Time to Act!

LCS·R Net

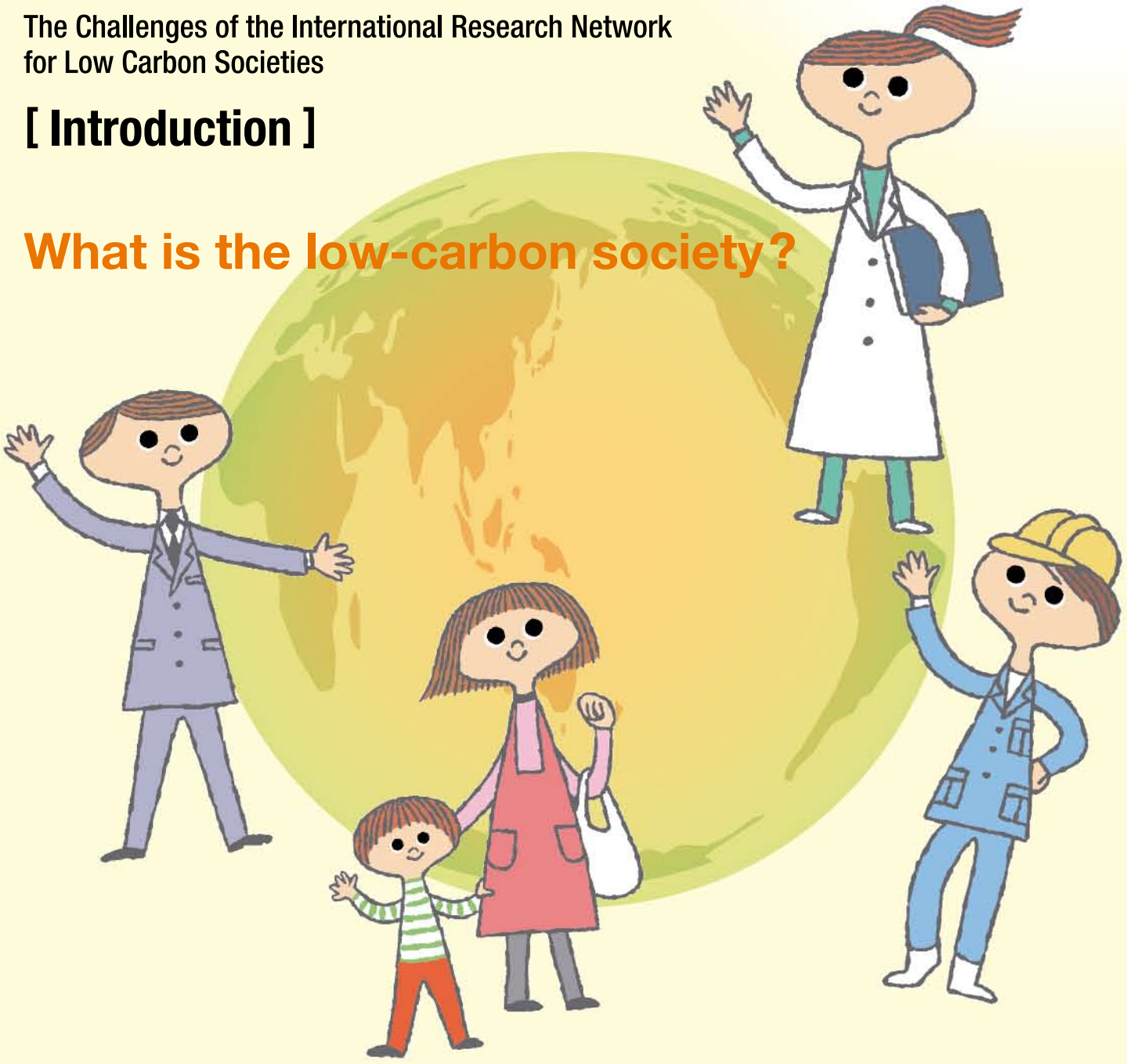
Low Carbon Societies

Introduction to Low Carbon Societies

The Challenges of the International Research Network for Low Carbon Societies

[Introduction]

What is the low-carbon society?



What should be done to create a sustainable, affluent society under a stable climate? The answer to this question is shifting to a low-carbon society. This is a major issue faced by the world in the 21st century, one that must be addressed by people from all regions and all fields working together. Today, researchers from around the world have formed a network and begun activities to take on the challenge of this issue by combining together various types of knowledge. This is the International Research Network for Low Carbon Societies. But what kind of society is a low-carbon society? Why do we need to shift to such a society now? What kinds of new research are being conducted for that purpose, and how are the results of such research useful?

1. Climate change: Why does it threaten the existence of the human being?

As exemplified by the way we refer to it as Mother Nature, nature is the foundation for our existence. We live by receiving the blessings of nature. It is a stable climate that protects this nature. While there are regional differences in heat and cold, the surface of the earth maintains an average temperature of approximately 15 degrees centigrade — a temperature suited to human life. The water that cycles through the earth's atmosphere becomes rain that falls to the ground, providing water for plants and animals. Soil and microorganisms growing under appropriate temperature and water conditions provide nutrition to forests and agricultural produce. Plants growing in this way also help regulate the content of the atmosphere. In this way, members of the world of nature support the way we live through interacting with each other and maintaining balance, under a stable climate.

This stable climate has continued for roughly 10,000 years. Human civilization has developed under this climate. Then, at the same time the technological civilization that began with industrialization in the 18th century gave rise to more abundant ways of living, the earth's population also grew rapidly. However, recently the earth's temperature has continued to increase, and it began to be pointed out that there was a high likelihood that this increase was caused by increases in the amounts of gases such as carbon dioxide from burning of coal and oil due to industrialization as well as methane and nitrous oxide emitted from farmland. These gases are referred to collectively as greenhouse gases (Box 1). It is forecast that if greenhouse gas emissions continue unchecked, the temperature would increase further, causing various changes to the climate (Fig. 1).

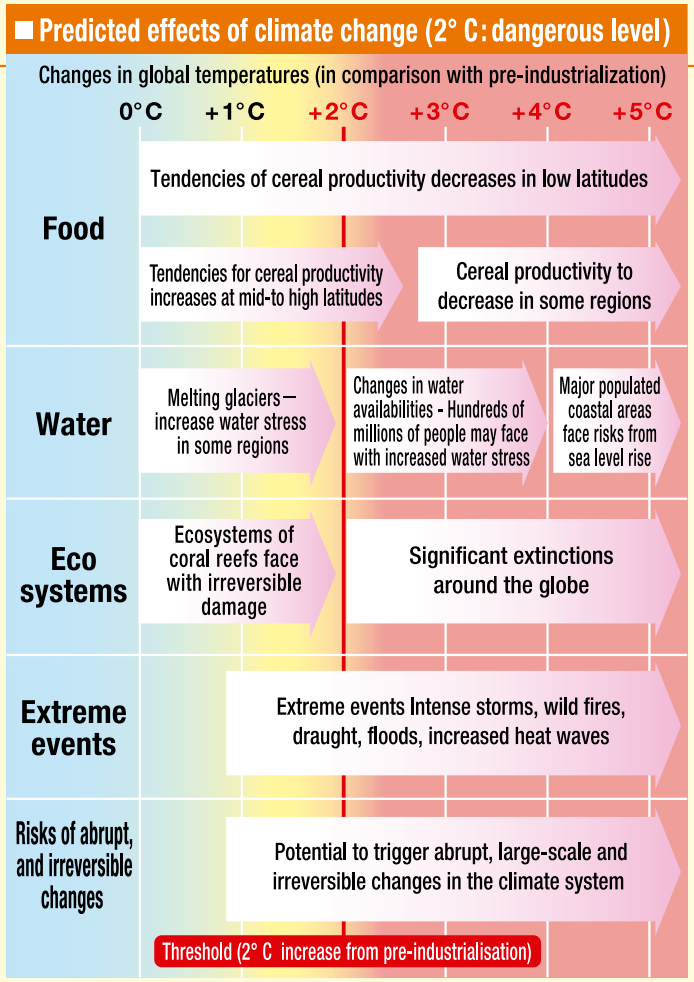


Fig.1: Potential effects of climate change
Source:IPCC, and Stern Review

Box 1 Greenhouse gases

The major greenhouse gases include carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (CFCs). The degree of the greenhouse effect varies by gas. In the same weight, methane has about 20 times the effect of carbon dioxide, nitrous oxide about 300 times, and while there are various types of CFC gases, in general they have effects of 100 - 10,000 or more times that of carbon dioxide.

For this reason, restraining gases other than carbon dioxide also is important to preventing global warming. Carbon dioxide is generated primarily from power plants, motor vehicles, and industrial processes that burn substances that contain carbon, such as fossil fuels including oil, coal, and natural gas and plastics. Methane is generated primarily from sources such as waste fills, wetlands such as rice fields, and wastewater treatment facilities, as well as enteric fermentation of livestock and processing of livestock excrement. Nitrous oxide is generated when burning fuel and also comes from nitrogenous fertilizers and sewage treatment facilities. CFCs are used in the coolants of devices such as refrigerators and air-conditioners, cleaners used for semiconductors and other articles, and foaming agents used in urethane foam and other materials.

In these ways, greenhouse gases are generated from activities closely related to our way of life.

A low-carbon society

the working definition of Japan-UK Joint Research project on LCS

A society that demonstrates high levels of energy efficiency and uses low-carbon energy sources and production technologies

A society that makes an equitable contribution towards the global effort to stabilise atmospheric concentrations of carbon dioxide and other greenhouse gases at a level that will avoid dangerous climate change through deep cuts in global emissions

A society that takes actions that are compatible with the principles of sustainable development, ensuring that the development needs of all groups within society are met

Vision for an

2. Preventing climate change: Shifting to a low-carbon society

Greenhouse gases such as carbon dioxide and methane are present in the atmosphere originally, where they have played important roles in maintaining the earth's temperature at roughly 15 degrees. Greenhouse gases emitted from the earth's land and sea surfaces have been reabsorbed by the land and sea surfaces. This balance has maintained their concentration at certain levels. However, with the addition of carbon dioxide and other gases released into the atmosphere as human beings burn coal and oil, the balance that had been maintained until then began to break down. Emissions of greenhouse gases came to exceed the volume that could be absorbed by nature, and this difference began to build up steadily in the atmosphere. Emissions in the year 2000 had reached the level of more than double the amount that could be absorbed by nature. It is thought that this caused climate change to begin. For this reason, stabilizing the climate requires at the very least reducing current emissions to the level that could be absorbed by nature — that is, they need to be cut by at least one-half.

However, it is thought that if temperatures continue to increase as they are doing now, the capacity of nature to absorb greenhouse gases will decrease. Halving emissions will not be enough to stabilize the climate. Instead, emissions must be reduced over the long term to roughly zero (Box 2).

In other words, in order to stabilize the climate and ensure coexistence between human beings and nature, there is a need to shift to a low-carbon society and a low-carbon civilization, in which emissions of greenhouse gases such as carbon dioxide are restrained massively. In this way, shifting to a low-carbon society is the way for the survival of the human race, and what's more it is a responding measure that must be taken quickly.

Box 2 Rising global temperatures and danger levels

The earth's temperature already has been observed to have risen by 0.74 degrees centigrade in the past 100 years. Scientists believe that the various effects of climate change would deepen if the temperature were to increase by two degrees centigrade. At the meeting of countries that are signatories to the United Nations Framework Convention on Climate Change held in December 2009, representatives of nations around the world agreed to prevent such increases in temperatures. This is known as the Copenhagen Accord. For this purpose, there is a need to begin reducing global greenhouse-gas emissions over the coming 10 - 20 years.

3. Our future: An abundant society under a stable climate

Our civilization in present industrial society has been formed based on an energy foundation obtained through use of fossil fuels. If we enumerate the technologies around us today, we can see that almost every one of them would not function without energy. For this reason, concerns arise as to whether today's relatively abundant lifestyles could be maintained when switching to a low-carbon society with decreased energy use and restrained use of fossil fuels. However, if we continue to emit greenhouse gases because we value the current generation's way of life, accumulations in the atmosphere will increase, causing later generations to face the threat of massive changes to the climate. To build a society in which the human race can live sustainably, today's generation needs to begin reducing greenhouse gas emissions immediately.

Today's world also faces shortages of natural resources such as energy and water supply. Countries struggling with poverty still want to achieve better levels of living standards even if they use fossil fuels to do so. Under such conditions, climate change is the first major barrier the human race faces that must be overcome to realize a desirable society that guarantees stable, abundant living that satisfies basic human needs. We need to realize the shift to a low-carbon society by combining together the knowledge of humanity, seeing it as a good opportunity to build a sustainable society.

Let us build a society that makes it possible to live in even more abundance than today, by devising technologies that emit less greenhouse gases and rebuilding the social infrastructure into a low-carbon one? This should imply realization of an abundant society in which everybody works with vitality and creativity, without being locked-in our possessions.

A society that adopts patterns of consumption and behaviour that are consistent with low levels of GHG emissions

abundant, secure society

Toward a low-carbon society

Do!

Let's Act Together!

LCS・R Net

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[Research Topics]

4. What must be done now to move toward a low-carbon society?

The world has begun major steps toward building a low-carbon society.
Since if any one country were to continue emitting greenhouse gases without restraint the climate could never be stabilized, countries will first discuss with each other to decide on the degree of reductions to make in total and the reductions to be made by each country, and then each country will consider reduction measures in accordance with these targets.
But what must be done now, and how should it be done, to move toward a low-carbon society?

How should each country's reduction targets be decided?

In negotiating on reduction targets for each country in venues such as the United Nations Framework Convention on Climate Change, there is a need first of all to know the amount of greenhouse gases that need to be reduced worldwide and the speed at which they need to be reduced in order to stabilize the climate. Only through sharing such information backed by science will it be possible to carry out practical negotiations on the degree of reductions that each country needs to make to achieve the reductions needed on a global basis (Box 3). At issue in such negotiations is the topic of fairness. What does it mean to say that each country will have a fair burden in reduction efforts? For example, there is a need to set reduction targets while taking into consideration countries' different stages of development in order to, for example, avoid impeding the future economic growth of developing countries and low-carbon development. Also, to advance international negotiations rationally, there is a need for ethical or economic comparative research on what kind of method of distributing the burden would be fair.

In recent years, in order to decide on courses of action for reducing greenhouse-gas emissions many countries of the world have begun setting long-term reduction targets for 2050, deciding on short- and medium-range reduction targets, generally for the years 2020 and 2030, as key points for checking progress toward achievement of the long-term targets, and studying roadmaps for achieving these targets. Within each country, it is very important to study the degrees to which emissions should and can be reduced while maintaining the international competiveness of domestic industry or utilizing this as an opportunity to acquire economic and technological power (Fig. 2).

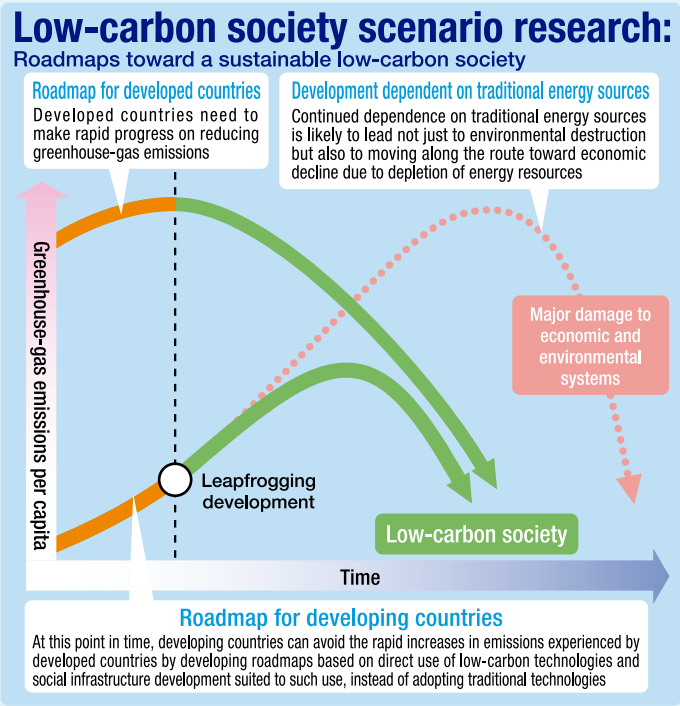


Fig.2 Source: National Institute for Environmental Studies, Low-carbon society scenarios in Asia

Key factors: Development of low-carbon technologies and funding to support such development

Building a low-carbon society requires thorough energy-conservation efforts on the demand side and switching to low-carbon sources of the energy supplied for that demand. Since the degree to which reductions can be made by each country depends greatly on that country's technological abilities, international competition has begun on development of the technologies needed for building a low-carbon society. There also is a need to research which kinds of technologies are necessary and effective, the kinds of steps by which technological development can be advanced, how to raise the funds to make technological innovation possible, and what kinds of fiscal and monetary support is appropriate for national governments to provide to the industries and consumers that will drive the general use and spread of such technologies. For example, although it appears likely that energy prices will rise in the future, fossil fuels still remain inexpensive when compared to the renewable energy sources that will be needed in the shift to a low-carbon society, so that it is difficult for such a shift to progress under the current energy pricing structure. There is a need to consider measures such as adding climate value or climate maintenance costs to energy prices in the form of a carbon tax, in order to maintain a stable climate. There also is a need for research into the tax amounts and systems that would enable efficient control of emissions, and into the impact such a system would have on each industry. It also is important to assess who would be an effective source of the necessary initial funding and what kind of effects it would have on the national economy.

Restructuring the social infrastructure

Even once good renewable energy technologies have been achieved, to ensure energy from such sources can be used there is a need for social infrastructure elements such as power grids and lines. Also, to enable people to live without depending on automobiles there is a need for urban development for pedestrian living. Such shifts in the social infrastructure concern not just physical hardware but also social systems, business practices, and people's preferences and behavior. Building a low-carbon society is an opportunity to develop such a new national society.

Changes in individual lifestyle

Since the shift to a low-carbon society is a major transformation in society, it is thought that it will bring about changes in the living patterns of individual citizens as well. There also is a need for provision of information and education to encourage people to shift toward low-carbon living. For example, to reduce greenhouse gas emissions from the transportation sector we need to think about not just combination of low-carbon means of public transportation such as railways with urban development but also incentives to encourage the public to choose public transportation.

5. What does low-carbon society research involve?

The need for a brand new research style

The research needed for advancing this shift to a low-carbon society is conducted in a different style from traditional research. This is because since researchers in this area have been entrusted with the important, urgent task of taking on the challenges of the future at this major crossroads for the human race, such research requires research networks formed through interdisciplinary, international cooperation in order to combine together knowledge from around the world. But what is new about research into building a low-carbon society, in comparison with traditional research?

Fusion of the natural sciences, engineering, and the social sciences toward climate-stabilization policies

When a nation decides on emissions reduction targets, it takes into consideration future temperature increases estimated using climate models (Box 4) and other tools as well as the resulting damage, and it also considers the impact on industries of restricting greenhouse gases. Decision-making with balance between the remaining uncertainties in climate models, the irreversibility of the effects of climate change, and the feasibility and economic impact of countermeasures requires fusion of research in the areas of climate science, regional environmental science, engineering, and industrial economics.

Natural science: Climate models are used for research to forecast how the climate could be changed as various conditions interact with each other as well as what causes climate change, what occurs as a result of climate change, and what kind of damage could arise as a result.

Engineering, agriculture, medicine, etc.: Research also is conducted into what is known as the irreversibility of the impacts of climate change: the limits of climate change that ecosystems and the human race can withstand. There is a need to research what can be done to stop climate change so that these limits are not surpassed and what kinds of countermeasures can be taken. Also important is forecasting the possibilities of technology, in the areas of the extent to which technology can be used to respond to changes once they occur and what kinds of technologies are feasible.

Social science: In implementing policies, it also is important to know in advance the extent of the possibility that model forecasts will occur. This involves research into uncertainties and risks. Together with the irreversibility of the effects of climate change, the costs and benefits of countermeasures also must be given consideration from the standpoint of economic impact. Policies need to be decided on based on an understanding of their impact on society as a whole. Forecasts of economic growth and population also are needed.

In this way, fusion of various research fields — climate science, regional environmental science and engineering, and industrial economics — is necessary in deciding on policies toward climate stabilization. Policy judgment on the extent to which to reduce emissions can be conducted only through interdisciplinary fusion of various sciences.

Cooperation between techniques in various fields and supporting scientific fields as needed to achieve targets

Once a target has been decided on, there is a need first of all to test the feasibility of various technologies to achieve such targets. To ensure technologies actually are useful, there is a need for social infrastructures utilizing such technologies. This is where urban planning, regional planning, and transportation engineering come into play. In addition, making progress in conserving energy in homes and offices requires not just energy-saving technologies but also taxation systems and information provision for the purpose of promoting such efforts. While it also is important to develop technologies with dramatically low levels of greenhouse gas emissions, such as technologies aimed at achieving zero emissions by powering motor vehicles with solar energy, at the same time there is a need to spread technologies already in practical use and existing technologies, and it is important to ascertain which somewhat more practical low-carbon technologies should be focused on and to aim to manage limited funds rationally. Useful for these purposes are study of fiscal and monetary policy, economics, management science, industrial policy research, communication theory, and furthermore efforts in areas such as behavioral science analysis for promoting desirable behavior. Also, policy studies concerning legal systems and practices, as well as research in cultural theory and anthropology, are likely to be necessary for changing social systems overall. In this way, there is a need for research cooperation through full mobilization of various types of knowledge.

Policy decisions through back-casting

To study which policies and means in what context would be most effective to adopt for purposes of achieving targets, traditionally forecasting has been employed. However, when developing plans for achieving reduction targets decided on through effective mobilization of various means in order not to leave the problem for future generations, the method of back-casting, in which the necessary policies for achieving a target are considered through working backward from the targets, is appropriate. Research and development into such new methods are necessary to building a low-carbon society (Fig. 3).

Future scenarios chosen by society: a participatory approach

Shifting to a low-carbon society essentially is the same as a nation's citizens deciding what their country should be like in the future. That is, it involves citizens choosing scenarios for the future, or devising them by themselves. For this reason, proactive dialogue with citizens and researchers is needed not just in the process of choosing future scenarios and developing policies for their implementation but also in the research processes that will become the basis for such policies. This method is referred to among researchers as a participatory approach. Toward new development of nations in the 21st century Research also must be carried out through a participatory approach. It is very important to continue dialogue among researchers, the public, policy decision-makers, and industry.

The importance of international cooperation

Climate stabilization requires the participation of all countries in reducing greenhouse gases. Particularly vital is joint research to seek out methods by which developing and developed countries can cooperate effectively and on effective use of funding for this purpose, to ensure that developing countries, which appear likely to see major growth in emissions in the future, to grow toward the goal of a society employing low-carbon technologies.

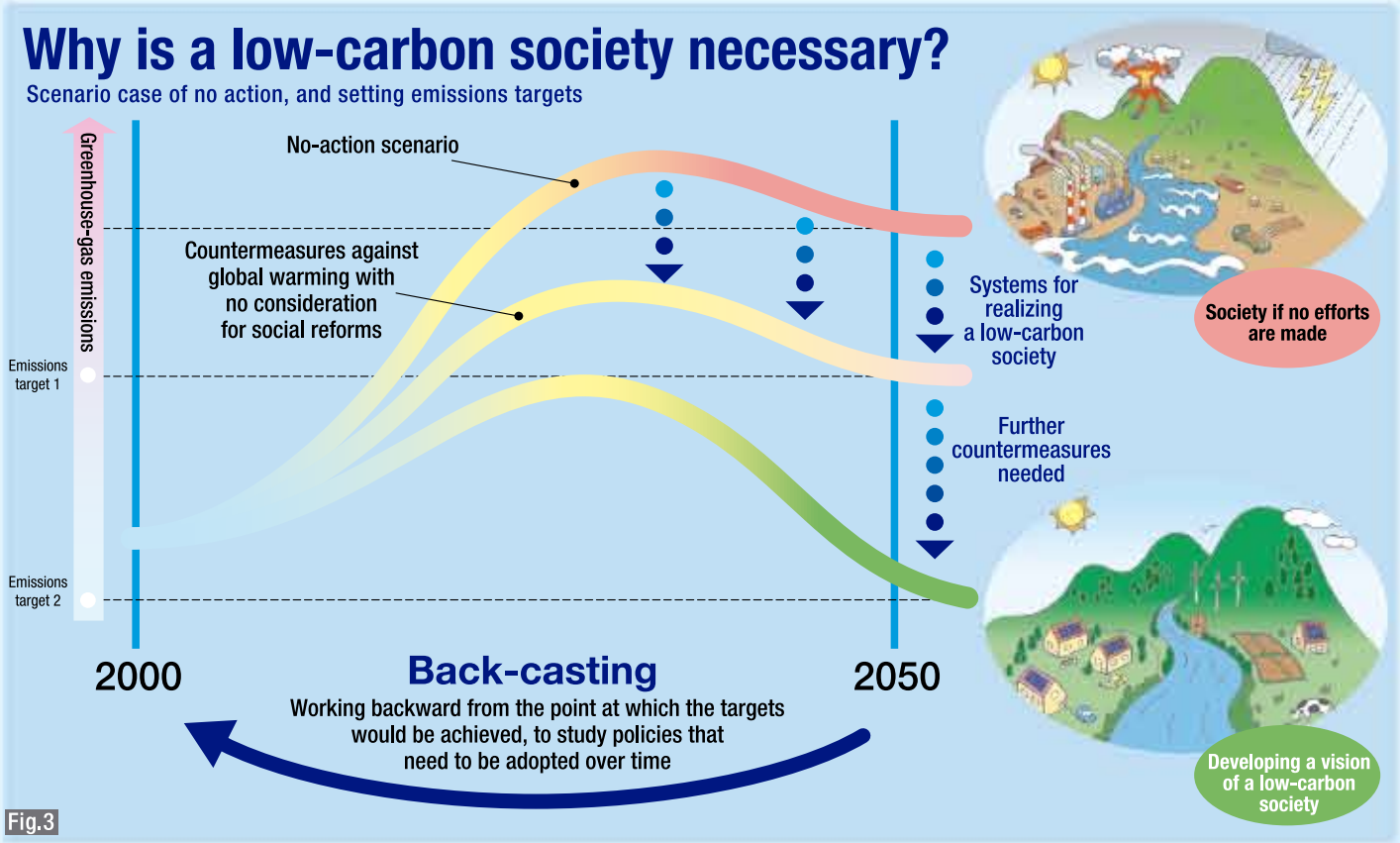


Fig.3

Public bicycles in Milan

A bicycle stroller in Denmark

A COP 15 side event

Box 3 International movements toward climate stabilization

The key points of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), published in 2007, included the following:

- Temperatures continue increasing further, and the effects of such increase have started to be observed around the world.
- It is very likely that the warming is caused by anthropogenic greenhouse-gas emissions.
- Continuation of emissions unchanged would make extreme climate change such as flooding and droughts more likely and would have significant effects on water resources, natural ecosystems, and agricultural production.
- While climate stabilization would require massive reductions in greenhouse gases, these are technologically feasible if addressed early.

In response, at meetings of the Group of Eight and Group of 20, world leaders have agreed to goals including halving the world's emissions of greenhouse gases by 2050 from current levels and aiming to achieve major reductions of 60 - 80% by 2050 in developed countries. In meetings of the United Nations Framework Convention on Climate Change, negotiations have taken place concerning the reductions to be made by each country. In the Bali conference in 2007, the course of action of reducing emissions by 25 - 40% in developing countries by 2020 was discussed, and in the Copenhagen conference in 2009 agreement was reached on all developed and developing countries registering their reduction targets and actions and beginning to move toward reductions.

Box 4 What are models?

As used here, models are tools for explaining where certain conditions will arise by explaining certain phenomena through combination of various factors and having various conditions arise in various locations. They also are used sometimes to solve for certain circumstances depending on the times and locations of the conditions from which they resulted. They simplify the subject of explanation and the causes of phenomena to understandable levels by focusing solely on the essentials. A familiar example of a model is a globe. Modeling of things ranging from minute particles to things as large as the solar system helps elucidate the subjects of the models. They also have made clear facts such as that the earth is not flat.

In other words, the most important result obtained from a model is an understanding of the interrelation between elements of a system. On this point, models differ from experiments intended to reproduce actual phenomena themselves.

Models are used in various forms to explain things. Some models are mathematical. Today, one often hears the term "computer simulation." Using computers for large-scale calculations has made it possible to forecast changes in climate on a global scale over the long term.

Models are used to understand the changes in climate resulting from combination of various conditions, and to explain separate phenomena resulting from these.

Box 5 The International Research Network for Low Carbon Societies (LCS-RNet)

Today, researchers from around the world have begun activities to form a network to take on the challenge of combining together various types of knowledge for realizing a low-carbon society. This is the International Research Network for Low Carbon Societies.

Established based on a proposal from Japan: Japan, which chaired the G8 in 2008, advocated the necessity of activities to link policies and research, and participating countries agreed to this proposal. Activities began in 2009, with the secretariat located in Japan (Institute for Global Environmental Strategies [IGES]).

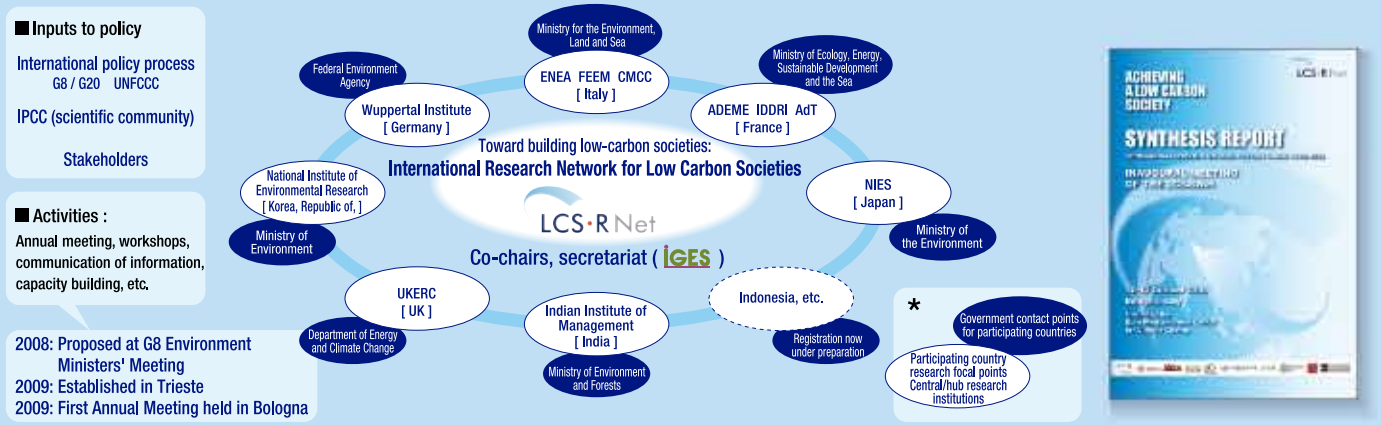
A platform for dialogue between policy and research: As a platform for sharing of scientific knowledge needed to create a low-carbon society and for creation of new ideas for this purpose, this network is an attempt to support timely policy implementation directly linking policy with research at the same time it creates a platform for research exchange between the countries of the world. Instead of addressing simple theory and side discussions, it will conduct study closely related to the central issues essential to creating a low-carbon society.

Participation of leading research institutions in the area of low-carbon research: The network organization is expected to advance interdisciplinary cooperation between domestic research institutions at the same time it strengthens cooperation in policy and research worldwide, by having leading research institutions from each country serve as the core/node institutions in their respective countries. Among G8 members, the United Kingdom, Germany, Italy, France, and Japan already have designated their central institutions, as have Republic of Korea and India, both of which are advocates of green growth. Other countries such as Indonesia also are making progress in participation.

Directly connected to the policy decision-making process in G8 and other nations: At present, research institutions in G8 countries serve as members of the steering committee, with the representatives of the research institutions from the countries chairing the G8 in the current year and the following year managing the network overall as co-chairs. The secretariat in Japan provides support for this structure. The G8 Environment Ministers Meeting held in Siracusa, Italy in April 2009 "requested the LCS-RNet to report back its outcomes periodically," and it is expected that knowledge from the network will be reflected at the top level in environmental policies worldwide. The results will be used as inputs in the United Nations Framework Convention on Climate Change and related international institutions as well. Researchers use results from the network to contribute proactively to drafting of low-carbon and green-growth strategies in their respective countries.

What kind of research needs to be conducted? From the Annual Meeting of the International Research Network for Low Carbon Societies

On October 12 - 13, 2009, more than 50 researchers and government officials involved in researching low-carbon societies from around the world met in Bologna, Italy to discuss policies and research topics toward realization of a low-carbon society, making the recommendations below.
Details have been published in the Synthesis Report from the meeting.
http://lcs-rnet.org/meetings/2009/07/1st_annual_meeting.html



Box 6 Main conclusions of the Bologna meeting

•Long-term and mid-term targets

- •World leaders aspire to bold targets for emissions reductions.
- •Co-benefits will arise from setting appropriate country- and region-specific targets.
- •Back-casting approaches can identify feasible and desirable pathways towards sustainable low-carbon societies.

•Economic aspects of low carbon societies

- •Co-ordination is needed between environmental goals and innovation policies.
- •Sectoral and regional perspectives need to be taken into account.
- •New financing paradigms will be required if developing countries' mitigation and adaptation needs are to be met.

•The role of technology

- •Radical technological change is crucial in reaching a low-carbon society.
- •More investment in energy technology is needed.
- •Technology will not deliver a low-carbon society on its own.
- •Climate policies and R&D strategies must be synchronized.

•Public policy and lifestyle change

- •Public policy can lead the way to lifestyle change and a low-carbon society.
- •Facilitating behavior change is not easy, but can be accomplished.
- •The most effective measures will be tailored to individual countries and localities.
- •LCS lifestyles do not have to entail sacrifice.

•Cross-cutting issues

- •A persistent signal is needed to stimulate change across all sectors.
- •Planning for land use change is essential.
- •Cities provide an excellent opportunity to promote a Low Carbon Society.
- •Research that would allow developing countries to set their own targets and pathways is essential.
- •Human resource development is needed as well as technology co-operation.
- •We need to adapt to unavoidable climate change and remain alert to new scientific insights.

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Author: LCS-RNet Secretariat
Publisher: Institute for Global Environmental Strategies (IGES)
Address: 2108-11 Kamiyamaguchi, Hayama,
Miura-gun, Kanagawa 240-0115, Japan
Tel.: +81-46-855-3700
http://lcs-rnet.org/

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