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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[Abstract]　　　The purpose of this study is developing transport visions towards Low Carbon Society in Japan.　A vision was developed and revised to reduce transport CO$_2$ emissions by 70% in 2050 with the combination of various types of countermeasures such as promoting higher land-use densities and higher efficient vehicles suitable to each region (metropolitan-urban, metropolitan-suburban, non-metro-urban and non-metro-suburban).　It was pointed that travel demand change as well as technological innovations are required to reduce transport CO$_2$ emissions considerably.　The integrated plan of land-use and transport for each region in view of 40-50 years later would be required to help stakeholders preparing toward Low Carbon Society.

Toward 2020, it is critical to enhance production capacity of hybrid electric vehicles (HEVs) for providing enough number of various HEVs met to most of new car needs in short term. It is also required to keep the recent declining trend of traffic volume so as to reach 10-20% lower level than the traffic volume of 2020 estimated by MLIT.

In FY2007, we studied to revise the low carbon visions and policy-packages.　Visions were extended to cover inter-regional passenger and freight transport, adjusted to fit to the demographic settings of S-3 scenarios, and revised to describe practical counter-measures and road-maps in detail to accomplish the target of Environmentally Sustainable Transports in Low Carbon Societies.

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 similar to OECD's average 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

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 automotive fuel toward 2020 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 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.

In FY2007, low carbon visions were examined to be extended to cover inter-regional passenger and freight transport, adjusted to fit to the demographic settings of S-3 scenarios, and revised to describe practical counter-measures and road-maps in detail to accomplish the target of Environmentally Sustainable Transports in Low Carbon Societies.

4. Results

Regional CO_2 emissions of passenger cars in local government scale were estimated.   It was founded that the emissions per person increased in the local government of where population had decreased recently, and that population decrease especially in lower density areas than 2,000 person/km^2.

The effect of bus network reorganization into trunk-feeder system with exclusive trunk lanes, which can be one of effective measures for encouraging public transportation rider-ship and improving bus operational efficiency, was studied taking a case of Nagano city as an example. Stated preference survey and analysis showed that a multi-activity facility integrated with a convenient bus terminal alleviated transfer resistance equivalent to about 12 minute reduction of on-board time. In addition, a bus transportation demand analysis which takes into consideration the

Table 1: Summary of the Effect of Bus Network Reorganization

		Current	Reorganized without MAF	Reorganized with MAF
Scenario	Bus vehicle-kilometer	14,728	13,818 (-6%)	13,818 (-6%)
Bus usage and efficiency	Number of linked trips using bus	13,851	13,360 (-4%)	14,890 (+8%)
	Bus passenger-kilometer	65,834	64,952 (-1%)	73,081 (+11%)
	Average occupancy	4.44	4.84 (+9%)	5.28 (+19%)
	Operation ratio	93.1	98.1 (+5%)	92.4 (-1%)

MAF: multi-activity facilities

speed-up of trunk bus lines and the above-mentioned alleviation effect showed the possibility of more efficient bus operation with gaining more bus users and contribution to CO_2 emission reduction (Table 1).

For achieving the long-term target of transport system for low carbon society, it is necessary to explore ways of offering suitable and efficient "road maps" for each area with distinct local characteristics. Firstly, based on the reviewing of existing challenges of how well Japan has utilized low carbon policies, a matrix identifying the relationship between the order of execution and synergy effects of the associated policies is identified. Secondly, each area is classified with its local transport characteristics. Finally, the overall low carbon policy strategy is clarified and three separate road maps are proposed for guiding local passenger transport policy making in Japan.

We calibrated amount of CO_2 emission of interregional transportation in 2005 by using MLIT (Ministry of Land, Infrastructure, Transport and Tourism) Air Demand Forecasting Model 2007. It was clarified that the longer distance market evacuates more CO_2. We tested a sensitive analysis of transportation fare and CO_2 emission. Differences of the unit of emission cause positive or negative effects on the increase of fare (Fig. 1). Especially, the emission factor of air is higher than others', therefore, the appropriate fare structure by distance or aircraft types should be discussed in future. Fig.2 displayed the representative aircraft CO_2 emission factors. It suggests that the promotion of low emission aircrafts would be an important measure for interregional transportation market.

The structure of the demand forecasting model was created based on the existing models and present situation analyses. Trip Generation models and the modal choice model were constructed within the process of creating the structure of the demand forecasting model. In the modal choice model, road, railroad, and coastal ships were chosen as means of freight transport, and the model was constructed with transportation costs and transportation time as independent variables.

A study committee was held in which committee members other than research members of the
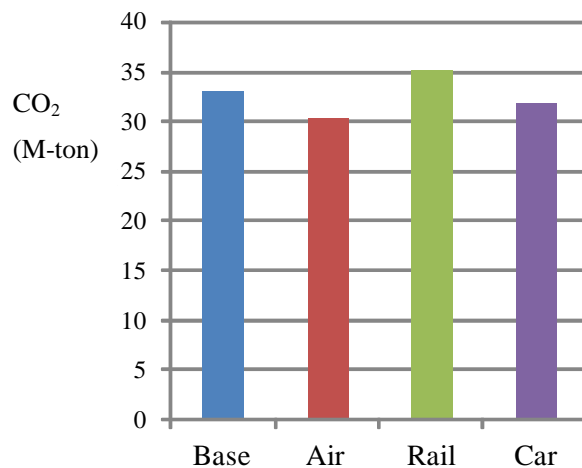

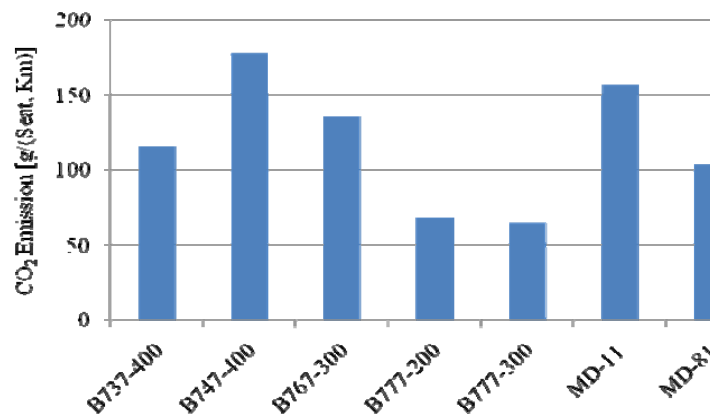Fig. 1: Relation between CO_2 Emission and 20% Fare Increase of Each Mode

Fig. 2: Various CO_2 Emission Factor by Aircrafts

"Japan Low Carbon Society Scenarios toward 2050" have discussed in order to create a comprehensive vision and scenario of transport sector.   Based on much new knowledge achieved from the discussions, two policy-packages "The combination of multi-scale centered land uses and networks of suitable transport modes" and "Penetration of light-weighted electric passenger cars" were developed.

Major Publications

1) Y. Kudoh, K. Nansai, Y. Kondo and K. Tahara, "Life Cycle CO2 Emissions of FCEV, BEV and GV in Actual Use", Proceedings of the 23rd International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exposition, CD-ROM, 2007

2) Y. Kondo, Y. Kudoh, H. Kato, K. Matsuhashi and S. Kobayashi, "Evaluation of Commercial Small-Sized Battery Electric Vehicle in Actual Use", Proceedings of the 23rd International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exposition, CD-ROM, 2007

3)   K. Matsuhashi:, "A Study on Developing Visions of Future Transport Systems toward Low Carbon Society in Japan", Journal of City Planning Institute of Japan, 42(3), 889-894, 2007

4) K. Matsuhashi, Y. Kudoh and Y. Moriguchi：A study on combinations of countermeasures to reduce transport CO_2 emissions in long-term，Global Environmental Research, 12(2), 179-189, 2007