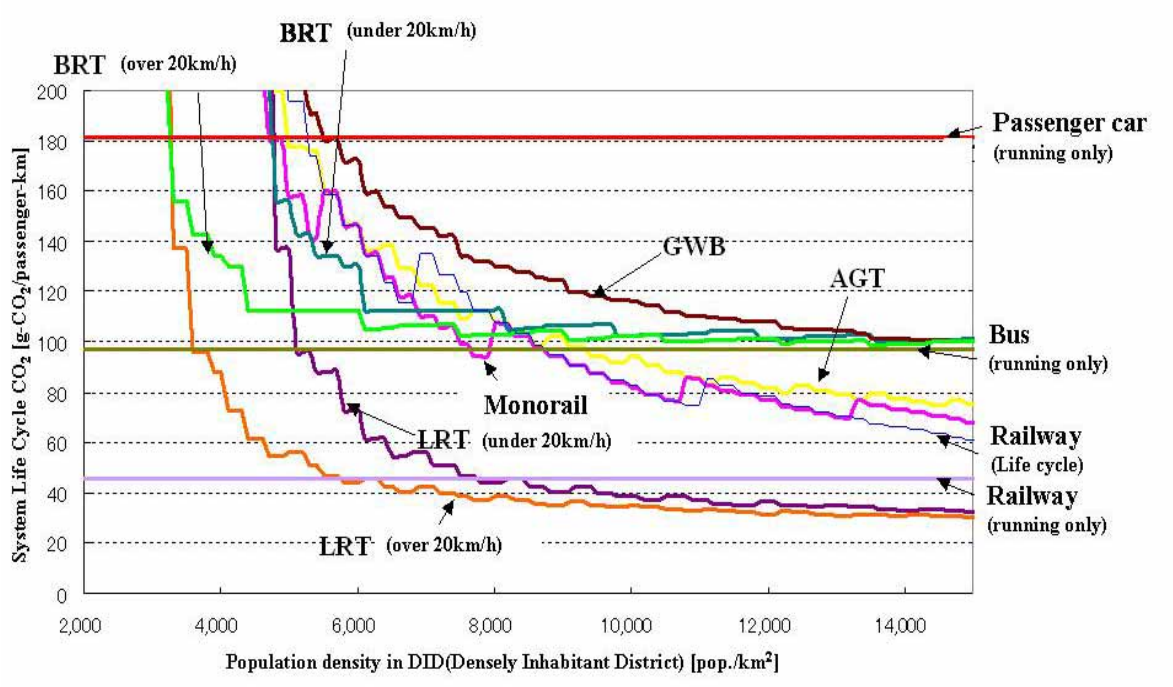
Fig.1 Overview of transport scenario study

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 has been 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

In FY2006, the following studies supporting the EST scenarios were carried out. The EST 2020 scenario which was focused on penetration of hybrid electric vehicles (HEVs) had been revised to reflect the comments from professionals. The efficiency of Hybrid light duty vehicle s (LDVs) was changed from 60% to 80%. As a result, the emission of each EST scenario has been increased by 1%.



LRT(Light Rail Transit)・BRT(Bus Rapid Transit)・
AGT(Automated Guideway Transit)・GWB(Guideway Bus)

Fig.2 Impacts of population density on life cycle CO_2 of various transit system

The potential of penetrationg battery electric vehicles (BEVs) was examined with simulation model based on detailed traffic data. It was found that 30% to 90% of household with multi cars could introduce BEV for secondary-use which runs shorter mileages than 100km per day.

From a statistical analysis of the actual fuel consumption database of passenger vehicles that have been established from voluntary reported fuel consumption log data of passenger vehicle users collected through internet-connected mobile phone system and vehicle specification data, it was estimated that CO_2 emissions can be reduced by approximately 45% by hybridization of current passenger vehicles mounted with conventional gasoline engines.

Average pay-back time of HEVs was calculated by comparing the total amount of gasoline cost of 10,000km drive per year and difference between prices of HEV and ICEV (internal combustion engine vehicle). In 2010, the pay-back time of HEV will be nearly three years. HEVs are thought to be one of the promising and feasible options in from the viewpoint of not only environmental consciousness but also cost efficiencies.

Life-cycle CO_2 emissions of various public transport systems were compared considering population density of densely inhabited district, travel demand, construction of infrastructures and load capacities as shown in Fig.2. It was found that Light Rail Transit was the best public transport system from the viewpoint of CO_2 emissions for most regions.

Countermeasures to accomplish EST 2050 vision were discussed. Preferential tax treatments for desirable land-use and desirable transport system were thought to be powerful tool to enhance the combination of efficient and comfortable land-uses and

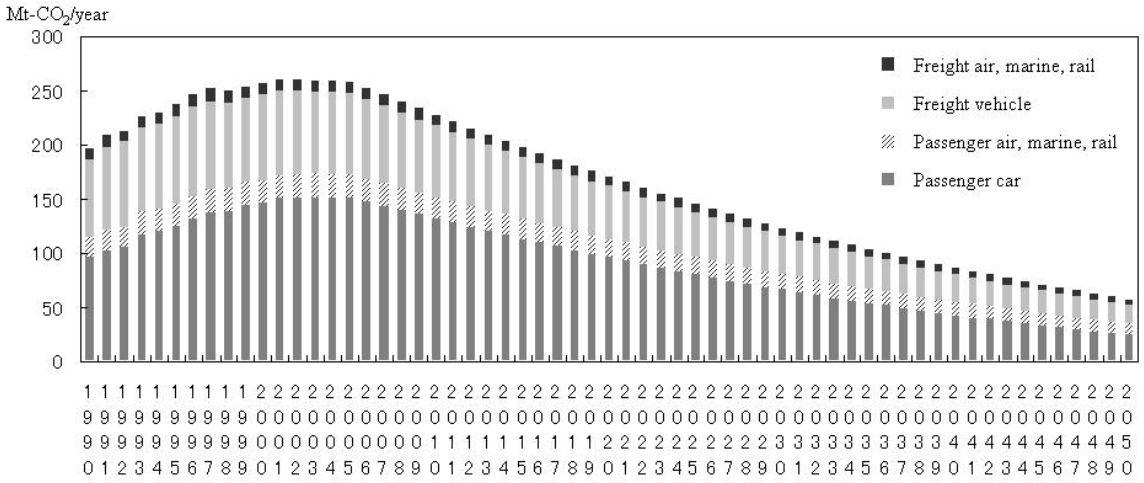


Fig.3 EST scenario of 70% reduction in 2050 and 14% reduction in 2020

transport system in longer term. Long term regional plan of land-use and transport from the viewpoint of Low Carbon Society would be a good guidance for residences and investors to prepare for the future uncertainties.

The estimation tool based on cohort analysis was extended to consider regional categories and counter-measures to change travel demand so as to draw EST 2050 scenarios. It was shown as Fig. 2 that the path to reduce 70% of CO2 emissions in 2050 with constant ratio went through 14% reduction in 2020. It meets the case of the EST 2020 scenario with combination of penetration of HEVs and reducing traffic volume. The growth of traffic volume was found as avoidable, because the traffic volume was stable or slightly decreasing since 2002 which was the same year as depopulation.

Major Publications

1) Y. Murata, J. Kusaka, Y. Daisho, et al, "Achievement of Medium Engine Speed and Load Premixed Diesel Combustion with Variable Valve Timing", Society of Automotive Engineers International (SAE) World Congress SP-2005, 99-109, 2006
2) Y. Daisho, "Developing Advanced Low-Emission and Fuel-Efficient Vehicle Technologies beyond 2010", Review of Automotive Engineering, 27, 489-495, 2006
3) Y. Murata, J. Kusaka, Y. Daisho, et al, "Potential of Emissions Reduction by Premixed Diesel Combustion with Variable Valve Timing", Review of Automotive Engineering, 27, 370-386, 2006
4) Y. Kamiya, Y. Daisho, et al, "Development and Performance Evaluation of an Advanced Electric Micro Bus Transportation System - Part 1: Waseda Advanced Electric Micro Bus –", The 22nd International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exposition, 836-846, 2006
5) M. Tsutsumi, H. Ishida, N. Okamoto, and Y. Sekine: "Long Term Simulation of Family Car Trips for the Allocation of Alternative Fuel Stations", Electronic Proceedings of ICHIT (International Conference on Hybrid Information Technology)

Special Sessions: ITS Modelling and Analysis 1, 2006
6) K. Matsuhashi, "A vision for the Sustainable Transport and City Planning", Environmental Research Quarterly, 141, 22-28, 2006
7) Y. Daisho, "Perspectives on Future Motor Vehicle Technologies Associated with Environmental and Energy", Proceedings of Eco Design 2006 Asia Pacific Symposium, Tokyo, 14-23, 2006
8) Y. Kudoh, K. Matsuhashi, Y. Kondo, S. Kobayashi, Y. Moriguchi and H. Yagita: "Statistical Analysis of Fuel Consumption of Hybrid Electric Vehicles in Japan", Proceedings of the 22nd International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exposition, 393-401, 2006
9) Y. Moriguchi, and K. Matsuhashi, "A Long-term Perspective of the Social Condition Surrounding Japanese Automobiles", Journal of Society of Automotive Engineers of Japan, 61, 31-36, 2007.
10) Y. Kudoh, H. Yagita and A. Inaba: "Analysis of Existing Variation in Fuel Consumption of Hybrid Electric Vehicles" Electric proceedings of International Conference on Ecologic Vehicles & Renewable Energies, Monaco, 2007