Main Report

Global Environmental Research Fund (GERF/S-3-1)
Japan-UK Joint Research Project “a Sustainable Low-Carbon Society (LCS)”

a Dozen of Actions towards Low-Carbon Societies (LCSs)

Please see “**Appendix**” to this main report for details of each action.

May 2008

“2050 Japan Low-Carbon Society” scenario team

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and Mizuho Information and Research Institute.

This is a tentative translation of the report originally written in Japanese “低炭素社会に向けた 12 の方策”.
The original report and its press release on May 22, 2008 can be downloaded from http://2050.nies.go.jp/.

Principal contents

This report proposes a dozen of actions to be taken in Japan to reduce carbon dioxide emissions by 70% by 2050 from the emission level in 1990. These actions should be taken without delay in order to create low-carbon society in Japan.

1. "2050 Japan Low-Carbon Society" scenario team published a report entitled "Japan Low Carbon Society Scenarios: Feasibility study for 70% CO_2 emission reduction by 2050 below 1990 level" in February 2007, in which it stated that Japan has the technological potential to reduce the emissions of CO_2, which is the major greenhouse gas, by 70% by 2050 from the emission level in 1990 while satisfying the required amount of energy services. The report also mentioned that to achieve the goal, the Japanese government must take strong initiatives in sharing the goals of a low-carbon society, establishing comprehensive measures and long-term plans, reforming industrial structures, and funding infrastructures to encourage private investment in energy-saving technologies and R&D of low-carbon energy technologies.
2. Based on analyses of scenarios, innovations such as technologies and reform programs for social systems have been studied from the viewpoint of when and how such innovations should be implemented and what kind of measures and policies are effective to realize them. A dozen of actions are proposed and their effectiveness has been studied with the use of an assessment model. The actions are expected to cover the entire 70% reduction goal. Cross-sectional and/or additional measures will enable emissions to be reduced further, but efforts in the energy demand sectors are particularly important. The 70% reduction will be shared as follows: 13 to 15% in industry, 21 to 24% in buildings, 19 to 20% in transportation, and 35 to 41% in energy sectors.
3. The effects of measures and policies undertaken in a particular sector for achieving a low-carbon society also help carbon reduction in other sectors. For example, well insulated houses and the use of solar energy are direct and effective low-carbon measures for the residential and commercial sectors (including the building sector). Low-carbon measures taken by primary energy suppliers, such as increased use of renewables, will also contribute to the CO_2 reduction in the building sector. To expand the use of renewables, it is also necessary to encourage their use in the end-use sectors. Publicity and environmental education underpin all measures. There are also various technological and social barriers to achieving reduction goals, and it takes time to remove these barriers. Therefore proper steps must be taken in a due sequence. In this report, an action denotes a set of technological measures, social system reform programs and stimulatory policies that are combined appropriately by also considering mutual relationships.
4. In this report, economic methods that are cross-sectorally effective, such as a carbon tax and emissions trading, are not included as independent actions. The addition of economic methods will enhance the effects of the dozen of actions proposed here. Social infrastructures, such as public works and the capital market, are assumed to be properly in place.
5. The actions proposed here were prepared based on the results of studies by about 60 researchers in the project and opinions of experts. The scenario team has a responsibility to summarize this report. It is hoped that the report will contribute to drawing up policies and measures for low-carbon societies.

1. Low-carbon societies in 2050: CO_2 emissions can be reduced by 70%

On February 15, 2007, “2050 Japan Low-Carbon Society” scenario team mentioned in its report entitled “Japan Low Carbon Society Scenarios: Feasibility study for 70% CO_2 emission reduction by 2050 below 1990 level” that Japan has the technological potential to reduce the emissions of CO_2, which is the major greenhouse gas, by 70% by 2050 from the emission level in 1990 while satisfying the required amount of energy services in either of the two possible socioeconomic scenarios (Scenario A: active / Scenario B: slow).

Table 1 Two socioeconomic scenarios (Scenarios A and B)

Scenario A: Vivid	Scenario B: Slow
Technology-driven	Nature-oriented
Urban/Personal	Decentralized/Community
Technology breakthrough Centralized production /recycle	Self-sufficient Produce locally, consume locally
Comfortable and Convenient	Social and Cultural Values
2%/yr GDP per capita growth	1%/yr GDP per capita growth
	

Further investigations were conducted for the purpose of setting reduction goals, formulating methods for designing low-carbon society scenarios, and estimating roles of technologies related to energy, city, transportation and ICT. In February 2008 a part of the study results was published entitled “Vision and achieving scenarios of a low-carbon society (in Japanese)” (Global Environment, Vol. 12, No. 2, 2007, Association of International Research Initiatives for Environmental Studies).

In Scenarios A and B, the GDP per capita is estimated to increase by 2.7 and 1.6 fold, while the population will decrease by factors of 0.74 and 0.8, leading the GDP to increase by 2.0 and 1.3 fold, respectively, from the corresponding levels in 2000. There are several movements that will reduce energy service demands such as shifts to service industries, saturation of number of vehicles, and change of industrial structures through decrease of investment in social infrastructures. Thus, the total energy demand for services will be almost equal to that in 2000 (Table 1, Figure 1).

Various innovations, such as well insulated buildings, city structures where people can live within

walking distance, and the development and spread of energy-saving devices will enable energy demand to be reduced by about 40% while satisfying the service demands. It is shown that CO_2 emissions can be reduced by 70% from the emission level in 1990 by implementing low-carbon measures by energy suppliers, such as increasing the share of solar, wind power and other renewables and appropriate use of nuclear power and carbon capture and storage (Figures 1 and 2).

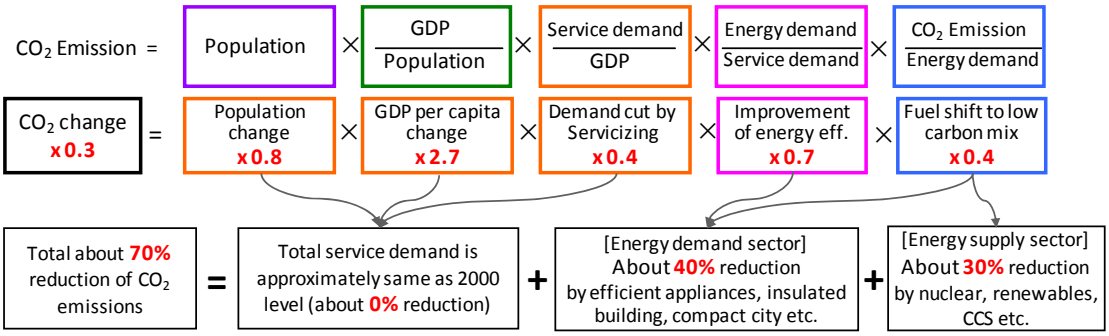

Figure 1　Relationships among components for achieving 70% CO_2 emission reduction from the 1990 level (The ratio indicates the approximate value in 2050 to the value in 2000, Scenario A)

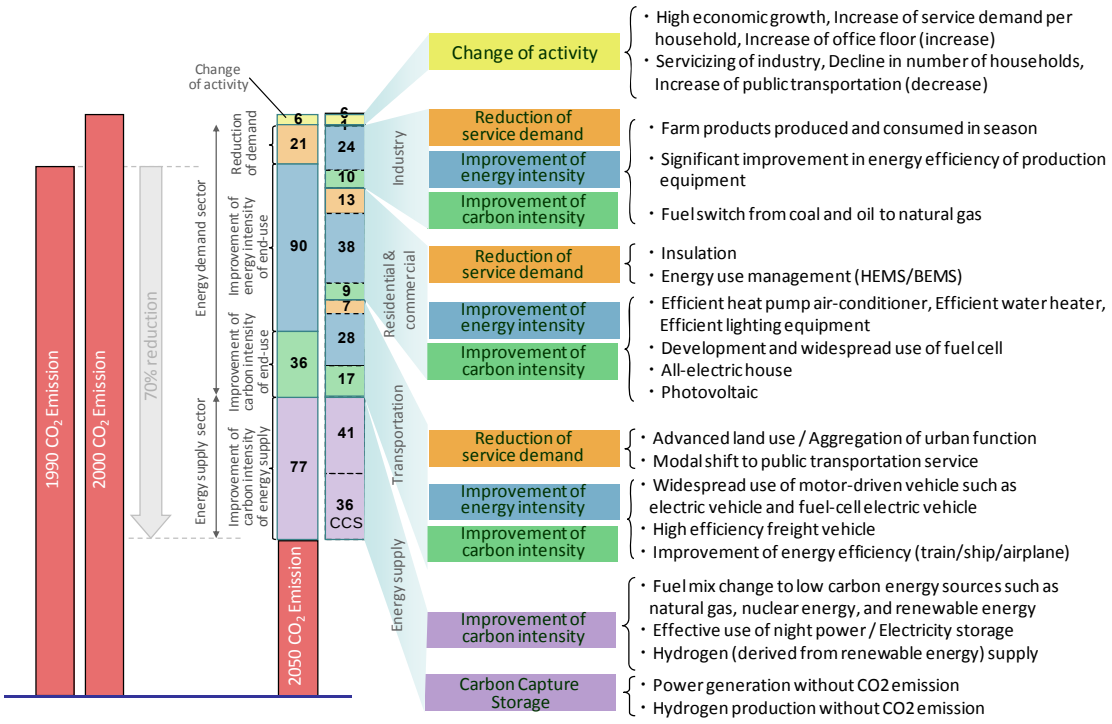

Figure 2 Combinations of actions for achieving 70% reduction by 2050 (Scenario A)

2. Reduction effects of the dozen of actions for each sector

In order to achieve the goal of 70% reduction by 2050, innovations such as technologies and reform programs have been studied from the viewpoint of when and how such innovations should be

implemented and what kind of measures and policies are effective to realize them (Figure 3). A dozen of actions is proposed and their effectiveness has been studied.

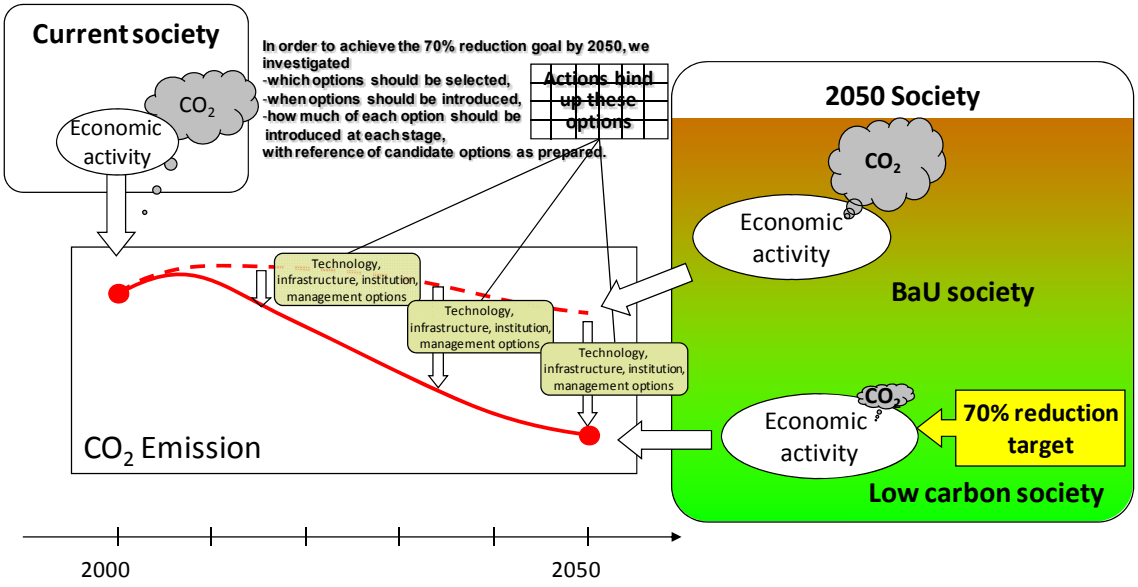

Figure 3 The role of actions towards low-carbon societies in 2050

Measures and policies undertaken in a particular sector for achieving a low-carbon society not only affect that sector but also promote carbon reduction in other sectors. For example, well insulated houses and the use of solar energy are direct and effective low-carbon measures for the residential and commercial sectors. Low-carbon measures taken by primary energy suppliers, such as increased use of renewables, will also contribute to the CO_2 reduction in the building. To expand the use of renewables, it is also necessary to encourage their use in the end-use sectors. Wide publicity and environmental education underpin all measures. There are also various technological and social barriers to achieving reduction goals, and it takes time to remove these barriers. Therefore proper steps must be taken in a due sequence. In this report, an action denotes a set of technological measures, social system reform programs and stimulatory policies that are combined appropriately by also considering mutual relationships (Figure 3).

The model studies indicate the reduction potential in each sector. The effective measures and policies to realize such reduction potential are summarized as actions. A dozen of actions are formulated by taking into account the model results and experts interviews (Table 2).

Principal target fields of the actions are residential and commercial sector (1 and 2), agriculture and forestry (3 and 4), industries (5), transportation sector (6 and 7), and energy (8, 9 and 10). Actions 11 and 12 are cross-sectional actions.

In this report, economic methods that are cross-sectorally effective, such as a carbon tax and emissions trading, are not included as independent actions. The addition of economic methods will add value effects and enhance the effects of the dozen of actions. Social infrastructures, such as public works and the capital market, were assumed to be properly in place and improved.

Table 2　a Dozen of Actions towards Low-Carbon Societies

	Name of Action	Explanation	Expected CO_2 reductions
1	Comfortable and Green Built Environment	Efficiently use of sunlight and energy efficient built environment design. Intelligent buildings.	Residential sector: 56~48 MtC
2	Anytime, Anywhere Appropriate Appliances	Use of Top-runner and Appropriate appliances. Initial cost reduction by rent and release system resulting in improved availability.	
3	Promoting Seasonal Local Food	Supply of seasonal and safe low carbon local foods for local cuisine	Industrial sector: 30~35 MtC
4	Sustainable Building Materials	Using local and renewable buildings materials and products.	
5	Environmentally Enlightened Business and Industry	Businesses aiming at creating and operating in low carbon market. Supplying low carbon and high value-added goods and services through energy efficient production systems.	
6	Swift and Smooth Logistics	Networking seamless logistics systems with supply chain management, using both transportation and ICT infrastructure	Transportation sector: 44~45 MtC
7	Pedestrian Friendly City Design	City design requiring short trips and pedestrian (and bicycle) friendly transport, augmented by efficient public transport	
8	Low-Carbon Electricity	Supplying low carbon electricity by large-scale renewables, nuclear power and CCS-equipped fossil (and biomass) fired plants	Energy conversion sector: 95~81 MtC
9	Local Renewable Resources for Local Demand	Enhancing local renewables use, such as solar, wind, biomass and others.	
10	Next Generation Fuels	Development of carbon free hydrogen- and/or biomass-based energy supply system with required infrastructure	
11	Labeling to Encourage Smart and rational Choices	Publicizing of energy use and CO_2 costs information for smart choices of low carbon goods and service by consumers, and public acknowledgement of such consumers	Cross-sectional
12	Low Carbon Society Leadership	Human resource development for building “Low-Carbon Society” and recognizing extraordinary contributions.	

The reductions in each sector are based on Scenario A and Scenario B, respectively.

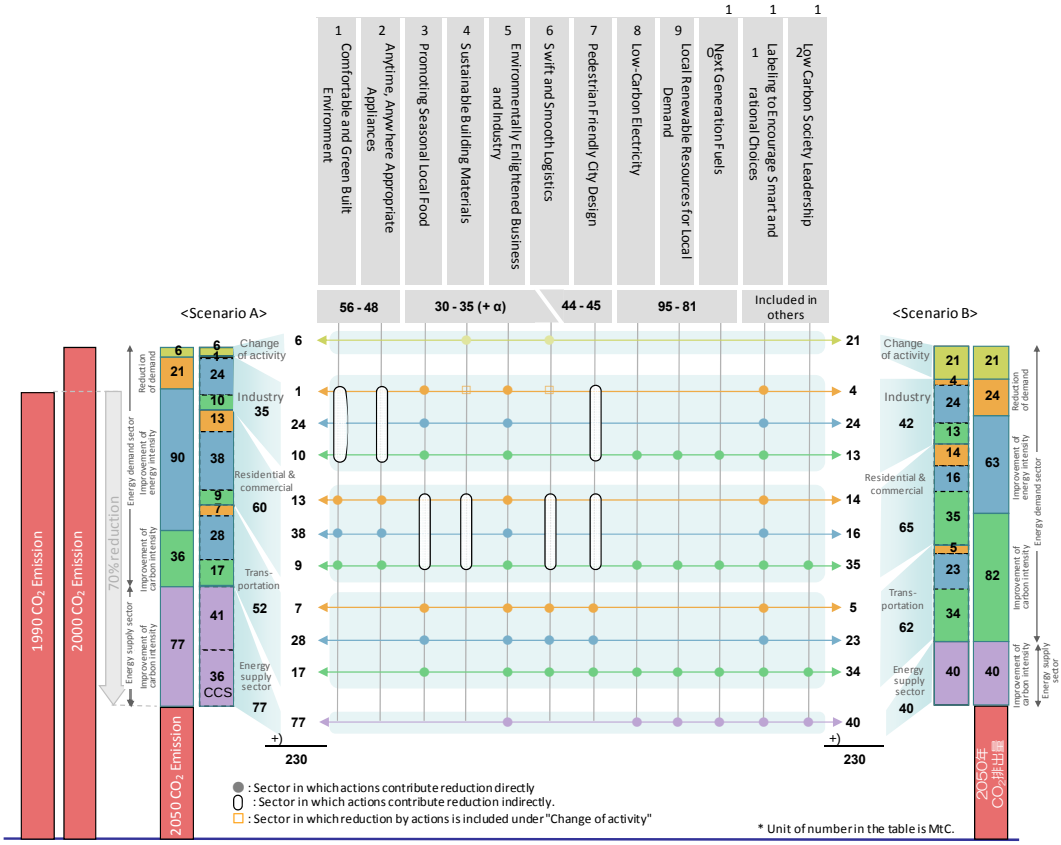

Figure 4 Role of a dozen of actions to reduce CO_2 emissions

Figure 4 shows the reduction effects of the dozen of actions. The relationships among ranges and the estimated reductions in CO_2 emissions from each sector for each scenario are shown. One action contributes to reductions in two or more components and sectors, and reductions in a sector and in a component are the result of contributions of two or more actions. Possible reduction levels were calculated not for each action but for each cross-sectional approach. The values were then used to calculate the levels for energy supply and demand sectors, for each measure, such as changes in services, improved efficiency, and improved carbon intensity, and for each sector such as industry, residential and commercial, transportation, and energy conversion.

The total reduction value of 230 MtC corresponds to a 70% reduction from the emissions level in 1990. The reduction levels in each sector are shown in the right column for each scenario. Combinations of the dozen of actions results in reductions of 35 to 42 MtC in industry, 60 to 65 MtC in residential and commercial, 52 to 62 MtC in transportation, and 68 to 96 MtC by energy conversion. Thus, the 70% reduction will be shared as follows: 15 to 18% in industry, 26 to 28% in residential and commercial, 23 to 27% in transportation, and 33 to 17% in energy conversion.

Improvement of carbon intensity in both energy supply and demand and improvement of energy efficiency on the demand side will be especially effective. On the whole, efforts in the energy demand side will be the key.

3. Concept of Action

Figure 5 outlines components of Action.

1) Future Objectives: Desired social systems in 2050 are described here. Concrete figures for the target, such as CO_2 emissions, technological levels, and penetration levels are indicated quantitatively as much as possible.

2) Implementation Barriers and Strategic Steps: Actions cannot be taken spontaneously; it takes time to lay the foundations for establishing the actions first, then for the actions to gain public acceptance and become rooted in society. There are also technological and social barriers to be removed. Implementation time is needed to remove the barriers through various strategies, including approaches, countermeasures and policies. These strategies should be executed in the proper sequence. There are some strategies that can and must be taken immediately. Other strategies may need certain barriers to be removed before they can be implemented. There are certain barriers that need continuous counteracting efforts.

3) Procedure of actions: The bottom part of the figure shows elements of both (1) and (2) with timeline in the form of Gantt chart. Various actions, countermeasures and policies for overcoming the barriers, and their chronological implementation for achieving the goal are shown in the lower part of the sheet.

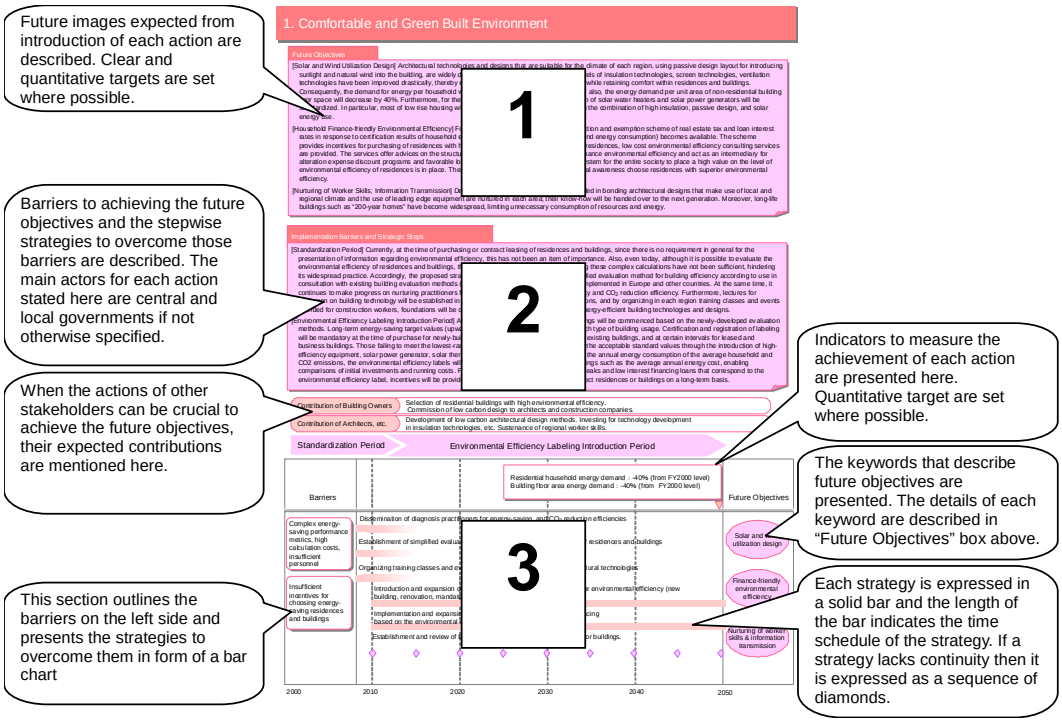

Figure 5 Components of Action

The dozen of actions are outlined as an appendix with one page dedicated to each action.

4. Actions and their implications for homes and offices, transport and Industry

The effects of the dozen of actions for achieving low-carbon homes, offices, transport, and industry were investigated. Not only the actions for directly reducing greenhouse gas emissions of a sector, but also actions which induce CO_2 reductions indirectly were investigated.

Actions in homes and offices

Many energy-consuming devices are used in homes and offices to make life and work more comfortable and efficient. Such devices are a major source of CO_2 emissions.

To reduce energy load sharply, houses and buildings need to be designed to prevent heat from escaping and penetrating inside; solar heat and natural wind should be used for temperature control of buildings, and solar power should support lighting. To encourage the construction and penetration of such houses and buildings, policies should be implemented for reducing the economic burden on their owners and systems should be introduced for assessing and labeling the environmental performance of buildings. Well insulated houses minimize temperature differences among rooms, enable the provision of high-quality heat with low carbon emissions, such as radiant heat. These measures are appropriate for an aged society (Actions 1, 5).

Energy-efficient appliances and devices also contribute to the CO_2 reduction in homes and offices. In order to accelerate the improvement of energy efficiency, the coverage of the conventional top-runner system should be extended to include all energy devices, and the improvement targets should be revised every few years. Rewarding systems for entities that develop excellent technologies should also be adopted for strengthening market penetration of energy-efficient technologies (Actions 2, 5).

However, these newly-developed efficient devices will not be widely used unless users actively adopt them. To support such low-carbon consumption, advertising systems and infrastructures should be constructed to enable consumers to obtain correct information about greenhouse gas emissions from their consumption behavior. Through these activities, CO_2 emission from production of goods and services could be cut indirectly (Actions 11, 12).

Not eating vegetables, fruits and other food that are not seasonal reduces the energy required to produce farm products (Action 3). Active use of wood instead of steel and cement for constructing houses and buildings will reduce the consumption of materials whose production processes need high energy (Action 4).

There are also measures for sharply reducing energy, such as active use of solar, wind and biomass energies available locally and purchase of low-carbon electricity (Actions 8, 9 and 10).

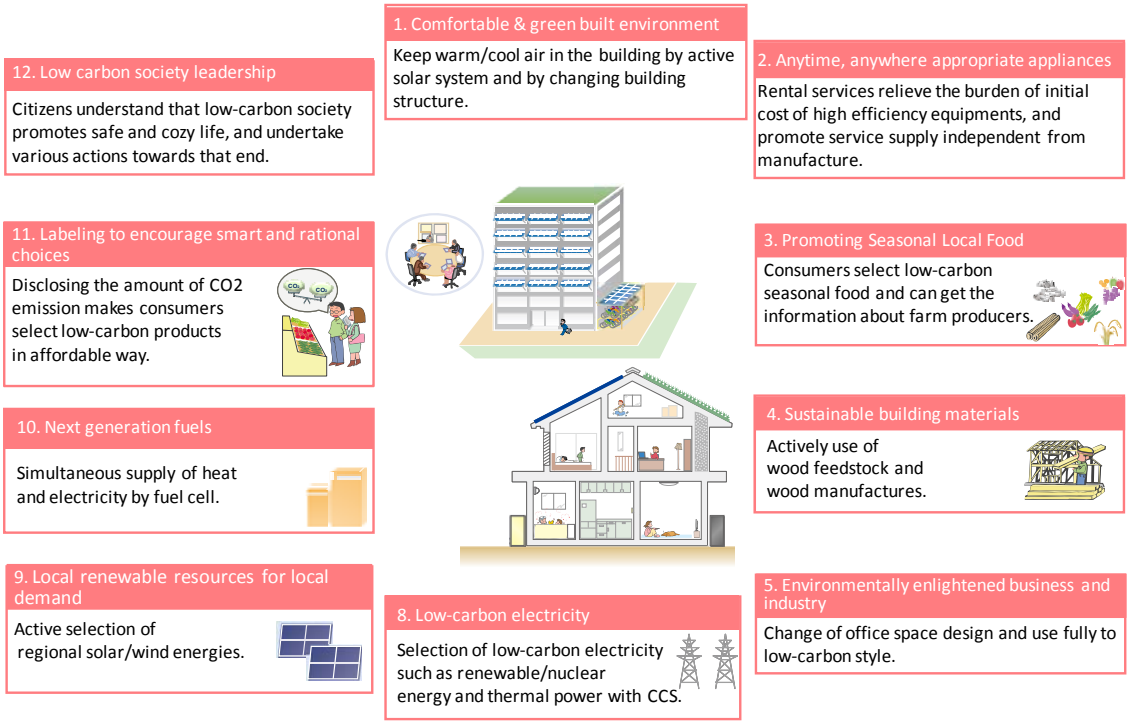

Figure 6 Actions for low-carbon homes and offices

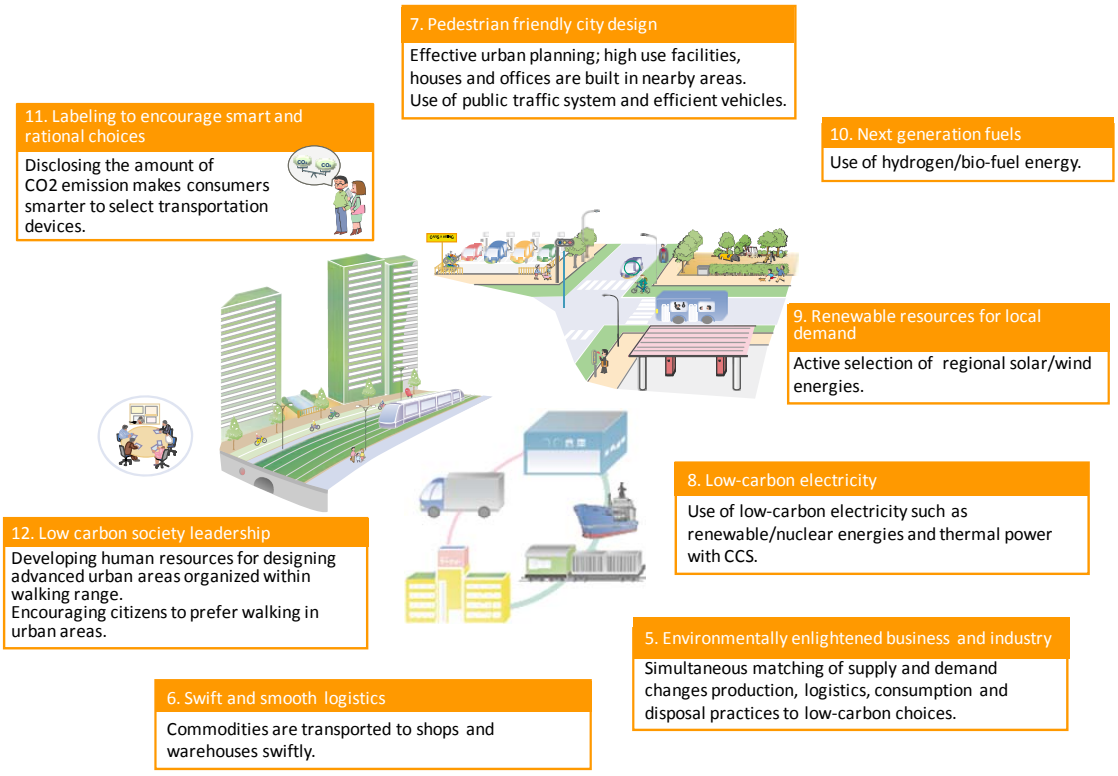

Figure 7 Actions for low-carbon transport

Actions for transport

Greenhouse gases in the transportation sector are mainly emitted when people travel by car or public transportation, and when goods are transported by truck and ship.

Concentrating houses, offices and commercial facilities at the center of cities will reduce the distances traveled by people and hence reduce greenhouse gas emissions. To achieve this goal, people should fully understand the advantages of living in cities where they do not need cars but can walk for living. Municipal governments, together with citizens, should draw up land use plans that consider such low carbon designs. Realizing such cities will raise market competitiveness of public transportation systems, such as bus, railways and Light Railway Transit (LRT), and thus these systems should be actively constructed. On the other hand, in regions where people live far away, they will need cars to move. The efficiency of cars should be greatly improved by switching engines to electric motors and reducing vehicle weight, resulting in the drastic reduction of CO_2 emissions from transportation (Action 7, 12).

To achieve low-carbon logistics, infrastructures for mass transportation systems such as railways and ships need to be constructed. Diverse forms of support should be given to increase the transportation capacities of these systems, such as by improving and expanding harbors and the railway network and developing high efficiency transportation devices. Systems and infrastructures should also be constructed to enable smooth transshipment at distribution centers (Action 6).

Active use of solar and wind energy available locally for cars will contribute to sharp reduction of CO_2 emissions. Purchasing low-carbon electricity is also effective. It is also necessary to encourage the use of hydrogen fuel cell cars and bioenergy fuels (Actions 8, 9 and 10).

To support low-carbon mobility, systems are needed to enable all entities involved in transport to acquire, at any time and place, information both on transportation system, such as timetable and transportation fare and on greenhouse gas emissions from transport (Actions 11, 12).

Actions for industry

Companies should minimize carbon production in the lifecycle of their products (production, transport, sales, consumption, and disposal). The entire business process should also be optimized using advanced information technologies so as to synchronize supply and demand and to construct efficient production-transportation systems (Actions 5, 6).

With government providing economic support to low-carbon businesses, such as strengthening public investment and giving tax benefits, companies can continue to develop leading technologies with high energy-efficiency and low carbon intensity. Conventionally, energy devices are sold to users, but to shift to the low-carbon business model, industries and/or commerce should shift to leasing of devices and appliances. This business style also supplements the pathways towards sustainable and/or recycling society. Under this style, companies will be responsible for keeping the devices operating at maximum efficiency (Actions 1, 2, 5, and 11).

For farm products, farmers should intend to produce in-season foods, and information on production should be actively publicized to consumers to enable them to select low-carbon products (Action 6). In forestry, the timber market should be expanded to replace steel and cement, which

consume high energy in manufacture, and competitiveness should be enhanced by rationalization (Action 5).

The energy industry should aim to supply zero-carbon power by combining renewable energies, nuclear power, and CCS-equipped fossil-fired power. Introduction of hydrogen- and biomass-based fuels are also indispensable for achieving low-carbonization of industries (Actions 8, 9 and 10).

Fosterage of low-carbon experts through school education curricula and establishment of qualification system, such as a low-carbon advisory system, will grow human capital and resources for practice of activities towards low-carbonizing industries (Action 12).

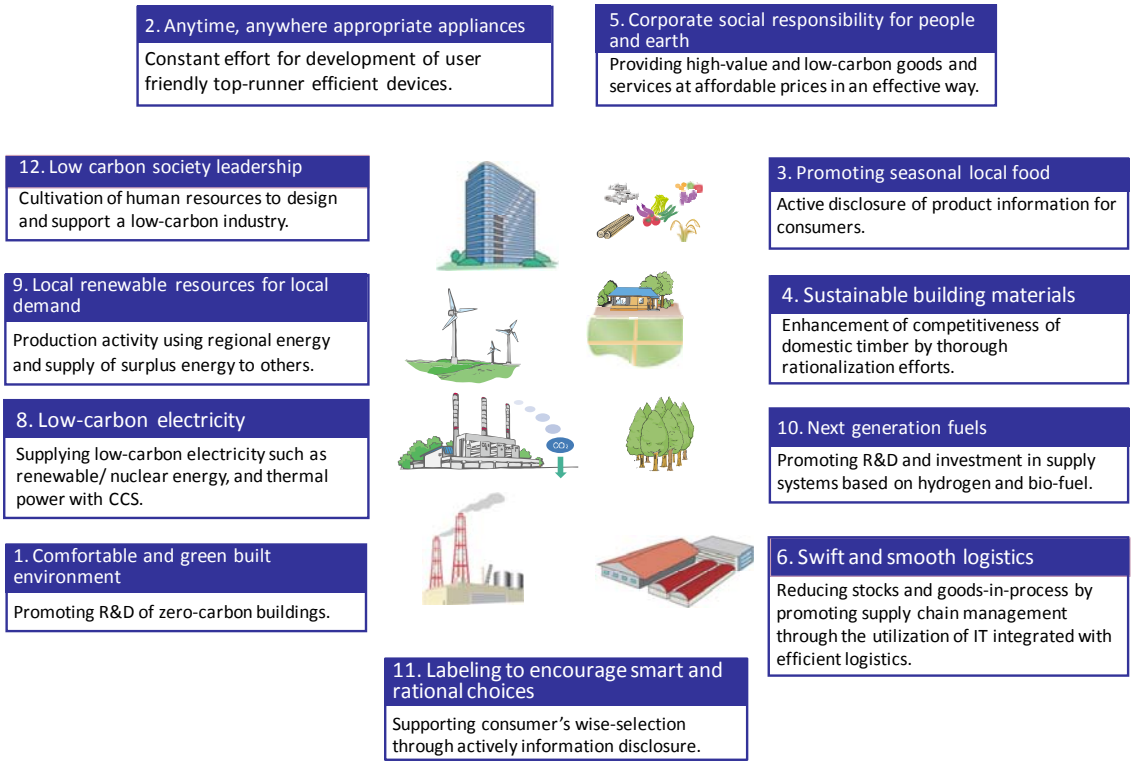

Figure 8 Actions for low-carbon industry

5. Summary

(1) **Proposing a dozen of actions and their quantification**: A dozen of actions are proposed that enables Japan to reduce carbon dioxide emissions by 70% by 2050 from the level in 1990, based on technological selection models. An action denotes a set of technological measures, social system reform programs and stimulatory policies that are combined appropriately by also considering mutual relationships.

(2) **Investigating actions by back-casting method**: We use back-casting method, which investigates actions to achieve the 70% reduction goal starting from 2050 and working back to today. From the model, numerical estimates can be prepared on what energy use (or carbon dioxide emissions) should be done. Actions are summary of necessary approaches, technological selections, social reforms, policies and measures to achieve the targets. It would have financial advantage to start the actions later for technological progress, however approaches to halt climate change cannot be taken at once. It takes time to construct the necessary infrastructures, and taking actions at once would impose higher costs due to limited resources, funds and manpower. Consistent policies towards clear goals must be developed in proper sequence.

(3) **First step towards a sustainable society**: Taking measures against climate change is a major opportunity to transform the conventional technological society that depends on huge resources and energy, into a society in which little energy and resources are used. This will also be the first step towards a sustainable society, which is our goal. Japan is one of the most rapidly aging societies, and now is the time to restructure the nation. A low-carbon society should be created by fully considering these conditions, which require reforms, and so as to be mutually effective.

(4) **Need for collaborative efforts**: The government must demonstrate leadership for creating a low-carbon society, but this alone is insufficient. The national government, municipal governments, citizens, business entities, NGOs and other entities should share the vision of a low-carbon society, understand their roles and act in cooperation with each other. Most of the actions proposed here will be the basis of such cooperation and cannot be fulfilled unless all cooperate. All researchers involved in this study sincerely hope that a low-carbon society will be created by all people collaborating on the dozen of actions in order to stabilize the climate.

The Japan–UK Joint Research Project on a Sustainable Low-Carbon Society (LCS)

The Ministry of the Environment of Japan (MoEJ) and the Department for Environment, Food and Rural Affairs in the UK (Defra) are jointly promoting a scientific research project towards achieving a Low Carbon Society (LCS) by 2050. The National Institute for Environmental Studies (NIES), the UK Energy Research Centre (UKERC) and the Tyndall Centre for Climate Change Research are conducting research activities in line with this goal. We held the 1st LCS workshop in June 2006 (Tokyo) and the 2nd LCS workshop in June 2007 (London). The 3rd LCS workshop was held in February 2008 (Tokyo).

Through the workshop series we have studied the necessity, urgency and feasibility of local, national and international action on reducing global greenhouse gas emissions through sustainable development, and have developed a shared understanding of low-carbon societies and their impacts on future development pathways and economic growth.

We have delivered "Call for Action" of the three workshops, "Executive Summary" of the 3rd workshop and others to G8 Japan process, such as Gleneagles dialogue (G20) in Chiba, during 14-16 March 2008 and G8 Environmental Ministerial Meeting in Kobe, during 24-26 May 2008. Further information: http://2050.nies.go.jp.

"Japan Low-Carbon Society Scenarios toward 2050"

This research project, initiated in 2004, is sponsored by Global Environment Research Fund (S-3) of MoEJ. The objective of the project is to propose concrete countermeasures to achieve LCSs in Japan by 2050, including institutional change, technology development and lifestyle change. More than 50 research experts have studied together to develop visions and roadmaps. This project supports the "Japan–UK Joint Research Project."

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