S-3 Low-Carbon Society Scenario toward 2050: Scenario Development and its Implication for Policy Measures （Abstract of the Interim Report）

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Key Words Japan, Low-carbon Society, the year of 2050, Long-term scenario, Global warming policy

1. Introduction

To avoid serious climate change impact, there is discussion to limit the global mean temperature increase at 2℃ from pre-industrial level. Then the global GHG reduction target required in 2050 will be 50% of 1990 emission level. It implies that reduction rate for Japan will be around 60-80%. We need Japan low-carbon society scenarios to achieve such 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

This project (S-3) focuses on the following issues:

1) Long-term scenario development study to integrate environmental options consistently using simulation models (S-3-1),
2) Long-term GHG reduction target setting considering effectiveness and validity (S-3-2), and
3) Assessment of environmental options considering future socio-economic conditions in
  a) Urban system (S-3-3),
  b) Information technology (IT) society (S-3-4) and
  c) Transportation system (S-3-5).

We have the above 5 sub projects consisting of research experts in those areas. We have developed socially and technically consistent middle and long-term global warming policy (Fig.1).

The figure shows probable paths towards a low carbon society in Japan which are compatible with economic development and would enhance public interest leading to social and lifestyle changes.

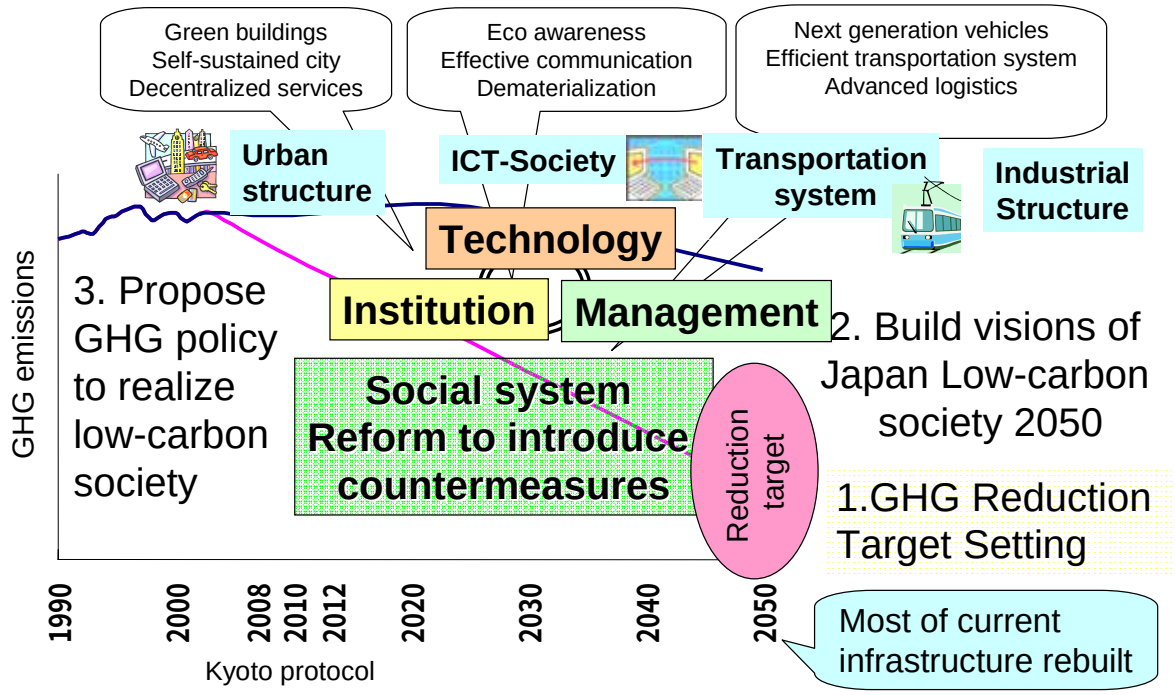


Fig.1 Research Framework of "Japan Low-Carbon Society (LCS) Scenarios toward 2050"

3. Research Method and Results

Our research outcomes for the FY2006 are given below. These findings are in the context of our ultimate goal to develop Japan low-carbon society scenarios toward 2050;

1) We examine the "backcasting" method, which first develops emission target representing favorable LCS visions and then explores the methods to achieve it.
2) We have developed the narrative storylines, their quantitative scenarios, and trend-breaking countermeasures in residential sector, service sector, transportation sector, industrial sector, energy supply sector, and others.
3) Technological and economic countermeasures for each sector such as urban, IT society and transportation were evaluated. These became input for model simulation.
4) We have decided to facilitate Japan – UK Joint Research Project "Developing visions for a Low Carbon Society through sustainable development". We will promote studies toward achieving a Low Carbon Society (LCS) by 2050 in collaboration, encourage other countries to engage in LCS studies, and jointly hold series of international workshops. The first workshop will be held in 2006 in Tokyo.

Outcomes from each sub-project are briefly summarized below.

3-1 Long-term Scenario Development Study to Integrate Environmental Option using Simulation Models (S-3-1)

Satisfying of the energy services demand as envisioned in the expected socio-economic scenarios, a 70% CO_2 emission reduction below the 1990 level can be achieved by reducing

40-45% the energy demand and by introducing low-carbon energy supply. The annual direct cost related to a CO2 emission reduction of 70% by 2050 would range between JPY 6.7 and 9.8 trillion, which would account for around 1% of the estimated GDP in 2050. The energy demand-side emission reductions could be accomplished by combining a shrinking population scenario with promoting rational energy use, energy conservation and improvements in energy efficiency, while allowing the per capita GDP growth at 1-2% towards 2050.

3-2 Multi criteria evaluation of long-term scenario and policy on climate change (S-3-2)

This research project addresses issues on medium to long term target-setting on climate change policy. In order to mitigate climate change, it is important to clarify a goal of mitigation activities. We have found that negotiators of the time expected the Article 2 of UNFCCC to be a kind of indication of collective will of countries that climate change is a serious global problem. Article 2 of UNFCCC is unique, in comparison to objective of other MEAs, in terms of its goal-oriented feature and its mentioning of a concrete target for the commitments underlined in the convention. In order for international society to reach the ultimate goal, it is necessary to agree on a short-term emission reduction agreement that is in line with the global trajectory. As for Japan's long-term target, it became clear that 60-90% reduction of GHG emissions in 2050 from 1990 level is necessary in order to avoid a dangerous level of climate change. The calculation is made taking into account of three scientific uncertainties, namely the level of temperature increase, climate sensitivity in the model, and global differentiation scheme. In order to achieve such level of GHG reduction, both civil society participation and technology development is needed, whereas policies supporting the former seem to be lacking now. Creation of diffused energy use structure is in need.

As for the existing targets in Japan, many targets are addressing the first commitment period of the Kyoto Protocol, and not many has addressed long-term target.

3-3 Effects of introducing countermeasures for carbon dioxide emission reduction in urban area (S-3-3)

The research objectives are to develop the method of evaluation of potential carbon dioxide emission reduction in urban area, and to apply the developed method to cities with various sizes and in various climate conditions in Japan in 2020 and 2050. The unique method of this research is to evaluate the effect of implementing integrated technological options into actual cities for carbon dioxide emission reduction. Prediction of cities in the future target years is also included.

CO_2 emission associated with operation, construction and renovation of office buildings in Japan was predicted by administrative divisions until 2050.

Scenario A (urban concentration type society: an active, quick-changing, and technology oriented society), scenario B (local decentralized society: a calmer, slower, and nature oriented society), and scenario M (average of scenario A and B) would be assumed as a society image as shown in Table 2. Scenario 1 into which the CO_2 intensity of electric power supply does not

change after 2005 and scenario 2 based on the "Energy technology vision 2100" by Ministry of Economy, Trade and Industry, Japan.

The forecast result of the M1 scenario is shown in Table 1. CO_2 emission in 2050 will be reduced by 42% in the BAU case and reduced by 52% in the energy saving case. Moreover, the M2 scenario will be reduced by 68% in the BAU case and reduced by 78% in the energy saving case.

Table 2. Scenarios of case studies and reduction rate of CO_2 emission associated with operation, construction and renovation of office buildings in Japan.

Scenarios of case studies							Reduction rate of CO_2 emission (1990=100%)			
No.	Future society	Scenarios of power supply sector and CO_2 intensity of electricity (kg-CO_2/kWh)					Business as usual case in building sector		Energy saving case in building sector	
				1990	2020	2050	2020	2050	2020	2050
A1	A scenario	1	No change after 2005	0.421	0.390	0.390	-12%	-34%	-12%	-46%
A2		2	Energy Technology Vision 2100 by METI	0.421	0.315	0.120	-26%	-63%	-26%	-64%
B1	B scenario	1	No change after 2005	0.421	0.390	0.390	-23%	-50%	-23%	-69%
B2		2	Energy Technology Vision 2100 by METI	0.421	0.315	0.120	-36%	-72%	-35%	-81%
M1	M scenario	1	No change after 2005	0.421	0.390	0.390	-18%	-42%	-18%	-52%
M2		2	Energy Technology Vision 2100 by METI	0.421	0.315	0.120	-31%	-68%	-31%	-78%

3-4 Integrated Measures of Technologies and Lifestyles against Global Warming

This research focuses on the influence of ICT diffusion on environmental problems. From previous study's results, we selected three important ICT applications. These are a "SCM (Supply Chain Management) system", which reduces resources used in the industry sector, "advanced traffic utilization system & teleworking", which increases energy use efficiency and decreases the frequency of traffic use, and "Eco-life guidance system", which changes people's actions to a more environmentally conscious one. We investigated these effects on environmental loads in more detail. In addition to these, we drew a clear vision of a networked society, which many people desire strongly, under the condition of achieving low carbon emissions in the year 2050.

We investigated the effect of reducing CO_2 emissions caused by using ICT in production and distribution management systems such as SCM, in the food, textile, medicine, and cosmetics industries. We developed the above estimation methods further not only with respect to SCM but also with respect to the use of direct-from-factory and build-to-order (BTO) systems in net

retail, as in the Dell model, and the computerization of goods distribution.

Table 3 Results of calculations of CO_2 reduction effect due to application of ICT

(units: 1,000t-CO_2)

Items			2010	2020	2030	2050
a. SCM	Manufacturing industry	Suppression of unnecessary production	16,221	16,221	35,960	41,461
		Reduction in number of factory buildings	84	124	178	202
	Wholesalers	Reduction of storage space	7,777	11,497	16,140	17,875
		Suppression of unnecessary production	443	660	943	1,065
		Wholesalers made unnecessary	2,274	4,724	6,477	8,630
	Retail stores	Reduction of storage space	3,326	4,830	6,848	7,382
		Suppression of unnecessary production	329	480	692	755
	Reduction in warehouse building		2,275	3,308	4,496	4,933
	Reduced distribution of returned goods		1,943	2,819	3,541	4,600
	Optimization of accounting work		1,429	2,382	3,334	4,763
Subtotal			36,100	47,044	78,609	91,665
b. Direct-from-factory and BTO		Wholesalers made unnecessary	2,722	4,084	5,445	8,167
		Retail stores made unnecessary	2,380	3,571	4,761	7,141
		Increase in inventory space in net-retailers	▲ 1,328	▲ 1,992	▲ 2,657	▲ 3,985
		Suppression of unnecessary production	215	323	431	646
		Increase in retail goods distribution	▲ 808	▲ 1,211	▲ 1,615	▲ 2,423
		Reduction in returned goods distribution	28	42	56	84
		Reduction in movements of customers	426	639	852	1,278
Subtotal			3,636	5,455	7,273	10,909
c. Application of ICT to goods distribution		Journey management system	1,588	3,970	6,352	7,940
		Logisitic (distribution) management system	1,295	3,238	5,181	6,476
Subtotal			2,883	7,208	11,533	14,416
Total			**42,619**	**59,707**	**97,415**	**116,991**

3-5 Long-term CO_2 reduction strategy of transport sector in view of technological innovation and travel demand change (S-3-5)

EST (Environmentally Sustainable Transport) 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%.

The potential of penetration 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.

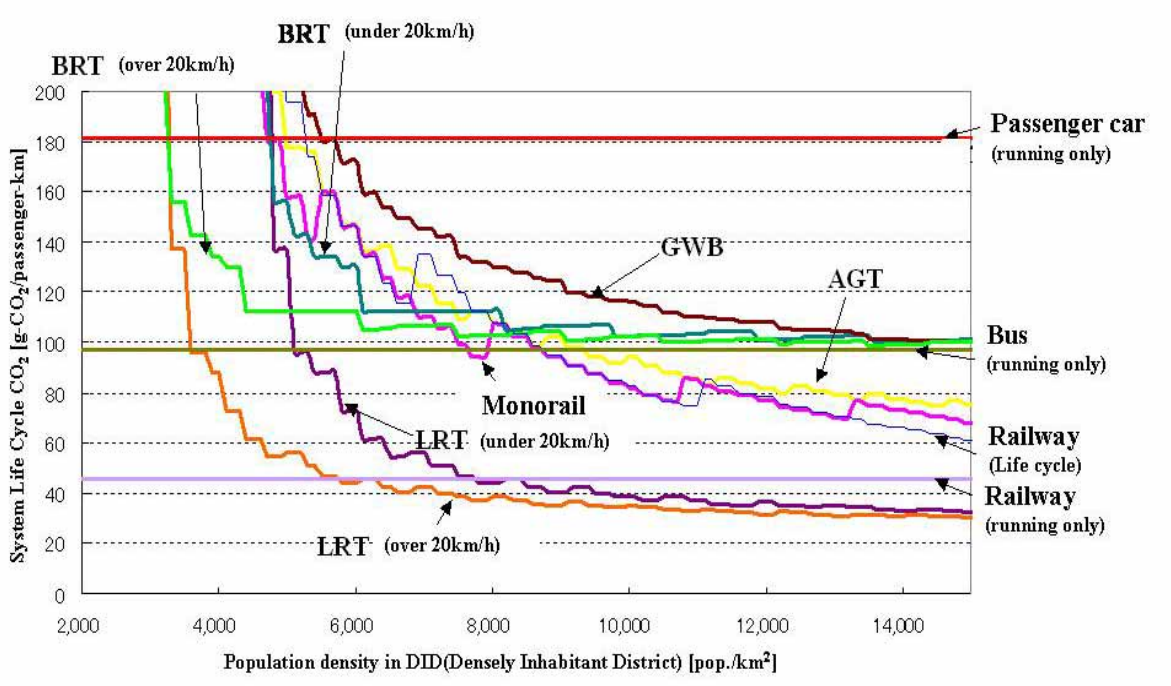
Average pay-back time of HEVs was calculated by comparing the total amount of gasoline cost of 10,000km drive per year and difference between prices of HEV and ICEV (internal combustion engine vehicle). In 2010, the pay-back time of HEV will be nearly three years. HEVs are thought to be one of the promising 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 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



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

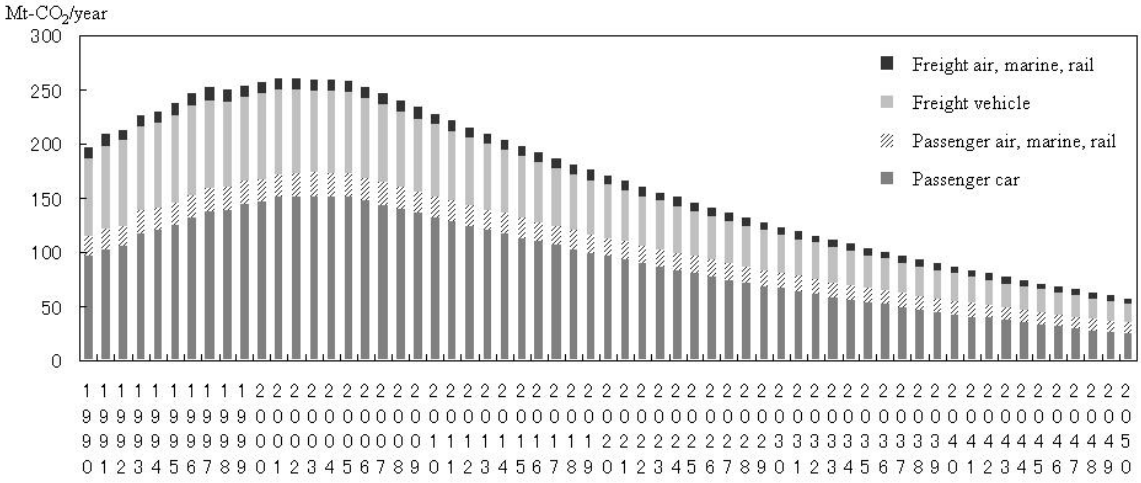


Fig.3 EST scenario of 70% reduction in 2050 and 14% reduction in 2020

categories and counter-measures to change travel demand so as to draw EST 2050 scenarios. It was shown as Fig. 3 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.

4. Discussions

In order to achieve the LCS goals while satisfying the required amount of energy services at the same time, prompt actions should be taken at the earliest stage of the roadmap. Such actions involve structural changes in the industrial sector and investment in infrastructure. Moreover, it is necessary to accelerate development, investment, and use of energy-saving technologies and low-carbon energy technologies. The government should play a leading role in promoting a common vision towards LCS at the earliest stage, enforcing comprehensive measures for social and technological innovation, implementing strong measures for translating such reduction potentials into a reality, promoting measures for public investment based on long-term perspectives and leading incentives for private investment.

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