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Low Carbon Society Research 2009

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International Research Network for Low Carbon Societies (LCS-RNet) Secretariat

LCS·R Net

International Research Network For Low Carbon Societies (LCS-RNet)

IGES

Institute for Global Environmental Strategies

Low-carbon society research: Activities of academic society/specialists/industries supporting policy and measures taken by individual countries (including governments, local governments, and local communities) to reduce the green house gas emission for stabilizing climate. As the focus is on mitigation efforts aimed to low carbon society, adaptationo measures are refered only when necessary.

Table of Contents

Summary

The trends of the world research for the establishment of a low-carbon society are summarized as follows:

1. Integration of efforts by policy-making communities and research communities in progress to establishing low-carbon societies
   Responding to the international efforts for climate stabilization, the government of respective country in the world has shifted their policy toward low-carbon policies, though the expression of it is in a different way of a low-carbon society, a low-carbon economy and a green growth. Following this, developed countries such as European countries are calling up researchers to formulate their policies. In the North America, the notion of low-carbon society has not been fully accepted yet. The direction of policies has not been clear. On the other hands, Asian developing countries, in response to Green Growth and Nationally Appropriate Mitigation Actions (NAMA), have started to formulate their mitigation plan through intensified cooperation with the research world.

2. Approaches and issues of low-carbon society research
   The knowledge required for those who are involved in policy making for the construction of a low-carbon society cuts across a wide range of areas. Major tasks include how to set the medium to long term targets, policies to achieve the target and thier impact ont the economy, effectiveness of technological development, how to let the people move toward a low-carbon society, and reconstruction of local communities/urban areas. The main concerns of policy makers in the developing countries include, in addition to those mentioned above, conservation of forests and soil, how to distribute funds, how to and in what manner identify a path leading to the low-carbon development while putting priority on economic development/ poverty elimination.

3. Orchestration of the research:
   To effectively support such policy as construction of low-carbon society which is urgent and requires integrated knowledge encompassing various areas, Center of Excellence:COE, etc. which cut across research areas are, in parallel with formulation of policies, being established. The UK, which is driving forward climate change strategy in a proactive manner, has established, as an administrative machinery, the Department of Energy and Climate Change. It also clarified the policy package by enacting an act to encourage a transition toward the low-carbon economy, established the Committee on Climate Change to formulate unified policies, and, responding to these initiatives, formulated a network to integrate such research institutions and universities for the purpose of promoting inter-disciplinary research on climate change so that the result can be reflected on the policies. In Japan, formation of permanent headquarter organisation has been delayed and researches are being carried out independently by individual ministry/agency. Although Japan Science and Technology Agency has recently begun taking initiatives for cross-sectional orchestration of the academic world, there still is a long way to go before it gets to the levels that are called for to taking a leading role towards the low carbon societies. In Asian developing countries, for example in Indonesia and Thailand, etc., COE is being established as well.

4. Added-value of international research network
   The policy makers who attended the Bologna meeting in October 2009 were acutely aware of the importance of research exchange through international research network. Their opinions were that what is urgently needed for the policy makers now is accurate information; it is

very important to learn each other from the policies of others and their successes and failures; excellent opportunities should be provided to carry out an effective research by making it respond to the request from the policies; and more value should be added by carrying out those researches that have not been carried out by other international institutions, for example, research on long-term perspective, sociological analysis, and policies related to individual behavioural change (lifestyle). They expressed their expectation for timely outputs that can serve as a reference to the policy makers as well as necessity to expand the activities to G20 and outreach countries. The background for this seems to be the urgency in formulating policies toward a low-carbon society where little time afford to wait for accumulation of knowledge and policy examples in one country and the rationality of learning from each other's knowledge and experience among Annex I countries which have, to some extent, similar developmental stage, political system, and economic/social background.

5. Future direction of low-carbon society research:
For the establishment of effective low-carbon world, individual countries strongly feel the necessity of integrated research in support of the policies. In addition, the importance and the benefits of international cooperation were also recognized at the Bologna meeting. Furthermore, the developed countries have began to think that it is desirable to establish policy research bases in the developing countries as mitigation in the developing countries is essential for the future climate stabilization. Under such circumstances, it is necessary for the International Research Network for Low Carbon Societies to do more activities for identification and sharing of research themes required for the policy, promotion of exchange between policy and research as well as among researchers, and intensified research activities in the developing countries.

INTERNATIONAL RESEARCH NETWORK FOR LOW CARBON SOCIETIES (LCS-RNET)

Background

At their 2008 meeting in Kobe, G8 Environment Ministers recognised the need for countries to make the transition to low-carbon societies. This would contribute to the goal, discussed at the 2007 G8 Heiligendamm Summit, of halving global emissions of greenhouse gases by 2050. To make the transition, each country needs a clear vision of what a low-carbon society would look like and how the transition might be achieved. In Kobe, the G8 Environment Ministers strongly supported the establishment of an *International Research Network for Low Carbon Societies (LCS-RNet)* to help with developing these visions and pathways.

What are the objectives of LCS-RNet?

The objectives of the Network are:

- to promote information exchange and research cooperation relating to low-carbon societies;
- to promote understanding of low carbon societies through dialogue between researchers and various stakeholders including policy-makers, business and citizens;
- to share national and sub-national visions of low-carbon societies; and
- to contribute to international policy-making processes on climate change, including the G8, by communicating research outcomes and recommendations.

What is the focus of its activities?

Among the topics covered by LCS-RNet are: energy technologies and resources; finance, investment and the economics of a low carbon society; low carbon cities and infrastructure; mobility in a low carbon society; lifestyle and behaviour; the contribution of low carbon societies to sustainable development; low carbon society policies; low carbon society modelling; and the low carbon society research environment. A unique feature of LCS-RNet is that it addresses the social and human dimensions of the low carbon society as well as technology and economics.

How does it operate?

LCS-RNet has been established under the auspices of G8 governments but is operated by a group of leading research institutions. A Steering Group composed of representatives from participating research institutions guides the development of the network and plans its activities. Government representatives from the countries holding the current and succeeding G8 Presidencies participate in the Steering Group as observers. The Institute of Global Environmental Studies (IGES) based in Hayama Japan hosts the LCSR-Net Secretariat.

LCS-RNet strives to be policy relevant without being policy prescriptive and is independent of any government. Membership of the network does not imply any constraint on the activities of participating research organisations.

The key event in the LCS-RNet calendar is a two-day annual Researchers' Meeting to which all member organisations are invited. Other proposed activities include: a one week summer school for intensive study; promotion and support for stakeholder meetings in different national settings; and the development of tools and measures to facilitate stakeholder dialogue.

What are the outputs?

A key goal is to generate accessible outputs that will bridge the gap between the research community and policy-makers. LCS-RNet will communicate its activities and findings to G8 Environment Ministers Meeting, Major Economies Meeting on Energy Security and Climate Change, the UNFCCC and other international policy processes.

In addition to reports of the annual researchers meeting, the network will produce a newsletter and annual report.

Who is engaged with LCS-RNet?

Research institutions conducting activities that will help to form a vision of and make the transition to a low carbon society are eligible to participate in LCS-RNet. The following research institutions participated in the first Researchers Meeting in Trieste in April 2009:

Institute for Sustainable Development and International Relations (IDDRI), France
Environment and Energy Management Agency (ADEME), France
Wuppertal Institute for Climate Environment Energy (WI), Germany
Euro Mediterranean Centre for Climate Change (CMCC), Italy
National Agency for New Technologies, Energy, and the Environment (ENEA), Italy
Institute for Global Environmental Studies (IGES), Japan
National Institute for Environmental Studies (NIES), Japan
UK Energy Research Centre, UK, and
National Institute of Environmental Research (NIER), Korea, Republic of

LCS-RNet takes an inclusive approach to its membership and qualifying institutions from countries within and beyond the G8 are welcome to participate. The participation of Institutions from developing countries is particularly encouraged.

Where to find more information
For more information about LCS-RNet visit the website http://www.lcs-rnet.org.

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1. Integration of efforts by policy-making communities and research communities in progress to establishing low-carbon societies

Responding to the international efforts for climate stabilization, the government of respective country in the world has shifted their policy toward low-carbon policies, though the expression of it is in a different way of a low-carbon society, a low-carbon economy and a green growth. Following this, developed countries such as European countries are calling up researchers to formulate their policies. In the North America, the notion of low-carbon society has not been fully accepted yet. The direction of policies has not been clear. On the other hands, Asian developing countries, in response to Green Growth and Nationally Appropriate Mitigation Actions (NAMA), have started to formulate their mitigation plan through intensified cooperation with the research world.

For the purpose of organizing an international research network for low carbon societies ("Network", hereafter), the current status of policy and research responses obtained through the hearing sessions with the policy makers in charge of the establishment of a low-carbon society and researchers involved in that is shown in Table 1. The following is the rough sketch of the situation.

Europe:

It has already hammered out a number of initiatives in relation to the reduction target and its realisation; and developed research and research organisation to support them. On the other hand, concern has been expressed about the current status of R&D budget coming from the governments of EU countries as the budge allocated to the research on climate change and low-carbon technology is leveling off (presented by CMCC at LCS-RNet Annual Meeting, 2009).

Germany:

It is one of the forerunners in terms of the discussion on long-term target. The country has already started discussion on energy and emission targets since 1990; and the Parliamentary Enquete Commission was considering the target of 80% reduction by 2050. By 1996, it seems that they have started to focus, in accordance with the EU policy, on energy initiatives and related researches. From around 2000, the Unweltbundesamt ("UBA") or the Federal Environment Agency of Germany began studying a long-term energy scenario, etc. The shift to the renewable energies was strengthened from the early period, and in April 2000, the Renewable Energy Act was enforced where there were such ambitious targets as to make the ratio of renewable energy be 20% in total electricity consumption by 2020; and be more than 50% in total primary electricity consumption by 2050. Multiple research institutions have been conducting long-term energy scenario analysis. Although these policies have been put in place against the background of the trend toward discontinuation of atomic power generation in Germany as a consequence of Chernobyl, there is a possibility that these policies will be reviewed because of the result of federal parliamentary election in 2009 and the subsequent policy change by the new government. There are a number of background issues for this, including problems associated with the drastic shift to the renewable energies, the current situation where electricity is imported from France where there are many nuclear power plants, the fact that the electricity prices have increased by a large margin because of the FIT system applied to the renewable energies, and the pressure to achieve the emission reduction target. With regard to this, in 2009, Öko-Institut has, as requested by the UBA of Germany, conducted a research to calculate the total green house gas emission for all types of power generation.

France:

The same as other EU countries, the main focus of efforts to achieve the reduction target is on changeover to biomass energy and improvement on efficiency of building related energy saving measures. As is obvious from the fact that more than 70% of the R&D budget of the Ministry of Higher Education and Research (MESR) and that of ADEME which is an official agency of the Ministry of Ecology, Energy, Sustainable Development, and Management of Territory (MEEDDAT) and also a member of LCS-RNet is spent on energy related matters, they have been discussing about energy related policies since the 1990s. In 1995, the National Program for measures against global warming was formulated by International Negotiating Committee (INC) in an effort to achieve the action targets of the United Nations Framework Convention on Climate Change. In 2000, the prime minister summoned Interministerial Commission on the Climate Change (CIES) to adopt the National Program for Tackling Climate Change (PNLCC) submitted by the Interministerial Taskforce on Climate Change (MIES). In 2004, Climate Plan is published as a measure against global warming. In recent years, MEEDDAT was established in 2007 making it possible to coordinate between measures related to climate change/energy and policies related, in the broad sense, to domestic and overseas development. As for the carbon tax bill which has been proposed a number of times since the beginning of 2000, although there was a court decision again in 2009 to consider it as unconstitutional on the basis of the issue of fairness between sectors/enterprises, as the current government is very keen to introduce it, an amended bill was approved in a Cabinet meeting in January 2010.

Formulation of a roadmap through participatory approach, where researchers and stakeholders invited by the Council for Strategic Analysis (Conseil d'Analyse Stratégique, used to be "Committee for Plan (Commissariat au Plan)", have a series of dialogues, has been progressing since early days. The Grenelle Environment meeting (Grenelle Environnement) began in 2007. In order to consider the environmental problems throughout the entire society, participated by five stakeholders, the government, local governments, consumer groups, unions, and NGOs, this meeting, after setting such targets as ecology and sustainable national land development, formulates a roadmap. As much as three subcommittees out of six which commenced in 2007 potently contain those elements that are associated with the low-carbon society, for example, "Measures against climate change and suppression of energy demand", "Adoption of sustainable production/consumption methods", and "Recommendation of environmental protection oriented development model favorable for employment and competitiveness". Recently, investment in sustainable development leveraged by a large quantity of government bond of about 100 billion euros was announced; out of it, 6 billion euros will be spent on support for cutting-edge environmental technologies. Priority areas include such low-carbon technologies as biomass energy, wind power, solar energy, geothermal power, ocean energy, bio fuel, automobile, zero-carbon via carbon capture and CCS, smart grid, energy storage and battery, improvement on building efficiency, biomass materials, and optimization of industrial processes, distribution and management.

Italy:

The Italian Ministry for the Environment and Land and Sea took initiative to establish Euro-Mediterranean Centre for Climate Change by integrating six climate change related research institutions as follows: Istituto Nazionale di Geofisica e Vulcanologia, Fondazione Eni Enrico Mattei (FEEM), Università degli Studi del Salento, Centro Italiano Ricerche Aerospaziali, Consorzio Venezia Ricerche, Università degli Studi del Sannio. The purpose of integration was to establish a more integrated research center where a variety of research projects can, while restricted to the Mediterranean area, supplement each other. The main area of research is the development of climate model and development of those models that are related to influence, adaptation and reduction. For example, at FEEM, they are conducting model analysis regarding influence of R&D, policies and carbon prices. The awareness of the Italian government that the cross-sectional

approach is important for low-carbon society research was the background for the establishment of LCS-RNet and the support for hosting the 2009 annual meeting. In 2009, Italy, as G8 presidency holder, led the way to Copenhagen by hosting a high-level forum for low-carbon technology.

The US:

As the US trying to achieve carbon reduction mainly by means of technological response/ technology development, the research framework at DOE/EPA is being developed. Such concept as "low-carbon society" has not been promoted in a clear-cut manner.

Although the US broke away from Kyoto Protocol in 2001 due to rather negative political attitude toward the measures to reduce GHG emission by the previous government which lasted for 8 years since 2001, it was expected that there would be a change of policy as the supreme court handed down a decision in 2007 that green house gas should be subject to the Clean Air Act. Starting from 2008, the process to adopt the cap and trade legislation, which aims to reduce the GHG by 14% (from 2005) by 2020 and 83% by 2050, has begun.

In 2009, the new president, in the State of the Union message, requested Congress to pass the cap and trade legislation as well as the Acceleration of Renewable Energy Production Bill, and in the Budget Message outline, to formulate an economy-wide emission reduction plan to reduce the green house gas emission by about 14% (from 2005) by 2020 and about 83% (from 2005) by 2050. In June of the same year, the House of Representatives passed the American Clean Energy and Security Act (Waxman-Markey Bill: establishes a cap & trade system for greenhouse gas emissions, establishes a renewable electricity standard, a low carbon fuel standard, and energy efficiency programs and standards for buildings, lighting, vehicles, etc. output-based allowance allocation mechanism). In September, the Senate Bill (to make the GHG emission decrease in 3 years time) was submitted. At the UNFCCC COP15 in December 2009, the US showed its enthusiasm by taking an active role in the establishment of a new framework.

Activities at state level are in progress particularly in the Western states. They include Regional Greenhouse Gas Initiative (RGGI), California Global Warming Solutions Act (AB32), Western Climate Initiative (WCI), and Midwestern Greenhouse Gas Accord (MGA). Northeastern states like Massachusetts,are also pioneering in the emission trade system.

With regard to the research based on low-carbon society approach, although it has been recognized that, in addition to the conventional technology scenario based research, social science based research is necessary, there have not been many examples of research actually carried out by researchers.

People not only in the environment area, but also in the science and technology area are getting interested in such approach as low-carbon society.

Canada:

Although Canada was actively engaged in formulation of countermeasures against a difficult background where the 2003 GHG emission was 24% higher than that of 1990, there was a strong opposition from the business world. As the trend shifted after the change of the government, in May 2007, Canada announced that it abandoned the implementation of Kyoto Protocol obligation. The amount of emission, after that, is basically in an upward trend due to the GHG emission in the process of refining of oil sand, which is an alternative fuel caused by the spike in oil prices. As the attitude of the central government is somewhat negative towards global warming issues, there has not been much progress in policy/research area. However, as Canada is a country of two-tiered structure, federal level and regional level, there is a possibility that some independent policies are pursued at regional level independent of those at federal level. There are active movements in relation to such stakeholder meetings as Round Table on the Environment and the Economy as well as the initiatives taken by the local government to share the emission trade market with the northern states of the US. The National Round Table on the Environment and the Economy (NRTEE) is an

approach to let the knowledge of business and research experts be reflected on the policy making where those reports that have been approved by the members of round table meeting appointed by the Minister for Environment are submitted to the parliament. The members get together regularly to carry out a range of activities such as research review, adoption of reports, and establishment of new themes. Reports that have been prepared like this include Achieving 2050: A Carbon Pricing Policy for Canada (2009) and its Technical Report, Getting to 2050 Canada's Transition to a Low-emission Future (2007). Among other researchers at university, there are those researchers who hold such perspective as making a reduction scenario while incorporating people's taste/preference when selecting technologies (for example: Professor John Nyboer, Simon Fraser University). However, there seems to be no collaboration, etc. among researchers. In addition, the Ministry of Environment itself, partly due to the federal system, does not have information concerning what sort of related researches are being conducted at various Canadian universities nor there seems to be a move toward orchetrated research cooperation.

- Japan:

As you can see from the fact that the Basic Law for Prevention of Global Warming is being discussed at the moment, the framework for low-carbon policy has not sufficiently been developed yet. The policy discussion started from around 2007. "Low-carbon society research" of the National Institute for Environmental Studies whose policy consideration began to move and which started from 2007 preceded other activities and supported the policy formulation. Following that, the Council for Science and Technology Policy and the Ministry of Economy, Trade and Industry started to formulate technology roadmaps. The Ministry of Education, Culture, Sports, Science and Technology launched Investigative Meeting for Research and Development Strategy for Achieving a Low-carbon Society from 2010 and established the JST Centre for Low Carbon Society Strategy in December 2009. A number of research organisations adopting low-carbon society as their slogan are being established in a variety of forms including those similar to COE at universities and so on. However, any cross-sectional research organisation which gives unified support as a whole to the policy has not formed yet. In this network, the National Institute for Environmental Studies is nominated as the core research institution for domestic coordination in Japan.

Developing countries in Asia:

Although these countries have not been very keen in taking a initiative to suppress the greenhouse gas emission, they are now willing to formulate a medium to long term mitigation plan as there is a mounting necessity, in the discussion process for the new international framework in preparation for Copenhagen, to formulate a GHG reduction measures using the funds from the developed countries for the NAMA, for example. In addition, in ASEAN countries, although it has not become a sort of policy which sets a direction for the overall policy, more and more countries started to include "green growth strategy" as one of the national targets. There has been a move toward establishment of COE among those research institutions such as university which, in response to that, have been cooperating with the government to set up a national plan.

China:

China has been systematically conducting research projects for the future establishment of low-carbon society from early days. In 2008, the Chinese Academy of Sciences published a report titled "China's Approach towards a Low Carbon Future". In 2009, the Energy Research Institute, National Development and Reform Commission published a scenario research titled "Chinese Road to Low Carbon Development for 2050" (started as a joint research with the National Institute for Environmental Studies of Japan). As a number of COEs adopting low-carbon as their slogan, including a few at Tsinghua University, are being established at universities all over China, there is no doubt that research base is being established in China. With regard to those research institutions

under the Ministry of Environment, CREAS has newly established a research group concerning low-carbon development; and another institution has established a center for research on low-carbon economy inviting a director from Europe. At Tsinghua University, a research institute which has been carrying out researches on nuclear energy established a low-carbon society research division, inputting as many as 40 young researchers including postdoctoral fellows, and becoming a member of ICLCS (of which the State University of New York at Stony Brook is playing a key role), an international research network mainly consisting of universities. As you can see above, the research on low-carbon development and low-carbon economy is becoming so popular that you can almost say that there are too many institutions of them.

India:

In June 2008, India announced its own National Action Plan to tackle global warming.
The following eight items are specified: 1) Promotion of the use of natural energy such as solar power (100 MW PV/yr; 1,000 MW Thermal by 2017), 2) Improvement on energy efficiency (10,000 MW saving by 2012), 3) Sustainable environment, 4) Improvement on efficiency concerning the water use by 20%, 5) Preservation of Himalayan eco system, 6) “Green India” to increase the ratio of forest area from 23% to 33% by encouraging reforestation, 7) Strategic knowledge concerning the sustainable agriculture and climate change, 8) Save 10,000 Megawatt by 2012 by improving energy efficiency. According to the medium term target reported to the United Nations Framework Convention on Climate Change in January 2010, India is going to reduce the energy consumption per GDP by 20-25% from 2005. However, it is that emission from agriculture sector is excluded from the target.

The 2008 National Action Plan includes an item called “strategic knowledge for climate change”. Mr. Shukla et. al of the Indian Institute of Management Ahmedabad are carrying out scenario studies using a nationwide scenario based on integration model and city-by-city expanded snap shot model (ExSS).

Indonesia:

In Indonesia, following the President Yudhoyono’s announcement of the policy of 26% reduction of emission from the baseline (BAU) by 2020 in September 2009, the government-wide initiative to formulate the mitigation plan has began with an intention of achieving the dual goal of climate change prevention and sustainable development of the society/economy. Already, the State Ministry of Environment (KLH) has published National Action Plan Addressing Climate Change (RAN-PI) and the 2nd National Communication; and the National Development Planning Agency (BAPPENAS) has published Climate Change Roadmap as well as Medium Term Development Plan 2010-2014 (RPJM). Mitigation targets involve the following seven main areas: energy, forestry, waste management, peat-lands, traffic, industry and agriculture (forestry: 13.3%, peat-lands: 9.5%, the remaining five sectors: 3.2%).

The Indonesian National Commission on Climate Change (NCCC) has prepared a strategic report regarding low-carbon economy development support in Jambi and Kalimantan region calculating the GHG reduction cost curve for Indonesia.

In the scenario/model analysis in 2007 National Action Plan Addressing Climate Change, the future path of the following four emissions are examined: 1) Implementation of the Presidential Decree to deal with the energy crisis (May 2005), 2) Nuclear power generation, 3) Geothermal power generation, and 4) CCS.

Indonesia is cooperating with Japan through climate change tackling program loan program. A number of universities are involved in this program loan in a variety of manners. In addition, the Arief Anshory Yusuf research group of Padjadjaran University is carrying out an analysis project in relation to three “E”, (Economy, Equity and Environment) using a general equilibrium model, INDONESIA-E3. Research in energy sector is being carried out at the Center for Research on

Energy Policy, Bandung Institute of Technology and research in forestry sector is being carried out at the Centre for Climate Risk and Opportunity Management, Bogor Agricultural University, while the results of these research projects being communicated to the policy makers.

Thailand:

It seems that there are regional targets as well, for example, the Bangkok area five-year plan: 15% reduction by 2012. The main pillars include improvement of traffic system, renewable energy, economic use of energy and economic use of energy concerning buildings, waste disposal, and expansion of forest. In Thailand, an environment energy consortium has been formed led by the government/Science Foundation. In addition, social science based research is being carried out focusing on "Sufficient Economy" i.e. the philosophy of "moderation" where doing too much should be avoided, and the importance of collaboration/cooperation/synergy in the community. However, we don't have much information about research projects which would give basic support for the preparation of roadmap containing actual policy mix.

• As discussed above, integration of research corresponding to the policy is progressing among G8, G20 and outreach countries. However, as there are many situations, even in the developed countries, which could make the integration particularly difficult, reality is that effort to unify it is not necessarily being made. It would be probably appropriate to say that the developing countries are keen in accepting research projects from the developed countries in response to the formation of policies connected to foreign aid and trying to conduct researches for the low-carbon development.

Table 1. Progress of LCS poklicy and related research (next page)

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
Overall Item-by-item	Rapidly moving	Rapidly moving	More international treaties are coming into the scene	Gradually being set up	Cross-sectional orchestration such as COE has been progressing	There are differences between the developing countries and the developed countries
Japan	Slightly behind		07: "21st Century Environment Nation Strategy" 08: "Action Plan for Achieving a Low-Carbon Society" 09: "Basic Law for Promotion of Achieving a Low-Carbon Society" bill was submitted to the Diet (before the change of government) 09: "Hatoyama Initiative" 09: "The Ministry of Education, Culture, Sports, Science and Technology, Research and Development Strategy for Achieving a Low-Carbon Society" 10: "Medium to Long term Roadmap plan" 10: "Basic Law for Prevention of Global Warming" is scheduled to by submitted to the Diet	04: "Low-Carbon Society Scenarios toward 2050 Research Project" (NIES) started 06: "Energy Technology Vision and Roadmap 2100" (Ministry of Economy, Trade and Industry) 09: "Center for Low Carbon Society Strategy" was established (Japan Science and Technology Agency: JST) 09: Japan Climate Leaders Partnership (Japan-CLP) (industry)	Increase of the number of COE at universities Integrated promotion budget for research of earth environment (S6) "Low-Carbon Society Scenarios toward 2050 Research Project" (commenced in 2004, NIES) "Energy Technology Vision and Roadmap 2100" (METI) "The Ministry of Education, Culture, Sports, Science and Technology, Research and Development Strategy for Achieving a Low-Carbon Society" (2009) Japan Science and Technology Agency (JST) established the Center for Low Carbon Society Strategy (2009)	
The UK	Leading the pack	The industry, government and private sector are cooperating in sharing/managing all the knowledge and information related to research, policy and actual economic activities toward a low-carbon society	08: Policy package: "Climate Change Act", "Energy Act", and "Planning Act". 09: The Fifth National Communication (DECC) 09: The UK Low Carbon Transition Plan 09: Low Carbon Industrial Strategy: A vision 09: Joined International Renewable Energy Agency (IRENA) 09: Report "Energy Security: A national challenge in a changing world" 10: CRC: Carbon Reduction Commitment	06: Stern Review 07: Energy white paper (DTI) / MARKAL and MARKAL–MACRO model of UKERC PAS2050 standard / Carbon footprint (pilot project from 2007) Under the Climate Change Act, the Committee of Climate Change consisting of experts of science and economy was established. This committee conducted analysis on science/economy/society, prepare a report and give advice to the government.	02: Establishment of UKERC, etc. This is a center for renewable energy research and a consortium of 15 research institutes. For example, Tyndall Centre, one of its members, is involved in a range of researches including benefits of low-carbon society in terms of air quality and human health, governance of climate change, consumption, economic costs and roadmap of low-carbon initiative using E3MG/CIAS model	Model based scenario research Renewable energy, nuclear power, carbon capture and storage technology (CCS), etc. Market mechanism based policies such as EU Emission Trade System (EU ETS), and Climate Change Levy

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
Korea		Flag of green growth	Korea, under Low Carbon Initiative, is implementing more advanced policies than Japan 09: Promotion of Green New Deal for job creation 09: Five year plan for green growth 09: Basic Law for Low-Carbon Green Growth (scheduled to be enforced in April 2010) Green growth business includes the following six areas: (1) Mew/Renewable energy, (2) Carbon reducing energy, (3) High-level water treatment, (4) Application of LED, (5) Green transportation system, (6) Advanced green city	Urgent national task includes response to environmental resource crisis and creation of new growth engine. The Korean National Institute of Environmental Research (NIER) has developed a national scenario for the realisation of low-carbon society.	Research on Green growth by the Korean National Institute of Environmental Research (NIER) and the Korea Environment Institute (KEI)	

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
Italy			The same as other EU member countries, the mainstay is the improvement of efficiency on energy and building. Fixed price purchase system (Feed-in-tariff) has been established in relation to solar energy and other forms of small-scale renewable energy power generation up to 1 MW. For example, 20 EUR cents/kWh for geothermal plant, 34 EUR cents/kWh for wave/tidal power generation, 22 EUR cents/kWh for water power generation; other modes of power generation include biomass and wind power	Established the Euro-Mediterranean Centre for Climate Change by integrating six climate change related research institutions. The purpose of integration is to establish a more integrated research center. The main area of research is climate model and development of those models that are related to influence, adaptation and reduction.	Six institutions, which became a part of CMCC, are carrying out, while taking advantage of their own specialties, research projects based on climate model and models related to impact, adoption and reduction. FEEM is carrying out model analysis regarding impact of R&D, policies and carbon prices.	
Germany	Leading the pack	Research toward a low-carbon society is being conducted with the help of private sector in the form of commissioned research from the government to research institutions.	90: The Parliamentary Enquete Commission (50% MPs, 50% scientists) has already considered 80% reduction target by 2050. 96: Policy to promote utilisation of renewable energy 00: Decided to discontinue atomic power generation 2002: Parliamentary Enquete Commission for renewable energy 2004: Quantitative energy scenarios for Germany: -80% GHG by 2050, with DLR (German Aerospace Center), etc. 2005: Long term energy scenarios for Germany (UBA) 07: Meseberg Package (aim: 40% target) “Integrated Energy/Climate Program Outline” 07: “Integrated Energy/Climate Program” 08: “German Strategy for Adaptation to Climate Change” 09: Revised “RE Law”	Since 1990, researches on energy and reduction targets have been conducted. More than one institution are conducting research on 2050 energy scenario. The half of Parliamentary Enquete Commission members are invited scientists in 1990. Research on Integrated Energy/Climate Program by the German Federal Environment Agency (partly done by Fraunhofer ISI Institute) UBA’s research commissioned to New Energy Research Institute (IfnE) “Expansion of renewable energy in the electricity sector” (to estimate the short/long term impact of the revised Renewable Energy Law which became effective from 2009) There is no research cooperation regarding LCS. Research on low-carbon city (Munich) by Wuppertal Climate Environment Energy Institute (WI) Scenario/Model analysis by Potsdam Institute for Climate Impact Research	There is no robust network among research institutes, or anything like that.	

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
France	Cooperation with researchers and stakeholders is progressing through participatory approach		95: National Program for measures against global warming 00: Adoption of National Program for Tackling Climate Change (PNLCC) 04: Climate Plan as a measure against global warming 07: Establishment of the Ministry of Ecology, Energy, Sustainable Development, and Management of Territory Target of 75% reduction below 1990 levels by 2050 and minimum 20% reduction below current level by 2020 (target of EU) Carbon tax legislation has been submitted a number of times since the beginning of 2000. 09: Court decision to consider Carbon tax as unconstitutional Jan 2010: The amended bill was approved in a Cabinet meeting. Formulation of roadmap through participatory approach Approach where researchers and stakeholders have a series of discussions has been developed since early days. The Grenelle Environment meeting (Grenelle Environnement) which began in 2007 was participated by the government, local governments, consumer groups, unions, and NGOs. As much as three subcommittees out of six are related to the low-carbon society, for example, “Measures against climate change and suppression of energy demand”.	The main focus of efforts to achieve the reduction target is on changeover to biomass energy and improvement on efficiency of building related energy saving measures. MIES (Interministerial Taskforce on Climate Change): Factor 4 scenario analysis of the target of 75% reduction below the 1990 levels by 2050 (IDDRI, ADEME) Recently, investment in sustainable development leveraged by a large quantity of government bond of about 10 billion euros was announced; out of that, 6 billion euros will be spent on support for cutting-edge environmental technologies. Priority areas include biomass energy, wind power, solar energy, geothermal power, ocean energy, bio fuel, automobile, zero-carbon via carbon capture and CCS, smart grid, energy storage and battery, improvement on building efficiency, biomass materials, and optimization of industrial processes, distribution and management.	The French Environment and Energy Management Agency (ADEME), although it is not a research organisation in itself, is playing a central role, under MEDDAT and Ministry of Higher Education, in facilitating and coordinating research projects.	Priority areas include biomass energy, wind power, solar energy, geothermal power, ocean energy, bio fuel, automobile, zero-carbon via carbon capture and CCS, smart grid, energy storage and battery, improvement on building efficiency, biomass materials, and optimization of industrial processes, distribution and management.

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
Korea		Flag of green growth	Korea, under Low Carbon Initiative, is implementing more advanced policies than Japan 09: Promotion of Green New Deal for job creation 09: Five year plan for green growth 09: Basic Law for Low-Carbon Green Growth (scheduled to be enforced in April 2010) Green growth business includes the following six areas: (1) Mew/Renewable energy, (2) Carbon reducing energy, (3) High-level water treatment, (4) Application of LED, (5) Green transportation system, (6) Advanced green city	Urgent national task includes response to environmental resource crisis and creation of new growth engine. The Korean National Institute of Environmental Research (NIER) has developed a national scenario for the realisation of low-carbon society.	Research on Green growth by the Korean National Institute of Environmental Research (NIER) and the Korea Environment Institute (KEI)	

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
Canada	The characteristics of Canadian policies are the fact that they tend to be greatly influenced by the US climate change policies		Two-tiered policy structure consisting of those at the federal level and those at the regional level Federal level: Response to the KP: (1) Ratification of the KP, “hurry up and wait”, (2) Gave up implementation of the target, focus on post-2012 framework Regional level: Two kinds of dynamics: (1) Its own policies in the absence of those at the federal level, (2) Influence the federal government through common regional policies 07: Turning the Corner Green Plan 07: Regulatory Framework for Air Emissions which includes the use of emission trade system 08: Detailed draft of emission trade system (Turning the Corner: Regulatory Framework for Industrial GHG Emissions). This was scheduled to be effective in January 2010, but postponed. However, the government is still expressing its commitment to 17% GHG reduction (below 2005 levels) by 2020 The government is implementing the following policies/measures: Emission regulation (an offset system was established in 2008. In the future, this will be linked to the US cap and trade system), improvement of energy efficiency, increase of renewable energy, and promotion of technology development/dissemination.	06: Advice on a Long-term Strategy on Energy and Climate Change (NRTEE) Other NRTEE reports Getting to 2050: Canada's Transition to a Low-emission Future (2007) Achieving 2050: A Carbon Pricing Policy for Canada (2009) Natural Resources Canada (NRCan) has prepared five scenarios consisting of four scenarios representing those future images that do not include reduction target and the one that maintains the reduction ratio required to achieve the Kyoto targets.	Research papers presented at academic conferences are in themselves not many. People not only in the environment area, but also in the science and technology area are getting interested in such approach as low-carbon society	

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
China		Rapidly developing	National Climate Change Programme by the government. 06: An energy-saving /emission-reduction steering group was established under the prime minister. 07: Energy-saving/Emission-reduction work plan; Energy-saving Law Monitoring will to be carried out by introducing the Energy Intensity per GDP system, etc. Differentiation of energy charge applied to the energy intensive industries. Low-carbon economy was mentioned in the 12th five year plan.	The notion of low-carbon economy was incorporated in the five year plan, making it an important part of the national policy. For this reason, many research institutes have raced to start LCE research. As a result, there are almost too many of them. NDRC Energy Research Institute presented a scenario Center for Climate Change and Environmental Policy (CCEP), Environmental Regulation Planning Academy, Ministry of Environmental Protection, Institute of Policy and Management, Chinese Academy of Science Tsinghua University: Institute of Nuclear and New Energy Technology, Institute of Energy, Environmental Economy, and Low-carbon Laboratory Institute of Policy and Management, Chinese Academy of Science: Report on low-carbon society research (Chinese sustainable development strategy report – searching for Chinese way of low-carbon society Future, Professor Wang Yi, used to work for CRAE, 2009)		Research on LCE Co-benefits including environmental, social, economic solution other than GHG
Thailand		Collaboration with social satisfaction society	Bangkok area five year plan: 15% reduction by 2012 The main focuses of attention include improvement of traffic system, renewable energy, economic use of energy and economic use of energy concerning buildings, waste disposal, and expansion of forest	Social science based research is being carried out focusing on “Sufficient economy” i.e. the philosophy of “moderation” where doing too much should be avoided, and the importance of collaboration/cooperation/synergy in the community.		

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
India			08: Announced National Action Plan to tackle global warming. The following eight items have been specified: promotion of the use of natural energy such as solar power, improvement on energy efficiency, to increase the ratio of forest area from 23% to 33% by encouraging reforestation, and to improve energy efficiency. According to the medium term target in January 2010, India is going to reduce the energy consumption per GDP 20-25% below 2005 levels. However, it is that emission from agriculture sector is excluded from the target.	2008 Action Plan includes an item called “strategic knowledge for climate change”	Scenario study using a nationwide scenario based on integrated model and city-by-city expanded snap shot model (ExSS) and so on	
Indonesia	Regardless of what Indonesia says in the international negotiation, the government has started to take reduction initiatives	Movement in response to aid	09: As the president announced a policy of 26% reduction of emission from the baseline (BAU) by 2020, this value was also reported as the voluntary reduction target in a report to the UNFCCC required by the Copenhagen agreement. National Action Plan Addressing Climate Change (RAN-PI) and the 2nd National Communication by the State Ministry of Environment (KLH) The Climate Change Roadmap and the Medium Term Development Plan 2010-2014 (RPJM) by the National Development Planning Agency (BAPPENAS)	At the dialogue between policy makers and researchers held by the LCS-RNet Secretariat in February 2010, some of the researchers who participated said that it was the first time for them to have such opportunity.	Research is being carried out by a group led by Arief Anshory Yusuf at Padjadjaran University (general equilibrium model analysis); in energy sector at the Center for Research on Energy Policy, Bandung Institute of Technology; and in forestry sector at the Centre for Climate Risk and Opportunity Management, Bogor Agricultural University, while the results of these research projects are communicated to the policy makers	The government has set the mitigation targets centering around the following seven areas: energy, forestry, waste management, peat-lands, traffic, industry and agriculture

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
The US	Focus of the policy is on technology. The research world is also in a state of waiting for government's articulated direction and funding.		April 01: Broke away from Kyoto Protocol 07: The supreme court handed down the decision that green house gas should be subject to the Clean Air Act. Since 2008, Deliberation to reduce the GHG by 14% (from 2005) by 2020 and 83% by 2050 was done. 09: The State of the Union message: requested Congress to pass the cap and trade legislation as well as the Acceleration of Renewable Energy Production Bill June 09: The House of Representatives passed the American Clean Energy and Security Act, Waxman-Markey Bill, cap & trade bill: reduction by 17% (from 2005) by 2020 and 83% (from 2005) by 2050 September 09: the Senate Bill (to make the GHG emission decrease in 3 years time) was submitted. At the UNFCCC COP15 in December 2009, the US took an active role in the establishment of the new framework. Activities at state level: Regional Greenhouse Gas Initiative (RGGI), California Global Warming Solutions Act (AB32), Western Climate Initiative (WCI), and Midwestern Greenhouse Gas Accord (MGA)	Scenarios for a Clean Energy Future Report by DOE; Researchers of Argonne National Laboratory, Lawrence Berkeley National Laboratory, the National Renewable Energy Laboratory, Oak Ridge National Laboratory, and PNNL jointly evaluated the possibility of scenario/model analysis, R&D, public policy to promote clean energy and so on. The All Modular Industry Growth Assessment (AMIGA), a general equilibrium model, by Donald Hanson of Argonne National Laboratory and others showed, targeting the period up to 2050, BaU and three other scenarios plus respective scenarios of which climate change measures were factored in. 09: EPA used two general equilibrium models, IGEM (Harvard Kennedy School) and ADAGE (RTI: International Sphere Institute) for evaluation/analysis of the impact of Waxman-Markey Bill 09: The US Climate Action Partnership (USCAP) published a blueprint (industry/NGO) There is a tendency for research institutions to obtain funds from multiple numbers of government agencies to maintain impartiality. In addition, there are many cases where funding is coming from research fund organisations rather than government agencies. People not only in the environment area, but also in the science and technology area are getting interested in such approach as low-carbon society.	With regard to the research based on low-carbon society approach, although it has been recognized that, in addition to the conventional technology scenario based research, social science based research is necessary, there have not been many examples of research actually carried out by researchers. People not only in the environment area, but also in the science and technology area are getting interested in such approach as low-carbon society.	

	Overall Country-by-country	Summary	Policy trend	Cooperation between policy and research	Trend of research world/orchestration	Important research theme
IEA UNEP		Trying		In case of IEA/OECD, they carry out many researches in relation to renewable energy including bio fuel and efficiency improvement including building energy saving because their mission is to provide information and products required by the member countries (developed countries). Mining of oil They carry out those researches that help achieve the maximum use of fossil fuel available to use, for example, improvement on efficiency of refinery operation. There hasn't been perspective to connect energy saving to CO_2 reduction.		

2. Approaches and issues of low-carbon society research

The knowledge required of the staff in charge of policy making for the construction of a low-carbon society cuts across a wide range of areas. Major tasks include how to set the medium to long term targets, policies to achieve the target and economic evaluation of them, effectiveness of technological development, how to let the people move toward a low-carbon society, and reconstruction of local communities/urban areas. The main concerns of the staff in charge of policy making in the developing countries include, in addition to those mentioned above, conservation of forests and soil, how to distribute aid funds, how to and in what manner identify a path leading to the low-carbon development while putting priority on economic development/poverty elimination.

2.1 Necessity for the integration of policies and research for low-carbon society research

The reason why low-carbon society research needs policy support through integrated research will be described in section 4 below. In this network, research approaches and issues were discussed mainly at annual research meetings with the participation of some staff in charge of policy making and stakeholders.

The reasons for adopting this method are based on the following characteristics of low-carbon society research:

Participatory approach: Although the creation of low-carbon societies is policy-driven, the responsive actions are carried out by stakeholders in each field. To ensure that research is effective in creating low-carbon societies, stakeholder participation is necessary for all the stages of identifying issues in the beginning, establishing a whole plan and formulating individual policies. Because the transition to low-carbon societies requires great and rapid changes, dialogues with the stakeholders are important from the early stages of the planning and implementation of the transition.

Place-based approach: The situation of policy makers and stakeholders differs among countries, regions, or development stages. Research that takes into account this difference (place-based science) is necessary for each stakeholder to put the research into action.

In this network, from the viewpoint described above, a world research meeting, a meeting between staff in charge of policy making and researchers, and dialogues among policy makers, stakeholders, and researchers were held in Bologna, Bogor and Yokohama, respectively this year, and distinguished suggestions were made at each of the meetings concerning the direction for the promotion of low-carbon research. In addition to these meetings, the Secretariat analyzed research issues concerning the creation of a low-carbon society (“12 Items Demanded by Policy Makers from Modelers”). Moreover, at the sectional meetings on daily life, industries, community development, and zero-emissions energy in the “Mid- and Long-Term Roadmap Review Conference” commissioned by the Ministry of the Environment of Japan, about 50 experts have examined what policies and research issues are necessary for achieving Japan’s mid-term targets, and some necessary research issues have been identified.

2.2 International research meeting in Bologna (reference: Toward the Realization of Low-Carbon Societies: Synthesis Report on the First Annual Meeting of LCS-RNet)

This was an annual meeting of LCS-RNet with the participation of 56 members of staff in charge of policy making, stakeholders, and researchers from advanced and developing countries throughout the world. In the two-day meeting, the following directions for policies and research were presented for the realization of low-carbon societies:

Summary of key messages

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.
- Backcasting 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 synchronised.

Public policy and lifestyle change
- Public policy can lead the way to lifestyle change and a low-carbon society.
- Facilitating behaviour 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.

2.3 Dialogue between policy making staff and researchers in Bogor (reference: Synthesis Report of the Bogor Meeting): This was a meeting for dialogues between policy makers and researchers. A two-day workshop was held in Indonesia with the participation of 80 persons, with the result that developing countries made suggestions concerning policies and research issues for low-carbon development. What were especially highlighted at the meeting were efforts for low-carbon growth strategies, effective international cooperation and the use of funds, creation of cooperation systems between the central government, local governments and various sectors, and knowledge about appropriate technologies and good practices.

Key messages of Indonesia
from the Dialogue between policy makers and researchers:
Demands and roles of SLCD/GG researches from policy perspective

Low Carbon Development and Green Growth
- Low Carbon Development is a good opportunity to realise sustainable development.
- Fundamental change in people's mindset is necessary to promote development.
- Harmonised policies and coordination between central and local governments, as well as across sectors, are key.
- Networking between/across local, national, regional and global levels to promote low carbon development, such as LSC-RNet, is important

Collaboration between policy- and research communities

- Developing national and sectoral roadmaps is effective approach to identify a course of actions required.
- Dynamic modeling is an effective tool to understand how policies in different sectors affect with each other.
- Activating research network with better linkage with policy-makers is an immediate need for sustainable development led by the low carbon development.
- Multi-disciplinary approach in the formulation of research is called for to meet needs in policy-making.

Areas to focus for promoting low carbon development

- Forestry and peat land and Land-use Change followed by Energy sector are given priority.
- Sustainable forestry/land use and land use change policies must be put in place.
- Energy source must be diversified by promoting locally produced renewable energy. (particularly geo-thermal source and solar power).
- To promote renewable, impact on whole ecosystem must be understood.

Technologies as fundamental element in Green Growth

- Technology is fundamental element to draw positive emission scenarios while ensuring sustainable development.
- Identification and deployment and dissemination of readily available low-carbon technologies should be prioritized in short-term.
- Development of appropriate local technologies is important in long-term.

Mobilisation of available financing schemes

- Scaled-up financing from international source is fundamental to achieve Indonesian target.
- Available source includes national budget, finances from international sources including ODA and multilateral schemes, private sectors, and NGOs.
- Best utilisiation of all available financial resources should be ensured.
- New institutional arrangement to ensure the efficient use of resource across sectors must be realized.
- Better coordination both vertically (national and local) and horizontally (across-sector) must be ensured.
- Clear signals to shift towards low carbon development, and diffusion of good practices, is essential

Life-style innovation for the sustainable low carbon development

- Traditional values and practices are rich in the tips for designing innovative lifestyle to enable low carbon development, while applicability to the modern context and different locality should be also carefully examined.
- Principles of traditional society, such as ‘sufficiency,’’ ‘co-existence with nature,’ and ‘cooperation’ should be re-vitalized in the current development context.
- Local and indigenous technologies, methods, and wisdom should be fully utilized in promoting Green Growth especially in sectors such as agriculture, fishery and forestry.

Notice: participants’ review in progress (26 March 2010)

2.4 Stakeholders Meeting in Yokohama (reference: Report on Stakeholders Meeting in Yokohama): As a meeting of stakeholders in Japan, an open meeting was held mainly with the participation of researchers in housing, regional development, retailing, technical development, regional administration, finance, social planning and low-carbon societies. The discussion issues were Japan's vision of a low-carbon society, obstacles to be overcome for low-carbon development, and policy problems from an on-site perspective. Many problems were pointed out against the background of the situation Japan will face in the future – that is, a declining birthrate, an increasing number of elderly persons, increasing energy costs, and the reconstruction of communities. Moreover, challenges to be tackled by Japan were identified, such as taking leadership in the transition, establishing the foundations for the provision of human resources and funds, and government-community cooperation in social systems reform.

Six key findings from the Stakeholders Dialogue in Yokohama
- Overcoming barriers to Low-Carbon Societies -

It is time to act. Change is an opportunity.

Japan is now in the midst of major changes as it faces a decline in population, an aging society, increased global competition for its industries, issues of managing national finances, energy security, the restructuring of land use, and so forth. Efforts to shift from the current energy-intensive society towards a low-carbon one will guide us in a major transition to realising a better future. It is thus important to consider these substantial changes as a major opportunity and make every effort to deal with them in a positive manner.

It is time to discover, find and create new values.

When the conditions surrounding the society change, this sheds light on things that were not sufficiently valued in the past. Discovering things that we lost due to industrialisation, such as traditional social systems that have long being maintained in local communities, traditions, institutions, and values, will help us to create new values to live in a low-carbon society. Venture business created using "Trust" capital is a good example. If people consider a house as a service to use in accordance with the needs of each generation, not something to "possess", this will help to establish houses as good long-lasting social capital together with their environment.

It is time to stop the compartmentalization of systems to make full use of the potential of each component in a harmonised way.

By internalising new values in economics, new industries or businesses will be created. Business people should be more positive in trying to develop new enterprises through joint ventures with different industries as well as through cooperation between cities and rural areas. By rediscovering the basic strength that was gradually established through tough experiences, such as pollution and economic recession, and by finding ways to establish new collaborative relationships amongst different industries, the Kawasaki coastal industrial zone has become rejuvenated as a new industrial area from its previous obstructive style. It is important for each government agency to give up its bureaucratic and compartmentalised policy-making style, and try to achieve the integration and harmonisation of policies. As an example, in housing policies it is necessary to implement comprehensive policy revisions such the abandonment of policies that encourage people to become private home owners, as well as to promote capacity-building for local carpenters to construct houses with low carbon emissions, to extend the average life of houses by promoting renovations, to revise building standards to eliminate basic obstacles to energy-efficient houses, etc. Business sectors should also give the authority for decision-making to the people working at the front line.

It is time to take risks and face challenges

In the midst of major social change, everyone must be ready to take risks to meet the challenges and build a new society. It is necessary to avoid adhering to the apparent current stability. It is encouraging to see more and more entrepreneurs who are willing to take risks. The financial sector could also apply methods of venture capital taking risks into account. The government must take up the role of providing safety nets for those who challenge these risks and guarantee opportunities to

start over again.

For policy-makers, it is time to give a clear signal of the need to shift to a low-carbon society and formulate policies with a long-term perspective that include safety nets, and then share this vision with the private sector.

It is time to espouse a clear vision as a nation of how to maintain a prosperous Japanese economy and of the kind of society we would like to pursue. The role of the government is to give a clear signal to indicate that we are in a transitional period, to propose strategies for the future and roadmaps toward achieving them. It is also important to involve the demand side on a global scale, and to support the identification and accumulation of intellectual property that is necessary for the technologies and systems required. Developed countries are putting individual technologies, systems technologies and planning, infrastructure, and finance together as whole systems to develop low-carbon societies or for urban planning and to sell these in the global market, mainly targeting developing countries. There is a huge potential for Japanese technologies if they are integrated into larger technological structures and systems, and this is the direction for Japan to go forward. Subsidies to overcome the initial barriers to making this shift towards a low-carbon society must be implemented within an appropriate time frame in ways that support social capital development and strengthen the capacity of industries over the long term. The role of the government is to raise the levels of the lowest standards. It would be better to leave it to competition within the private sector to then raise general levels to the highest standards.

It is time to trust the capacity of the private sector and make use of it

It is the private sector and individuals that will make the transition, and the government must trust their capacity. Japanese enterprises have sufficient potential to make changes. It is the private sector and individuals who will decide on, act on, and create the means to achieve a low-carbon society. It is important for them to demand what they require from each other. However, it is also important to make clear who will carry this out, and who are the objects of the changes. All stakeholders must be aware of their own responsibilities. Individuals and businesses must be aware of the mutual benefits and the importance of sharing them in order to design solutions in a rational way.

2.5 Policy makers' 12 questions (reference: Power Point with the same title)

Asia Energy Modeling Meeting (17 September 2009, Tsukuba, Japan) was held by National Institute for Environmental Studies (NIES) and Stanford University's Energy Modeling Forum (EMF) with about 30 participants from Japan, USA, Europe and other Asian countries. In discussion of the last session, titled future research themes, LCS-RNet was asked to provide inputs and Dr. Shuzo Nishioka, Secretary General of LCS-RNet presented on the relation between policies and researches in Japan. By reviewing the questions from policymakers through the working group for the 2020 (mid-term) target for emission reduction under the Aso Administration, and how researchers respond to them, the twelve frequently asked questions from policy makers to researchers were presented as follows:

- What will happen if there is no climate policy?
- How much reduction is necessary ultimately?
- How are reduction targets set for the world?
- What options are there for mid- and long-term reduction targets?
- How will the industrial structure change if domestic measures are taken?
- How much reduction is possible in each sector?
- Does land use have to be changed?
- How much does reduction cost?
- What policy means are there to achieve the targets?
- How much will they influence the state economy?
- Is it possible to win international competition?
- How can Japan contribute to the world?

3. Orchestration of the research: research promotion through domestic/ international cooperation

To effectively support such policy as construction of low-carbon society which is urgent and requires integrated knowledge encompassing a number of areas, Center of Excellence:COE, etc. which cut across research areas are, in parallel with formulation of policies, being established. The UK, which is driving forward climate change strategy in a proactive manner, has established, as an administrative machinery, the Department of Energy and Climate Change, clarified the policy package by enacting an act to encourage a transition toward the low-carbon economy, established the Committee on Climate Change to formulate unified policies, and, responding to these initiatives, formulated a network to integrate such research institutions as university for the purpose of promoting inter-disciplinary research on climate change so that the result can be reflected on the policies. In Japan, formation of permanent headquarter organisation has been delayed and researches are being carried out independently by individual ministry/agency. Although Japan Science and Technology Agency has recently begun taking initiatives for cross-sectional orchestration of the academic world, there still is a long way to go before it gets to the policy level. In Asian developing countries, for example in Indonesia and Thailand, etc., COE is being established as well.

3.1 Background to the need for integrated research and networks

Since the research institutes of many countries have already begun to carry out the research necessary for the creation of low-carbon societies, why is it necessary to create domestic or international networks of researchers? Because the purpose of a network is to promote the participants' sharing of information, joint addition of values, coordination, and supplementation, the network must facilitate the participants' achievements of targets through their cooperation. The following presents the background to the need for integrating and networking research for the creation of low-carbon societies:

(1) Importance and urgency: Low-carbon societies represent a considerable transition from the highly energy-dependent societies developed so far. In addition, since the emissions of greenhouse gases should be made to peak during the next several decades so that these emissions are halved by the mid-21st century, it is urgently necessary to share intelligence.
(2) Necessity of integrated knowledge: Because the transition to a low-carbon society has to occur in every field, knowledge in a wide range of fields is necessary and should be integrated effectively.
(3) The maintenance of global public goods through international cooperation: Because the climate is one of the global public goods, free-riders should not be allowed.. To prevent this, it is effective to improve the level of intelligence among all the members. In addition, if all the members in the world share intelligence, it will become easier to cope with the problem.
(4) Participatory approaches that ensure effectiveness: Activities for creating low-carbon societies are carried out by stakeholders and policy making staffs. The immediate use of the research results requires exchanges of these results from the point in time the issues emerge.
(5) Confirmation of regional characteristics: Conditions for the creation of low-carbon societies differ among countries and regions. Networks will enable better understanding of the differences and make cooperation more effective.
(6) Necessity for a new research approach: Because low-carbon society research, which has the clear goal of stabilizing the climate, applies Gibbons' Mode II research concept to a more global approach, it is necessary to jointly develop a new research concept, approach and method.

3.2 Characteristics of low-carbon society research

Low-carbon society research is important and urgent work that challenges the future at a critical crossroads for the human beings. This great challenge requires a research style (approach) that is different from the style so far. The creation of world networks will become a place for establishing a new research style through practice.

Fusion of natural, engineering, and social sciences for climate stabilization policies

When countries set reduction targets to realise a low-carbon society, consideration will be given to the temperature rise estimated from climate models and the damage caused by the rise, while consideration is given also to the impact of the control of greenhouse gases on industries. When countries make decisions, balancing the uncertainty of climate models, the irreversibility of the impacts, and the possibility and economic efficiency of measures, it is necessary to fuse climate science, regional environmental studies, engineering, industrial economics, and other studies. Only such a fusion of various sciences makes it possible to come up with political decisions about by how much emissions should be reduced.

Technologies in every field are necessary for the achievement of the targets, and the cooperation in science fields that supports them

Once targets are set, the potential of every technology should be tested to achieve the targets. Practical use of technologies requires the infrastructure for utilizing them based on the results of urban planning, regional planning, and traffic engineering. Moreover, the promotion of energy saving in houses and offices requires not only energy-saving technologies, but also tax and information systems that facilitate their promotion. It is also important to develop zero emissions technologies, such as those that greatly reduce greenhouse gases and those that make it possible to run cars using solar energy. At the same time, it is important also to manage research reasonably with limited funds by disseminating technologies already put into practice and existing technologies and by identifying low-carbon technologies that will become feasible in the near future and can be developed with some effort. It is helpful to use fiscal science, economics, business science, industrial policy studies, communications theories, and behavioural science analysis that facilitates human actions. To change the whole social system, it is necessary also to adopt policy studies concerning laws and customs as well as the ways of thinking of cultural studies and anthropology. In this way, it is essential to carry out cooperative research by mobilizing various kinds of intelligence.

Policy making by back-casting

The forecasting method has so far been used frequently to examine what policies and measures are effective in achieving targets and when they should be introduced. To eliminate the cause of later trouble, however, it is appropriate to use the back-casting method for making a plan to achieve reduction targets effectively by using all possible means. This new method sets targets first and then devises policies retroactively from the targets. Research and development with the use of such a new method is necessary for creating low-carbon societies.

Future scenarios chosen by the society: participatory approach

The transition to a low-carbon society is almost synonymous with how to create one's own country in the future. This means that each country is able to choose or visualize its own future. Therefore, a participatory approach – positive dialogues with citizens – is necessary not only during the process of choosing a future scenario and devising policies for the scenario, but also during the process of carrying out research on which such policies are based. To facilitate the development of the country in the 21st century, low-carbon research should proceed through a participatory approach. It is therefore important for researchers to continue dialogues with citizens, policy makers, and industries.

Importance of international cooperation

Climate stability requires the participation of all the countries in the reduction of greenhouse gases. It is especially essential to carry out joint research on methods for the promotion of effective cooperation between developing countries and advanced countries and the effective use of funds for cooperation so that developing countries which are likely to increase emissions greatly can develop into low-carbon societies.

3.3 Climate change policies and integrated research in the UK

The UK has been positively promoting climate change measures. The UK established the Department of Energy and Climate Change as an administrative organ, clarified a package of policies through the enactment of laws that facilitate the transition to a low-carbon economy, established a Committee on Climate Change for the formation of unified policies, and created a network of universities and other research institutes to promote cross-disciplinary research on climate change and to reflect the research results in the measures to be taken. (Mainly based on materials published by the UK Embassy in Japan)

Policies: The Stern Review published in October 2006 explained that if measures are not taken against climate change, the cost will rise to an unacceptable level, while the cost of climate change measures is estimated to be 1% of the annual GDP. Responding to findings of such research, in October 2008 the UK established the Department of Energy and Climate Change (DECC) as an agency that comprehensively coordinates the formulation of policies for two challenges; energy security and climate change. In November that year, the UK established a package of policies for controlling carbon emissions and facilitating the transition to a low-carbon economy, the Climate Change Act, the Energy Act, and the Planning Act which ensures the enforcement of the former two acts. The Climate Change Act 2008 is the world's first long-term and binding law for climate change policies and provides for the following: 1) legally binding numerical targets; 2) carbon budget (emissions caps on three agencies to be fixed every five years); 3) establishment of a Climate Change Committee; and 4) the UK Government's imposition of the obligation of emissions reporting on companies pursuant to the Companies Act by April 2012.

In June 2009, DECC published its Fifth National Communication, which was to be submitted to the UNFCCC. The Communication describes that the UK's emissions of greenhouse gases are expected to decrease by about 23% compared with the level in 1990. This rate of decrease is far greater than the target of 12.5% set in the Kyoto Protocol,[1] indicating that the UK is heading towards a low-carbon society. Moreover, in July 2009, the UK published the UK Low Carbon Transition Plan, which lists the following targets to be achieved by 2020: green employment of 1.2 million people; reconstruction of 7 million houses; support for clean energy generation at more than 1.5 million households; a carbon reduction in power generation by 40%; reduction of gas imports by half; and the reduction of average emissions from cars by 40%. Before the publication of this strategy, in March 2009, the "Low Carbon Industrial Strategy: A Vision" was published as the industrial world's first paper to give stakeholders an explanation if the long-term view on low-carbon industrial strategies.

The UK's climate change policies have placed importance on the realization of greenhouse gas reductions using a highly cost-effective method for organisations. The UK has used market-based policies, such as the European Union Greenhouse Gas Emissions Trading System (EU ETS), the Climate Change Levy, the Climate Change Agreements, and the Carbon Reduction Commitment, in order to maintain the principle of sound competition and improve the business environment, while

1 http://ukinjapan.fco.gov.uk/resources/ja/news/11700226/19081700/uk-kyoto-protocol-annoucement-j

dealing with climate change.[2]

In addition to the EU ETS, which started in 2005 for power stations and heavy industries, the three-year trial period of the Carbon Reduction Commitment (CRC) started in April 2010. CRC is an obligatory emissions trading system imposed on non-energy-concentrated businesses and the companies and associations belonging to the commercial and public sectors. CRC will be introduced in earnest after the trial period.[3]

To cope with the decline in fossil fuel reserves, the UK has a choice between their replacement with an increasing volume of imported fuels or their replacement with low-carbon energy. Because the use of low-carbon energy is very important not only for climate change policies, but also for the UK's energy security and price guarantee, the UK considers that renewable energy, nuclear power, and carbon capture and storage (CCS) will play important roles in climate change policies. Concretely, the UK officially became a member of the International Renewable Energy Agency (IRENA) in June 2009 and published a report entitled "Energy Security: A national challenge in a changing world" in August 2009, in which the UK asserted that the transition to a low-carbon economy is important for energy security, along with climate change policies.

In the Low Carbon Industrial Strategy published on July 15, 2009, the UK Government has established Low Carbon Economic Areas (LCEAs), a plan to accelerate the growth of low-carbon industries and related technologies and industries in cooperation with the central and local governments and the Regional Development Agencies (RDAs), taking into consideration the geographical and industrial advantages of each domestic region.

Research: UKERC's research on the energy system model (ESM) has been carried out at Kings College London (KCL) and the University of Cambridge. The results of research on MARKAL and MARKAL-MACRO models were also in the UK Energy White Paper published in 2007 by the Department of Trade and Industry (DTI).

In its low-carbon society program, the Tyndall Centre, which carries out academic efforts for climate change research, has analyzed challenges concerning different climate stability levels and low-carbon roadmaps and has dealt with such themes as technology, behaviour, and control across a wide range of issues in space, time, and sectors. Concretely, research has been carried out on themes such as low-carbon society's benefits to atmospheric quality and human health, the control of climate change, consumption, the economic cost and roadmap for decarbonisation according to the E3MG/CIAS model, and the revision of REDD and CDM.

Spergen/FlexNet is a federation that is proceeding with research on low-carbon energy systems from the viewpoints of social science and technologies. Based on the UK Government's Low Carbon Transition Plan (LCTP), Spergen/FlexNet has analyzed what effects will arise when 40% of electricity is supplied by renewable energy in 2020 and what power systems will be necessary for achieving the Climate Change Committee's objectives – that is, an 80% reduction by 2050 and full decarbonisation by 2030.

The Carbon Vision Building Initiative is a four-year research project about how to reduce carbon

2 http://ukinjapan.fco.gov.uk/ja/about-us/working-with-japan/energy-environment/low-carbon-economy/

3 http://ukinjapan.fco.gov.uk/ja/about-us/working-with-japan/energy-environment/low-carbon-uk/carbon-reduction-commitment/

emissions in buildings.[4] This project has been financed by the Carbon Trust and the Engineering and Physical Sciences Research Council (EPSRC). Carbon Vision has also financed other research fields, such as the industrial process.

Towards a Sustainable Energy Economy (TSEC) is a research program supported by EPSRC and others and has been carrying out cross-field research activities, including not only UKERC's activities but also Keeping the Nuclear Option Open (KNOO), Managing uncertainties, and carbon management and renewable.

In addition, E-On, an energy company, also has used a large amount of funds to proceed with various research projects through a partnership with EPSRC, including the transition to a low-carbon economy.

In the 1990s, William Rees in Canada and others, advocated a concept called "ecological footprint," which expresses the load of human activities on the environment considered as an area necessary for reproducing resources or purifying waste. The metaphor of ecological footprint was used for the carbon footprint, which expresses the footprint of the volume of emissions. The method is similar to the methodology of life cycle assessment (LCA). This method has been used all over the world in the context of "sustainable consumption" and the "visualization of CO_2." In the UK especially, the Carbon Trust established standards called PAS2050 jointly with the British Standards Institution, began a pilot project in 2007, put the world's first carbon footprint-indicating goods on the market, and had the carbon footprint displayed on about 75 items from 20 companies by 2008. This attempt has drawn attention as an example whereby a research method has influenced not only policies, but also the behaviour of producers and consumers. The Carbon Trust was established by the UK Government in 2001 as an independent company that facilitates the transition to a low-carbon economy in response to the climate change problem. Its mission is to accelerate the transition to a low-carbon economy through joint efforts with various organisations to reduce carbon emissions and develop commercial low-carbon technologies. The Carbon Trust is partly financed by a climate change tax and is managing support measures such as the provision of no-interest loans to small and midsize companies for the introduction of energy-saving equipment.

As described so far, it can be said that, in the UK industry, academia, and government have cooperated with each other to share and manage knowledge and information at all the levels of research, policies, and actual economic activities toward achieving a low-carbon society.

3.4 Policies and research in Japan

In Japan also, the "creation of a low-carbon society" and research on it have begun to be integrated.

Policies: In Japan, the Cabinet approved the "Action Plan for Achieving a Low-Carbon Society" in July 2008 as a concrete roadmap for the transition to a low-carbon society. After this, the Liberal Democratic Party's Global Warming Countermeasures Headquarters drafted the "Basic Law on Promotion of the Creation of a Low-Carbon Society" and submitted it to the Diet in July 2009. After the Democratic Party of Japan came into power in 2009, the new Government announced a policy of providing support for measures in developing countries to combat global warming as well as the "Hatoyama Initiative," which includes the MRV principle. Domestically, the Minister of the Environment, Sakihito Ozawa, published "draft mid- and long-term roadmaps" for measures against global warming in February 2010, which specifies mid- and long-term targets: a 25% reduction in the amount of greenhouse gases by 2020 and an 80% reduction by 2050 (compared with the level in 1990). Moreover, although agreement has still not been reached concerning issues such as the concrete direction of environmental taxes and emissions trading, the industrial world's profits, and

4 http://pioneers.epsrc.ac.uk/exhibition/Interactivehome/Pages/Carbonvisionbuildings.aspx

the treatment of nuclear power plants, the "Basic Bill to Prevent Global Warming" will be submitted to the Diet during this year's session, which indicates that Japan has begun to move towards a low-carbon society.

Research: In Japan, as a forerunner of the consideration of policies for low-carbon society that begun around 2007, the National Institute for Environmental Studies began research under the "Low-Carbon Society 2050 Project" in 2004 to support the Government's formulation of policies. In/after 2007, the Ministry of Economy, Trade and Industry published the "Energy Technology Vision and Roadmap 2100" concerning energy technologies essential for achieving the targets. In August 2009, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) published the "R&D Strategies for the Creation of a Low-Carbon Society" and established a strategic headquarters. Utilizing its advantage in the fields of science, technology, and education, MEXT came out with integrated concepts of green innovation (efforts for a low-carbon society), brown innovation (revitalization of agriculture, forestry, and fisheries) and silver innovation (urban planning for an aged society). In December 2009, the Japan Science and Technology Agency (JST) inaugurated the Center for a Low Carbon Society Strategy, and universities have begun to establish research institutes for a low-carbon society in various forms, such as a "center of excellence." Established comprehensive strategies and scenarios will be used for the Government's efforts to create strategies for a low-carbon society. In addition, the National Institute for Environmental Studies, a member of LCS-Rnet, has been designated as a core research institute for domestic cooperation in Japan. To respond to these movements, it is necessary to create a network that covers the whole of Japan.

Business: In the industrial world, a "low-carbon society" is one of the important keywords in the light of how companies can contribute to the solution of the climate change problem as members of the society. The Japan Climate Leaders' Partnership (Japan-CLP) is a network of companies that regard taking the leadership in the transition to a sustainable low-carbon society as their business chance and opportunity for the next stages of development (the members are AEON, SAP Japan, Obayashi Corporation, Tokio Marine & Nichido, Fujitsu, Bank of Tokyo, Mitsubishi UFJ, and Ricoh). For example, Ricoh has adopted the back-casting method. Although Ricoh has established a mid-term environmental action plan every three years, this caused delays in the development of technologies and Ricoh could not keep up with the rapid change in society and competition. To cope with this problem, in 2007 Ricoh established a mid-term action plan based on the long-term environmental targets for 2010 set up from the environmental vision for 2050. Such a plan is used only for in-house behavioural standards, and does not indicate the direction Japan that should take.

City: After Prime Minister Yasuo Fukuda made his policy address to the Diet in January 2008, Japan has been making efforts to promote low-carbon cities, including the "Environmental Model City," a concrete measure specified in the "Plan to Improve Cities and Urban Life" approved by the Regional Revitalization Headquarters, and the Promotion Council for Low-Carbon Cities, which was inaugurated in December 2009 to create low-carbon cities and communities by carrying out excellent measures for environmental model cities throughout Japan and by disseminating Japan's excellent measures to the world in cooperation with foreign cities that are positively addressing the creation of low-carbon societies. Tokyo Metropolitan Government starts its own Emission (cap and) Trading system from 2010, proir to the Central Government.

Research on the creation of low-carbon societies: The following are the main research activities.

- The National Institute for Environmental Studies presented a scenario of 70% reduction by 2050 in its "Low Carbon Society 2050 Project," using an integrated model.
- In its "Asian Low-Carbon Society Study," the National Institute for Environmental Studies expanded the above-mentioned integrated model to an integrated evaluation model for measures

against global warming in the Asia-Pacific Region.

- Kyoto University prepared a policy roadmap for self-governing bodies in its “Scenario and Model Studies on Low-Carbon Cities (Shiga and Kyoto).
- The Research Institute for Innovative Technology for the Earth has researched environmental technologies and made economic evaluations for the 21st century in its “Dynamic New Earth 21 (DNE21) Model.”
- Osaka University presented its research results in the “Direction of Low-Carbon Cities: Environmental Innovations to Improve Sustainability.”
- The Institute for Global Environmental Strategies published “A New Development Pathway to Low-Carbon and Sustainable Asia and the Pacific.”
- In its “Ultra-Long-Term Energy Technology Vision,” the Institute of Energy Economics showed a roadmap until 2100 concerning energy technologies necessary for the creation of low-carbon society.
- The Center for Low Carbon Society Strategy of the Japan Science and Technology Agency (JST) is preparing R&D strategies for the creation of low-carbon societies on behalf of the Ministry of Education, Culture, Sports, Science and Technology.

4. Why international research network ?: Added-value

(See: Summary Report of Responses to the Evaluation Questionnaire for Government Focal Points and Observers at the Bologna Annual Meeting.)

The policy makers who attended the Bologna meeting in October 2009 were acutely aware of the importance of research exchange through international research network. Their opinions were that what is urgently needed for the policy makers now is accurate information; it is very important to learn each other from the policies of others and their successes and failures; excellent opportunities should be provided to carry out an effective research by making it respond to the request from the policies; and more value should be added by carrying out those researches that have not been carried out by other international institutions, for example, research on long-term perspective, sociological analysis, and policies related to individual behavioural change (lifestyle). They expressed their expectation for timely outputs that can serve as a reference to the policy makers as well as necessity to expand the activities to G20 and outreach countries. The background for this seems to be the urgency in formulating policies toward a low-carbon society where little time afford to wait for accumulation of knowledge and policy examples in one country and the rationality of learning from each other's knowledge and experience among Annex I countries which have, to some extent, similar developmental stage, political system, and economic/social background.

Do the staff in charge of policy making really think that such a network is needed? This question was asked in a questionnaire that was presented to key participants in the 2009 Bologna Annual Meeting jointly by the Unweltbundesamt ("UBA"), or the Federal Environment Agency of Germany, which will host the 2010 Annual Meeting, and the LCS-RNet secretariat. In-depth responses were obtained from the government agencies of the U.K., Japan, Germany, and Italy (the government focal points). The main objectives of the questionnaire survey were to grasp the expectations of the participating governments more concretely and to reflect them in the 2010 Annual Meeting agenda and, more broadly, in future LCS-RNet activities. The very fact that this survey was conducted can be viewed as an indication of the strong interest the German government has in LCS-RNet. Created in 1974, UBA is the largest administrative body in Germany for environment matters. Its mandates include analysis, research, and development in the field of environment, and it also functions as a think tank to provide scientific support to environmental policies of the federal government.

4.1 Selection of research themes

Would you prefer the Network to focus on several particular aspects of Low- Carbon Society?

□ **Yes: 3 No: 1**

Comments attached to the affirmative responses included suggestions that duplication with other networks should be avoided, and (i) LCS-RNet should make differentiated efforts, and (ii) should choose one topic related to the themes for a project period of 1-2 years in view of the objectives and activities of LCS-RNet.

Suggested specific themes were: targets and trajectories; sustainable development; transformational pathways and political instruments to reach targets; technology, technology transfer, mitigation potentials, and energy efficiency approaches; green economy; economy & taxation; and behavioural change sociology.

With respect to theme selection, the importance of listening to the opinions of non-researchers was pointed out, by statements such as: that policy makers as well as researchers in the process of researches should participate in the theme selection process, and that dialogue and partnership with stakeholders are important.

Meanwhile, some expressed a concern that many other organisations are already engaged in

research programs on the themes of technology and the like and that focusing on some projects for each theme would not be the best option for LCS-RNet.

4.2 The need to develop a scenario

How important do you rate the development of a *"2050 Scenario"* for your country, and could the Network support you?

- **Important: 3**

All agreed that it is "important." Some respondents commented that many countries are now preparing 2050 scenarios, and accordingly, sharing of scientific knowledge among countries is all the more important. There was a more concrete suggestion that the G8 and the outreach countries share information as to how to promote energy shift. A respondent noted the importance of presenting policy makers with scientific guidance in line with IPCC works.

Countries are pressed with the unprecedented requirement to set 2050 reduction targets and identify policy pathways thereto. It is very important that countries cooperate by sharing each other's knowledge and experiences in order to draw up workable and subsequently verifiable scenarios in a timely fashion with limited budgetary and human resources. Recognition of this challenging task and a strong sense of commitment to international cooperation are apparently reflected in the expectations expressed about the role of LCS-RNet through the responses to the questionnaire.

4.3 Style of LCS meetings

Should the Network meetings maintain an *informal* or a more *formal character?*

- **Informal: 3 Formal: 1**

RNet in itself is a formal entity officially inaugurated under the G8 process. This question was directed to the format of RNet meetings---whether a more formal style is preferred or the current "casual" style should be kept. Those who favored the informal style added: that the network should time its meetings with the international negotiation timetable if it is to make inputs to international policy making processes, and that the informal format is preferable because the main purpose is to exchange ideas and information among researchers. Meanwhile a respondent who favoured the informal character added a certain degree of formality may be necessary only in aspects such as ceremonial sessions and openings with high politicians and business leaders in order to increase the international presence of the network.

One respondent who favored more formal meetings pointed out the necessity of an organisation's constitution/charter including procedural rules, finances, and the organisational organs. It was suggested that the example of international collaborative partnership on energy efficiency might be of some reference because it is likewise launched under the G8 process and is hosted by a large international body, the International Energy Agency (IEA).

Participating research institutes generally agreed that LCS-RNet should be an informal forum in terms of not only activities but also organisational structure. The questionnaire survey revealed that the majority opinion of the government focal points was not different. It also revealed, however, that some believe strongly that the network should be transformed into a more formal organisation.

4.4 LCS-RNet and policies

Should the Network produce formal policy recommendations?

- **YES: 2 Maybe: 1 NO: 1**

While the responses diverged somewhat, the affirmative answer that the Network should produce policy recommendations ranked first.

The responses confirmed that the Network's recommendations should be relevant to policies but should not be prescriptive. A respondent stated that no more than strategic outlooks should be produced. Another wrote that recommendations should be made to G8/G20 on specified and

concrete themes.

4.5 Benefits of information exchange among industrialized countries

How important do you think policy learning between Annex I countries should be?

MOST IMPORTANT: 3 Somehow Important: 1

All respondents answered either “most important” or “somehow important.” Comments included: that policy learning and comparison of success and failure strategies of other countries are highly important, and that the Network should be expanded to non-Annex I G20 countries beyond Annex I countries. Some commented that Annex I countries in particular should learn from each other more in the aspects of long-term outlook, sociological analysis, and policies on change in individual behaviour (lifestyle), and that the added value of LCS-RNet would be increased by addressing those themes that have not been addressed by IEA or OECD.

The responses imply that there are still differences in knowledge among industrialized countries and policy makers are searching for effective methods to study and compare other countries’ experiences for possible reflection in their own policies. Policy decision-making directed toward a shift to low-carbon society requires a comprehensive review of numerous factors. The underlying thoughts behind these comments are believed to be: a sense of urgency in making low-carbon society policy decisions without waiting for its accumulation of one’s own national knowledge and policy experiences, as well as the genuine rationale for Annex I countries of similar development stages, political regimes, and socioeconomic backgrounds to learn from each other’s knowledge and experiences.

4.6 Connecting government focal points

The idea was brought up to found a government policy board to give input and address the Network with specific questions; what is your opinion on a government board?

Yes: 1 No: 1 No idea: 2

The apparent indecision indicates the importance the respondents place on scientific independence. Any such policy board would unlikely be able to give unified input, because policies vary from one country to another. A respondent commented that it is more important what policies the governments would formulate, taking into account LCS-RNet outputs.

Meanwhile, another respondent commented that interaction with any stakeholders (including government policy makers) should be welcomed.

4.7 Potential of LCS-RNet

How do you rate the potential of the Network?

High potential: 3 Middle: 1

The responses reflect the strong expectations placed upon the contributions of LCS-RNet. Concrete comments included: the need to produce policy relevant products in a timely manner, and the network of researchers providing knowledge for policy decision-making directed forward Factor 4 group. Some suggested participation in themes most needed by policy makers, but it would be difficult to restrict participating researchers on the basis of their academic specialization. While focusing is important, restricted membership would preclude exploration of new crosscutting research themes.

4.8 Expectations of the governments

What kind of input could the Network deliver for your Ministry?

Apart from the fundamental objective of knowledge sharing, some concrete suggestions were

obtained.
Regarding the scenario issue, recommending methodologies and tools for development of long-term pathways for countries was suggested. Regarding the policy issue, comparison of measures toward attainment of country objectives was requested. Another suggestion was impact evaluation of low-carbon society investment to the economy and assessment of the role of green economy for sustainable development. One specific suggested output was assessment of mitigation potential of innovative low-carbon technologies, but, as the responses to Questions 1 and 5 indicated, study in those areas would overlap with the work already being promoted by IEA or OECD and should preferably be avoided. A close examination would be in order, before LCS-RNet decides to go beyond information pooling and sharing, or considers how to differentiate itself from others.
One respondent wrote “dialogue and partnerships between officials and researchers.” This is indeed one of the three objectives of LCS-RNet, but dialogue and partnerships cannot be an output per se; they should rather be considered methodology.

4.9 Themes for the next LCS-RNet Annual Meeting

Which issues should the next annual conference cover?

Suggested topics varied including: low-carbon pathway, policies, green economy, behavioural change/demand reduction, energy, and technologies.
Perhaps reflecting the recession that has lingered since the 2008 worldwide credit crunch, respondents put green economy, economically beneficial climate policy, and other economy-related issues high on the list. Others added decarbonisation pathway and lifestyle change. Regarding scenarios, some suggested that the Network look into not just those to 2050 but also to 2100, while others proposed energy, technologies, consumer behaviour, demand reduction, and other specific issues related to 2050 scenarios.
And as projects extending over one to two years, respondents suggested: carbon tax and its impact on sustainable development in the field of economy & taxation; green growth on jobs and fair transition issues in the field of sociology; and deployment of low- carbon technologies to industrial and household applications in the field of technology.

4.10 Other matters of importance

Comments about the Second Annual Meeting included the following:
Most respondents were interested in enlargement of participating research institutes membership, especially those of developing countries (outreach countries and G20).
One respondent pointed to the need for dialogue between researchers/climate scientists and climate economists, writing “there is a problem of climate economists saying that it’s not going to be that bad, whereas climate scientists pray for catastrophe: as officials we need to get a clearer picture on the urgency of climate change.” This is indeed a candidly-expressed genuine expectation on the part of policy makers who are charged with the responsibility of designing the futures of their respective countries.
For governments that have their research institutes registered in the LCS-RNet, the most important question is what feedback is gained from the participation. The responses collected by the questionnaire survey will be taken into serious consideration when UBA, Wuppertal Institute (the research contact point for Germany), and the LCS-RNet secretariat prepare the agenda of this year’s Annual Meeting. In parallel, they will serve as a good reference for the steering committee in their drive toward generation of clearer and more beneficial outputs through the activities of the next few years.

5. Future direction of low-carbon society research

For the establishment of effective low-carbon world, individual countries strongly feel the necessity of integrated research in support of the policies. In addition, the importance and the benefits of international cooperation were also recognized at the Bologna meeting. Furthermore, the developed countries have began to think that it is desirable to establish policy research bases in the developing countries as mitigation in the developing countries is essential for the future climate stabilization. Under such circumstances, it is necessary for the International Research Network for Low Carbon Societies to do more activities for identification and sharing of research themes required for the policy, promotion of exchange between policy and research as well as among researchers, and intensified research activities in the developing countries.

The LCS-RNet secretariatis in the process of reconstructing the work plan for next year and beyond, based on the above-described background situation as well as the views expressed to the work of the Network grasped as a result of this year's work. The recent developments in the world climate policy scenes require the urgent establishment of research networks within a few years. The mission will be fulfilled if such networked activities become a standard among major institutes around the world. The general directions toward which future efforts should be headed are:

1. Promotion of further exchange among countries, between staff in charge of policy making and researchers, and among researchers;
2. Construction of research base particularly in developing countries that hold the key to successful global climate policies; and
3. Empowerment of research sector as to presenting its knowledge and findings to the policy making processes.

6. Considerations on basic indexes of low-carbon society and socioeconomic system

The LCS-RNet secretariat is engaged in a basic study that is needed to define the perspectives for review of low-carbon society works. A gist of findings during the year follows.

Summary of the paper:
Economy is represented by the index "GDP." Low-carbon situation is represented by the GHG emissions. Insofar as the goal of low-carbon society is expressed in terms of economy or low carbon or both, neither the GDP nor GHG emissions, whether per capita or as a whole, can serve as the single universal index, because countries are all different in regard to population size, development stage, global technology efficiency, and efficiency of available technologies. If the low-carbon society is to possess certain socioeconomic driving force, and rather than to stay in equilibrium, keep moving on in pursuit of development and growth, the goal of such a society should be the enhancement of per capita GDP (feel rich-index) and the constraint factor should be the total GHG emissions with attention to climate stability. A low-carbon society moving forward in socioeconomic terms will seek, for example, to increase the per capita GDP of its economic members, and not total GDP, which simply measures the total size of its economic system. It is suggested that the current economic system that is structured to pursue growth of its total GDP would have to eventually be replaced by a new kind of socioeconomic system.

Basic Indicators of Low Carbon Societies and Socio-economic system[1]

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Table of Contents

1 The article , "Low Carbon Society embedding or embedded in Economy?; Speed of indicators or Direction against the constraint", was submitted and accepted to Journal of Renewable and Sustainable Energy, American Institute of Physics (forthcoming). The paper was abstracted to be included in this Annual Report.

1. INTRODUCTION: What is LCS and how to approach this in this paper

What is Low Carbon Society (LCS)? One of the definitions of LCS is that made in NIES (2006). A Low Carbon Society; 1) takes actions that are compatible with the principle of sustainable development, ensuring that the development needs of all groups within society are met; 2) makes an equitable contribution towards the global efforts to stabilize atmospheric concentrations of carbon dioxide and other green house gases at a level that will avoid dangerous climate change through deep cuts in global emissions; 3) demonstrates high levels of energy efficiency and uses low-carbon energy sources and production technologies, and 4) adopts patters of consumption and behavior that are consistent with low levels of GHG emissions.

There can be several ways to interpret such definition into quantitative term, but in this paper, Low Carbon Society is described by using phase diagram with several numerical indicators from IPAT equation[1] where environmental impact (I) is calculated from Population (P), Affluence (A) and Technology (T). In this manner, the goal, achieving LCS, is rather mechanically translated into objects and constraints; the three objects (i.e. GDP, GDP per capita and non-economic indicator such as happiness index) and the two different types of constraints (i.e. emission and emission per capita). Each choice on objects and constraints of LCS results in each different argument and logic.

2. PROBLEM DEFINITIONS and RESEARCH QUESTIONS

2.1. Problem Definition 1: Economy is not everything for Low Carbon Society

In Japan, the two scenarios toward Low Carbon Societies in 2050 were illustrated (Nishioka, 2008: NIES, 2008a: NIES 2008b); Scenario A as active, quick-changing, and technology oriented society and Scenario B as a calmer, slower, and nature oriented society. To connect the past[2], the present and the future, the historical data of GDP/capita, CO2 emission/capita and population since 1950 and the results of the two future scenarios in 2050 are integrated in Figure 1. The two questions are worth considering from this figure.

The first question is about whether the object of Low Carbon Society is GDP or GDP/capita. As in Stern Review and the Green Golden Rule (Chichilnisky, 1995), GDP rather than GDP/capita[3] has been the main object for discounted utilitarianism which is widely used approach by economists. This tradition can go back to the underlying moral principle for legal and social reforms in the 18th century, proposed by Jeremy Bentham, *the greatest happiness for the greatest number*, where the happiness can be interpreted as GDP/capita and the number as population.

Meanwhile, in Millennium Development Goals (MDGs, United Nations (2008)), the indicators are more related to per capita; the economy of each individual rather than the aggregated national economy is the object. Human Development Index (HDI), as summary measure of human development, also adopts GDP per capita (UNDP, 2009)

Does Low Carbon Society have priority over GDP for the whole economy or over GDP per capita for each individual? The rationale to pursuit GDP per capita could be based on human development and happiness for each individual. Meanwhile, one rationale in the economic theories for setting GDP as object (to maximize) would be that our society behaves so within the current market system. And maximizing GDP and GDP per are not always consistent to each other.

The second question is about whether the main object of Low Carbon Society can be measured by economic indicators such as GDP and GDP/capita. In Figure 1, Scenario A results in much higher GDP and GDP per capita than Scenario B, mainly because of the higher GDP growth rate. However it might be the case that a society might prefer Scenario B, regardless of its lower GDP and GDP per capita. For instance, Karl Polanyi, in

1 For history and academic discussion on IPAT equation, read Chertow (2001)

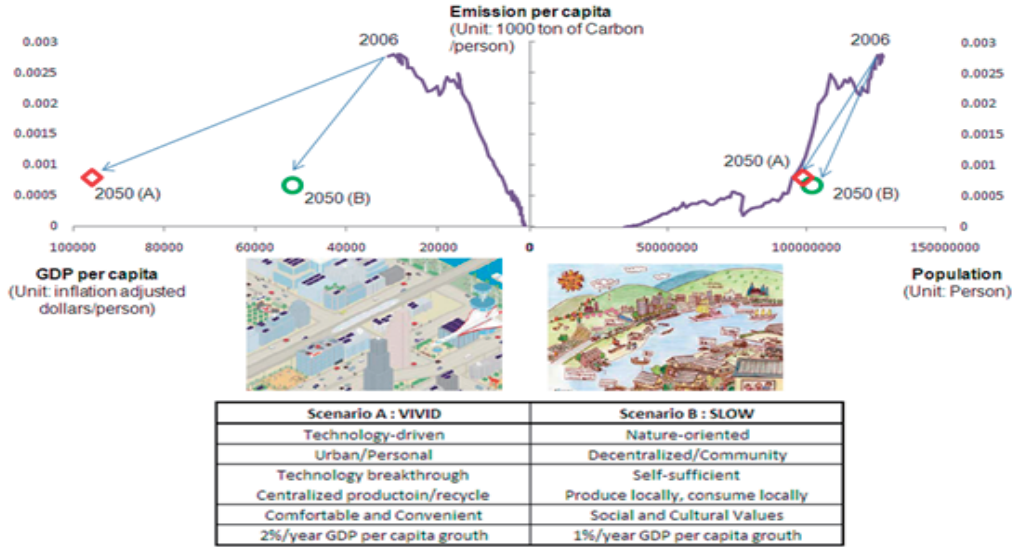
2 Data from Gapminder (2009)

3 Regarding the level of aggregation, Stern Review team (2007) wrote as follows;

"Much of the discussion of values in this note and in the literature takes place at a high level of aggregation. Thus it considers total world consumption or income or aggregate country level income. There is often little distinction between different kinds of goods or allocation of individuals' income across different periods of their lives. And in much of the formal modelling the attention to within country distribution is very limited".

his book, *The Great Transformation*, pointed out three general types of economic systems that existed before the society was embedded into free market economy: redistributive, reciprocity and householding. (Polanyi, 1944).

What are the indicators to properly illustrate Low Carbon Societies in addition to economic ones (i.e. total GDP and GDP/capita)? This has not been answered yet.



Scenario A : VIVID	Scenario B : SLOW
Technology-driven	Nature-oriented
Urban/Personal	Decentralized/Community
Technology breakthrough Centralized productoin/recycle	Self-sufficient Produce locally, consume locally
Comfortable and Convenient	Social and Cultural Values
2%/year GDP per capita grouth	1%/year GDP per capita grouth

Figure 1. Historical path and future scenarios in Japan toward Low Carbon Societies in 2050[4]

2.2. Problem Definition 2: Speed on the Constraint or Liberation from it?

Low Carbon Society would have a constraint on total GHG emissions. In numerical modeling, the optimal solution is often found on the constraint, especially when the objects and constraints are assumed to be in trade-off relation. For instance, if the limit of GHG emissions is 50 giga ton of CO2 equivalent, the optimal solution for the economic growth would be also when 50 giga ton is emitted. However, this depends on the assumptions. For instance, Figure 2 shows three paths (Business as Usual, Low Carbon Technology and Intensive Low Carbon Technology) and the constraint on emission, starting from t = 0 (A0, B0 and C0). On the path of BaU, the economy cannot grow after t = 1 (i.e. A1), since A2 is beyond the emission constraint. Thus, from A1, the economy has to make transition to the path with Low Carbon Technology. When t = 2, it can be in the same position of B1 (i.e. A2') or B3 (i.e. A2''). If the latter is the case it can be said that taking the path closer to the constraint is more optimal, because it is quicker to arrive at the same location. However, if the former is the case, taking the path away from the constraint is faster for the rapid growth of GDP. When t = 1, if the speed of GDP growth is what to be maximized, A1 is better than B1 and C1. However, for the later periods, C1 might be the best; the direction away from the constraint is important especially when transition into more low carbon technology takes some cost.

Regarding technology transfer, low carbon infrastructure, lock-in effect and technology leap-frog, it is often said that developing countries have more opportunities than the developed ones, since they have late-comer advantage as their society, economy and technology have not been locked in unsustainable ways. For instance, suppose that developing countries stands on A0 and developed countries in A1 in 2010. If the goal is to reach C6 and changing the directions between the three paths would take time and cost, then developing countries could move on C1 and reach C6 and even might reach the goal quicker than the developed countries. The important message here is that if developing countries take the same paths that developed ones had already passed, then they would also have to be running on the constraint. Also notice that if developed countries help developing ones to take the path of intensive low carbon technology, then developed countries can push the constrain from their own paths.

In addition to the issue of the cost of transition, the assumptions on objects and constraints determine if trade-off would appear or not. For instance, the slope in the upper-left of Figure 6, later discussed, shows the trade-off between total GDP and total emission, while the slope in Figure 7 represents the trade-off between GDP

4 GDP per capita in 2050 of Nishioka (2008) is converted into Purchasing Power Parity by the values in 2000 of Nishioka (2008) and Gapminder (2009).

per capita and Emission per capita. Thus, if the object is GDP per capita and the constraint is total emission, then the trade-off between them might not necessarily exist.

Will a Low Carbon Society be a society right on the threshold which does not violate the constraint, or a society liberated from such constraint? In this paper, the latter, the path to avoid the constraints, are further analyzed.

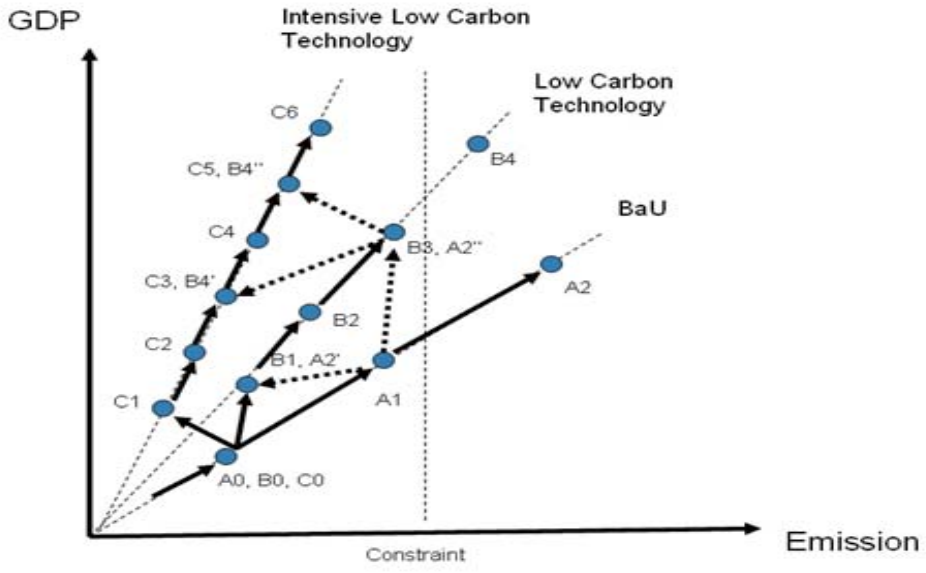


Figure 2. Paths and constraint

2.3. RESEARCH QUESTIONS

Considering these problem definitions, the following two research questions are derived.

Research Question 1: Starting from IPAT equation, what are the basic indicators, objects and constraints to shape the arguments of Low Carbon Societies?

Research Question 2: What are the historical paths of several countries and what can be said for their future paths toward Low Carbon Societies?

3. DATA and METHODOLOGIES

As for methodologies, the concept of IPAT equation is employed as the start of the argument by decomposing the emission (i.e. environmental impact) into each variable (i.e. population, affluence and technology) and has been developed into the use of phase diagram to geometrically analyze paths from the past to the future, while defining the object of the model (e.g. GDP, GDP per capita). IPAT variables are employed in this paper because each variable in IPAT equation is in scalar value so that several variables can be shown simultaneously in phase diagram and also because the equation is very similar to the structure of Input Output Analysis and Life Cycle Assessment (LCA), which model the material balance of economic system.[5]

Most of the data are obtained from Gapminder (2009), such as GDP/capita (in Purchasing Power Parity), CO2 emission per capita and population, since it has the consistent dataset covering many countries, many different types of economic, environmental and social indicators and long time series (e.g. from

5 For details about these similarities, see Heijungs (2001) and Heijungs and Suh(2002)

18th century for GDP/capita). Especially preparing the data for longer time scale is important, because time scale would define the nature of argument.

For instance, historical data on population is shown in Figure 3 (with logarithmic scale).

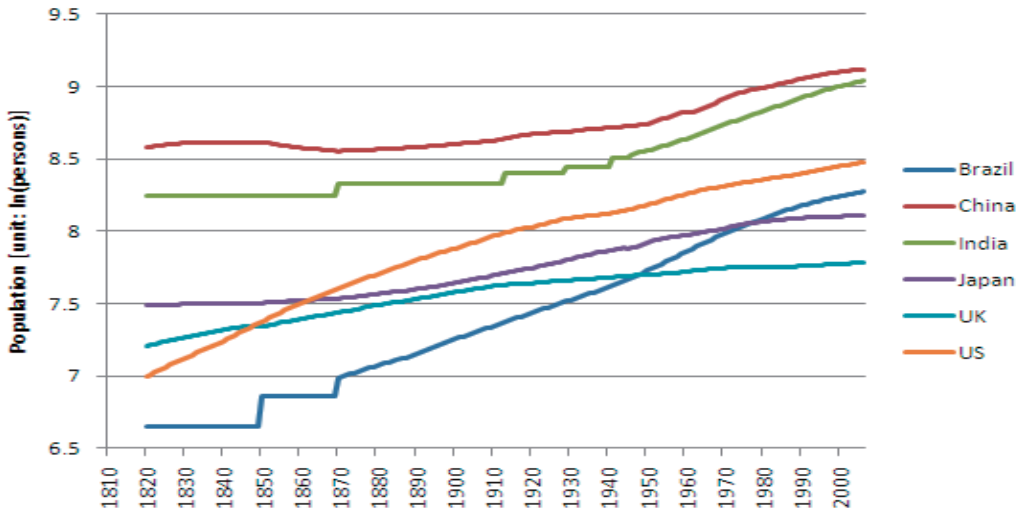


Figure 3 Historical Population

In the end of 20th century, the rates of population growth in China and India are higher than those of US, UK and Japan. However, if we consider the whole 19th and 20th centuries, this is not the case. For example, that of US is much higher than that of China. And those of China and UK are similar to each other. Notice that in logarithmic scale, the slope corresponds to growth rate (of population).

4. ARGUMENTS and RESULTS

4.1. IPAT equation and Basic Indicators for LCS

As IPAT equation has been chosen to derive basic indicators to be used in this paper, first this equation is explained in this section. IPAT equation is described as follows.[6]

$$\text{total } CO_2 \text{ emission} = \text{Population} \times \text{Affluence} \times \text{Technology intensity}$$

$$= \text{population} \times \frac{\text{total GDP}}{\text{population}} \times \frac{\text{total } CO_2 \text{ emission}}{\text{total GDP}}$$

These indicators in IPAT equation correspond to main variables in economic models such as General Equilibrium.

In addition to these variables, land per capita would be important variable for considering Low Carbon Societies, partly because the visions of LCSs are strongly related to how they use lands as seen in the illustrations of two different scenarios in Figure 1, and partly because land has been one of the principal elements among economists from the past, such as François Quesney who made Tableau Économique in 1759 and to the present such as ecological footprint. Also in LCS-RNet annual meeting in bologna in 2009, it was pointed out that terrestrial policy is one of the key issues to achieve low carbon society (LCS-RNet, 2009).

Figure 4 shows territorial size of each country (unit: square kilometer) divided by population in arithmetical scale. Variation of quality of land (e.g. suitability for farming, living and extracting other natural resources) is not considered at all for simplification, but, solely from this figure, it could be possible to reason that the decrease of land/person is saturated in UK, India and Japan with current

6 For details and variations of IPAT equation, see Chertow (2001)

technology, China is getting close to it, while lands of Brazil and US have more capacity for population.

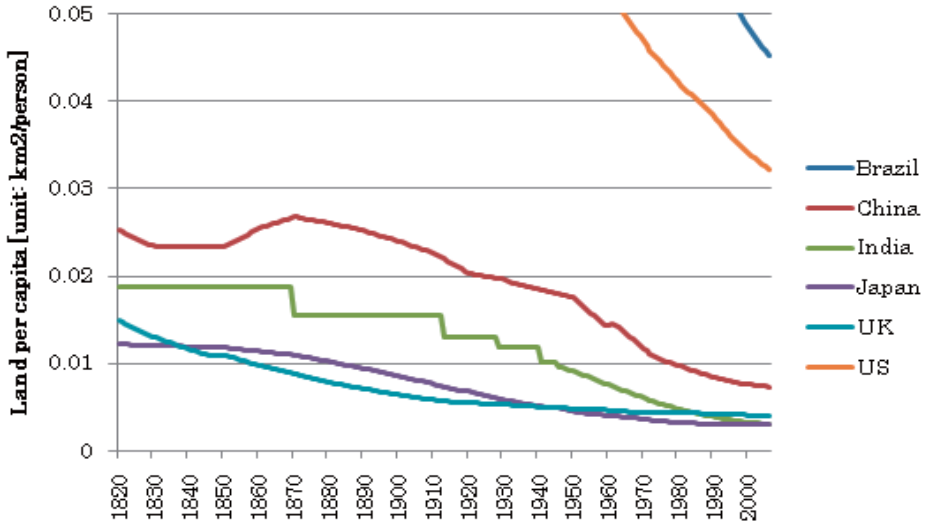


Figure 4. Historical Data of Land per capita

4.2. Framing Objects and Constraints

As already discussed in the first of problem definition, the three different kinds of objects are set for considering the paths for Low Carbon Societies; GDP, GDP per capita and indicators such as Human Development Index and Satisfaction with Life Index (named Social Indicators)..

As for the constraints, emission (e.g. unit: ton) and emission per capita are chosen. Indicator of land, square km per person, is important both as amenity (i.e. object) and constraint, but the further numerical analysis on land is out of the scope of this paper.

How can one choose between the constraints; total emission and emission per capita? If the carrying capacity of GHG absorption in the environment is the start of the logic, one would choose total emission as the constraint. If he starts from the logic that GDP per capita shall be the same for any individual thus one might say that the constraint on emission shall be also based on per capita and emission per capita would be proper. Meanwhile, this paper also will introduce a case where GDP per capita is the object while total emission is the constraint (Case C in Table 1, discussed later).

Base on these objects and constraints, the five different cases are analyzed as illustrated in Table 1.

Table 1. Five cases with different objects and constra

	OBJECT	CONSTRAINT	Low Carbon TECH	OTHER VARIABLES
Case A	Total GDP	Total emission	Yes	Population
Case B	Total GDP	Emission per capita	Yes	Population
Case C	GDP per capita	Total emission	Yes	Population, Affluence
Case D	GDP per capita	Emission per capita	Yes	Population, Affluence
Case E	Social indicator	-	-	-

7 These social indicators are also affected positively by GDP/capita, for instance, since HDI consists of life expectancy index, education index and the value calculated from GDP per capita. Thus social indicators do not mean that they exclude economic ones but rather that economic indicators are embedded in social ones.

For Case E, the biographical path of population, affluence, technology and impact is not analyzed and discussed, but it is shown in Figure 5 that the correlation between GDP per capita and social indicators is not always clear (e.g. Japan) As shown in Figure 1, visions toward low carbon societies would not be depicted solely by economic indicators. While taking into account of the limitation of economic indicators to illustrate low carbon societies, Case A-D will be further analyzed in the following sections, by setting the objects of societies as GDP or GDP per capita.

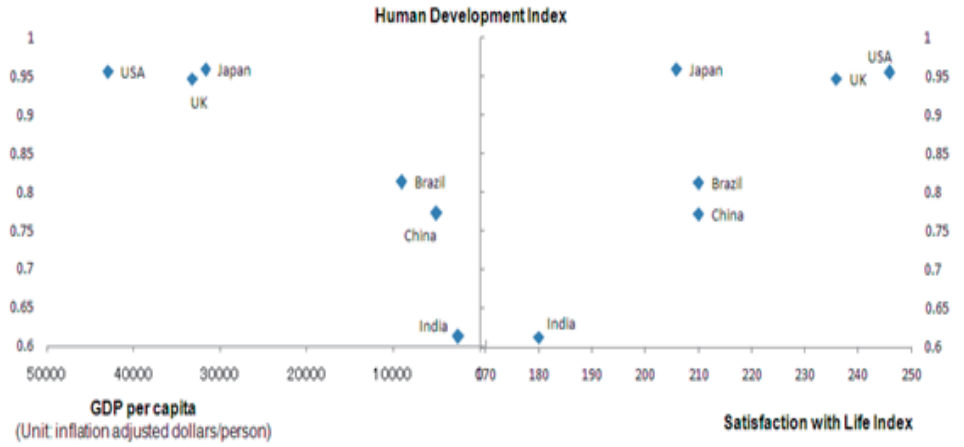


Figure 5. Correlation between GDP/capita and social indicators[8]

4.3. Historical and Future Paths toward LCS

For an example, paths for China and USA are shown. First, Case A and B are analyzed and discussed in Figure 6.

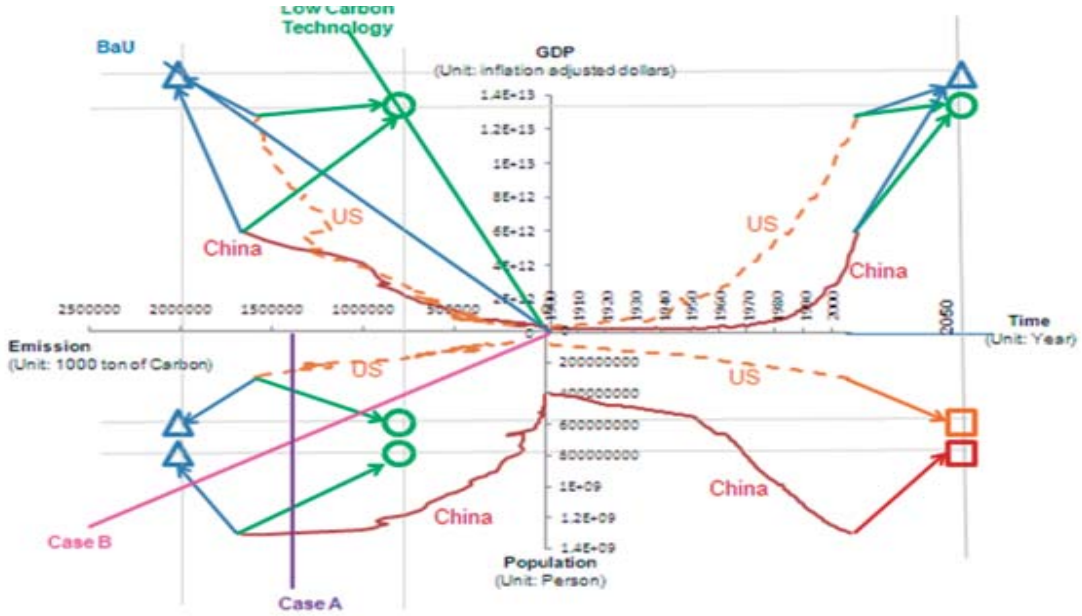


Figure 6. GDP is Object for society (Case A and B)

The path of each country is drawn for the past (1900-2006) and for the future (to 2050). Targets of GDP and population in 2050 are on the right side of the figure. The efficiency of technology is given by the slope in the

8 GDP per capita (PPP) comes from Gapminder (2009) for the year 2007, Human Development Index comes from UNDP (2009) for 2007, and Satisfaction with Life index from White (2007) for 2006.

upper left part. In the bottom left part of the figure, the constraint of total emission is parallel to y-axis (for Case A), while that of emission per capita is the slope (for Case B).

The behavior of this figure is based on the assumption that GDP and technology affect total emission, not population, since GDP itself is given exogenously regardless of population. This can be expressed by changing IPAT equation into *I = GDP*Technology* because *Population*Affluence = GDP*.

This could lead to an unsustainable outcome for the constraint of emission per capita (Case B); if other things (e.g. GDP and technology) are the same, the more population, the less emission per capita. And more population enables more total GDP, emitting more emission.

For the constraint of total emission (Case A), when the target of GDP is set, technology is the only variable that can be adjustable to meet the object. From this logic, it can be said that Low Carbon Society can be achieved by Low Carbon Technology and the target of total GDP, not by other socio-economic elements such as population and affluence. The problem of this case is that the target, total GDP, cannot be continued to increase if technology development is saturated. Next, Case C and D are shown in Figure 7.

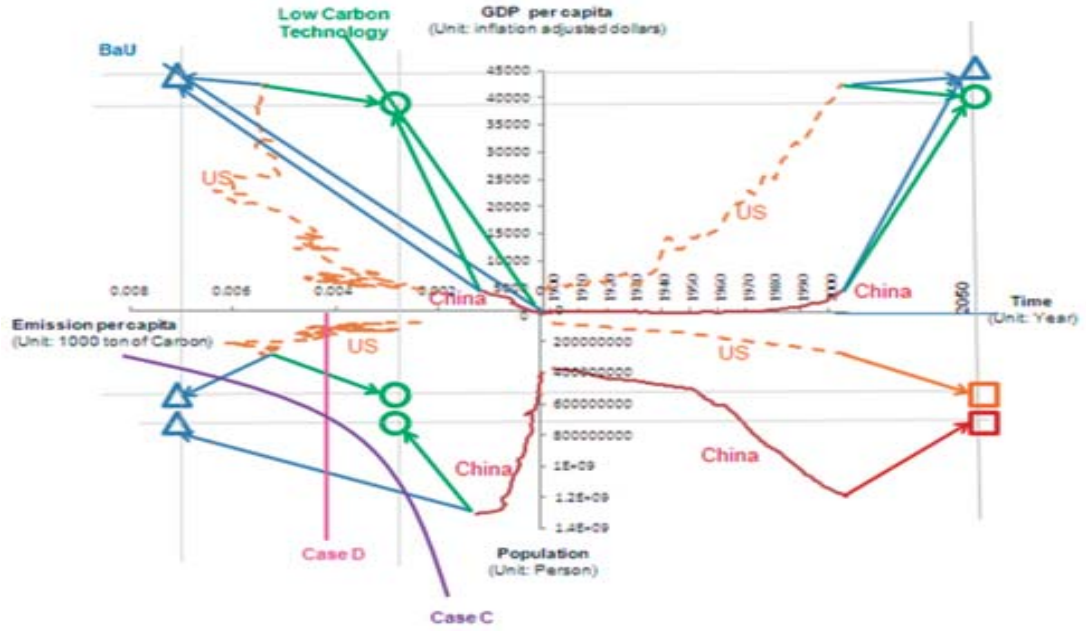


Figure 7. GDP per capita is Object (Case C and D)

Targets of GDP per capita and population in 2050 are on the right side of the figure. The efficiency of technology is given by the slope in the upper left part. In the bottom left part of the figure, the constraint of total emission is the curve (*A*P<constraint*) (for Case C), while that of emission per capita is parallel to y-axis (for Case D). When GDP per capita, not total GDP is set as target, the situation is different from case A and B. For the constraint of emission (Case C), not only technology but also population are the elements to be adjusted to achieve the target, affluence. Notice that perusing affluence does not necessarily go together with the growth of total GDP. For the constraint of emission per capita (Case D), only technology affects whether the constraint is satisfied or not. The problem of this case is the target, affluence, cannot be continuously increased because of the constraint.

The outcomes of the logics for these four cases are summarized in Table 2.

It is important to notice that the strategies on population changes very widely based on the assumption on object and constraint. These results suggest that not only GDP and technology but also socio-economic indicators such as affluence and population shall be properly integrated in consistent visions and strategies toward Low Carbon Society.

From the view that the carrying capacity of the climate is well expressed in total emission which shall be the constraint, Case A and C are feasible, while Case B and D focus on the equity of responsibility.

From the assumption that economy behaves to maximize GDP regardless of visions toward low carbon societies, Case A and B are feasible, while Case C and D considers more on individual rather than the economy as a whole. GDP per capita can be also interpreted into the human rights to develop.

From the notion that trade-offs which might arise from the efficiency of technology shall be disappeared in objects and constraints, Case B and C are feasible, since population can be increased or decreased to get liberated from the constraint. Meanwhile, if one thinks that standing right on constraints are the mother of efforts,

development and progress, then Case A and D would be better.

From the logic that the carrying capacity of land is limited and less population is better, then Case B is not proper.

Thus, for instance, Case C satisfies the principles of the carrying capacity of the climate and land (i.e. total emission and land per capita have to be lower than certain threshold), human rights to develop (i.e. GDP per capita growth is not constrained), but not necessarily the nature of the free market to maximize GDP.

Table 2. Strategies of Technology and Population for each different object and constra

	OBJECT	CONSTRAINT	Technology	Population
Case A	Total GDP	Total emission	More efficient	Not Affecting the Object
Case B	Total GDP	Emission per capita	More efficient	More Population
Case C	GDP per capita	Total emission	More efficient	Less Population
Case D	GDP per capita	Emission per capita	More efficient	Not Affecting the Object

5. CONCLUSION and DISCUSSION

Research questions have been answered as follows.

Research Question 1: Starting from IPAT equation, what are the basic indicators, objects and constraints to shape the arguments of Low Carbon Societies? Answer: as for the indicators, in addition to IPAT variables, another indicator, land per capita, is important for Low Carbon Society. For object, in addition to total GDP and GDP per capita, social indicators such as Human Development Index and Satisfaction with Life index are worth considering. For constraint, the rationale of constraint on emission (ton) and emission per capita (ton/capita) shall be given consistent logic between them, regarding the carrying capacity of climate and equity issue.

Research Question 2: What are the historical paths of several countries and what can be said for their future paths toward Low Carbon Societies? Answer: Not only GDP and technology but also socio-economic indicators such as affluence and population shall be properly integrated in consistent visions and strategies toward Low Carbon Society.

The four combination of the two objects (i.e. total GDP and GDP per capita) and constraints (i.e. total emission and emission per capita) are analyzed in phase diagram. For instance, the case of GDP per capita as object and total emission as constraint (Case C) satisfies the principles of the carrying capacity of the climate and land, human rights to develop, but not necessarily the nature of the free market to maximize GDP.

Also it is worth considering about if the optimal solution toward Low Carbon Society can be found on the constraint or away from such constraint. If changing the direction of the path with low carbon technology development takes time and cost, institutional arrangement would be additionally necessary in addition to market mechanism where optimal solutions are found on constraint.

The two problems were defined in this paper; 1) Economy is not everything for Low Carbon Society and 2) Speed on the Constraint or Liberation from it? These problem definitions were not solved fully in this paper. However, the research questions and answers lead to the starting point for the discussion on these problems. Especially, the case C where the object is GDP per capita, the constraint is total emission and the population is going to decrease is interesting setting for the future research, since this assumption does not seem to contradict to the one of the definitions of Low Carbon Society cited in the beginning of the paper. The challenge of such society would exist in how to balance between social object (i.e. GDP per capita), nature of market to maximize total GDP, environmental carrying capacity of the climate and land (i.e. total emission and square kilometer per capita) and human population.

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Appendix: List of reference materials

1) Synthesis Report of the Bologna Meeting
2) Synthesis Report of the Bogor Workshop
3) Report of the Stakeholders Dialogue in Yokohama
4) A Dozen Frequently Asked Questions from decision makers to modelers: Japan's case
5) "Low Carbon Society Research Network : Questionnaire for Government Focal Points and Observers" by the German government focal point
6) Machida, W., K. Miwa, S. Nishioka (2010) Basic Indicators of Low Carbon Societies and Socio - economic system

Reference Paper

Summary of key messages

● 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.
- ○ Backcasting 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 synchronised.

● Public policy and lifestyle change

- ○ Public policy can lead the way to lifestyle change and a low-carbon society.
- ○ Facilitating behaviour 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.

Acknowledgement

This Synthesis Report draws together findings from various sessions held during the Inaugural Meeting of LCS-RNet in Bologna Italy on 12-13 October 2009. This should be of interest to those conducting LCS related research as well as interested policy-makers and other stakeholders. The report also highlights key issues for LCS policy-making and identifies gaps in knowledge to enable scientists to develop future research agendas.

The scope of the Synthesis Report covers issues addressed during the meeting:

- long-term and mid-term targets for GHG emissions reductions;
- economic aspects of LCS and Green Growth;
- the role of technologies, public policy, social and individual lifestyle change; and
- cross-cutting issues.

For the readers who want to go into more depth, summaries of sessions and presentations are included in the attached CD-ROM.

I would like to take this opportunity to express our gratitude to the contributors of the synthesis report: Dr Jim Skea (UKERC) who took the leading role in scientific editorial work to all drafts in the Synthesis Report, Dr Junichi Fujino (NIES, Japan), Dr Giulia Galluccio (CMCC), Dr Mikiko Kainuma (NIES, Japan), Dr Stefan Lechtenböhmer (Wuppertal Insititute), and Mr Jean-Pierre Tabet (ADEME) .

I would also like to thank those who acted as facilitators and rapporteurs at the Bologna meeting. Their session summaries form the basis of the Synthesis Report.

Finally, I would like to express our gratitude to all participants of the meeting in Bologna for their contribution.

Shuzo Nishioka
Secretary General
LCS-RNet Secretariat

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Contents

Session 3 - LCS National Pathways and the Research Environment		
Scope:	LCS research and latest development of scientific tools/methodologies to draw LCS national pathways.	
	Facilitator: Jim Skea, UKERC, UK	Rapporteur: Junichi Fujino, NIES, Japan
S3-1	*The Climate Modelling Research for LCS national pathway* Antonio Navarra, CMCC, Italy	
S3-2	*Low Carbon Society National Pathways and Research* Giulio Boccaletti, McKinsey, UK	
S3-3	*The Low Carbon Scenario for Germany* Manfred Fischedick, Wuppertal Institute for Climate, Environment and Energy (WI), Germany	
S3-4	*The Low Carbon Scenario for the Caribbean Region* Kenrick R. Leslie, Caribbean Community Climate Change, Center (CCCCC)	
S3-5	*The Low Carbon Scenario for Japan* Mikiko Kainuma, Junichi Fujino, National Research Institute for Environmental Studies, (NIES), Japan	
S3-6	*The Low Carbon Scenario for China* Shuwei Zhang, State Power Economic Research Institute, China	
S3-7	*The Low Carbon Scenario for India* P.R. Shukla, Indian Institute of Management Ahmedabad,(IIMA), India	

Session 4 - LCS and Technology Innovation		
Scope:	Core strategies for technological innovation and energy supply for LCS	
	Facilitator: David McLaughlin, NRTEE, Canada	Rapporteur : John Nyboer, Simon Fraser University, Canada
S4-1	*The Low Carbon Scenario - Global Energy Technology Strategy* James A. Edmonds, Pacific Northwest National Laboratory(PNNL), USA	
S4-2	*Modelling Innovation and Technology Diffusion* Emanuele Massetti, Fondazione Eni Enrico Mattei (FEEM), Italy	

SESSION 5 - LCS and Behavioural Change		
Scope:	Behavioural change in developed countries and implications for developing countries	
	Facilitator: Jean-Pierre Tabet, Environment and Energy Management Agency (ADEME), France	Rapporteur: Takashi Otsuka, Institute for Global Environemntal Strategies (IGES)/LCS-RNet Secretariat
S5-1	*Behavioural change in society* Hal Wilhite, University of Oslo, Norway	
S5-2	*Behavioural Change – example of Japan* Midori Aoyagi-Usui, NIES, Japan	
S5-3	*Behavioural Change – example of Canada* John Nyboer, Simon Fraser University, Canada	

Meeting Agenda

Preface

The International Research Network for Low Carbon Societies (LCS-RNet) was established in 2009 on the initiative of the G8 Environment Ministers Meeting (G8EMM). At their 2008 meeting in Kobe, G8 Environment Ministers recognised the need for countries to make the transition to low-carbon societies. This would contribute to the goal, discussed at the 2007 G8 Heiligendamm Summit, of halving global emissions of greenhouse gases by 2050. To make the transition, each country needs a clear vision of what a low-carbon society would look like and how the transition might be achieved. Given this, the G8 Environment Ministers in Kobe strongly supported the establishment of the research network to help with developing these visions and pathways.

Prior to the official launch of the network, a group of low-carbon society researchers met in Trieste, Italy on 1-2 April 2009. This meeting was held under the auspice of the Italian G8 Presidency through the Ministry for the Environment, Land and Sea. Participants at this meeting acknowledged the importance of collaboration in taking forward LCS research at the interface between science and technology, society and policy. Researchers also identified important research themes and approaches such as: scenario and modelling approaches; interdisciplinary perspectives on the transition to LCS; integration of environmental, energy, economic and social systems; dissemination of knowledge; and building awareness outside the scientific community[1].

Following the official launch of the LCS-RNet, the Euro Mediterranean Centre for Climate Change (CMCC), Italy, organised the inaugural meeting of LCS-RNet in Bologna Italy on 12-13 October, 2009. The agenda of the Inaugural Meeting was developed by CMCC and an Interim Steering Group responsible for the scientific planning of the meeting.

This report of the Inaugural Meeting of the LCS-RNet consists of two parts: a synthesis report; and session summaries. The synthesis report sets out the conclusions of discussions, focusing specifically on issues that require further consideration by researchers and by policy-makers. Addressing these issues will help to fill the gaps in designing future low carbon societies in ways that promote sustainable development in both developed and developing countries. Session summaries and summaries and abstracts of presentations during the sessions are attached in electronic format.

This report demonstrates LCS-RNet's achievements in its first six months. We would like to express our gratitude to all of those who contributed. We also would like to express our sincere gratitude to governments and government contact points for their support and advice.

Special thanks are due to CMCC and Dr Carlo Carraro, Dr Giulia Galluccio, and Ms Sara Venturini, for their initiative in planning the Inaugural Meeting and their hospitality in Bologna.

We would also like to express our special appreciation to the Ministry for the Environment, Land and Sea, Italy, for their generous support for LCS-RNet activities during 2009. We would also like to thank the Ministry of the Environment, Japan, for their initiative in setting up the network. As a result, light will be shed on the role that science can play in designing policies that will bring about the large societal changes needed to achieve deep cuts in greenhouse gas emissions reductions for the benefit of future generations.

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[1] see http://lcs-rnet.org

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Part I Synthesis Report

1. Long-term and mid-term targets

World leaders aspire to bold targets for emissions reductions.

At the G8 Hokkaido Toyako Summit in 2008, G8 leaders agreed to consider the achievement of at least a 50% reduction in global emissions by 2050. In 2009, at the L'Aquila Summit, G8 leaders recognised: 1) scientific evidence on the need to keep global temperature rises below two degrees Celsius above pre-industrial levels; 2) the need for a more ambitious emissions reduction goal for developed countries of 80% or more by 2050; and 3) the need for mid-term goals which would result in global emissions peaking as soon as possible. These issues were also discussed in the MEF that followed the G8 Summit. These goals are based on evidence presented by the IPCC and the wider scientific community. The new research task is to identify concrete and feasible measures that will allow us to achieve low carbon societies.

Co-benefits will arise from setting appropriate country- and region-specific targets.

As the consequences of climate change have become evident, emission reduction targets have come to play a more central role. However, profound differences among regions need to be considered when considering mitigation. For developed countries, traditional patterns of socio-economic development must be transformed into more robust and sustainable directions with implications for energy security, the re-engineering of existing processes and the transition from material-driven life-styles to value-driven ones. For developing countries, people's basic needs must be met and economic growth must be pursued to ensure a better quality of life. To achieve this, developing countries must seek to avoid the negative impacts, e.g. local air pollution, associated with traditional growth. "Leap-frogging" strategies are required that skip the material-driven industrial stage experienced by developed countries. Traditionally, economies have been driven by the abundant availability of fossil fuels and materials, giving rise to climate change, resource exhaustion and pollution. Low-carbon societies will have more balanced patterns of demand where the use of materials is no greater than is needed to achieve quality of life and permit required levels of economic growth. Research on new indices is needed to support the transition to LCS. These indices should cover: material-use efficiency; people's perceptions of quality-of-life; and the achievement of innovation targets. New indices such as these would underpin the setting of country- and region-specific targets for low-carbon societies reflecting local conditions.

Backcasting approaches can identify feasible and desirable pathways towards sustainable low-carbon societies.

Quantitative scenarios, using numerical simulation models, are needed to draw pictures of a future low-carbon society which integrate different targets. A participatory approach, building on dialogue with stakeholders in order to share visions of the LCS based on quantitative scenarios, is important. "Back-casting" can be used to identify the measures necessary to achieve shared visions of a LCS. A package of measures could include: targets for specific fields/sectors; the identification of barriers; technologies that address specific problems; and policies to support those technologies. Model-based back-casting approaches can demonstrate how such packages can achieve a LCS. Visualising the impact of packages of measures can motivate people by demonstrating the multiple benefits that they bring.

2. Economic aspects of Low Carbon Societies

Co-ordination is needed between environmental goals and innovation policies.

A low-carbon economy can be seen as a competitive, knowledge-driven economy. Technological innovation

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will be a major driver for the achievement of consistency between economic growth, sustainable development and the stabilisation of GHG concentrations. Technological innovation at both the economic and political level is essential in order to achieve green goals.

Technological change can change profoundly the socio-economic system as a whole. It shapes not only the business environment, but also the cultural and the institutional context. This in turn can have important feedback effects on current and emerging technologies. Green growth is therefore the result of a coordinated, policy-driven process. The EU Climate and Energy Package has shown, for example, that economic growth and climate policy can go hand-in-hand.

To achieve coordination between innovation policies and environmental goals, policy instruments such as pricing and regulation need to be formulated flexibly taking into account the interaction between different policy instruments.

Sectoral and regional perspectives need to be taken into account.

While cost-effectiveness at the global level is essential, there must be awareness of factors that are specific to countries and regions. Local perspectives must be taken into account. The feasibility of specific actions will depend on financial and other factors that come into play in both the private and the public domains. The social transformation associated with the transition to a LCS in different sectoral and regional contexts needs further research.

New financing paradigms will be required if developing countries' mitigation and adaptation needs are to be met.

Investment flows will need to draw on both public and private contributions if a sustainable low-carbon society is to be achieved. Analytical tools are available to assess financial flows associated with the public sector as well as the institutional mechanisms through they could be delivered. There is a risk that international carbon markets as presently constituted will be neither adequate nor efficient in realising stated objectives. Internationally and nationally, a portfolio of mechanisms must be established. Developing countries need support in reducing poverty and improving financing and funding mechanisms. Particular attention has to be paid to: the development of social capital; institutional setting; and adaptation strategies which have major implications for the allocation of financial resources.

Issues to be considered

There is a need to improve the understanding of and integrate existing theoretical and empirical approaches to green growth, policy formulation and technological innovation.

It is also particularly necessary to take a comprehensive approach to the transition to LCS that takes into account the specificities of the situation of developing countries' relative to those of developed and newly-industrialised countries.

Market instruments are key in financing and supporting a new green growth development paradigm. An assessment of the implications of any new international climate agreement on the emerging carbon market will be required. The role of new financing instruments at the global and country levels needs to be identified.

3. The Role of Technology

Radical technological change is crucial in reaching a low-carbon society.

In order to reach a low-carbon society where GHG emissions are low and living standards are high, technology must play a key role in the near-, mid- and long-term. Each time frame needs a different R&D strategy. Near-term R&D needs to focus on improving existing technologies. It can also enhance the range of available technologies, lowering their cost and raising the effectiveness of investments. R&D investments focused on delivering radical technology innovation for the long term require investments in basic science to lay down the foundations for radical innovation.

Technological change is needed on the demand as well as the supply side. On the demand side, reducing GHG emissions will require an improvement in energy efficiency of more than a factor four in the long-term.

If global temperature increases are to be kept below 2^{O}C, bio-energy could play a very important role. Negative emissions are possible in principle if carbon capture and storage (CCS) is combined with bio-energy use. This would however pose huge technical, economic and policy challenges. Alternatively, if bio-energy is used with high efficiency in the transportation sector, CCS/bio-energy might not be necessary. In both cases, policies to manage related land use changes effectively would be critical.

New "smart" electricity systems which actively match the demand and supply of electricity should be developed to encourage local production and consumption of renewable energy within each region. The most appropriate set of renewable technologies will differ from one region to another. "Supergrids" which can transmit large-scale renewable energy over long distances could also play a role, both domestically and internationally.

The development and diffusion of demand-side technologies such as LED lighting, hybrid cars and heat pumps are also essential in order to achieve a low-carbon society.

More investment in energy technology is needed.

The inherent inability to prevent the spill-over of knowledge gained through R&D is the root cause of sub-optimal levels of investment. Yet, the "positive externality of knowledge creation" is a key opportunity for the LCS transition. Externalities occur within and between sectors, nationally and internationally. International consortia may be necessary to facilitate knowledge exchange and reduce the financial risks associated with very costly projects.

Energy R&D accounts for only a small proportion of overall R&D investment. Addressing efficiency improvement and cost reduction is the most immediate challenge. Here, research and technology programmes need to be expanded very considerably, by as much as 5-fold. Encouraging the deployment and diffusion of technologies is crucial to realise the benefits of innovation.

Learning-by-doing effects can amplify the effect of R&D investment, accelerating the diffusion of advanced technologies as experience brings down costs and improves performance. With learning-by-doing, the cost of reducing CO_2 emissions will decline as technologies are deployed. If investment is delayed, the cost of achieving a low-carbon society will increase correspondingly.

The lack of a carbon price is one factor explaining low levels of energy R&D. We have under-invested in energy R&D partly because energy has been cheap for more than a century. Changing the relative prices of energy and other factors of production (e.g. labour), could help induce a radical long–term shift in R&D patterns.

Technology will not deliver a low-carbon society on its own.

Technology alone will not lead to the stabilisation of greenhouse gas concentrations at low levels. Ever more stringent limitations on emissions and ever higher carbon prices are essential if CO_2 concentrations are to be stabilised. It is essential that no sector should be exempted from emission limits. Exemptions not only raise the cost of meeting concentration targets, but may also render lower levels of emissions infeasible.

Technology measures need to be complemented by measures to transform industrial, transportation and social structures. Climate policy needs to include measures that induce investment in new infrastructures which will enhance quality of life and energy security.

Policy intervention will be needed to remove barriers to the diffusion of new technologies. These include: 1) the inadequacy of support infrastructures for delivery, technical support and maintenance; 2) the technical preparedness of users (both industries and end consumers); and 3) social values and preferences. Such barriers tend to be stronger in developing countries and in rural areas.

In order to achieve a low-carbon society, it is vital that people become aware of and actively choose new technologies. Studying the linkage between lifestyle and technology could enhance the deployment of energy-saving technologies.

Climate policies and R&D strategies must be synchronised.

If R&D policies are coupled with climate mitigation policy, investments in energy technology on both the supply and demand side could increase. Policies that align economic development and reduction of GHG emissions, often characterised as "green growth", could result in increased energy R&D investment.

The transformation of our economic structure should take into account not only climate change, but also other important issues such as health care, food security and energy security. Long-term policies with clear goals which accommodate a wide range of perspectives should be set. This is crucial for acceptance of climate policy by, different interest groups, policy makers and society at large.

Issues to be considered

The location of technology deployment is an issue. Investment in technology has a direct impact on a

region's economic development.

A substantial increase in energy R&D spending is necessary. Since R&D spending in the energy sector is only a small fraction of overall R&D spending, additional energy R&D investments induced by climate policy are not expected to cause a reduction in R&D investments in other sectors in the medium-long term.

We need to be cautious about using subsidies to encourage the take-up of energy end-use technologies. Even though the subsidy accelerates the deployment of advanced technologies, the funds available for subsidies are limited and might not flow back completely and there may be rebound effects which encourage increased use of energy services.

Given inherent uncertainties about technology development and diffusion, hedging strategies should be formulated. Broad portfolios of technologies are essential. For example, technologies such as CCS and nuclear, two important technologies, entail significant risks that could inhibit their deployment. A careful assessment of associated acceptability and safety issues is also necessary.

4. Public policy and lifestyle change

Public policy can lead the way to lifestyle change and a low-carbon society.

The shift towards LCS needs not only targets and technological change but also the promotion of behaviour change. New forms of governance which enable lower emissions will facilitate behavioural change. Conversely, an increased readiness on people' s part to adopt behavioural changes will permit a smoother process of societal change.

Many developed countries are facing critical decisions as to which pathways to follow in order to reduce emissions significantly. Some developing countries face a similar choice as to whether they can maintain low emission levels while realising economic growth.

Policy-makers need to take some risks in introducing effective measures that will lead societies towards LCS. To manage these risks, there is a need for a better understanding of public perceptions of LCS and people's capacity for action. To this end, there is a need for further behavioural research on LCS to demonstrate people's willingness and capacity to change and to quantify the possible impacts on emissions.

Facilitating behaviour change is not easy, but can be accomplished.

Facilitating behaviour change in order to reduce emissions is not an easy task. Research has shown a big discrepancy between what people say they are prepared to do and what they actually do in practice. This insight applies both at the individual and societal level. For example, a series of campaigns on environment and climate issues conducted in Canada have not achieved their goals.

On the other hand, there are successful stories associated with local initiatives. These include congestion charges introduced in London, UK, Singapore, Melbourne, Australia, Toronto, Canada and Oslo and Bergen in Norway. Other successful local initiatives relate to renewable energy, light rail track and bus rapid transit systems, and the introduction of bicycle-sharing in office areas.

The most effective measures will be tailored to individual countries and localities.

Both the perception of climate change actual and behaviour patterns vary from country to country. Behaviour patterns are influenced by socio-cultural context, the built environment and the range of options available in each society. Therefore, the policy mix should be carefully examined and customised for each country and for each locality,

One study found, for example, that Japanese people tend to be affected by information provided through the mass media, while people in Shanghai are more affected by information received through social networks, encompassing family members and neighbours.

Education and information provision are important and effective as part of a package. But there is also a need for direct approaches to induce behavioural change. These include regulatory and financial measures which provide direct positive and negative incentives.

There was a view expressed at the meeting that experimental or pilot projects conducted in a designated locality (e.g. a special LCS zone) have a role to play. If the impact of such projects on technology, the economy and people's behaviour are closely monitored, this could be an effective way to identify and customise the measures that might be undertaken more widely.

LCS lifestyles do not have to entail sacrifice.

Focussing on the upside of low-carbon strategies, in other words the co-benefits, could help to raise the level of public acceptance. Shifting towards LCS need not and should not imply that people must lower their quality of life. Attaining higher quality of life with lower carbon emissions is possible. For example, the introduction of low-carbon energy and transportation technologies is likely to reduce air pollution and congestion problems in urban areas. Pursuing a new lifestyle in line with LCS could help people to achieve a better work-life balance. Given that working towards LCS implies introducing new systems of environmental governance that must be acceptable to the public, further interaction between policy makers and social scientists is a high priority.

5. Cross-cutting issues

In addition to the areas discussed in the previous sections, the Meeting identified the following issues that have a cross-cutting nature or require coordinated efforts.

A persistent signal is needed to stimulate change across all sectors.

Innovation is needed in all LCS-related sectors. Environmental policies should not be considered as an "add-on" to economic policy. Environmental and economic policies need to be integrated as they are dependent, not in opposition to each other. Co-ordinated ("joined-up") policy making in the environmental and economic domains is essential.

There is no single technological innovation that can solve the climate change problem. No technology that could contribute to a potential solution should be ignored. Setting ambitious targets can stimulate technological innovation. Both industrial structure, and social capital, including social institutions, customs, urban infrastructure, and human capital, have to be transformed to achieve a LCS.

There is no option for human beings but to choose a low-carbon future. It can be attained only when everyone moves together with a shared determination. This strong message, reinforced by measures such as a carbon tax, has to be repeated to gain social consent and stimulate business innovation.

Planning for land use change is essential.

Even stringent emissions reductions will not be enough to stabilise atmospheric concentrations of CO_2. Therefore, alongside CCS, the capacity of terrestrial and ocean ecosystems to store increased amounts of carbon needs to be increased. The expectation of a large increase in bio-energy production implies that various types of land-use change will take place.

Land-use change which contributes to a LCS has to be well-designed so that energy does not compete with other land uses such as food production and settlement. Land-use change without careful planning could conflict with sustainable development. It is essential to design LCS in ways that bring co-benefits in terms of water resource and forest management. The historical example of ethanol production from corn conflicting with food security in less developed regions illustrates the undesirable result of unplanned land use change.

Cities provide an excellent opportunity to promote a Low Carbon Society.

To build a LCS, it is necessary to mobilise all the elements that make up society. Existing systems, which are already complicated and locked-in into an old "high-carbon" regime, need to be transformed to achieve the LCS. Cities contain all the elements needed to form a LCS. The administrative system generally falls under the control of a single local authority whose competence is wider than that of national authorities. As such, cities can form a test-bed for social experiments in LCS which can be replicated in other cities. The overall risk to society from conducting such experiments at the city level is smaller than the risk associated with experiments at the national level.

Research that would allow developing countries to set their own targets and pathways is essential.

Any delay in mitigation efforts in developing countries will place beyond reach any attempt to contain global temperature increases below $2^{O}C$. To enable developing countries to make progress toward a LCS, it is desirable for them to set their own targets and pathways, as developed countries are currently attempting. In some developing countries, efforts have already started. China, for example, has already conducted and published research which investigates bringing emissions, after an overshoot, back to current levels by 2050. Some developing countries are experimenting with LCS activities at the city level. Urbanisation and population growth in urban area in developing countries will continue. Therefore it is critical to apply LCS models to cities in developing

countries in order to avoid future lock-in to energy-dependent, high-emission systems.

For developing countries vulnerable to climate change, adaptation policies must be promoted in parallel with mitigations efforts. Policies for both mitigation and adaptation are at the core of sustainable development. Successful policies would bring co-benefits in areas such as water management and energy security.

Human resource development is needed as well as technology co-operation.

Funds must be secured to enable developing countries to undertake nationally appropriate mitigation actions (NAMA). The direct finance of investment in low-carbon technologies and social infrastructure in developing countries must be complemented by investment in human resource development. This should be undertaken from a long-term perspective and be long-lasting in character. Various types of funding are available: for example donations, loans, CDM investments or schemes entailing private investments. The appropriate mode of funding should be tailored to the specific investment.

We need to adapt to unavoidable climate change and remain alert to new scientific insights.

Working towards a low-carbon society requires us to adapt to climate change to which we are already committed and continue to improve climate predictions. Relevant insights may provide new information about elements of the earth system over which the human race exercises control (energy, land use, agriculture, etc.) and about the ambition of mitigation efforts required to avoid dangerous climate change. For example, it is necessary to further reduce uncertainties associated with the albedo effect of clouds.

A pre-requisite for improved adaptation and for the identification of the respective co-benefits from mitigation is the development of high resolution, short-term predictions of climate change. It is still not possible to translate regional impacts into monetary values. Short-term climate predictions can now be made on decadal scales and, in principle, grid spacings of as little as 1 km can be achieved. However, fine resolution predictions require exponentially increasing quantities of computational resources. Achieving fine resolutions will require the development of complex multi-institutional, transnational projects. Detailed multiyear planning covering the detailed definition of consortium targets and responsibilities and the phasing of experiment, analysis and archiving of results will be essential. It will also be necessary to assess the validity of results for use by the adaptation community. If numerical precision reflects “noise” rather than accuracy, model users may be misled.

Resources available for Earth systems research have been stationary or declining. To take climate prediction forwards, we need to identify the big scientific and technological questions that will make a real difference to policy and investment decisions in the coming decade. We need to mobilise new sources of funding and identify global institutional solutions, including public-private partnerships, to ensure that the private sector invests for the long term. We need to demonstrate that the benefits of improved climate prediction will be comparable to those from other advancements in knowledge and technology.

Key messages of Indonesia

from the *Dialogue between policy makers and researchers: Demands and roles of SLCD/GG researches from policy perspective*

Low Carbon Development and Green Growth

- Low Carbon Development is a good opportunity to realise sustainable development.
- Fundamental change in people's mindset is necessary to promote development.
- Harmonised policies and coordination between central and local governments, as well as across sectors, are key.
- Networking between/across local, national, regional and global levels to promote low carbon development, such as LSC-RNet, is important

Collaboration between policy- and research communities

- Developing national and sectoral roadmaps is effective approach to identify a course of actions required.
- Dynamic modeling is an effective tool to understand how policies in different sectors affect with each other.
- Activating research network with better linkage with policy-makers is an immediate need for sustainable development led by the low carbon development.
- Multi-disciplinary approach in the formulation of research is called for to meet needs in policy-making.

Areas to focus for promoting low carbon development

- Forestry and peat land and Land-use Change followed by Energy sector are given priority.
- Sustainable forestry/land use and land use change policies must be put in place.
- Energy source must be diversified by promoting locally produced renewable energy. (particularly geo-thermal source and solar power).
- To promote renewable, impact on whole ecosystem must be understood.

Technologies as fundamental element in Green Growth

- Technology is fundamental element to draw positive emission scenarios while ensuring sustainable development.
- Identification and deployment and dissemination of readily available low-carbon technologies should be prioritized in short-term.
- Development of appropriate local technologies is important in long-term.

Mobilisation of available financing schemes

- Scaled-up financing from international source is fundamental to achieve Indonesian target.
- Available source includes national budget, finances from international sources including ODA and multilateral schemes, private sectors, and NGOs.
- Best utilisiation of all available financial resources should be ensured.
- New institutional arrangement to ensure the efficient use of resource across sectors must be realized.
- Better coordination both vertically (national and local) and horizontally (across-sector) must be ensured.
- Clear signals to shift towards low carbon development, and diffusion of good practices, is essential

Life-style innovation for the sustainable low carbon development

- Traditional values and practices are rich in the tips for designing innovative lifestyle to enable low carbon development, while applicability to the modern context and different locality should be also carefully examined.
- Principles of traditional society, such as ‘sufficiency,’’ ‘co-existence with nature,’ and ‘cooperation’ should be re-vitalized in the current development context.
- Local and indigenous technologies, methods, and wisdom should be fully utilized in promoting Green Growth especially in sectors such as agriculture, fishery and forestry.

Synthesis of Findings

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Low Carbon Development and Green Growth

Low Carbon Development is a good opportunity to realise sustainable development.

Low carbon development provides opportunities for especially young people of Indonesia. With the initiative of the government to support local governments, private sectors and people in Indonesia, the optimal utilisation of their energy sources and lands can be achieved in sustainable manner. Active participation to the international arrangements to fight against the climate change will provide young generation of Indonesia for various opportunities to obtain skills and knowledge on various areas including technologies, information technologies, and governance. It will become a firm basis of the country for its future Green Growth.

Targets are already set.

Indonesia announced its bold voluntary target to reduce emissions by 26% below the level of business as usual by 2020 prior to the COP 15 of the UNFCCC held in Copenhagen in December 2009 and has submitted officially the voluntary target to the UNFCCC secretariat January 2010. That is the indication of the strong commitment of the Indonesian Government to act as the responsible member of the G20. With the international framework of nationally appropriate mitigation actions (NAMA) to be set, Indonesia is prepared to set the target of 41 % by 2020.

Implementation framework and centre agency were set.

In Indonesia, the National Council on Climate Change has been helping to shape Indonesia's debate on climate change to coordinate national policies amongst ministries and industrial sectors, develop and coordinate carbon trade mechanism, monitor and evaluate GHG reduction progress. Action Plan for the Reduction of GHG Emissions are coordinated by BAPPENAS (the National Development Planning Agency). National Development Plan for period 2010 – 2014 will already reflect the sectoral national roadmap for low carbon development. As for finance, a formal climate change policy center may soon be created to support the funding of climate change programmes in the Ministry of Finance replacing the current climate change work group.

Fundamental change in people's mindset is necessary to promote development and low carbon societies.

As Indonesia expects economic growth, together with the growing population, business as usual scenario indicates Indonesia's net emissions will reach 3.3 GtCO2e in 2025. Indonesia's emission per capita by all sectors in 2005 was over 2 ton /capita, and it is expected to increase to 3.05 ton C/capita as BAU in 2020, among which 1.04 ton C/capita comes from energy sector alone. Another study indicates those emissions from energy sector will reach ten times more by 2050. To achive 26% reduction target, for example of energy sector, 1.04 ton

C/capita must be reduced to 0.77 ton/capita, or with 41% reduction, emission by 2020 would be 0.62 ton/capita.
There is a need to shift in the mindset of the country, people and various parts of the society towards low carbon development with well aware of the damages caused by the climate change to the socio- economy. To achieve such a drastic emission reduction, the conventional efforts for the environment through 3R; recycle, reuse, and reduce, are not enough. Society as a whole must face more fundamental and innovative approach by re-imagine and redesign of their business.

Despite of the projected increase of the emission by per capita basis, economic status of Indonesia still allows many poor communities and many of those are not connected to the electricity supply. Therefore, pathways towards sustainable low carbon development must be pro-poor, pro growth and pro jobs.

In policy-making in Indonesia, also considering the optimal use of the limited resources available, mitigation and adaptation policies must be harmonized. In this regards, low carbon growth plan must be a holistic approach where economic growth and CO2 mitigation can go hand in hand.

Targets are set and policies are to be in line with sustainable low carbon development. For the implementation phase, more realistic target setting are called for, where the close cooperation between policy-makers and research community are crucial.

It is important and effective to develop a national Roadmap to set a course of actions

It is important to develop national roadmap with scenario catered for its data and assumptions, since countries differ in various aspects including their developmental, geo-political, aspirational, and cultural contexts. Finding the direction of research to serve as good inputs to draw national and sectoral roadmaps towards sustainable low carbon societies involves behavioral change, energy use and land-use management, and others.

Harmonised policies and better coordination between central and local governments, as well as across sectors, are key.

The environmental policies of Indonesia is sectoral basis to focus on main issues, such as forest conservation, river basis management, waste managment, etc., those must be integrated under the mitigation and adaptation policies of the Climate Change that must cover the promotion of renewable energies, energy efficiency improvements in energy sector, urban and rural sustainable development, and economic growth, to achieve efficient and substantive outcomes with efficient use of the resource available. Harmonization of key policies and coordination vertically and horizontally have to be strengthened.

Decentralised system of Indonesia is the advantage to promote sustainable low carbon development.

Indonesia’s administrative system can be characterized as decentralization. There are 33 provinces with more than 300 districts those are entrusted autonomous governance in

accordance with their level. Indonesia may well take this as the advantage to promote the sustainable low carbon development. As various studies, exercises and pilot projects done inside and outside of Indonesia indicate, cities and localities are better units to test experimental measures for low carbon than the national level.

In Indonesia, most of the power has been given to the local governments. In addition, considering diversified cultures and historical backgrounds of different provinces, it is important to design and implement policy measures and actions that focus on local level, not national level. However, local governments have not yet been well prepared to develop their own mitigation scenarios, nor designing science based low carbon policies. If there are research catering to local level with activity data and parameters that describe local characteristics in various ways, policies can be designed more efficient and effective ways. For this, the application of common methodologies to local areas and to sum up to know national level would be desirable.

A national level cost curve for abatement activities could inspire a provincial level case study of low carbon development.

Collaboration between policy- and research communities

Importance of interaction between policy-makers and researchers, as well as the multi-disciplinary approach to tackle SLCD, is underlined.

In the example of Japan, the government has been supporting climate change related research by providing e.g. the creation of a Global Environmental Research Fund and Asia Pacific Network for Global Change research. Government called for researchers to design a roadmap to consider how Japanese mid-term target of 25 % reduction from 1990 level can be achieved. In this way, policy-makers are strong supporter of the research, as well as main clients/beneficiaries of the research for their science-evidenced policy-making (which eventually make policies more transparent, verifiable and result-oriented.

Integrated models can capture interactions and interconnections among different sectors.

With integrated modelling how certain policy in one sector will affect emissions of other sectors. For example of one model study of LUCF sector, expecting decrease of emissions from forest degradation, increase of reforestation, and the need for agriculture & settlement development will remain constant, it is projected that the net emission from LCS will decrease to 1.3 Gt by 2020. However, the result may be very different if the population growth and the land use change that may associate with the economic growth are reflected in the projection. Economic and population growth projection must be carefully developed to be incorporated for national scenario.

The barriers to implement solutions identified through modelling approach differ from local level to the national level. Integrated modelling may be well designed to provide an useful insight into these problems.

Dynamic modeling is an effective tool for policy studies with the understanding of external factors.

Other external factors such as policies of other countries affect domestic policies as the world already experienced the policy promoting bioenergy sources. Impacts of global economy on Indonesian economic growth and its projection, the change of the characteristics of the economy, the composition of industry sectors e.g. service or manufacturing, also affects the scenario development.

For Indonesia who will go into the transition with new types of energy mix, dynamic modelling that could incorporate a set of structural mechanisms would help understanding the systematic impact of internal and external factors. Dynamic models show disequilibrium dynamics that prevent a smooth economic transition, sensitivities to major uncertainties, and analyse policies for the economy, the energy and the environment systems of the country.

Backcasting approache is more suitable for developing countries where continuous development is expected.

Model-based back-casting approaches can be used to identify sets of policies and measures that are necessary to achieve green growth. They provide the opportunity to consider various interdependent processes that are often ignored in the conventional modeling approaches. When their economies are expected to continue to grow, backcasting approaches are more suitable for developing countries than developed countries.

Activating research network and dialogues with policy makers to establish better linkage between scientific community and policy makers in designing strategies for sustainable low carbon is immediate need.

“Back-casting” can be a time consuming and data intensive process, and research on all influential sectors and other factors must be incorporated. Hence it could be difficult to apply for the local governments. On the other hand, in conduct model simulations, it is desirable to apply assumptions that are developed in a participatory manner. This way, the policies identified would be readily acceptable by the policy makers and local communities are practical. The cooperation and the support amongst national and local governments and the research community are highly important.

Multi-disciplinary approach is the formation of research is called for to meet needs in policy-making.

In addition to the scenarios and roadmaps studies, the implementation of policies and measures identified requires different discipline and expertises such as leadership, to promote innovations, willingness to change behaviour and participation, and others, those are not reflected in the modelling processes.

Research shedding light to local levels are also important for Indonesia.

It is identified that over 150 reduction opportunities from LULUCF, peat, agriculture, power, petroleum, transportation, buildings and cement sectors, by up to 2.7 Gt per year by 2030 that means 5 % of global abatement needed. Another study focusing on Kalimantan region shows more reduction potential than the national level studies. Studies enable efficient policy measures focusing on priority areas by region may be desirable to further increase the mitigation potentials in the regional levels, that consequently, in the national total.

Scientific studies on e.g., how to adopt inter- and intra annual changes of natural/climate conditions caused e.g. El Nino could also help..

Areas to focus for promoting low carbon development

Climate change measures in LULUCF, especially forest and peatland, and emissions from practices and land management of those land, and energy sector including renewables are given higher priorities in Indonesia, like some other Asian or tropical rain forest countries.

LULUCF:

Around 60% of country area is forest covered. Top three policies amongst seven to support Indonesian reduction target of 26% by 2020 are LULUCF sector related, namely, peatland management, reduction of deforestation and land degradation, and carbon sequestration projects in forestry and agriculture.

Indonesia has Climate Change Action Plan in Forestry sector under RENSTRA (Strategic Plan) that covers reduction of deforestation and forest degradation, avoiding/reducing forest conversion for other uses, illegal logging, forest fire, forest encroachment, carbon sequestration programme, and sustainable forest management, and forest fire.

Emissions reduction target from LULUCF sector needs to be set in the national development context.

The land use policies may affect other sectors. Likewise, the need of land of other sectors affects LULUCF sector heavily. The understanding on those interactions between forestry and other sectors, as well as their policy formations, is essential in designing low carbon development in Indonesia.Coordination with other sectors' mitigation/adaptation policies must be ensured, e.g. the establishment of new oil palm plantation (agriculture policy related) on forested land (forestry related) must be avoided. However, for which purpose, Conversion of peat land forest for agriculture land (including oil palm plantation) must comply with forest land use policy. Incentives or disincentive to palm oil industries to avoid plantation on forest land must be sought.

Sustainable forestry/land use and land use change policies must be put in place.

LUCF and peat fire combined consists of 60% of national GHG emission of Indonesia. Mitigation is already a mainstream of the forest policy of Indonesia. Expecting decrease of emissions from forest degradation, increase of reforestation, and the need for agriculture and

settlement development will remain constant, there is a study projecting that the net emission from this sector will turn to decrease by 2020.

The main legal references for managing forest of Indonesia is forestry and biodiversity conservation related[1]. Timber and other forest product are important for Indonesian economy. Forests also protect watershed and livelihood of local people. Indonesia set eight priority areas in forestry, and all of them are relating with climate change-related directly and indirectly. Those include; rehabilitation of degraded forest, forest protection and fire management. Mitigation and adaptation policies will be set in the center of those priority areas in the next 5 year plan of the Ministry of Forestry, Indonesia.

Peatland and forest fire could be prevented by more appropriate land management.

GHG emissions from peat fire comply 13 % of national total. Carbon stock loss and emissions due to the forest and peat fires are caused by both natural and anthropogenic reasons. Those of anthropogenic reasons, such as traditional practice of clearing land for fishery or safety from wild animals, for example, are associated with the development issues; that include market, institutional or government failure. Therefore, to tackle this issue, more effective management of production forest as well as more strategic approach for sustainable peat land management are needed.

For example, legal boundary of protected area must be clarified, as well as the rationalisation of boundaries of production forest would be effective. Capacity-building of production forest management, local community for land management, as well as proper management of oil palm industries are also crucial.

REDD-plus is expected to provide fund
Indonesia expects REDD-plus to provide financial resources which is necessary to go beyond RENSTRA, providing actions and incentives which result in emissions reduction, carbon stock conservation and carbon stock enhancement.

Energy:

Energy is the second largest sector of Indonesia when LUCF sector is included, and the largest without LUCF. Both population and economic growth expected will increase the energy consumption; Indonesia may reach 10 times more of emission level by 2050.

Indonesia’s emission per capita by all sectors in 2005 was over 2 ton/capita, and it is expected to increase to 3.05 ton C/capita as BAU in 2020, among which 1.04 ton C/capita will come from energy sector alone. Another study indicates those emissions from energy sector will reach ten times more by 2050. While with its 26% reduction target, 1.04 ton C/capita from

[1] The Law No. 41/1999 on Forestry and Law No. 5/1990 on Biodivesity Conservation

energy sector must be reduced to 0.77 ton/capita, or with 41% reduction, emission by 2020 would be 0.62 ton/capita, which is still above the global target of 0.5 ton C/capita.

As per capita energy intensity for Indonesia is projected to be higher than world target, energy efficiency improvement is indispensable for the low carbon development.

About 96.7 % of the Indonesian energy mix is fossil origin. Oil is still the dominant source of energy although the ratio of it in the energy mix tends to decrease. So far, the alternative fuel of oil was coal, whose increase may deteriorate GHG emissions in Indonesia.

Energy source must be diversified by promoting locally produced renewable energy

To achieve it's sectoral emission reduction target by 17% before 2020, Indonesia is now allocating budget for; utilisation of more natural gas for the transportation and the residential use, improvement of energy efficiencies, geo-thermal and biofuels, etc. Indonesia has a large potential of renewables, mainly from geo-thermal, biomass, those are followed by solar, micro-hydro, etc. Their exploitation by shifting from fossil fuels uses is crucial for the National Action Plan for GHG emission reduction in Indonesia.

Indonesia already sets target to promote renewables to increase to 17% in its energy mix by 2025. However, the government subsidises on both fuel and electricity prices that is considered as a major barrier for other source of energy including renewables to be promoted. T6 achieving the 17% renewable target, it is crucial for Indonesia to promote policies and measures prioritizing renewables and/or adjusting renewable pricing. Despite the strong private sector in Indonesia, the government already started to take various measures such as subsidies on biofuels. The consistent external pressure to remove subsidies on fossil fuels as a strong signal towards the sustainable low carbon future would support Indonesia to diversify its energy mix by promoting more renewables.

The absence of the appropriate financing schemes for promoting renewables is also considered as a barrier. As the Indonesian government tents to focus on project based financing, new financial schemes such as loans, especially by putting more focus on small and medium sized project-based financing, would be necessary to promote renewables.

Energy efficiency improvement, energy conservation, and conversion to renewable are inter-related with economic growth.

One study indicates that, with BAU scenario, by 2050, the energy demand will increase by 8.2 times and the associated emissions will increase by 12.5 times, both compared to 2005 levels. With moderate economic growth, with current policies and regulations and efficiency efforts will lead to 33% energy conservation and 53% emissions avoidance. Low energy conservation and emissions avoidance due to moderate economic growth will limit efforts in improving energy efficiency and investment in infrastructures related to energy supply – demand. With high economic growth, high energy demand, high emissions are expected, however, LCS is achievable in terms of emissions avoidance without sacrificing high

economic development by better infrastructure (with efficient and low carbon emitting energy systems) by higher level of investment.

To promote renewable, impact on whole ecosystem must be understood.

Promotion of renewables such as hydro power and biofuels require cross-sectoral policy-planning with the understanding of the whole ecosystem. As for hydro, especially micro hydro systems may be appropriate, however, the water reservoirs are not enough. To secure water reservoirs it requires more trees planted, which must have the impact on bio fuels and land-use policies.

Technologies

Technology is fundamental element for Green Growth.

Technology is fundamental element to draw positive emission scenarios while ensuring sustainable development for Indonesia.

Identification and deployment of readily available low-carbon technologies should be prioritized.

Since the mitigation efforts in short-term mainly led by the transfer of available technology may be off-set with the increasing energy demand, mid-term and long-term strategies for technologies are important. In addition, there are large uncertainties, especially of the new breakthrough technologies for their feasibilities and timings to be made available in the market. The identification of which technology economically feasible will be made available, and when, are important where the resource is limited.

There is a clear need to develop strategies on 1) how to accelerate utilization of both already available technology and technology still under research to materialize GHG reduction, 2) how to distribute such technologies, and 3)how to develop local low carbon technologies. Identification of available resource for R&D is also important.

In energy sector, Indonesia puts focus on the improvement of energy efficiency of existing systems and facilities, efficiency of home appliances, efficiency of technologies in other sectors are sought. The promotion of renewables such as geo-thermal and solar cells, waste to energy use are also put priority. Technologies such as integrated coal gasification combined cycle (IGCC), and the mass transport system using the renewable energy are also considered as very important for Indonesia. Indonesia also looks at the potential of agriculture sector, i.e. CH4 reduction from organic agriculture, such as system rice intensification (SRI) by improving agriculture engineering to control water levels and flooding for rice paddies and by minimise the fertiliser use.

Technology transfer

The international arrangements, such as NAMA, REDD-Plus, and CDM projects, are expected to serve as vehicles technology transfer. It is also expected to offers good opportunities for young generations for training and obtaining know-how through technology-transfer, that will eventually to develop the capacity to develop local technologies that will be indispensable for the Green Growth. However, on Green Economy, what kind of technology is suitable is still not clear.

The issues around the intellectual property right still need to be clarified. .

In mid- and long-term, development of appropriate local technologies and transfer of LC technology is also important

The mitigation efforts in short-term by transfer of available technology may be off-set by the increasing energy demand due to positive population and economic growth, mid-term and long-term strategies for technologies are important. There are large uncertainties, especially of the new breakthrough technologies for their feasibilities and timings to be made available in the market. The identification of which technology economically feasible will be made available, and when, are important where the resource for R&D is limited.

In addition, how to finance introducing new technology remains to be an issue that needs to be addressed. One thing to note is the Indonesian government's initiative to support companies in their exploitation stage of geo-thermal. Exploration of geo-thermal sites is costly and companies must face the risks to end-up with nothing from the sites. Therefore, the government support is indispensable for this type projects.

As dynamic model studies shows, the efforts to reduce negative loop and create positive and continuous environment for the national capacity are important. Long-term development planning to lead positive loop to create capacities of technology development and mastery, leads desired imports and desired foreign exchange reserves to increase investment) is desirable.

Carbon capture and storage (CCS) should be considered as a transitional technology, not a breakthrough or permanent solution to free mankind from fossil-dependency. Meeting the 17% renewable target will be essential for Indonesia to slowing the rate of growth in carbon dioxide (CO_2) emissions, while CCS could yield a significant deviation beyond that target. CCS is also an effective and desirable technology for Indonesia due to its geographical characteristics. National Energy Council refers the scenario to implement CCS from 2017 or from 2022. However, the availability and the timing of the CCS is still very uncertain.

Mobilisation of available financing schemes

Indonesia estimates 400 trillion rupiah will be needed to achieve Indonesia's 2020 voluntary mitigation target of 26 % reduction.

Scaled-up financing from international source is fundamental to achieve Indonesian target.

Current funding mechanism of Indonesia for the Climate Change consists of two main pillars; APBN (the State Budget) and non-APBN that consists of ODA(mainly grants) through bilateral- and multilateral- channels, fund from NGOs (Foreign/Local), and business (mainly CSR). However, they are not enough to finance policy measures for low carbon and R&D that will be necessary to achieve 26% target.

As for the domestically available fund, Indonesia considers its policy options for the climate change such as; private-public partnership to avoid risks in investment for large-scale projects such as the geo-thermal energy; taxes and subsidies, e.g. reallocation of energy subsidies to renewables, reallocation of sectoral budgets for climate change programmes, optimization of the existing climate change related budget. Implementation of direct regulations such as non-tariff barriers on the import of fossil-fuel machineries are already sought by the government.

Feed-in-tariffs can be used to promote geo-thermal, biomass, and PV for solar power. Feed-in-tariff has the rationale to be used since it provides strong signal from the government to the nation about its commitment towards low carbon societies, and its feasibility is already tested in overseas. In Indonesia, bio-diesel already receives subsidies.

Fund from the CDM, carbon trade, eco-tourism are expected to bring additional resource.

Best utilisiation of all available financial resources should be ensured.

Indonesia is expecting the economic growth, which means that it also has risks to increase debts. Indonesian economy is still vulnerable to the economic ups-downs due to e.g. foreign investments, and easily affected by various factors such as natural disasters and political instabilities. Risk management for funding schemes is very important for the sustainable low carbon development. Available source of funding need to be diversifies to finance sufficient money to Climate Change. Likewise, policies to allocate money to each individual scheme must be diversified for the risk-management, as well as the optimisation of the available resources.

Efficient, rational and transparent allocation of money to the most appropriate measures and sectors is one of the most challenging issues to realize the green growth. This reminds what we confirmed in the technology section where the strategic approach and the identification of the proper technologies for short-, mid- and long term are discussed.

New institutional arrangement to ensure the efficient use of resource across sectors must be realized

Best utilisiation of all available financial resources, national budget, finances from ODA, international donors, private sectors, and NGO, should be ensured through better coordination both vertically (national and local) and horizontally (across-sector). A formal climate change policy centre may soon be created by the Ministry of Finance to support funding of climate change related programmes replacing the current climate change work group. A new trust fund which is expected to provide financing green growth and ensure appropriate and timely financing to the most suitable policies, sectors and projects. The decision on details of the management, including how it will function, is being looked for.

Cost in short-term can be the benefit in long-term.

With the good skills, cost in short-term turns to be the investment in longer-term. In this respect, the role of government is important as the example of the government support for the exploitation of geo-thermal sites shows. Balance and best mixture of top-down and bottom-up approaches should be explored.

Strong pricing signal is necessary

As discussed in the energy section, oil subsidies prevent the shift to other low carbon or renewable energy sources. Such subsidies must be eliminated. The government of Indonesia already started to take various measures such as subsidies on biofuels, which is a strong signal of the government's commitment to power utilities and consumers.

Life-style innovation for the sustainable low carbon development

Life-style and behavioural change is considered as one of the key areas of research to promote sustainable low carbon development. How to integrate traditional values and practices into sustainable low-carbon development policies is an important question.

Traditional values and practices are rich in the tips for designing innovative lifestyle to enable low carbon development, while applicability to the modern context and different locality should be also carefully examined.

Values and practices embedded in the traditional lifestyle in certain locality are often found to go along with resource efficiency and energy efficiency, which are the key principles of the sustainable low-carbon society. However, such traditional values and practices are quickly being replaced with the non-in-situ values with the foreign life-styles. For example, many countries in Asia, including Indonesia, face changing trends in food preference, consuming more flour-based food than rice these days, as well as in energy and material utilization. This trend seems to be contributing to the increase of GHG emissions and likely to contribute further in due course.

Principles of traditional society, such as 'sufficiency,' 'co-existence with nature,' and 'cooperation' should be re-vitalized in the current development context.

A study conducted in rural area of Thailand sets 8 indicators for the notion called "sufficient economy" that support actions for low carbon. Some of indicators incorporate the traditional values such as application of local wisdom, integrated practices in natural resource and environmental management, recognition of carrying capacity and ecological balance, and most importantly the adjustment of lifestyle in coexistence with nature. In such society, three drivers of sufficient carbon economy are 'leadership,' 'good governance,' and 'unity.' The community with good political leaders, governance, and unity helps the community to lead the sufficient carbon economy society.

Mindset of consumption through eco-thinking and routine activities in rural population is different from urban communities. When CO2 emissions were linked to happiness index, there were communities with low CO2 emissions and high happiness index, and high CO2 and low happiness. What is needed to move to low CO2 emission and high happiness index is an important question to be asked.

To this end, research community can show not just information, but visualisation/images of the consequence of BAU such damages caused by the extreme weather, together with the visualised image of sustainable low carbon development.

Local and indigenous technologies, methods, and wisdom should be fully utilized in promoting Green Growth especially in sectors such as agriculture, fishery and forestry.

As projection indicates increase in GDP and population growth, part of CO2 emissions reduction in Indonesia should be achieved by maintaining and/or re-introducing low carbon life-style, in addition to the technological effort to reduce energy intensity. Policy measures have important role to play for encouraging people to choose low-carbon life-style. For example, energy pricing could help people to reconsider the high-carbon dependency of the life-style lately and widely adopted by a large amount of population, and may provide an opportunity to revisit less-carbon dependent life-style in traditional/local cultures.

- Overcoming barriers to low carbon societies -

"Six key messages" from the Stakeholders Dialogue in Yokohama

- Time to act. Change is an opportunity.
- Time to discover, find and create new values.
- Time to stop the compartmentalization of systems to make full use of the potential of each component in a harmonised way.
- Time to take risks and face challenges。
- For policy-makers, it is time to give a clear signal of the need to shift to a low-carbon society and formulate policies with a long-term perspective that include safety nets, and then share this vision with the private sector.
- Time to trust the capacity of the private sector and make use of it

IGES Global Environmental Seminar

March 15, 2010

Yokohama Workpia

Acknowledgement

This Report draws together findings from the round table discussions during the Stakeholders Dialogue held in Yokoyama Japan on 15 March 2010. This should be of interest to all stakeholders in the society, as well as policy-makers and researchers, with the recognition that what we are aiming for to realise low carbon societies is the societies more sustainable for all in future. The report highlights six key messages from Yokohama for LCS policy-making and identifies gaps in knowledge to enable scientists to develop future research agendas.

Summaries of the presentations and round table discussions are also contained in this report.

I would like to take this opportunity to express our gratitude to the panellists and commentators of round table discussions who actively participated and contributed in the Dialogues.

Their presentations and discussions form the basis of six messages and the synthesis of this report.

Shuzo Nishioka
Secretary General
LCS-RNet Secretariat

Stakeholders Dialogue in Yokohama
To overcome barriers towards Low Carbon Societies
Six messages from Yokohama

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Six key messages from Yokohama

It is time to act. Change is an opportunity.

Japan is now in the midst of major changes as it faces a decline in population, an aging society, increased global competition for its industries, issues of managing national finances, energy security, the restructuring of land use, and so forth. Efforts to shift from the current energy-intensive society towards a low-carbon one will guide us in a major transition to realising a better future. It is thus important to consider these substantial changes as a major opportunity and make every effort to deal with them in a positive manner.

It is time to discover, find and create new values.

When the conditions surrounding the society change, this sheds light on things that were not sufficiently valued in the past. Discovering things that we lost due to industrialisation, such as traditional social systems that have long being maintained in local communities, traditions, institutions, and values, will help us to create new values to live in a low-carbon society. Venture business created using “Trust” capital is a good example. If people consider a house as a service to use in accordance with the needs of each generation, not something to “possess”, this will help to establish houses as good long-lasting social capital together with their environment.

It is time to stop the compartmentalization of systems to make full use of the potential of each component in a harmonised way.

By internalising new values in economics, new industries or businesses will be created. Business people should be more positive in trying to develop new enterprises through joint ventures with different industries as well as through cooperation between cities and rural areas. By rediscovering the basic strength that was gradually established through tough experiences, such as pollution and economic recession, and by finding ways to establish new collaborative relationships amongst different industries, the Kawasaki coastal industrial zone has become rejuvenated as a new industrial area from its previous obstructive style. It is important for each government agency to give up its bureaucratic and compartmentalised policy-making style, and try to achieve the integration and harmonisation of policies. As an example, in housing policies it is necessary to implement comprehensive policy revisions such the abandonment of policies that encourage people to become private home owners, as well as to promote capacity-building for local carpenters to construct houses with low carbon emissions, to extend the average life of houses by promoting renovations, to revise building standards to eliminate basic obstacles to energy-efficient houses, etc. Business sectors should also give the authority for decision-making to the people working at the front line.

It is time to take risks and face challenges.

In the midst of major social change, everyone must be ready to take risks to meet the challenges and build a new society. It is necessary to avoid adhering to the apparent current stability. It is encouraging to see more and more entrepreneurs who are willing to take risks. The financial sector could also apply methods of venture capital taking risks into account. The government must take up the role of providing safety nets for those who challenge these risks and guarantee opportunities to start over again.

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* as an example of the alliance with different companies to develop lithium-ion batteries may be resulted in very different advantages for the companies involved.

** See example of agroforestry in page 14, 15

Six key messages from Yokohama

For policy-makers, it is time to give a clear signal of the need to shift to a low-carbon society and formulate policies with a long-term perspective that include safety nets, and then share this vision with the private sector.

It is time to espouse a clear vision as a nation of how to maintain a prosperous Japanese economy and of the kind of society we would like to pursue. The role of the government is to give a clear signal to indicate that we are in a transitional period, to propose strategies for the future and roadmaps toward achieving them. It is also important to involve the demand side on a global scale, and to support the identification and accumulation of intellectual property that is necessary for the technologies and systems required. Developed countries are putting individual technologies, systems technologies and planning, infrastructure, and finance together as whole systems to develop low-carbon societies or for urban planning and to sell these in the global market, mainly targeting developing countries. There is a huge potential for Japanese technologies if they are integrated into larger technological structures and systems, and this is the direction for Japan to go forward. Subsidies to overcome the initial barriers to making this shift towards a low-carbon society must be implemented within an appropriate time frame in ways that support social capital development and strengthen the capacity of industries over the long term. The role of the government is to raise the levels of the lowest standards. It would be better to leave it to competition within the private sector to then raise general levels to the highest standards.

It is time to trust the capacity of the private sector and make use of it.

It is the private sector and individuals that will make the transition, and the government must trust their capacity. Japanese enterprises have sufficient potential to make changes. It is the private sector and individuals who will decide on, act on, and create the means to achieve a low-carbon society. It is important for them to demand what they require from each other. However, it is also important to make clear who will carry this out, and who are the objects of the changes. All stakeholders must be aware of their own responsibilities. Individuals and businesses must be aware of the mutual benefits and the importance of sharing them in order to design solutions in a rational way.

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

The Japanese government proposed the idea of establishing the International Research Network for Low-Carbon Societies (LCS-RNet) to involve researchers around the world in promoting research on LCS-related issues on the occasion of the G8 Environment Ministers Meeting held in 2008. With the agreement of the participating countries, the Network started its activities with a Secretariat set up in IGES. On the occasion of the 1st Annual Meeting of LCS-RNet, held in Bologna, Italy, in October 2008, policy-makers and researchers highlighted the need to tackle issues including energy technologies, local planning, R&D, lifestyles, visions and scenarios, and their impact on economies.

Summary of key messages of the Inaugural Meeting of the LCS-RNet (Bologna, Italy, October 2009)

- 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.
  - Backcasting 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.

Overview

The world is now shifting towards low-carbon societies. In Japan, discussions over visions for the nation's future have just begun with the expected decline in the population and the aging of the society, with globalisation in progress, and the need for energy security. The need to shift to a low-carbon society can be an opportunity to consider a new vision of the future for the country. A shift towards a low-carbon society requires the involvement of all stakeholders in the society such as the citizens, distributors, people in agriculture, forestry and fisheries, the business sector, including industries, commerce, and finance, NGOs, and policy-makers who are engaged in local and national planning. All these stakeholders have their own images of a low-carbon society and the steps to take and their roles in taking them. They do also have different opinions on the technical and social barriers to achieving a low-carbon society, and how to overcome these barriers. To understand the various different images and opinions and incorporate them into efforts to develop a low-carbon society, it is necessary to share knowledge throughout the world.
In Japan, various stakeholders have already stated their determination to shift towards a LCS. It is now important to maintain a dialogue among all stakeholders to identify the kinds of efforts required to achieve a drastic reduction in greenhouse gas emissions through the most efficient means, how to promote cooperation amongst the different groups, and so forth.

Recognising the importance of such dialogues, the 5th IGES Global Environmental Seminar 2009, Stakeholders Dialogue in Yokohama – Overcoming barriers to low carbon societies - " was held on 15 March 2010. The objective of this Dialogue was to provide an overview of efforts towards a transition to low-carbon societies that are currently being undertaken by various sectors, and to identify barriers and to propose the solutions, policy measures and research required to materialise low-carbon societies. The points discussed in the Dialogue will be synthesised by the LCS-RNet to be published and disseminated to policy-makers and other stakeholders throughout the world.

- 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 synchronised.
- Public policy and lifestyle change
  - Public policy can lead the way to lifestyle change and a low-carbon society.
  - Facilitating behaviour 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.

Table of Content

Opening Remarks

Kuniaki Makiya
Institute for Global Environmental Strategies (IGES), Secretary General

He explained how this stakeholder dialogue is positioned in the trend of activities to combat climate change in Japan and the world.

Based on the Copenhagen Accord, national mid- and long-term targets were set in Japan, a group of scientists are now preparing a roadmap since last December. Recently, the Japanese Cabinet endorsed a new draft climate change bill that targets a 25% reduction in CO_2 emissions by 2020. Activities to combat climate change are now shifting to concrete actions such as setting reduction targets at local levels with local initiatives. Meanwhile, there are also conflicts over such actions due to their impacts on economic activities and the possible burden on households. To achieve the emission reductions targets for greenhouse gases, it is necessary to construct low-carbon societies by overcoming such conflicts among the stakeholders. Japan is facing now its major challenges, such as the ageing society, declining population, and globalization. Low-carbon societies need to be considered as positive visions for the future that fit for the changes in the societies and local circumstances in addition to a reduction in greenhouse gas emissions. Therefore, to make the transition to low-carbon societies, it is necessary to foster communication and an exchange of visions and knowledge among each stakeholder, and to clarify the obstacles and the means to solve the problems through policies, research and other activities.

It is expected that the outcomes of this stakeholders' dialogue will be summarized into a report with recommendations that will be input into the International Research Network for Low Carbon Societies (LCS-RNet), through which national and regional activities toward creating a low-carbon society in Japan can inspire others around the world.

Keynote Speech

Yasuo Takahashi
Director of the Climate Change Policy Division, Global Environment Bureau, Ministry of the Environment, Japan

Action towards a low-carbon society

He described the international trends in climate change policy and the policies in Japan, following to the emphasis of the need for large emissions reductions to stabilize the concentration of greenhouse gases in the atmosphere and the fact that the degree of climate impacts will be affected by the timing of such stabilization.

On 22 September 2009, at the United Nations Summit on Climate Change, Prime Minister Yukio Hatoyama announced the mid-term goal (a 25% reduction in emissions in 2020 based on the 1990 level), premised on agreement on ambitious targets by all the major economies, and indicated the will to utilize all possible measures including domestic emissions trading scheme, carbon taxes and feed-in tariff system for renewable energy to attain the mid-term target. He also announced the Hatoyama Initiative including financial support and support for technologies for adaptation measures in developing countries. In December 2009, Parties of the UNFCCC COP15 took note the Copenhagen Accord. Japan will continue its initiative to set up a framework for after-2013 with its bold targets.

As for the Japanese target under the Kyoto Protocol, Japan is now anticipating to achieving its 6% emissions reduction target compared to 1990 level. As for mid- and long-term targets and the planning of roadmaps to achieving those, all possible measures must be employed. The pricing of carbon and the visualization of emissions (e.g. carbon footprints) must be placed at the center of those measures.

On 12 March 2010, Japan's Cabinet endorsed the Bill for the Basic Act on Global Warming Countermeasures and sent it to the Diet. This bill is expected to establish the framework, and the important thing to note is its inclusion of mid- and long-term targets. The three pillars of the bill are the creation of a domestic emissions trading system, environmental tax to deal with climate change, and a feed-in-tariff system for all renewable forms of energy.

At the end of December 2009, a group of experts, chaired by Dr. Shuzo Nishioka, started to consider roadmaps for mid- and long-term targets, to propose scientific and technological advice for the government. On 30 December 2009, Japan’s Cabinet decided on a New Growth Strategy (Basic Policies) and the environment is considered as one of the most important fields for growth. The national campaign Team Minus 6% has been developed into the Challenge 25 Campaign since 14 January 2010). Discussions on roadmaps will now become much more important. This requires different ways of thinking through inter-ministry coordination. In particular, it is necessary to introduce unique local activities to spread throughout the country (e.g. environmental model cities). The stage of discussion is now over and we have to start creating roadmaps by sharing activities and knowledge.

Shuzo Nishioka
Senior Research Advisor, Institute for Global Environmental Strategies (IGES)

To overcome the obstacles to achieving low-carbon societies

He explained the importance of stakeholders overcoming obstacles and the general scope of this stakeholder dialogue.

The new draft climate change bill was decided on by the Cabinet and concrete actions toward creating a low-carbon society have been taking place. To stabilize the climate, the society has to change drastically. Now, the phase of arguing whether or not emissions reductions are possible is over, and we have to start thinking about how to actually construct a low-carbon society by combining the vision of each stakeholder through the dialogues. There are many types of stakeholders. Conflicts, demands and cooperation may occur among them as we move toward a low-carbon society. Ways of thinking about common obstacles and coming up with solutions are the points of the discussions.

There are three key elements of the scope of stakeholders' dialogue. The first one is an industrial transformation that must be accomplished up to the period 2030-2050. The second is regional management. Management at the level of prefectures and cities is an important issue to be considered in the situation of an ageing society with a declining birthrate. The third concerns the changes in ways of living. There are arguments as whether we need to change our lifestyles by ourselves or through changes to the social systems that naturally result in such lifestyles. It is important for people to freely enjoy a lively society without being forced into a certain lifestyle. The important roles of politicians and administrators stand at the cross-cutting intersection of these three elements where potential conflicts and cooperation among stakeholders arise. This is because obstacles (e.g. values, customs, traditions, ties of obligation, regulations and institutions) have to be overcome to ensure a rich and low-carbon society.

Another issue to be considered is how Japan can sustain its economy in the international society. It is necessary to set the right direction for changing the economy to achieve green growth without anxiety.

In today's dialogue, in the first part, each different vision will be presented from the micro level. In the second part, these will be systematically arranged and their entire scope will be discussed through a general discussion session. The outcomes of this dialogue will then be transformed into propositions from Japan for dissemination to the international society.

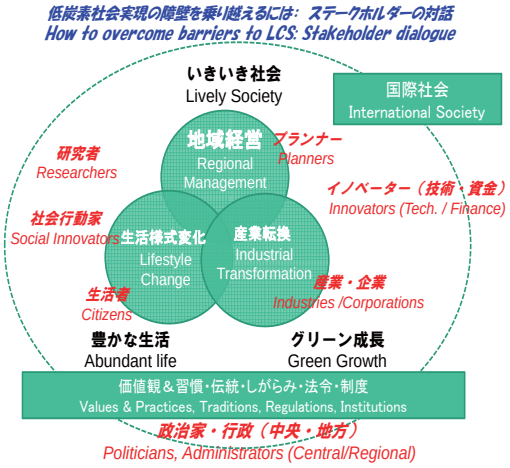
Roundtablle Discussion

低炭素社会実現への障壁を乗り越えるためには：ステークホルダー対話 in 横浜

Overcoming barriers to low carbon societies
Stakeholders Dialogue in Yokohama

- 気候安定化に向けて社会を変える
  Changing society for stabilization of climate
  - ヴィジョン・計画
    Vision and planning
- すべての人・組織がステークホルダー（利害関係者）
  All the people and organizations are stakeholders
  - 相互関係：対立・要求・協働
    Interrelation: conflicts, requests, and cooperation
- 共通の障壁
  Common obstacles
  - どう越える？
    How to overcome?

⇒国内ロードマップ/低炭素社会国際研究ネットワークなど発信
Outcomes disseminated for national roadmap, LCS-RNet, etc.



Roundtable Discussion: Part 1

Yuji Kinoshita
Corporate Managing Director & Executive General Manager,
Senior Executive General Manager, Retail Business Unit, Tokyo Corporation

Barrier and cross-sectional vision for low-carbon societies (LCS)

He explained how companies' efforts toward establishing a low-carbon society can be supported from the viewpoint of enterprises.

It is important to design mechanisms for change so that enterprises can still operate successfully.

Since the first half of the 1970s, regenerative breaking has been introduced in the trains of the Tokyu Corporation and the electricity generated by this energy recovery mechanism is fed back into the supply system to be utilized by the trains that follow. Tokyu Corporation was an early adopter of such low-carbon technology which is now becoming popular. This technology can be applicable in compact cities with a high population density.

Another example is the NOx regulations introduced in the 1990s. NOx regulations came into force only in Tokyo and Kanagawa prefectures and some bus companies sought to take advantage of a legal loophole by changing their corporate location to another prefecture. However, Tokyu had been operating only in these two regions and had to newly buy and replace all its vehicles. As a result, research on fuel efficiency was expanded, idling reduction and hybrid vehicles were adopted earlier, and swift action to reduce greenhouse gas emissions was achieved. It can be said that steady and sincere efforts by companies to comply with the regulations can transform the challenge of facing the costs into growth in the long run. When regulations are introduced, loopholes should be avoided so that the national system as a whole can tackle the problems together.

Another example shows the importance of flexible measures that take the actual conditions of corporations into account when regulations are introduced. It has already been proved that regulations on the use of plastic bags do not lead to consumer complaints about it (e.g. Suginami city in Tokyo). However, there should be a measure that supports companies that have stocks of the bags accompanying such a regulation. It is necessary for administrators to take some measures that enable corporations to go through a provisional period and give them a certain degree of freedom when systems are changed.

From the beginning of the 1950s, in the development of the Tama Garden City, Tokyu conducted urban planning within the framework of Land Readjustment Programs and a well-planned infrastructure and compact city were achieved. This is partly due to the flexible measures adopted by Yokohama City. This example illustrates the successful allocation of roles between corporations and administrations. Administrators need to adopt a viewpoint that enables the private sector to come up with creative ideas and actions.

Roundtable Discussion: Part 1

Nobuhide Kobayashi
Director
Coastal Area Development Office General Planning Bureau Kawasaki City Office

Barrier and cross-sectional vision for low-carbon societies (LCS)

He presented the history and current situation of the industrial area of Kawasaki City and the strategies to accumulate environmental technologies and market the products of environmental industries.

Kawasaki City extends along the Tamagawa river. In the Edo period, there were some smaller cities in this area with water channels for agriculture taking water from the river. These cities were later merged through the period of industrialization in the Meiji period and formed the current configuration of Kawasaki City with its large industrial area on the coast. In this area, there is an iron and steel manufacturer that produces about 4 million tons of iron and steel per year, as well as two petrochemical complexes, one of which produces 30% of the gasoline for the Kanto region. Greenhouse gas emissions from industries account for up to 76% (of which 90% is from manufacturing) of total emissions, thus it is difficult for the municipality to control emissions through its own policies.

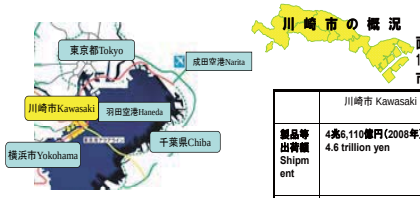
In the 1960s, during the process of developing these steel and chemical industries, heavy air pollution from NOx and SOx occurred, but the air quality has improved such that it is now possible to clearly see Mt. Fuji. This is due to the regulations for pollution control as well as the efforts of private corporations. Meanwhile, it is argued that regulations are not enough in an era of globalization. In the coastal area of Kawasaki, there are many kinds of environmental actions being carried out. Among these, there are also examples of where the area as a whole is promoting environmental actions beyond the limits of each business (e.g. a network for the use of steam from a gas-fired power plant).

The strengths of Kawasaki are that 1) it is one of the largest industrial areas in Japan, 2) it has a complex of several of the largest research institutions, 3) it has a history of pollution and the subsequent creation of an eco-town based on this experience, and 4) it is positioned close to the center of Tokyo. Through these characteristics, innovative environmental technologies have been accumulated, including ones related to energy efficiency, renewable energy, resources recycling and pollution prevention.

When considering environmental actions, it is necessary to have a vision of how to develop industries in addition to including the viewpoints of environmental movements and imposing environmental regulations. To do this, it is important to create environmental industries that consider the needs of the demand side. For instance, in some developing countries they are shifting directly to decentralized systems using solar panels and batteries for lighting and refrigeration, rather than relying on traditional ways of cutting forests and constructing electricity transmission lines from centralized power plants. What is needed here is not technological sophistication, but rather low cost, simplicity, general applicability and convenience. Without considering these aspects, it is not possible to market the products of Japanese environmental industries in other countries and take the initiative in establishing global standards. Because of this, strategies for selection and concentration in governmental support are required. Such coordinated actions will lead to a virtuous circle of success.

IGES地球環境セミナー2009第5回

川崎市の概況 Overview of Kawasaki City



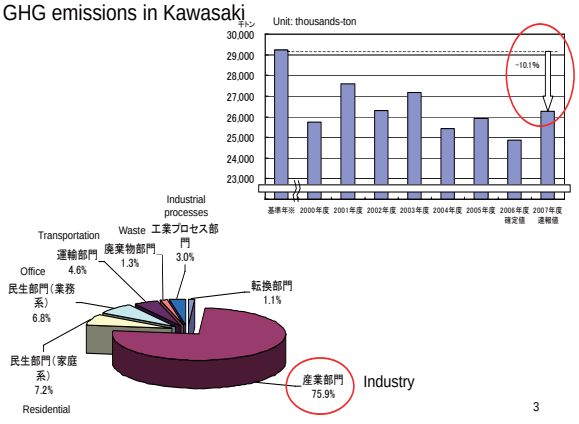
	川崎市 Kawasaki	首都圏・全国 Metropolitan area, Japan
人口 Population	1,409,558人 (2009年10月1日現在)	M) 首都圏 4,990,000人 J) 全 国 128 millions人 (2009年8月1日現在)
人口増加率	2.01%(2007年) Population growth rate	M)首都圏0.68%(2007) J) 全 国 0.02% (2007)
平均年齢	40.7歳 Average Age (2007年10月1日現在)	J) 全 国 43.9歳 (2007年10月1日現在)
労働力人口 Labor population	737,210人(2005年) (男male458,810人、女female 278,400人)	M) 首都圏18,420,000人 (2005年) J) 全 国 65,400,000人 (2005年)

	川崎市 Kawasaki	首都圏・全国 Metropolitan area, Japan
製品等出荷額 Shipment	4兆6,110億円(2008年) 4.6 trillion yen	M)首都圏92兆円(2007年) 92 trillion yen J) 全国325兆円(2008年) 325 trillion yen
主要産業 Major industry	製造業(鉄鋼、電子・通信、精密機械、石油・化学)、情報・サービス	Manufacture(steel&iron, electronics, precision machine, petro chemistry) , information service
発展産業 Developing Industry	新製造技術、情報通信、環境、福祉・ライフサイエンス、生活文化	New manufacturing tech. IT, environment, welfare/life science, lifestyle and culture
外資系企業立地数 Foreign Corporations	115社 (うち本社機能83社: 全国第5位)	M) 首都圏 2,988社 J) 全 国 3,500社

※出典『外資系企業総覧2006』東洋経済新報社

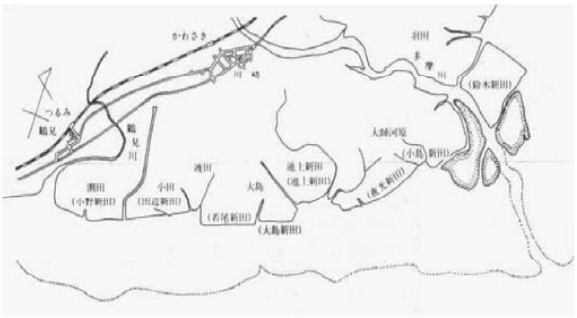
川崎市の概況 ー温室効果ガス排出量ー

GHG emissions in Kawasaki



明治末期の川崎臨海部

Coastal area of Kawasaki in the end of Meiji Era (1868-1912)



現在の臨海部 Coastal area at present

公害問題の克服に向けた取組の経験

Experience of overcoming pollution

View of coastal area in 1960s *View of present coastal area*

Roundtable Discussion: Part 1

臨海部に集積する環境技術～地球環境・エネルギー

Growing Environmental Technology in Kawasaki: Energy

臨海部に集積する環境技術～資源循環・廃棄物

Growing Environmental Technology in Kawasaki: Waste and Recycling

川崎の特徴・強み

Characteristics & Strengths of Kawasaki

川崎の特徴・強み

Characteristics and Strengths

- ●日本最大級の工業地域
  One of the largest industrial areas
  （製造品出荷額等大都市1位）
- ●日本最大級の研究学術機関の集約
  Many research institutions
  （研究員比率大都市1位）
- ●過去の公害問題・エコタウン創設の歴史
  The history of pollution and the sequent creation of eco-town
- ●都心に隣接した立地の好条件
  Close to the center of Tokyo

最先端の環境技術の集積

Accumulation of latest environmental technology

- ●省エネルギー
  Energy Saving
- ●再生可能エネルギー
  Renewable Energy
- ●資源循環
  （リサイクル）
  Recycling
- ●公害対策技術
  Pollution prevention technology

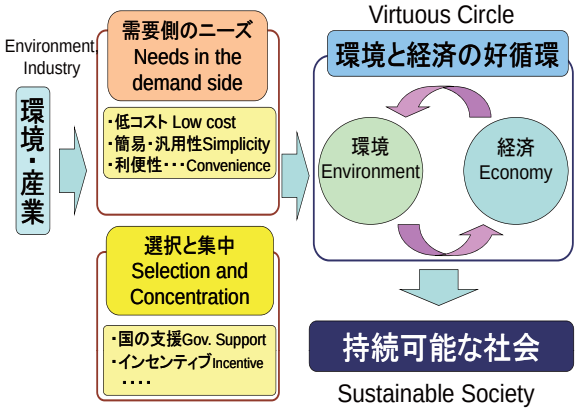
9

環境と経済の好循環

10

環境と経済の好循環

Virtuous circle of environment and economy



Yasuhisa Yamaguchi
President and CEO, Intellectual Properties Development &Investment, Inc.

Barrier and cross-sectional vision for low-carbon societies (LCS)

He explained the current situation and obstacles in relation to environmental venture capital in Japan and made suggestions for overcoming them and to vitalize environmental venture corporations and their technologies.

Intellectual Properties Development &Investment Inc. has developed the intellectual property development fund including private finances, manages it as venture capital. The fund was established to create industries for the next generation and to support companies in seed-stage and early-stage to grow.

In 2008, the total amount of environmental venture investment in the world was about 800 billion yen in total and investment has increasingly gone to environmental businesses. However, in Japan, even the total venture investment amounted to only about 26.2 billion yen in 2009 (about 30% of the peak in 2006), among which clean technologies account for only 8%, about 5 billion yen. In Japan, people do not take risks and risk money does not flow into venture capital. Clean-tech funds are in a bubble situation. There are doubts as to whether or not they are really contributing to reductions in CO_2 emissions and whether the funds are actually reaching venture companies or are solely being used for speculative investment.

The following environmental technologies are focused on by those providing venture capital; solar electricity generation, electric cars, bio-fuels, hydrogen gas from steel production process, LEDs, fuel cells, etc. Destructive and completely new technologies can sometimes succeed by going beyond institutions and business models.

[Actions by administrators] It is a challenge to find surprising and innovative environmental technologies and patents and then to commercialize them. Policy should support on the supply side (e.g. the creation of new industries) is necessary. Policy support including subsidies, tariffs and credit enables environmental ventures to turn themselves into real businesses. [Actions by business] The technologies owned by venture companies are those that large corporations do not deal with and have the characteristics of niche or blockbuster technologies. Blue ocean strategies should be adopted for the creation of intellectual property by making them internationally available and making technologies differentiated. Creative ideas in determining the prices of products and services and the conversion of service models are also necessary. [Actions by people] In environmental businesses, there are some areas where they cost too much to operate such as collection of waste of cooking oil for bio-diesel. It is very helpful if people help to separate and collect it in such case.

Roundtable Discussion: Part 1

知財開発投資株式会社

関係者外秘

知財開発ファンドの環境分野への取り組み

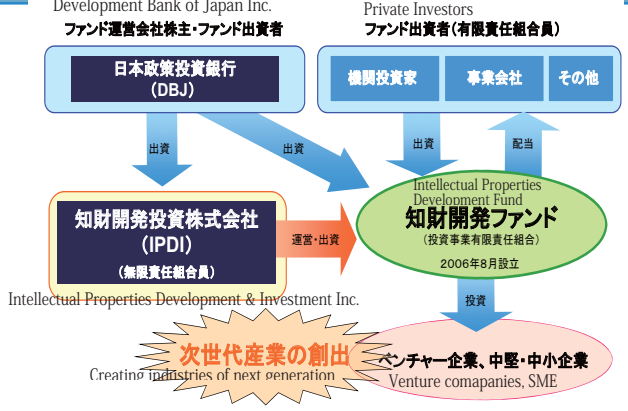
Intellectual Properties Development Fund in Environmental Field

2010年3月15日

知財開発投資株式会社
山口泰久 Yasuhisa YAMAGUCHI
yamaguchi@ipdi.jp

Scheme of Intellectual Properties Development Fund and Objectives

知財開発ファンドの投資スキームと目的



知財開発ファンドの知財・技術評価と投資判断プロセス

レベル1 特許情報解析・格付け（システム）
- ➢パテントリザルト社のパテントスコア・パテントエクスプレス®・パテントアトラス®を用いて特許・技術を公開済特許と比較することにより、対象特許の競合状況や、どのような特徴を持っているかを分析し、格付け。

レベル2 技術評価レポート（ヒト：特許・技術アナリスト）
- ➢技術の新規性や進歩性、既存・代替技術に対する優位性の有無、マーケッタビリティなどについて、各技術領域の専門家が定性的な分析・評価を行う。
- ➢公正で客観的な評価レポートを外部の第三者*に依頼して作成してもらう。

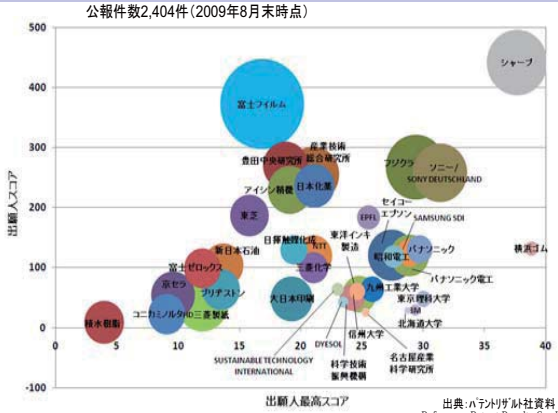
レベル3 市場性・事業計画評価（ヒト：ベンチャー投資アナリスト）
- ➢技術的に価値があると判断された案件に関して、ビジネスプランを評価。市場の現状把握、市場性評価、企業価値評価等を行う。
- ➢DBJの審査ノウハウを活用。

*IPDIでは、堀田氏（元新日鉄化学専務、材料分野）、小堀氏（シュタインバイス日本代表）、大隅氏（元NTT米国副社長、IT分野）、大津留氏（元ソニー、半導体分野）等の実務家をシニア・アドバイザーとして事業性について十分な議論を行う他、各技術分野の特許・技術調査専門家のネットワークを構築し随時活用している。

Example of patent applicants' MAP

色素増感型太陽電池に関する特許出願人MAP

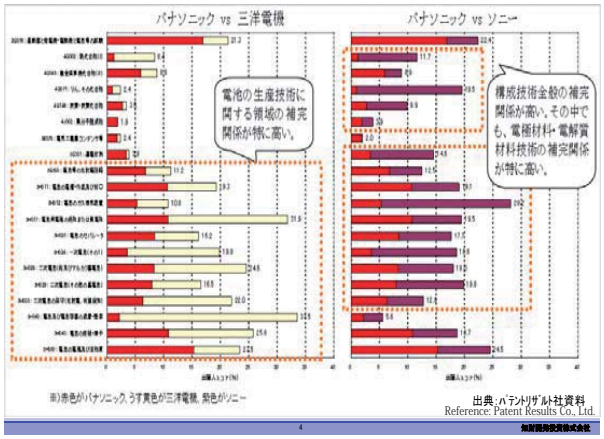
公報件数2,404件（2009年8月末時点）



出典：パテントリザルト社資料
Reference: Patent Results Co., Ltd.

Example of analysis on alliance effect of joint venture

リチウムイオン電池の技術領域アライアンス効果

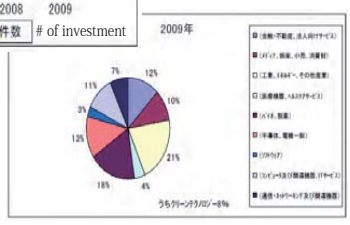


出典：パテントリザルト社資料
Reference: Patent Results Co., Ltd.

Trends of venture capital investment

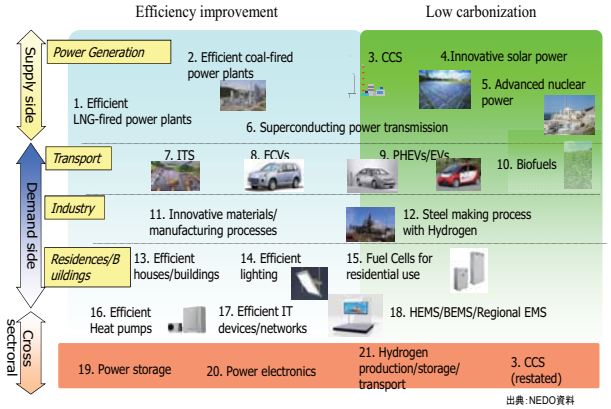
ベンチャーキャピタルの投資動向について

1. 年間投資額は、約262億円
2. ピーク時（2006年）の約3割まで落ち込む。
3. 2009年のベンチャー投資内訳をみると、クリーンテクノロジー向けは、約8%と50億円程度。
4. 一方、世界の環境ベンチャー投資は、8000億円を超えるバブル状況。



Promising New Environmental Technologies

注目される環境関連新技術

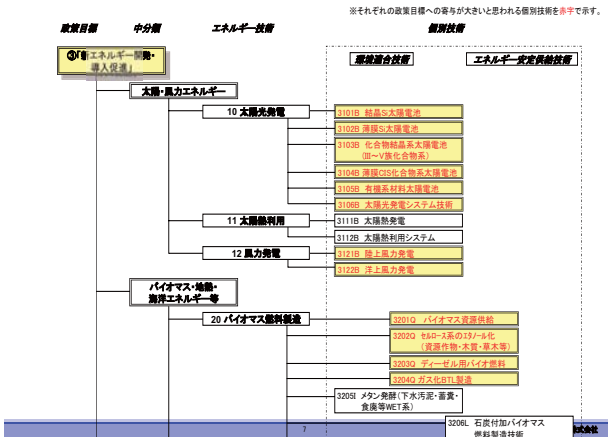


出典:NEDO資料

Technology Map of New Energy

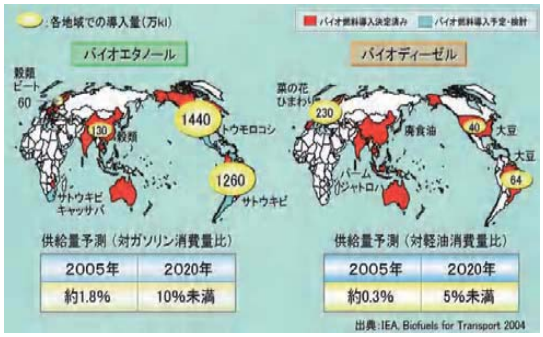
新エネルギー関連の技術マップ

出典:経済産業省資料



Diffusion of Bio-fuel

バイオ燃料の普及状況

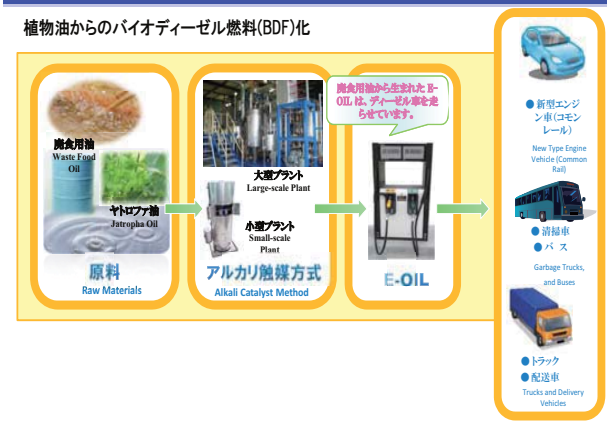


- 南米・北米は、バイオエタノール、欧州はバイオディーゼルが普及
- ガソリン消費量に比べると、普及率は低い。
- 食用植物を原料とするものは、食品価格に影響。

Examole of venture business of bio-fuel

バイオフュエル社が提供するBDF:製造と流通

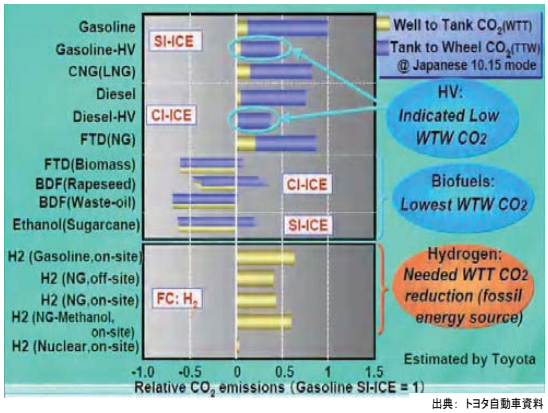
植物油からのバイオディーゼル燃料(BDF)化



バイオディーゼル燃料(BDF)の概要

- 植物油をメチルエステル化(エステル交換反応)し、ディーゼル機関用燃料としたもの
- 環境負荷の少ない軽油代替燃料
  - CO2削減効果が高い
  - 酸素を含む含酸素燃料
  - 硫黄分を殆ど含まない
  - 黒煙等の有害排気ガスの排出が少ない
- BDFの原料は、菜種、大豆、ヤトロファ、パーム、ユーカリ、微生物等から抽出された油
  - 日本では、コストの問題等で、主に廃食油を原料とした利活用が中心となっている。
- 日本では、2009年2月25日に品確法が改正。BDFを軽油に混合する基準・品質の確認を義務付け

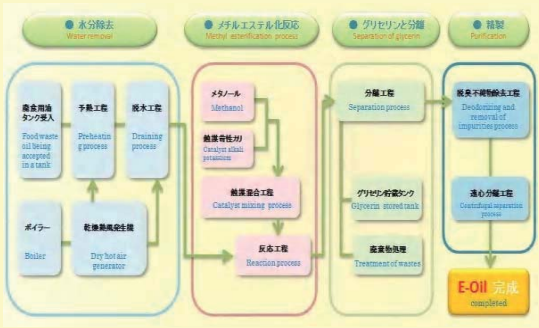
自動車燃料にみるCO2排出量比較(Well to Wheel)



出典: トヨタ自動車資料

Roundtable Discussion: Part 1

バイオフュエル社のコア・テクノロジー： 無水方式 の製造工程



- どのような廃食用油でも受け入れ可能。だから原料入手がスムーズ＆ローコスト。
- メチルエステル化反応後の水洗いなし。製造工程も環境に優しい。
- 製造工程の各段階で性状分析。徹底した品質管理を実現。
- 水分や不純物を徹底的に除去。安定して高品質の製造が可能。

バイオディーゼル岡山（農水省モデル事業第3号）

プラント内部

BDF給油所

廃油回収と生産能力

- 植物食用油の生産量　250万トン/年
- 廃食用油の排出量　90万トン
- 回収可能な廃食用油　40万トン
- 植物食用油で排出するダーク油　30万トン
- 家庭からの廃食用油　20万トン
- 未利用動物油　30万トン

計120万トン

原料

3000トン/年(8H稼働)
↓
1万トン/年(24H稼働)

× 40基 ＝ 40万トン/年

800万トン/年

B100
B5
20%

軽油　3500万トン/年

当社プラント40基のB5生産能力

日本の軽油消費量

VCからみた環境問題への提言

1. 日本国内に、さまざまな環境問題を解決する思いもよらない特許・技術が埋もれている。これを如何に見出し事業化するかが課題。新しい産業の創造（ベンチャー支援）など、サプライサイドへの政策的配慮が必要。（対行政）
2. ベンチャー企業が着目するテクノロジーは、大手企業がやらない分野。ニッチ、または、ブロックバスターの両極端。知的財産を国際的に確保し、技術による差別化により、ブルーオーシャン戦略を取るべき。（対企業）
3. 製品・サービスの価格決定に工夫が必要。サービスモデルへの変換が必要。環境ベンチャーについては、補助金、免税、タリフ（買取）、クレジット（排出権）など規制・制度の利用により、ビジネス化が可能に。（対企業、行政）
4. 環境ファンドは、バブル状況。CO2は、本当に削減されているのか？金融サイドでは、どの技術が本物が見抜けない。（対金融、対市民）
5. 破壊的、不連続なテクノロジーは、制度やビジネスモデルを超える。

Yuzo Minami
Adviser for Housing

Barrier and cross-sectional vision for low-carbon societies (LCS)

The current status and measures for eco-housing

He illustrated the problems of eco-housing in Japan whereby raising housing standards results in higher costs, and showed how to achieve high quality city planning by solving these problems

The main scope of this presentation is how to promote eco-housing using fundamental approaches. Eco-housing consists of three main elements; energy efficiency, prolonging the life of the house and promotion of the use of national timber resources. These three measures result not only in raising the level of housing standards, but also increase the costs, which have been covered by policies to provide subsidies in recent years, and the industry still has not fully caught up with this policy trend.

The average lifetime of houses in Japan is 30 years, compared to 55 years in the USA and 77 years in the UK. There are three reasons for this; 1) the houses themselves have no value, 2) houses are built under the authority of individual owners and 3) the housing industry tends to prefer building new houses to renovating old ones. The mechanism of these is as follows.

In Japan, the house and the land are valued separately and the house is considered a consumable item whose value is fully depreciated in 20 years. Thus, in the housing market, only the land is sold and the houses are generally demolished. Meanwhile in countries where they consider the house and land together, there is an incentive to increase the value of housing assets by constructing a good house and improving the surrounding environment. In Japan, people build houses just for themselves. If they built them as a social asset, the second hand market would be activated and the life of houses could be extended.

Concerning housing loans, in Japan houses are not considered to have value and the loan is made on the basis of the salary of each individual, which could turn into debt beyond the value of the house if the borrower’s economic activity ceases. Meanwhile, in the USA, the loans are a mortgage and nonrecourse financing is provided based on the value of the land and house alone. When the financial situation would be deteriorated, people could sell their houses to receive money to start something new. In an economic depression, such safety measures are necessary in order to promote the purchase of houses.

If there were a mechanism whereby a better house and environment could be sold at a better price in the future, raising the standard of housing would not lead to higher costs. It is wise for policies to focus on creating a secondhand housing market rather than to provide subsidies to promote more energy efficient houses.

Roundtable Discussion: Part 1

Takaaki Kaburagi
Secretary General, Hopeful Sustainable Society Project

Barrier and cross-sectional vision for low-carbon societies (LCS)

He introduced the example of pastures in forests, putting importance on a successful business whereby the value of natural assets is reflected in the price, and explained possible ways of changing human behavior through such businesses.

What should be done to change the quality of industry? Who is undertaking such activity? As an example, pastures in forests by Amita Holdings Co. Ltd. will be explained.

In Amita in Kyotango City, by using pastures in the forest, the milk that is produced from grazing cows (at 630 yen per 500 ml) is always sold out. This is not only because cows are cute and consumers sympathize with the willingness of the company to ensure forest preservation and create a sustainable society, but also because the price reflects these values. The point of achieving the transition to a low-carbon society is to develop such businesses one by one that are profitable due to an increase in the asset value of nature and human and social relations.

Businesses like this are not well known among the people. Innovative cases should receive more attention, but it is difficult to inform people of genuinely good things. People tend to believe only what they see. People also often only change their actions through experience. Thus it is important to actually create a sustainable community (e.g. the Nasu project), to attract people to come, see and then change themselves.

森林酪農とは？？ ー アミタ京丹後での取り組み

Pastures in forests run by Amita Holdings Co. Ltd.

○1haあたり、0.5～2頭の放牧 →ふん尿の自然循環が可能

○牛の蹄で山を耕し、草地を形成する。（蹄耕法）

○365日、昼夜周年放牧

○輸入飼料に依存せず、森林の下草を活用する（舌草刈）

森林の下草刈り

真冬の牧場

Takaaki KABURAGI

0

森からの贈り物 Products of the project.

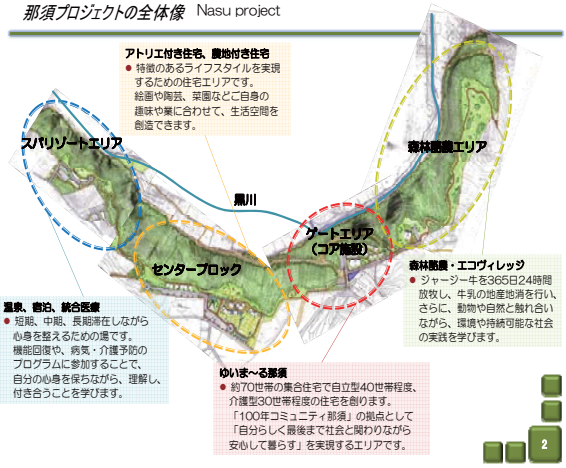
「森林ノ牛乳」
牛乳本来の味を活かすため
ノンホモジナイズ
低温殺菌牛乳

「森林ノアイス」
牛乳の風味豊かなアイス
（安定剤や乳化剤など不使用）

ソフトクリーム
牧場でしか食べられない
牛乳たっぷりのソフト

1

那須プロジェクトの全体像 Nasu project



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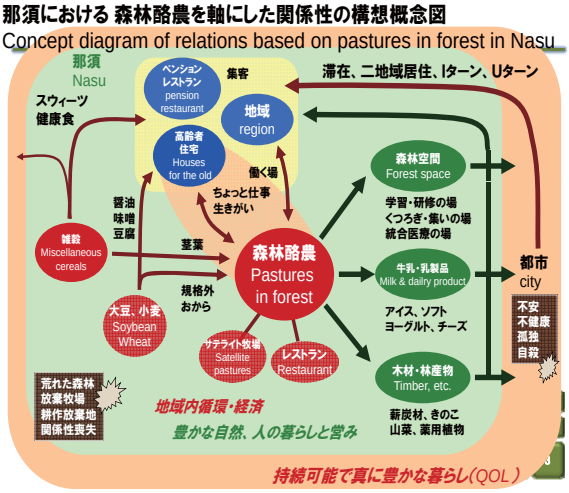
那須における 森林酪農を軸にした関係性の構想概念図

Concept diagram of relations based on pastures in forest in Nasu



3

Roundtable Discussion: Part 1

Satoru Mizuguchi
Hakuhodo Inc. Corporate Communication Director

Barrier and cross-sectional vision for low-carbon societies (LCS)

His comments include (1)psychological barriers to deter Japanese to take actions towards low carbon economy, (2) roles of governments to secure basic human rights to make the transition easier (3) Japan's detachment from traditional low carbon life style after World War II may be another barrier.

Comment 1:
Four misunderstandings seem to constitute psychological barriers to deter Japanese to take actions towards low carbon economy.

The first barrier is the Japanese mind set characterized as "Economy OR Environment". As table 1 shows, some of European countries including Sweden, UK, Germany and Denmark have already been achieving the "Economy AND Environment" by decoupling GDP growth and CO_2 emissions. The differences may lie partly due to the fact that those decoupling countries have been pricing carbon by introducing carbon tax and/or cap & trade. On the other, many Japanese believe carbon tax and trading schemes are "regulatory policies" to limit free enterprise activities.

This constitutes the second misunderstanding. Pricing carbon has been regarded as an economic incentive policy to make up for market failures which caused climate change, as Stern review and OECD reports suggested.

Third misunderstanding is "household and office sectors are main contributors of CO2 emission growth after 1990". As table suggest, it is due to gradual growth of emissions from electricity generation because of the increasing use of coal, a halt down of a nuclear power, and stagnant growth of renewable energy.

Fourth misunderstanding is "Japanese environmental technologies are far advanced than others". It may be true in some areas, however, I have seen many renewable facilities made in Europe operating both in Asian countries and even in Japan.
European countries have been built eco-towns as showcases, where low carbon technologies are organized into one "system". And cabinet members take their roles of sales persons for exports. Government guarantees and World Bank loans are often used for exports. Japan may lack such an effort .

Comment 2:
Another obstacle to transition towards low carbon economy may
be inadequacy of social security in Japan. In Europe, unemployed people are able to receive job training while receiving unemployment benefits. And unlike Japan, they don't need to save much money because governments provide free education up to the level of higher education for their children and social security for the retired. In addition to that, property market secure values of aging houses as assets, people in need of money are able to sell it.

Since life, liberty and the pursuit of happiness are secured by the governments, Europeans seems to be unafraid of changing jobs, which may be good for labor transfer from high carbon industries to low carbon ones.

Comment 3:
Mr Kaburagi showed the example of high quality milk from “dairy farming from agro-forestry”. In Europe, those locally produced food with distinction are labeled specifically, to make available in the market with higher prices. Suitable labeling may help locally produced, traditionally produced, low carbon foods to survive.

Comment 4:
Japan’s detachment from traditional low carbon life style after World War II may be another obstacle. Ministry of Construction and Academy of Construction once had proclaimed “we don’t permit to build wooden architecture anymore” in the late 1940s. As a consequence, traditional skills to use sunshine indirectly at offices and houses were abandoned.

Comment 5:
Our next step may be to have dialogues how to overcome barriers by sector, and by theme. “Some countries in Asia, Africa and Latin America have followed development paths emulating Japan as a role model”(Timothy Tailor, Economics professor of Minnesota University), so now Japan has a new important role to show a way towards low carbon economy to such countries.

Roundtable Discussion: Part 1

低炭素経済への4つの「誤解」:その1 「経済か環境か」 → 「経済(GDP成長)も環境(CO2減)も」の国々と、そうでない国

水口

1st misunderstanding on low carbon economy: "Economy OR Environment"
⇒ Some countries achieving "Economy AND Environment"

	2007 1990年比のGDP成長	2007 1990年比のCO_2排出量	一定のGDPを創出する際に排出するCO_2の量 (CO_2/GDP)	一人当たりCO_2排出量	京都議定書の目標	炭素税	排出量取引	主な自然エネルギー促進策
日本 Japan	26.2%	+8.2%	0.24kg	9.68t	-6%	なし	試行段階	固定価格買取制(太陽光発電の一部)
EU15ヶ国 EU15	43.9%	-4.3%	データなし	10.34t	-8%	なし	10年から第2ステージへ	EU 指令で20年までに自然エネルギー比率を 20 %に、(交通部門は10%に)
スウェーデン Sweden	47.8%	-9.1%	0.16kg	5.05t	+4%	91年から導入	同上	グリーンエネルギー証書(小水力、太陽、風力、バイオマスなど)
デンマーク Denmark	44.5%	-3.3%	0.28kg	9.24t	-21%	92年から導入	同上	固定価格買取制(風力、バイオマスなど)
ドイツ Germany	34.1%	-21.3%	0.39kg	9.71t	-21%	環境税(Eco-tax)を99年から導入	同上	固定価格買取制(太陽、風力、バイオマスなど)
イギリス UK	53.4%	-17.3	0.3kg	8.6t	-12.5%	気候変動税を01から導入	同上	固定価格買取制を10年から導入(小規模発電)
フランス France	38.2%	-5.3%	0.25kg	5.81t	±0%	なし	同上	固定価格買取制(小水力、太陽、風力、バイオマスなど)

出典:IEA(国際エネルギー機関)資料などをもとに、スウェーデン大使館の協力で作成

低炭素経済への4つの「誤解」:その2 「炭素税、C&Tは規制的手法」 →市場メカニズムを生かす「経済的手法」

水口

2nd misunderstanding: Carbon tax and Cap & Trade are regulatory policies
⇒ They are economic incentive policy to make up for market failure

(1)Stern Review: Tackling climate change is the pro-growth strategy,,,,,Climate change is the greatest market failure the world has ever seen, and it interacts with other market imperfections. Three elements of policy are required for an effective global response. The first is the pricing of carbon, implemented through tax, trading or regulation.

(2)「OECD 環境パフォーマンス・レビュー 日本編」(2002年1月)

OECD Environmental Performance Review: Japan

①**日本のCO2排出量**は、G7諸国の減少傾向とは対照的に、1990 年代GDPと同じ割合で増加している。特に交通とエネルギーは、絶対値が増加している。

②ほとんどのエネルギー消費部門は、**効率改善**を達成しており、これ以上のCO2削減は難しい。
③**排出課徴金、排出量取引または環境税といった経済的手法**が、広く活用されていない。こうした手法は、90年代に見られた運輸、民生部門からの排出量の増加を、効果的に削減させうるものである。
④90年代を通じて、**道路建設などの特定用途**に、ほとんどの自動車燃料及び自動車に関する税が充てられた。対照的に、道路交通の環境への悪影響を緩和するためには、ごくわずかの税収しか充てられていない。

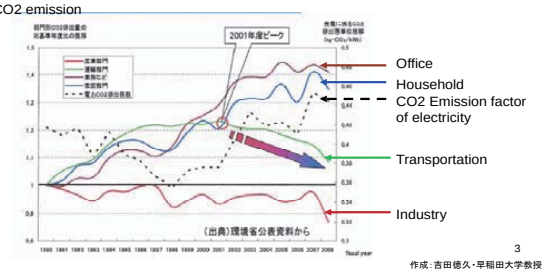
2

低炭素経済への4つの「誤解」:その3 「増えているのは家庭と業務」 →業務、家庭からの排出増と、電力CO_2排出係数の悪化は、比例

水口

3rd misunderstanding: Household and office sectors are emitting more CO2
⇒ The growth rate of emissions from household and office correlates to that of CO2 emission factor of electricity

CO2 emission



3

作成:吉田徳久・早稲田大学教授

低炭素経済への4つの「誤解」:その4 「環境技術は日本が優れている」 →途上国で売っているのは欧州諸国

水口

4th misunderstanding: Japanese environmental technologies are far advanced than others.
⇒ European countries are selling them in developing countries.

1. ストックホルム内のエコタウンをシステムごと、中国・唐山市(天津の隣)に売るスウェーデン

スウェーデン貿易・商業省と中国・唐山市

Sweden selling the system of eco-town as a whole to China

4

Selling environmental technologies by integrating them as system and brand

2. 環境技術をシステムにして、ブランドにして売る

3. グループ・ブランドで世界に売る、閣僚が売る

Selling them by group-brand to the world, by Cabinet ministers

5

Roundtable Discussion: Part 2

Dr Kimiko Kainuma
National Institute for Environmental Studies, Center for Global Environmental Research, Climate Change Research Program General Manager

How barriers to the formulation of a Low-Carbon Society (LCS) can be overcome?

Dr. Kimiko Kainuma who is an expert on climate change modeling and scenario analysis gave an outline of the "Japan Low-Carbon Society Scenarios toward 2050", a research project that was started in 2004. The project started from drawing a picture of a society with low GHG emissions and achieving high quality of life, analyzed barriers to realize such a society, and proposed options to overcome them..

The project was initiated with a long-term goal of reducing GHG emissions in Japan by 60-80% while global GHG emissions by 50% in 2050. When the project started, there were many opinions that the target was too severe to be achieved. However, the project promoted the movement to implement the significant reduction showing the feasibility of the reduction target and the specific measures to overcome barriers to prevent the achievement. There are two approaches to predict the future; the forecasting approach to analyze the trend expecting the future technological innovation and socioeconomic transformation and the back-casting approach to draft the roadmap from the vision in which the target has been achieved. This Japan 2050 project used the back-casting approach targeted to reduce Japan GHG emissions by 70% in 2050. The back-casting approach is effective considering the role of the government, industry and citizen and finding the pathway concerning the method and the timing the policy and activity should be implemented.

As the concrete vision, the project team visualized two socioeconomic scenarios (a vivid society and a slow society) estimating the type of lifestyle that we would have and how industries can carry out their business in the future with the aging of the society and declining fertility. From these viewpoints, the vision of a LCS was designed in such a way as to strike a balance between a comfortable and green built environment and energy-savings, while identifying the importance of three pillars to achieving this 1) the effective use of sunlight, 2) the development and dissemination of high-efficiency equipment, 3) information dissemination and recognition of the information supply system. In addition, the reduction for CO2 emissions by 40% based on CO2 2000 emissions levels by 2050 was described as the achievable target by reducing energy demand in each sector (industry, residential, commercial, transportation, energy supply), as an example, conducting the analysis of the reduction measures for transportation system under the regional specification (public transportation in the city, the policy

Roundtable Discussion: Part 2

for the use of individual vehicle in a countryside etc). Furthermore, for the rest part to achieve the goal of a 70% reduction based on CO2 1990 emissions levels by 2050, based on the discussion of how the energy system is converted to low-carbon in energy supplies level combining the energy mix of renewable energy, nuclear power, CCS-equipped fossil and biomass fuel-fired power plants, etc, it was estimated that the expansion of large scale energy technologies such as nuclear power plants, CCS and hydrogen was expected in the scenario of a vivid society while that of diffusive energy technologies in small scale such as solar and wind energy, biomass would be accepted in a slow society.

A dozen actions to be taken towards achieving a low-carbon society were proposed and the pathway to achieve the future vision in 2050 was described using the back-casting model under the 12 actions. The 12 actions are 1) development of a Comfortable and Green Built Environment, 2) By means of equipment rental and leasing, alleviate the initial cost burden of acquiring and installing high-efficiency equipment, 3) Promoting Seasonal Local Food, 4) Sustainable Building Materials, 5) Environmentally Enlightened Business and Industry, 6) Swift and Smooth Logistics, 7) Pedestrian-Friendly City Design, 8) Low-Carbon Electricity, 9) Local Renewable Resources for Local Demand, 10) the development of Next Generation Fuels and the infrastructure to deliver them, 11) Labeling to Encourage Smart and Rational Choices: Publicizing the energy use and CO2 cost of goods and services and public acknowledgement of consumers who use ones with low energy requirements, 12) Low-Carbon Society Leadership:

The cost-efficiency of financial investments was estimated to measure the timing and amount of the cost for the next 40 years in order to find cost-minimizing ways of achieving a LCS while the additional investment cost necessary for the conversion of conventional technologies into low-carbon technologies was discussed and calculated. The research findings show that the earlier the additional costs for reducing CO2 emissions are taken into account, the greater the resulting minimization of the total cost of investment in energy savings, the wider the diffusion of the technology and the more gradual the amortization of the equipment costs.

Lastly, Ms Kainuma mentioned that when the pathway for low-carbon life is considered using back-casting approach, the clearer target and the proposed actions are effective to overcome the various bottlenecks and to achieve the target. The 12 actions are ones which suggest when, where and how much direct countermeasures and policies, the action and choice and the initial supports are required. In order to implement the actions, the plan-making using the policy and system roadmap with long term vision is required concerning the order of the individual countermeasures and policy and estimating the time to implement it.

Visions and Actions towards a Low-Carbon Society

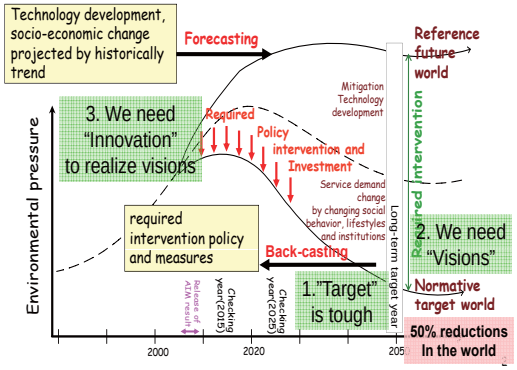
Mikiko Kainuma
National Institute for Environmental Studies

15 March 2010, Yokohama

1

Japan Low Carbon Society Scenarios toward 2050

[FY2004-2008, Global Environmental Research Program, MOEJ]



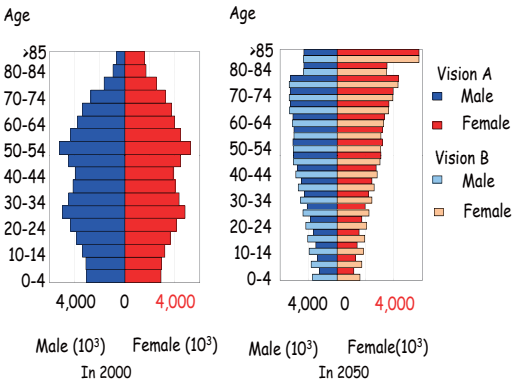
Visions

we prepared two different but likely future societies for Japan

Vision A	Vision B
Vivid, Technology-driven	Slow, Natural-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

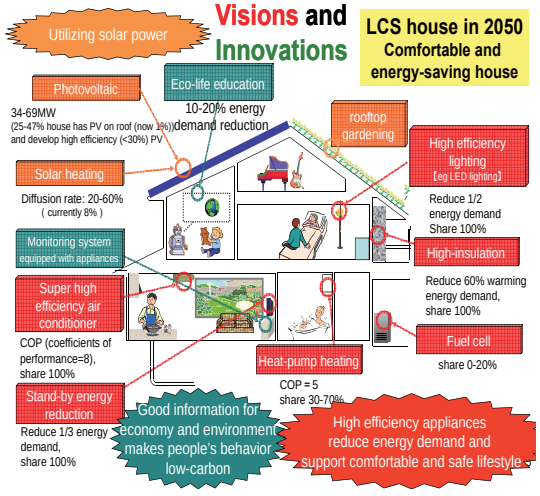
Japan: World Front Runner of Aged Society

What will Japan's population be in 2050?

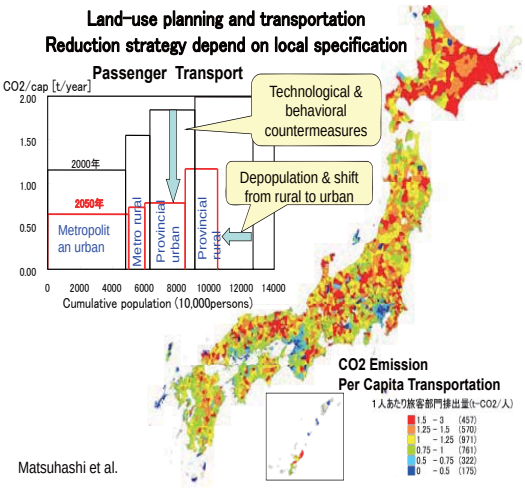


Visions and Innovations

LCS house in 2050
Comfortable and energy-saving house



Land-use planning and transportation Reduction strategy depend on local specification



Matsuhashi et al.

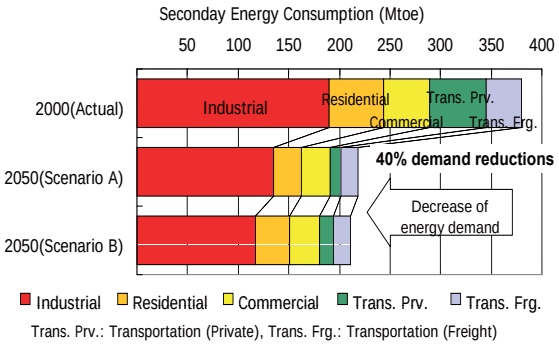
Roundtable Discussion: Part 2

Vision for 2050: Passenger transportation

	Metro Urban	Metro Suburb	Provincial Urban	Provincial Rural	Total
Compact neighborhood	△ Rehabilitation	○ Rehabilitation	△ Rehabilitation	○ Compact Settlement	112->33Mt To 1990
Compact city	△ City center renewal	△ Withdrawal	△ City center renewal	×	− 70%
Enhance public transit	△ Pricing	△ Park & Ride etc.	○ LRT	△ van pool, shared taxi	Including (Inter-city Passenger : 30km−)
Improve load efficiency	△ Utilize small vehicles		△ Enhance sharing	×	
Improve fuel consumption	◎ Urban mode	○ local mode			Index: ◎: − 30% ○: − 20% △: − 10% ×: no room
Low carbon energy	△ less room for improve	○ biofuel, Low Carbon Electricity for EV and PHEV etc.			
pop(million)	46→40	15→12	27→20	35→23	124→94
t-CO_2/capita	0.66→0.27	0.94→0.35	1.03→0.38	1.11→0.51	0.90→0.35

70% reduction by 2050

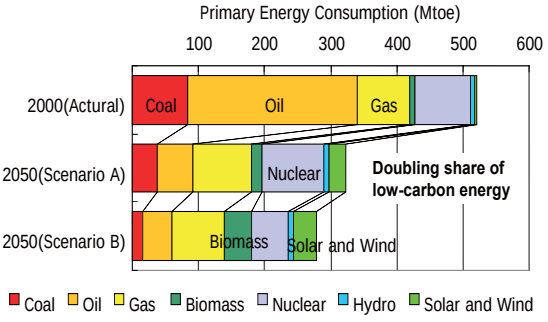
Matsuhashi et al.



Possible energy demands reductions for each sector:
Industry:structural change and introduction of saving energy tech. 30-40%
Passenger Transport :land use, saving energy, carbon-intensity change 80%
Freight Transport :efficient transportation system, energy efficient 50%
Residential: high-insulated and energy-saving houses 40-50%
Commercial: high-insulated building and energy saving devices 40%

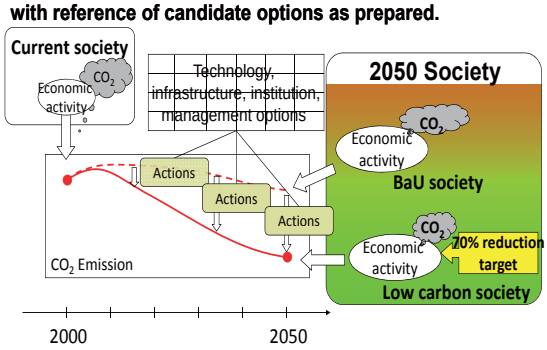
And we need low-carbon energy.

- Renewable energy
- Nuclear energy
- Fossil fuel + CCS



To achieve the 70% reduction goal by 2050, we investigated
- **which options should be selected,**
- **when options should be introduced,**
- **how much of each option should be introduced at each stage,**

with reference of candidate options as prepared.



A Dozen Actions towards Low-Carbon Societies

Press release on May 22, 2008

Residential/commercial sector actions

1. Comfortable and Green Built Environment
Efficiently use of sunlight and energy efficient built environment design. Intelligent buildings.

2. Anytime, Anywhere Appropriate Appliances
Use of Top-runner and Appropriate appliances. Initial cost reduction by rent and release system resulting in improved availability.

Industrial sector actions

3. Promoting Seasonal Local Food
Supply of seasonal and safe low-carbon local foods for local cuisine

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.

Transportation sector actions

6. Swift and Smooth Logistics
Networking seamless logistics systems with supply chain management, using both transportation and ICT infrastructure

7. Pedestrian Friendly City Design
City design requiring short trips and pedestrian (and bicycle) friendly transport, augmented by efficient public transport

Energy supply sector actions

8. Low-Carbon Electricity Supplying low carbon electricity by large-scale renewables, nuclear power and CCS-equipped fossil (and biomass) fired plants

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

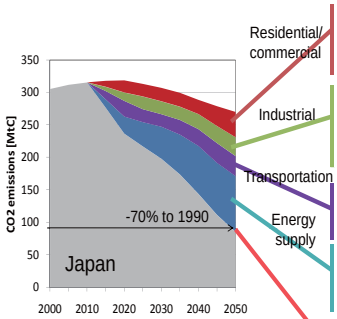
Cross-sector actions

11. Labeling to Encourage Smart and Rational Choices
Visualizing of energy use and CO2 costs information for smart choices of low carbon goods and service by consumers, and public acknowledgement of such consumers

12. Low-Carbon Society Leadership Human resource development for building "Low-Carbon Society" and recognizing extraordinary contributions.

CO2 emission projections based on a dozen actions toward 70% reduction

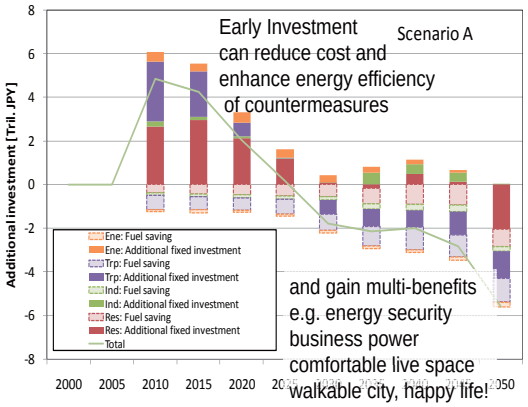
AIM/LCS



A Dozen Actions

1. Comfortable and Green Built Environment
2. Anytime, Anywhere Appropriate Appliances
3. Promoting Seasonal Local Food
4. Sustainable Building Materials
5. Environmentally Enlightened Business and Industry
6. Swift and Smooth Logistics
7. Pedestrian Friendly City Design
8. Low-Carbon Electricity
9. Local Renewable Resources for Local Demand
10. Next Generation Fuels
11. Labeling to Encourage Smart and Rational Choices
12. Low-Carbon Society Leadership

How to reach the Japan LCS?

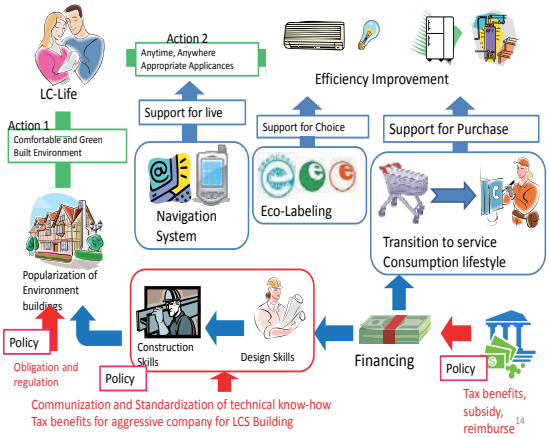


Early Investment can reduce cost and enhance energy efficiency of countermeasures

Scenario A

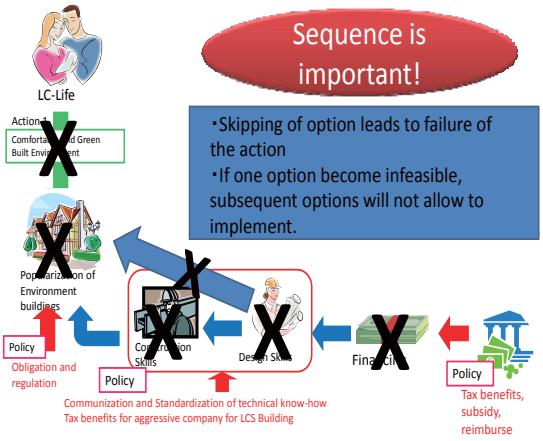
and gain multi-benefits
e.g. energy security
business power
comfortable live space
walkable city, happy life!

How to achieve Low-Carbon Life?



14

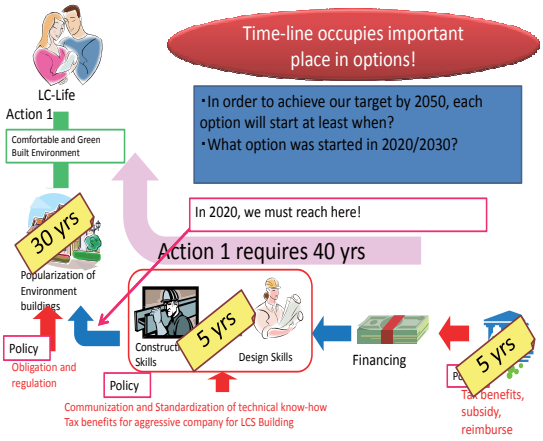
Sequence is important!



・Skipping of option leads to failure of the action
・If one option become infeasible, subsequent options will not allow to implement.

15

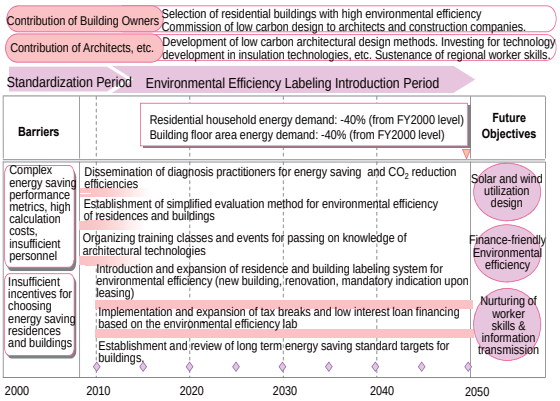
Time-line occupies important place in options!



・In order to achieve our target by 2050, each option will start at least when?
・What option was started in 2020/2030?

16

1. Comfortable and Green Built Environment



Low-Carbon Scenarios for Asian cities

http://2050.nies.go.jp/LCS/

18

Roundtable Discussion: Part 2

Takashi Otsuka
IGES Project Management Office, Project coordinator

How barriers to the formulation of a Low-Carbon Society (LCS) can be overcome?

As the lesson learnt from LCS researches and policy processes involved through IGES, Mr Otsuka introduced three issues; 1) the human resources required for a LCS, 2) the outcome of the First High Level Seminar on Environmentally Sustainable Cities and 3) Values and practices for Asian low carbon development

The human resources required for an LCS in the 21st century are those who can recognize the relationship and interactions between their own professional area and environmental protection, and who can internalize environmental conservation and its context in their daily life and work. A diagram of the relationship between the society, the economy and the environment is still discussed as a triple bottom line for sustainable development, whereby these three factors occur in parallel. However, I believe that it is important to recognize the comprehensive relationship of these three factors as social and economic activities are embedded within the comprehensive framework of the environment, where people conduct business activities.

Secondly, he talked about the “City and a low-carbon/low-pollution society session” in “the First High Level Seminar on Environmentally Sustainable Cities (ESC)”, where the various case studies on leading environmental measures were introduced. The seminar was held under the framework of East Asia Summit (EAS) of Environment Ministers Meeting (EMM) with 16 East Asian participating countries. As an example, in Ahmedabad, India, the bus rapid transit (BRT) system is promoted as an alternative public transportation system in the city where has difficulty to build subway system.

In the seminar, the junior ministers and city mayors in each country participated to share and exchange information on what need to establish LCS and what the roles are of each stakeholder, local government, country, aid agencies and international organizations. The points written down in the chairman’s summary was the importance of long-term city planning (long-term visions and goals) and of the formulation of roadmap to implement (short-, medium- and long-term achievement, policies and strategies). Furthermore, in order to guarantee the effective policy and strategies, the importance of the four pillars for ESC were also recognized; 1) governance, 2) knowledge management initiatives, 3) financing, and 4) community participation.

Mr Otsuka talked about a part of the researches, “the values and practices to anchor low-carbon development in Asia”, in “Analysis on Foundation and Potential of Low Carbon Development in Diverse Asia” implemented as the Prioritised Strategic Research of the Global Environment Research Fund. The research is based on the statement that “in Asia, while the values and practices for sustainable livelihood and its preservation remain, it rapidly disappears because of economic development and globalization. Therefore, these should be analysed and documented in order to learn the lessons from tradition for low-carbon development”. The international research team was established with the collaboration of Japan, Thailand, Indonesia and China and initiated the discussion regarding research framework and research methodology, as well as the scope of the values and practices which support low-carbon development. The past collaborative works led the team to focus on three key concepts, namely “coexistence

with nature (sustainable use of renewable resources),” “awareness of sufficiency,” and “coproduction, corporation, collaboration mechanism of community”.

For example, in the case of “the awareness of sufficiency”, mottainai concept in Japan, the sufficient economy in Thailand and Nyepi practice in Bali, Indonesia were introduced. As for the case of “coproduction, corporation, collaboration mechanism of community,” Gotong Reyong (mutual help) concept in Indonesia and its appearance in practice were introduced. There is a rice harvest method using traditional spike cutting hook called Aniani in Indonesia. By continually using such ineffective tool, it functions as a social safety-net in the community where all the member in the community can participate in the harvesting activities (creation of employment) and receive the harvested crops as the actual compensation. The next research topic is to consider how these value and practices affect to low-carbon development in rural and urban areas, and how it can be applied to. While in developing countries, how to draw the sufficient development pathway maintaining the social safety-net with mutual help remains the key challenge, Japan also need to consider slowing down the economic development and prioritizing the social safety-net.

Lastly, he talked about the necessity to comprehensively plan and coordinate the life with the awareness of coexistence with nature and the environmental capacity to overcome the bottleneck for LCS formulation. He shows the successful case study of planning and coordination implemented in Surabaya, Indonesia for organic garbage compost treatment technology through the collaboration of NGO, University, Japanese private company (J-power) and the neighborhood community association, the women association with finally obtained support from municipal government.

Roundtable Discussion: Part 2

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低炭素社会構築の障壁を どう乗り越えるか
How to overcome barriers to low carbon societies?

地球環境戦略研究機関（IGES）
プログラム・マネージメント・オフィス
大塚　隆志　Takashi OTSUKA
(otsuka@iges.or.jp)

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アウトライン

- 低炭素社会構築にむけて求められる人材
- 環境的に持続可能な都市に関するハイレベルセミナー（2010年3月2-3日、ジャカルタ）の結果
- アジアの低炭素発展を支える価値観と習慣
- まとめにかえて

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低炭素社会構築に向けて To build low carbon societies

- 求められる人材 Demands for human resource
  - 21世紀環境立国戦略（2007）
    Strategy for an Environmental Nation in the 21st
    - 環境保全に関する**基礎知識**(Basic Knowledge)をもち、環境に配慮した暮らしや環境保全のための**活動を実践**(Implementation of activities)できる（小・中・高等学校）
    - 環境**技術**、**政策**(technology and policy)等を学び行動する**企業人**(business man)や、幅広い関係者をつなげて持続可能な地域づくりを進める**コーディネーター**(coordinator)等、国内外で活躍できる環境リーダー（専門学校・大学・大学院）
  - 高橋・吉沢（2008）
    - 「あらゆる分野で、各人の専門分野と環境保全との**関係性を認識**(recognition of relations)し、職務等の追求の中で**環境保全の内在化**(internalization of environment preservation)に取り組むことのできる人材」を高等教育が目指す「環境人材」と定義

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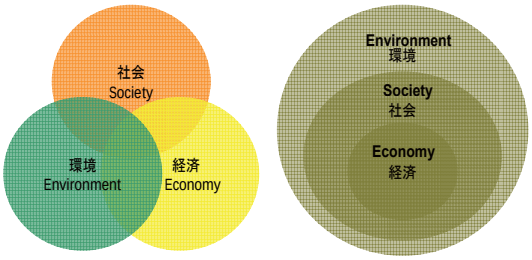
環境・社会・経済の関係は？
Relations between Environment, Society and Economy?



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東アジアサミット環境大臣会合の枠組みにおける
環境的に持続可能な都市に関するハイレベルセミナー
High Level Seminar on Environmentally Sustainable Cities
2010年3月2-3日、ジャカルタ、インドネシア
Jakarta, Indonesia

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環境的に持続可能な都市に関するハイレベルセミナー（1）

- 都市と資源効率性/3R
- 持続可能な都市開発を通じた気候変動への適応
- 都市と生物多様性
- **都市と低炭素/低公害社会**
- 資金調達及び能力開発
- 地域枠組み及び都市間ネットワーク

Roundtable Discussion: Part 2

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環境的に持続可能な都市に関するハイレベルセミナー(2)

- 東京(日本)
  - 公共交通(鉄道・バス)の充実、駅中心のベッドタウン開発
- アーメダバード(インド)
  - 公共交通(バス高速 輸送システム:BRT)、コベネ
- デグ(韓国)
  - 埋立地ガス利用(CDMプロジェクト)、コベネ
- リンアン(中国)
  - 環境保全モデル都市(計画・環境評価・汚染管理・法執行の強化等)
- オークランド(ニュージーランド)
  - 長期都市計画とマルチステークホルダー参加型アプローチ
- 北九州(日本)
  - 環境モデル都市(北九州グリーンフロンティアプラン)

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環境的に持続可能な都市に関するハイレベルセミナー(3)
High Level Seminar on Environmentally Sustainable Cities

- 長期的な都市計画が基礎となる
- 地方自治体は長期ビジョンとゴールを設定すべき
- ビジョンをロードマップに翻訳(短期・中期・長期目標、政策、戦略)
  - 統合的アプローチ
  - ギャップと障害の特定
  - 進捗把握のためのモニタリングと評価
  - **Long-term city planning is the basis for realizing ESC.** Local governments should set **long-term visions** and **goals** for ESC in respect to local history, tradition, culture, nature, geography, industry and other features. Visions should be translated into a **roadmap** consisting of basic principles, **short-, medium- and long-term targets**, **policies** and **strategies** using an **integrated approach** which links various sectors including energy, transport, urban planning, landscaping, housing, as well as water resources, solid waste and wastewater management, in addition to climate change **mitigation** and **adaptation**. Self-analysis could be conducted by local governments to determine the existing **gaps and barriers** to implementation, as well as necessary forms of support. **Monitoring and evaluation** with **measurable** indicators should be performed to verify progress made on ESC goals.

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環境的に持続可能な都市に関するハイレベルセミナー(4)

- **ガバナンス Governance**
  - 主要なステークホルダーの責任分担の明確化(特に中央政府と地方政府)
  - 政治的意思とリーダーシップ
  - すべてのステークホルダーの実効的参加(特に民間部門と地域共同体)
  - 分野横断的な統合
    - Effective **governance** provides a conducive and enabling environment through i) **clear definition of responsibilities** of key stakeholders, particularly the division of roles between national and local governments, ii) **political will and leadership,** which are identified as underlying success factors for many successful cases presented in the HLS; iii) **effective participation** of all stakeholders, including the private sector and local communities; and iv) **cross-sectoral integration** among the relevant sectors that contribute towards ESC;
- **知識管理イニシアティブ Knowledge management initiatives**
  - 知識と情報の共有
  - 伝統的知識・知恵の活用
  - 客観的かつ科学的分析とアプローチ
    - **knowledge management initiatives** to facilitate i) **knowledge and information sharing**; ii) making use of **traditional knowledge** and **wisdom**; and iii) **objective** and **scientific** analysis and approaches.

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環境的に持続可能な都市に関するハイレベルセミナー(5)

- **資金調達 Financing**
  - 現行課税政策の効果的運用と革新的資金調達メカニズムの導入(課金システム・誘因)
  - 投資環境の整備、民間投資の促進、民間部門の参入とPPP
  - 地方財政の強化(交付金等)
    - **Various modes of financing to** mobilize resources and funds from various sources, **starting from** i) effective enforcement of the current taxation policies and programmes; ii) encouraging the introduction of innovative financing mechanisms, such as **fee-and incentive-based models** in the provision of public services which would **ensure the sustainability of urban facilities and amenities**; iii) fostering a **favourable investment climate** by providing suitable regulatory frameworks and policies, and then involving the **private sector** in ESC initiatives through **public-private partnerships**; iv) **strengthening the local financial base** through the increased allocation of revenue from the central government, **matching** the expanded range of responsibilities devolved to the local governments; and v) **encouraging private sector investments** in the establishment of environmentally-friendly urban infrastructure and services towards a realizing a **green economy.**
- **コミュニティーの参加 Participation of communities**
  - 計画、意思決定プロセスへの参加(インフォーマルセクターの参加を含む)
  - オーナーシップの強化と意識向上のための環境教育機会の創出
    - **Meaningful participation of communities is an integral factor to promote the success of ESC efforts,** particularly by: i) involving communities, including the **informal sector**, in planning, decision-making processes, implementation and monitoring of ESC-related activities; ii) actively involving all levels of society **in community-based** initiatives to cultivate a **sense of ownership** that may ensure the longevity of ESC policies and projects; iii) providing extensive **environmental education opportunities** to various sectors to raise awareness for ESC policies and approaches and encourage active participation in relevant events and opportunities.

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地球環境研究総合推進費戦略研究課題6－2
アジア地域の多様性を踏まえた低炭素社会の可能性と
その評価手法に関する調査研究(発展基盤・メカニズム分析):

アジアの低炭素発展を支える価値観と習慣

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アジアの低炭素発展を支える価値観と習慣(1)

- アジアには、持続可能な暮らしとそれを維持するための社会的・文化的・共同体的背景(価値観と習慣)が依然として存在しているが、経済発展とグローバライゼーションによって、これらの一部は急速に失われつつある。
- このため、持続可能な暮らしの基盤となる価値観・習慣に注目しこれらを記述・記録し、また、低炭素発展に対する教訓を学ぶ必要がある。
- 日本・タイ・インドネシア・香港(中国)からなる国際研究チームを立ち上げ、低炭素発展を支える価値観に関する調査のスコーピング・調査方法に関する検討を開始

Roundtable Discussion: Part 2

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環境的に持続可能な都市に関するハイレベルセミナー(2)

- 東京(日本)
  - 公共交通(鉄道・バス)の充実、駅中心のベッドタウン開発
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- デグ(韓国)
  - 埋立地ガス利用(CDMプロジェクト)、コベネ
- リンアン(中国)
  - 環境保全モデル都市(計画・環境評価・汚染管理・法執行の強化等)
- オークランド(ニュージーランド)
  - 長期都市計画とマルチステークホルダー参加型アプローチ
- 北九州(日本)
  - 環境モデル都市(北九州グリーンフロンティアプラン)

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環境的に持続可能な都市に関するハイレベルセミナー(3)
High Level Seminar on Environmentally Sustainable Cities

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- ビジョンをロードマップに翻訳(短期・中期・長期目標、政策、戦略)
  - 統合的アプローチ
  - ギャップと障害の特定
  - 進捗把握のためのモニタリングと評価
  - **Long-term city planning is the basis for realizing ESC.** Local governments should set **long-term visions** and **goals** for ESC in respect to local history, tradition, culture, nature, geography, industry and other features. Visions should be translated into a **roadmap** consisting of basic principles, **short-, medium- and long-term targets**, **policies** and **strategies** using an **integrated approach** which links various sectors including energy, transport, urban planning, landscaping, housing, as well as water resources, solid waste and wastewater management, in addition to climate change **mitigation** and **adaptation**. Self-analysis could be conducted by local governments to determine the existing **gaps and barriers** to implementation, as well as necessary forms of support. **Monitoring and evaluation** with **measurable** indicators should be performed to verify progress made on ESC goals.

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環境的に持続可能な都市に関するハイレベルセミナー(4)

- **ガバナンス Governance**
  - 主要なステークホルダーの責任分担の明確化(特に中央政府と地方政府)
  - 政治的意思とリーダーシップ
  - すべてのステークホルダーの実効的参加(特に民間部門と地域共同体)
  - 分野横断的な統合
    - Effective **governance** provides a conducive and enabling environment through i) **clear definition of responsibilities** of key stakeholders, particularly the division of roles between national and local governments, ii) **political will and leadership,** which are identified as underlying success factors for many successful cases presented in the HLS; iii) **effective participation** of all stakeholders, including the private sector and local communities; and iv) **cross-sectoral integration** among the relevant sectors that contribute towards ESC;
- **知識管理イニシアティブ Knowledge management initiatives**
  - 知識と情報の共有
  - 伝統的知識・知恵の活用
  - 客観的かつ科学的分析とアプローチ
    - **knowledge management initiatives** to facilitate i) **knowledge and information sharing**; ii) making use of **traditional knowledge** and **wisdom**; and iii) **objective** and **scientific** analysis and approaches.

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環境的に持続可能な都市に関するハイレベルセミナー(5)

- **資金調達 Financing**
  - 現行課税政策の効果的運用と革新的資金調達メカニズムの導入(課金システム・誘因)
  - 投資環境の整備、民間投資の促進、民間部門の参入とPPP
  - 地方財政の強化(交付金等)
    - **Various modes of financing to** mobilize resources and funds from various sources, **starting from** i) effective enforcement of the current taxation policies and programmes; ii) encouraging the introduction of innovative financing mechanisms, such as **fee-and incentive-based models** in the provision of public services which would **ensure the sustainability of urban facilities and amenities**; iii) fostering a **favourable investment climate** by providing suitable regulatory frameworks and policies, and then involving the **private sector** in ESC initiatives through **public-private partnerships**; iv) **strengthening the local financial base** through the increased allocation of revenue from the central government, **matching** the expanded range of responsibilities devolved to the local governments; and v) **encouraging private sector investments** in the establishment of environmentally-friendly urban infrastructure and services towards a realizing a **green economy.**
- **コミュニティーの参加 Participation of communities**
  - 計画、意思決定プロセスへの参加(インフォーマルセクターの参加を含む)
  - オーナーシップの強化と意識向上とのための環境教育機会の創出
    - **Meaningful participation of communities is an integral factor to promote the success of ESC efforts,** particularly by: i) involving communities, including the **informal sector**, in planning, decision-making processes, implementation and monitoring of ESC-related activities; ii) actively involving all levels of society **in community-based** initiatives to cultivate a **sense of ownership** that may ensure the longevity of ESC policies and projects; iii) providing extensive **environmental education opportunities** to various sectors to raise awareness for ESC policies and approaches and encourage active participation in relevant events and opportunities.

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地球環境研究総合推進費戦略研究課題6－2
アジア地域の多様性を踏まえた低炭素社会の可能性と
その評価手法に関する調査研究(発展基盤・メカニズム分析):

アジアの低炭素発展を支える価値観と習慣

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アジアの低炭素発展を支える価値観と習慣(1)

- アジアには、持続可能な暮らしとそれを維持するための社会的・文化的・共同体的背景(価値観と習慣)が依然として存在しているが、経済発展とグローバライゼーションによって、これらの一部は急速に失われつつある。
- このため、持続可能な暮らしの基盤となる価値観・習慣に注目しこれらを記述・記録し、また、低炭素発展に対する教訓を学ぶ必要がある。
- 日本・タイ・インドネシア・香港(中国)からなる国際研究チームを立ち上げ、低炭素発展を支える価値観に関する調査のスコーピング・調査方法に関する検討を開始

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アジアの低炭素発展を支える価値観と習慣(2)

- 自然との共生(再生可能資源の持続可能な利用)
  - 例:マングローブ植林と木炭生産 (トラット州プレドナイ村:タイ)、ゲイワイ(マングローブ林と潮の干満を利用した伝統的エビ養殖:中国南部沿岸地域等)、地産地消・旬産旬消(各国)など
- 「足るを知る」
  - 例: もったいない(日本)、Sufficient Economy (経済活動における中庸の勧め:タイ)、Nyepi(バリヒンドゥーの正月は火の使用を禁止、労働を禁止、外出を禁止、謹慎の勧め:インドネシア)
- 共同体における協働・協力・協調のメカニズム
  - 例:Gotong Royong (互助精神:インドネシア)、アニアニ(穂刈鎌:インドネシア) 、Community Forest (入会林野:各国)

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アジアの低炭素発展を支える価値観と習慣(3)

- 事例に見られる価値観・習慣について、低炭素発展への**応用可能性**について引き続き検討(都市部及び農村部)。
- 互助精神に代表される**社会的セーフティーネット**を維持しつつ、経済的には中庸な発展パスを描くことができるか?
- 個人及び社会が中庸発展パスを**受容**できるのか?
- 「低炭素パラダイム価値観の受容」に関する意識調査の実施を予定。

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まとめにかえて

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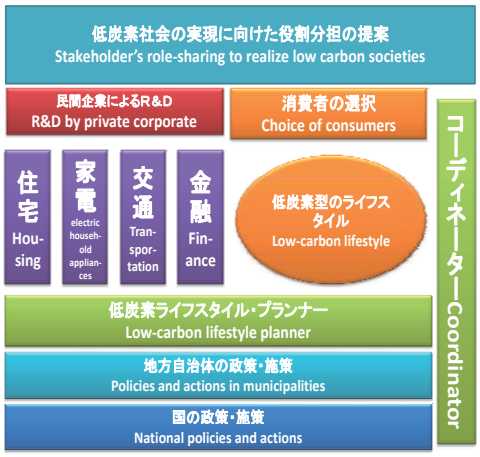
低炭素社会構築の障壁をどう乗り越えるか
How to overcome barriers to low carbon societies?

1. 環境(低炭素)を感じるココロ
   Heart to feel environment (low carbon)
   - 自然との共生/環境容量を意識した暮らし
     Way of living within environmental capacity and coexistance with nature
2. 境界・業界を超える発想力・突破力
   Creativity and ability to go beyond boundaries
   - 統合的アプローチ Integrated approach
   - プランニング/コーディネーション Planning and coordination
3. 参加・協力・協働する行動力
   Participation and cooperation
   - 伝統的な共同体 Traditional community
   - 新しいタイプの共同体/ネットワーク New type of community /network

Roundtable Discussion: Part 2



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ご清聴ありがとうございました

Discussion

1. Who are the actors in reducing GHG emissions?

During the discussion, it was pointed that the subject of "who are the actors" needed to be clear, as the subject of "who are the actors" is always omitted when people talking about issues of global warming. If the actors are not identified in the context of global warming, all the burden and responsibility for reducing GHG emissions comes down to private companies who are expected to make corporate efforts to fight global warming. Not only companies, the awareness of consumers also needs to be raised to reconsider their own lifestyles, preference, and the value. In Europe, retail stores are to be closed by half past six in the evening, and are off on Sunday. In Japan, people are taking for granted that stores open twenty-four hours a day seven days a week, even on the New Year holidays. Why does this situation occur in Japan? This is only because suppliers respond to the consumers' demand. If consumers take actions against global warming, reconsider their lifestyles, and change their habits and mind-set, energy-saving can be promoted. By raising the awareness of individuals, communities/societies can set regulations and agreements to tackle the issues. The reduction target for CO_2 emissions cannot be achieved through company efforts alone. Individuals, as one of the primary stakeholders, need to think about what they can do to contribute to the CO_2 reduction target and take actions. It is also necessary for individuals to think what they can do as members of their local community and the society with wider context to move towards a low carbon society.

2. Are subsidies needed to achieve a LCS?

The discussion moved onto the financing aspects of implementing a LCS. The efficiency and effectiveness of government subsidies was discussed focusing on their role in meeting the long-term target of reducing GHG emissions, taking up a topic discussed in an international meeting. The issue was considered of whether a tax system is more effective than subsidies for the long-term provision of funding and the sustainability of money flows. Speakers made various comments on the subsidy system and its economic effectiveness. From the business aspect, subsidies are beneficial in terms of their economic effect in the short term. For example, if a company needs to cut back some of its energy consumption, reforming the system as a whole is required by investing certain amount of money at a time. Subsidies are necessary to cover the cost for this. Taxes and tariffs concessions come after the subsidy scheme to help companies' running cost to produce environmental products to sell in the market on a wider scale. The reason why Japan used be one of the top photovoltaic suppliers in the world is because subsidies made them to foster R&D in short period and, at the same time, enabled them to do mass-production to supply their products in reasonable price. The case of hydroelectric generation in Sweden was also substantiated, which has also established a top position in the world for its wind power generation industry through long-term subsidies and financial support from the government.

3. City planning to promote the value of houses

The life of Japanese houses can be sustained for 50-60 years if they are well maintained. However, houses are usually demolished after 20 or 30 years and then replaced by a newly constructed house built for sale. Based on this fact, the value and traditional view of a Japanese house was discussed by comparing it with the western values and culture regarding houses. In Europe, city regulations have an important role in preserving and maintaining the exterior of a building as a part of the cityscape and for the protection of old buildings. Therefore, a house as a part of a city is recognized as a property asset in Europe. While in Japan, the house and the land are evaluated separately, and the value of the house drops to almost zero yen over 20 years. This is the background behind why Japanese do not spend money to reform their houses to add value. To raise the value of a house, the recognition of houses as a part of the townscape is required and adopted under city planning policies with a form of e.g. community agreements. As other example of

Discussion

the relationship between houses and the city, in America, in order to increase property values, land use zoning systems were introduced in certain areas which prompted the redevelopment of these areas with the result that house values increased, not just the land value. As the result, the increase in property values led to the residents making greater efforts to maintain the scenery and the environment of the zoning community with the expectation of further increases in the value of the area and a rise in the property value of the house. Japan also needs to have town planning strategies that maintain the environment of the communal society to increase the value of houses as a part of town development.

The case of Kawasaki City is one of the success stories. It was pointed out that key element in city environmental development was where the value of the area was reconsidered and planned with an area development strategy to increase the value of the city, while making the best use of the budget for city development.

4. Regulations and safety nets

The discussion developed to consider the issue of whether attempts to develop an area should be implemented on a regional scale. In Japan, town development activities have not been generated on a regional scale with horizontal connections. There are barriers to establishing horizontal connections among different stakeholders in order to develop regional activities. Although the private sector wants to create tie-ups with local communities and undertake corporative activities, they have to deal with the company regulations if the company is a subsidiary of a parent company with constraints imposed by the parent company and go through the process of obtaining permission. Furthermore, even if the subsidiary company obtains permission from the parent company, the next barrier is that a permit application to the town hall is required. However, as a new movement, the power to enforce horizontal connections has gradually increased through the establishment of venture companies that are carved out of the parent company through goodwill. In addition, a new policy has been formulated to back up this movement. As another issue, the social safety net required to support the initiation of new technologies and businesses does not exist in current policies. The absence of support systems to minimize risks for attempts of local businesses at e.g. developing solar power and methane recovery businesses do not encourage new entrepreneurs to go into new business. A system with policies and investors, to support such new businesses, is necessary for technology innovation and green development in Japan.

Other discussion points

The government can cover the whole area with a horizontal system while private companies have to list up the areas they cover and prioritize the ones for which to make an action plan, considering the company policy and strategy.

In order to introduce and export existing Japanese technologies overseas, especially to developing countries, Japan needs to make more effort to understand the demand of the target country and make a strategic business plan in cooperation with the government and private sector.

Through the discussion with different stakeholders, the ways to overcome barriers can be sought.

Lastly, Dr. Shuzo Nishioka concluded that in order to achieve a LCS, huge social reforms are required in the system of taking risks to make new investment and technological innovation possible and to develop new businesses. These innovations can be achieved through liaison between industries and the government in the form of horizontal connections. The discussions in this meeting were summarized into six messages.

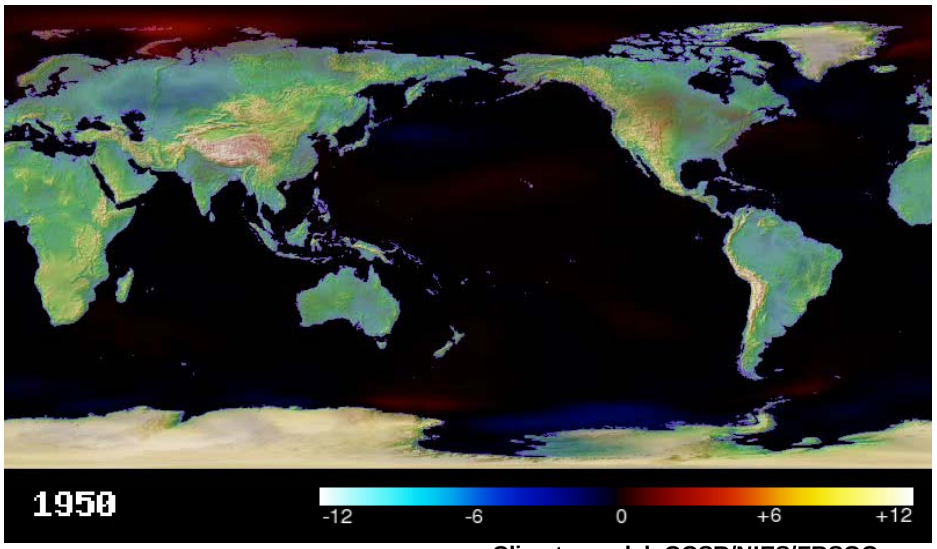
A Dozen Frequently Asked Questions from decision makers to modelers: Japan's case

- ＊What happens without climate policy ?
- ＊How much reduction needed ultimately ?
- ＊How to set world reduction target ?
- ＊Options of country's reduction target: long/mid- term
  - ＊Should industrial structure change ?
  - ＊How much reduction potential each sector has ?
  - ＊How to change land use ?
  - ＊ How much is the cost of reduction ?
  - ＊What policy options exist to attain the goal ?
  - ＊How much is the impact to country's economy ?
  - ＊Can we win in international technology competition ?
- ＊How Japan can contribute internationally?

Asian Modeling Meeting, 18 Sept, 2009 Tsukuba
Shuzo Nishioka National Institute for Environmental Studies (NIES) 1

Q1: What happens without climate policy ?

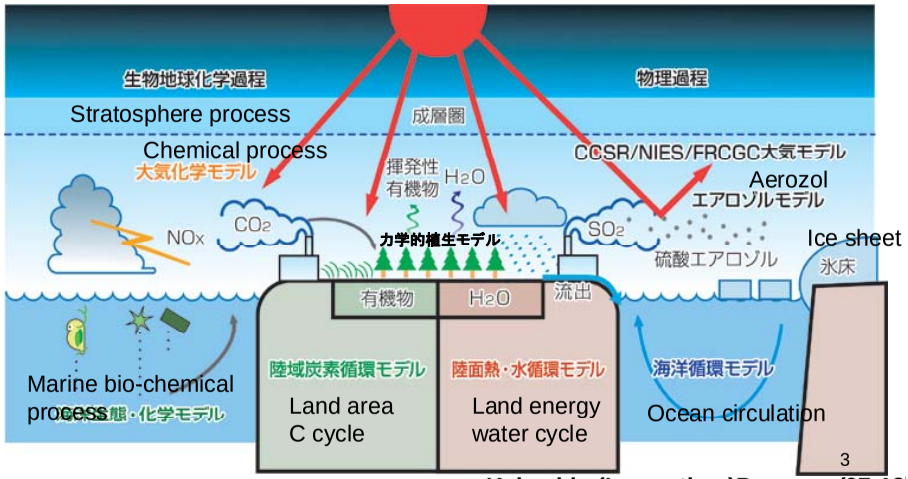
Projection of surface temperature from 1900



Climate model: CCSR/NIES/FRSGC

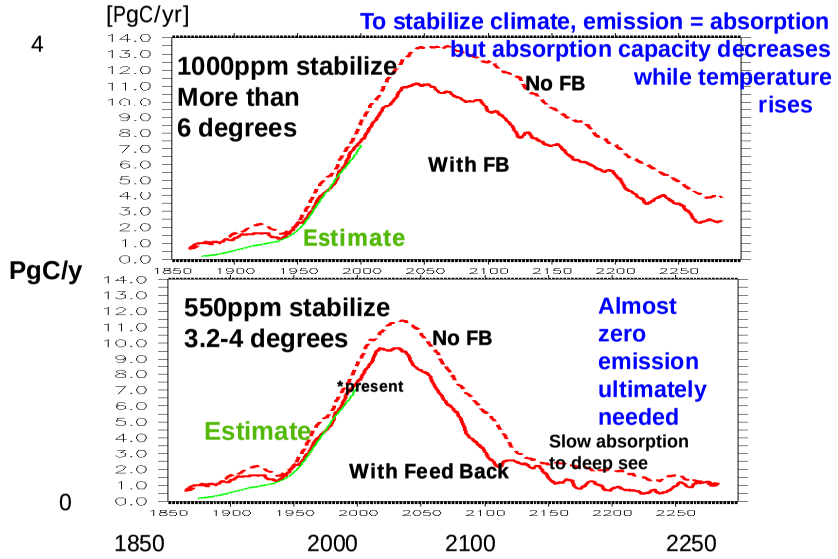
Q2: How much reduction needed ultimately ?

Earth System Integrated Model:
climate +carbon cycle model



Kakushin (Innovation)Program (07-12

Q2：How much reduction needed ultimately ?



Interim research findings of "Innovative" Earth System Model
JAMSTEC(2007)

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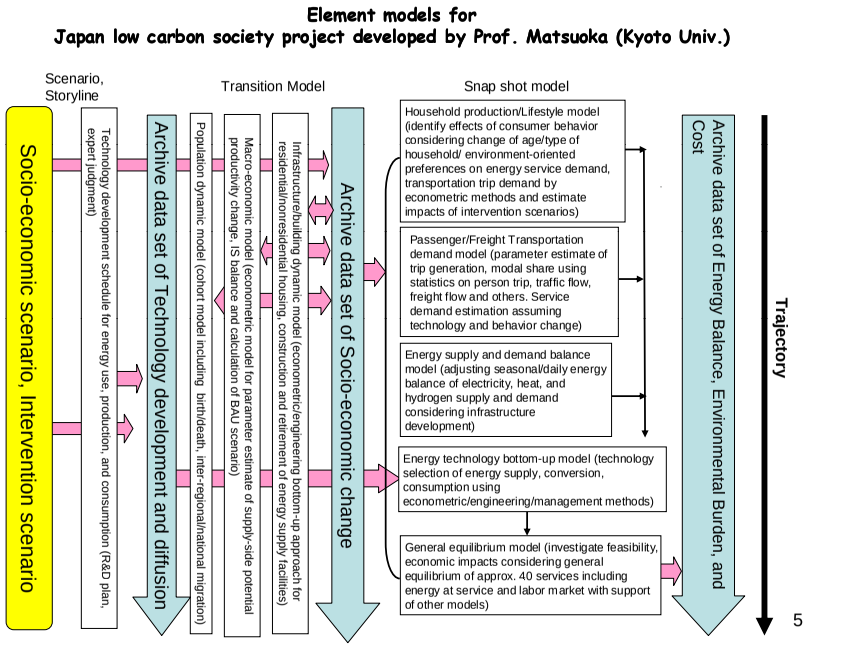

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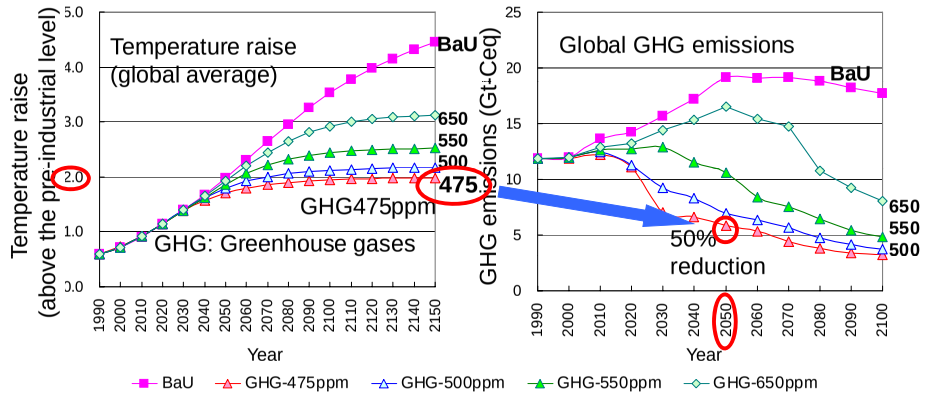
http://2050.nies.go.jp



Q3:How to set world reduction target ?

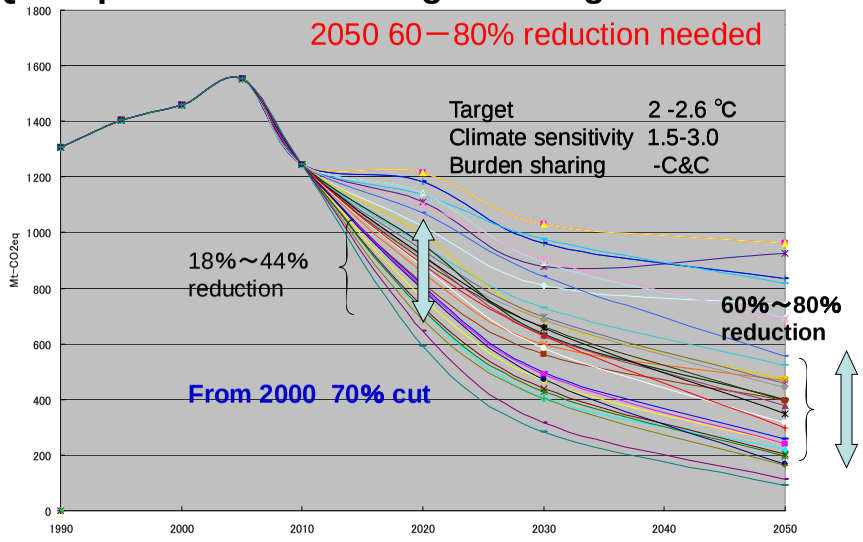
- **to avoid temperature rise of 2℃ from pre-industrial era, 50% GHG reductions in 2050 is required**

Calculated by AIM/Impact [policy] Model: NIES

6

http://2050.nies.go.jp

Q4:Japan's reduction target ?: long- term



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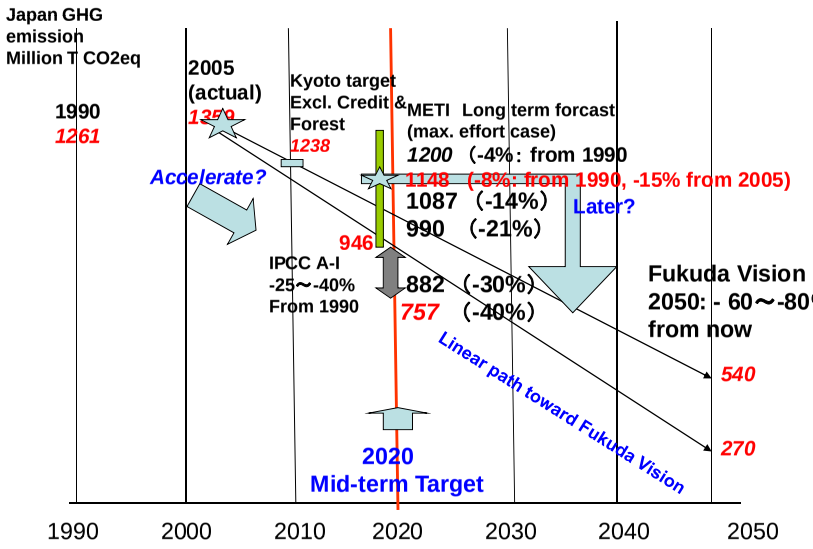
Q4:Japan's reduction target ?: mid- term



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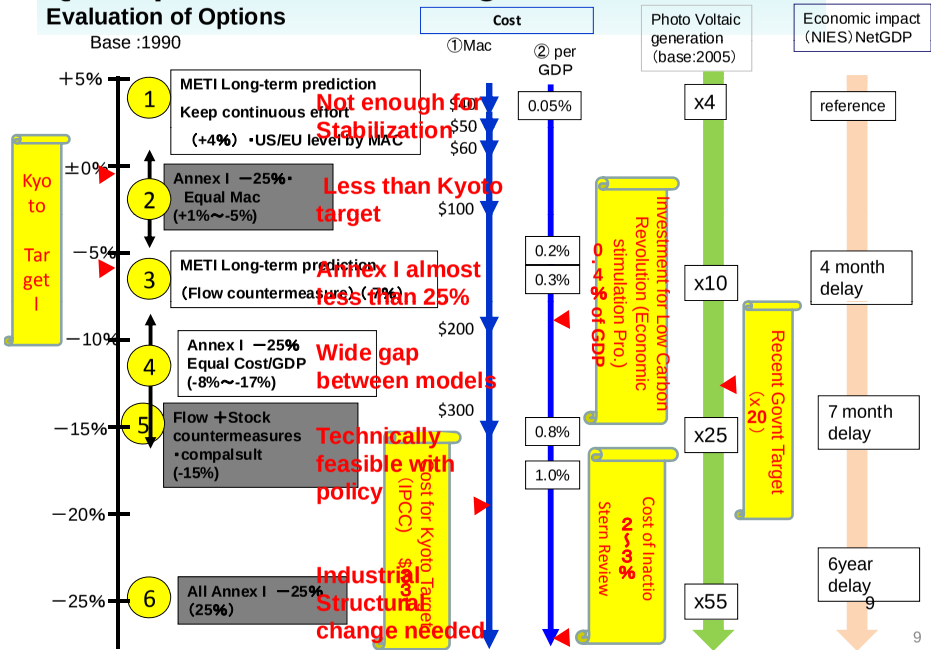
Q4: Japan's reduction target ?: mid- term

Evaluation of Options



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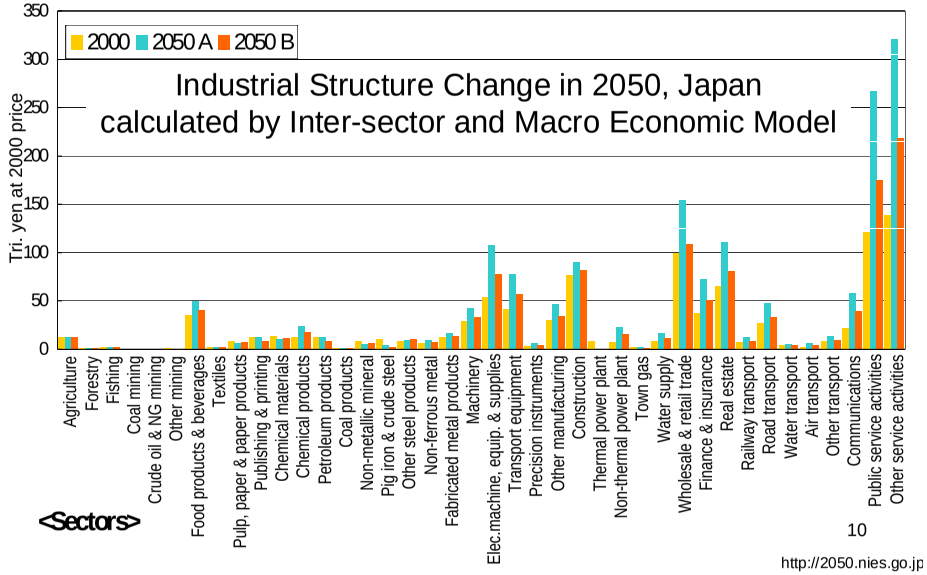
Q5: Should industrial structure change ?



10

http://2050.nies.go.jp

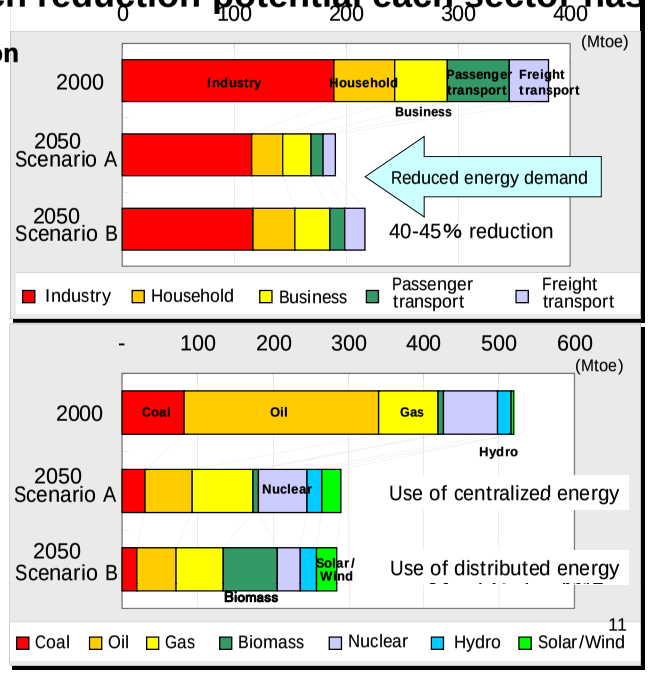
Q6: How much reduction potential each sector has ?

70% CO_2 reduction feasible

Smart consumer choices can reduce energy consumption by as much as 40-45%!

Equal effort by demand & supply side

Low carbon shift in primary energy sources via introduction of renewable energies



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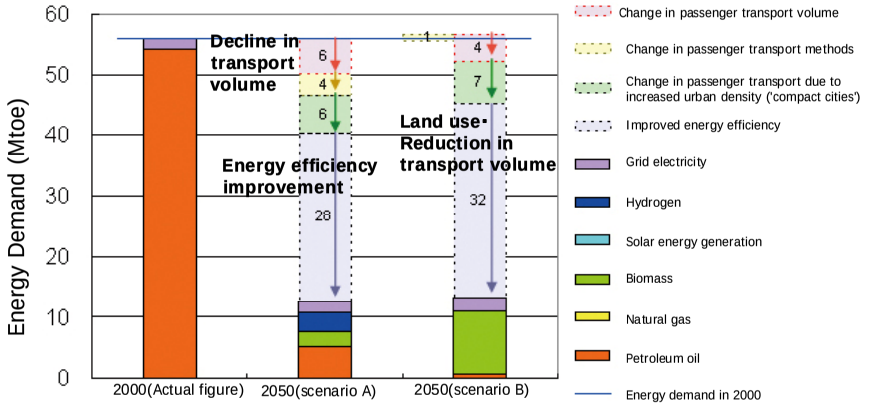
Q7: How to change land use ?

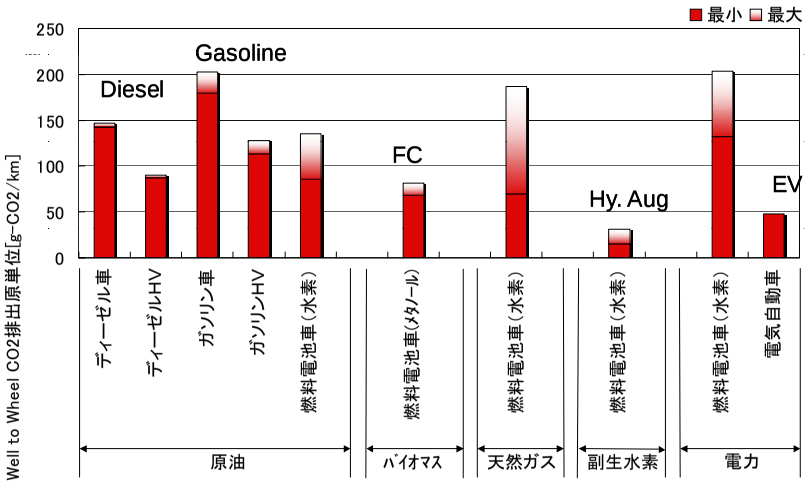
Passenger transport sector can achieve 80% reduction in energy demand via improved energy efficiency & suitable land use



Change in passenger transport volume: reduction in total movements due to population decline
Change in passenger transport methods: modal shift using public transport system (LRT etc.)
Change in passenger transport due to increased urban density ('compact cities'): reduced travel distance due to proximity of destination
Improved energy efficiency: improvements in automobiles & other passenger transport devices (hybrids, lightweight designs etc.)

12

Technical solution
Car CO_2 Emission/km:　EV: Gasoline= 1:4

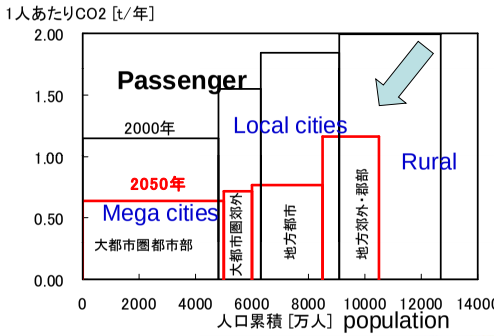


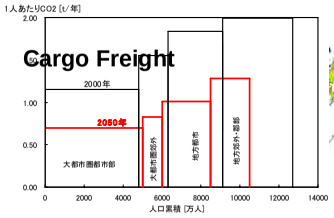
※HV:ハイブリッド車の省略形　　※電力:日本の平均電源構成
※燃料電池車:回生エネルギーを二次電池で回収　※水素:圧縮水素を仮定

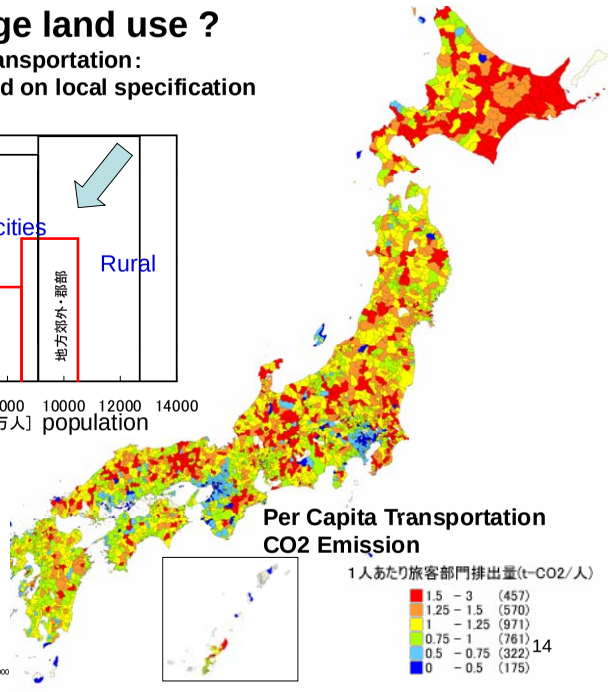
脱温暖化2050研究
交通チーム　工藤

Q7:How to change land use ?

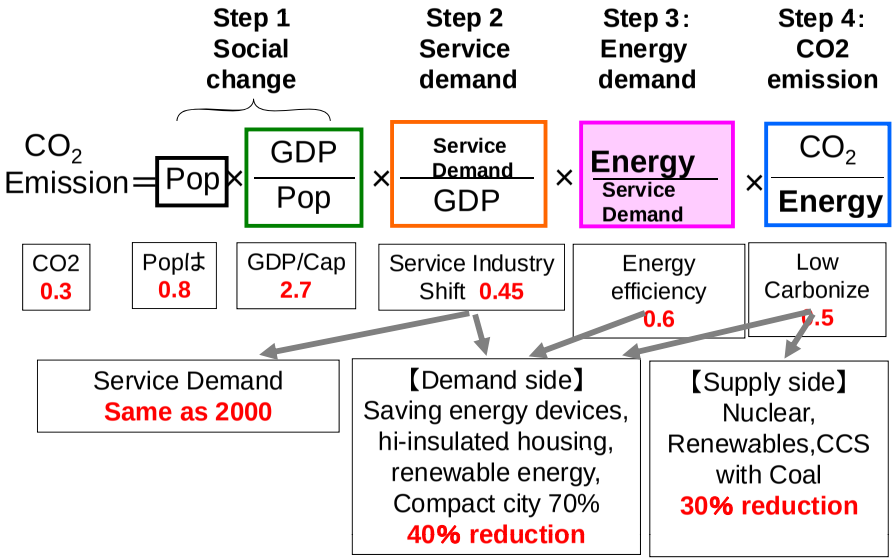
Land-use planning and transportation:
Reduction strategy depend on local specification







Energy Efficiency is the key, but not enough

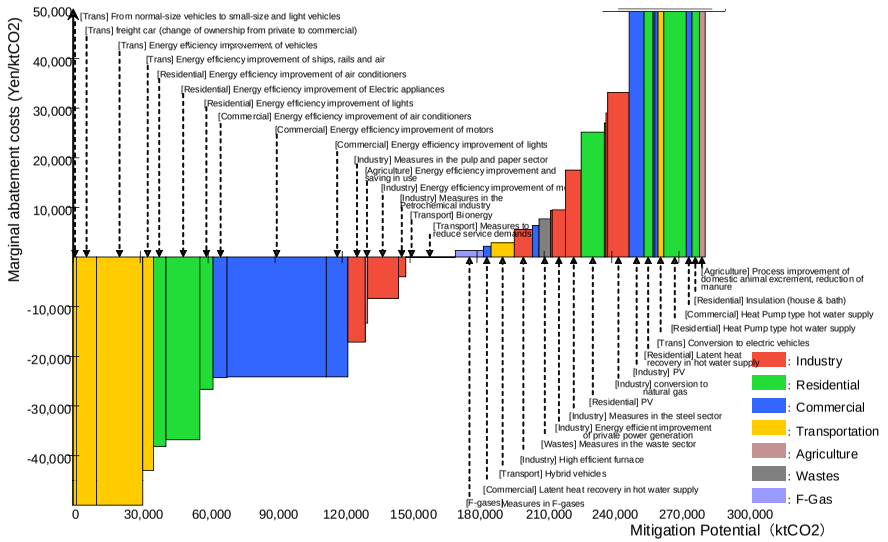


2050 Japan LCS Scenario

AIM/Enduse[Japan]

Q8: How much is the cost of reduction ?

Marginal Abatement Cost to Reduce GHG emissions in 2020

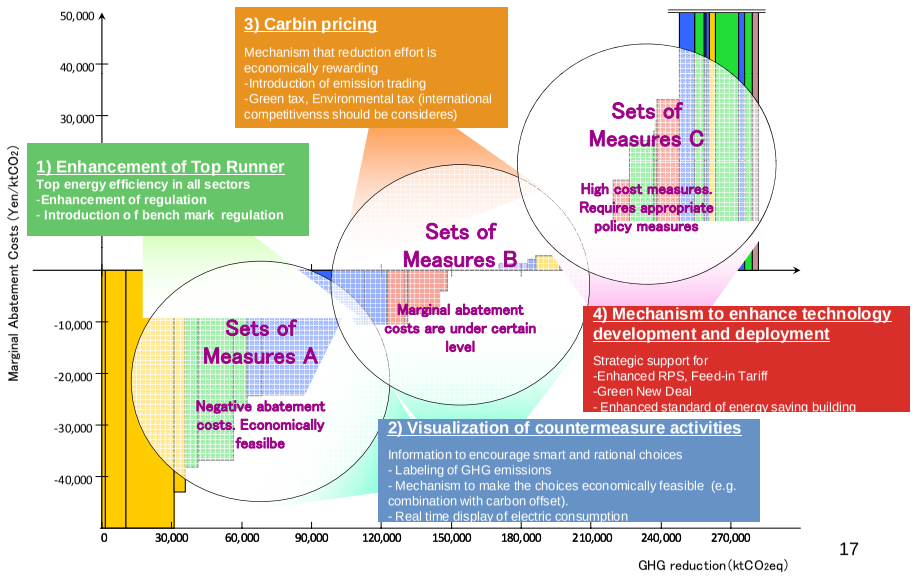


Note: MCII, Payback time is 3 years except 10 years in Insulation and PV. Mitigation potential is compared to the emissions in Frozen Case

AIM/Enduse[Japan]

Q9: How much is the cost of reduction ?

Feasible with Four sets of countermeasures to achieve the target of 2020

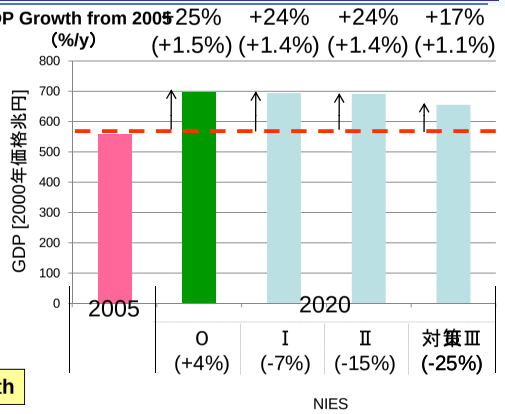


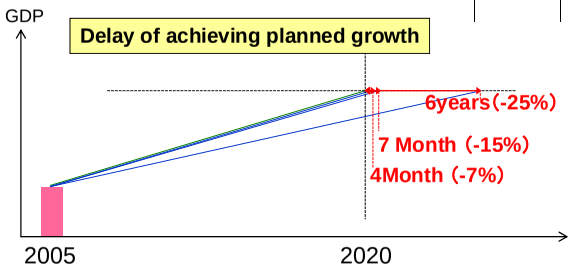
17

Q10: How much is the impact to country's economy ?

Endurable loss in GDP growth:?

- 7%～15% reduction from 1990 effect little to GDP
- 25% reduction from 1990 can secure 1.1%/y growth

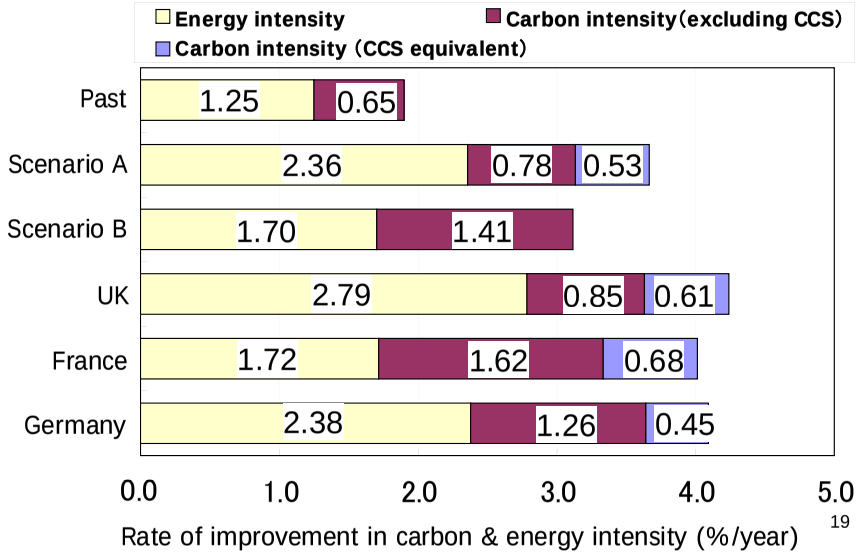




18

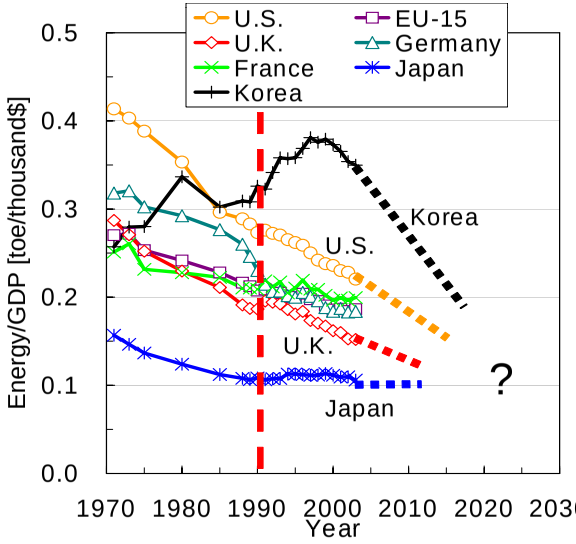
Q11: Can we survive in international technology competition ?

Acceleration of Technology Essential to Realize a Low Carbon Society



19

International Energy Intensity Competition

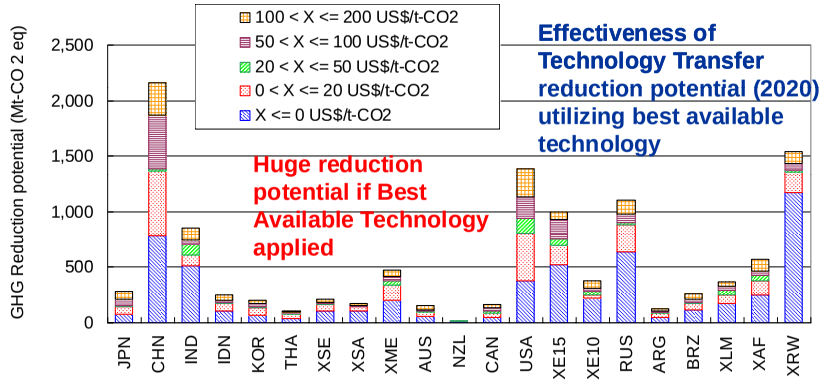


Japan almost caught up by European countries

IEA Energy statistics

20

Q12: How Japan can contribute internationally?



- **China, US, India, Western Europe and Russia are major 5 regions where there are large reduction potentials, and it accounts for 63 % of total reduction potentials in the world. Top 10 regions account for about 80 % of total reduction potentials.**

21

Sarah Rieseberg, Federal Environment Research Agency, Germany

Low Carbon Society Research Network

Questionnaire for Government Focal Points and Observers

Background:

At the G8 Environment Ministers Meeting held on 24-26 May 2008 in Kobe, Japan, the Japanese Minister of the Environment, Mr Ichiro Kamoshita, proposed to set up an international Network of research institutions with G8 countries to promote research on low carbon societies. The Network is to be a part of the international initiatives to solve the most urgent global issues of climate change. The proposal was welcomed with unanimous support by the G8 Environment Ministers.

The following ideas were brought up be government focal points and observers at the side of the Bologna Conference 2009. This questionnaire is an attempt to initiate a debate; please feel free to address other ideas and aspects not covered.

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1. Would you prefer the Network to focus on one/several particular aspect/s of Low Carbon Society, e.g. technology transfer? If yes, which ones?

☐ Yes, comments:

☐ No , comments:

2. Should the Network's meetings maintain an ***informal*** or more ***formal character?*** Please consider adding comments.

☐ Informal, comments:

☐ More formal, comments:

3. Should the Network produce formal policy recommendations?

Yes/No , comments:

4. How important do you think policy learning between Annex I countries should be?

5. The idea was brought up to found a government policy board to give input and address the Network with specific questions, what is your opinion on a government board?

6. How do you rate the potential of the Network?

7. What kind of input could the Network deliver for your Ministry?

8. Which issues should the next annual conference cover?

9. Do you have other ideas about the Network/ a next conference?

Basic Indicators of Low Carbon Societies and Socio-economic system

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Table of Contents

ABSTRACT

The aim of this paper is to define Low Carbon Society (LCS) based on phase diagram with the variables from IPAT equation, starting from the problem definitions; 1) economy is not everything for low carbon society and 2) It is not clear if speed on the constraint is more important than liberation from it. To tackle these problems, two research questions are set; 1) what are the basic indicators, objects and constraints to shape the argument of Low Carbon Societies? And 2) What are the historical paths of several countries and what can be said for their future paths toward carbon societies? Time series data from 1900 or before is used while phase diagram with the variables from IPAT equation is used as the core methodology. In addition to IPAT variables, the importance of land per capita shall be considered as another basic indicator for LCS, related to the carrying capacity. The three different kinds of objects (i.e. total GDP, GDP per capita and social indicator) and the two constraints (i.e. total emission and emission per capita) are considered and it is shown that the combination of these objects and constraints strongly affects the argument on the carrying capacity of climate and land, development of economic system and economic man and other human development. Among the four cases analyzed in phase diagram, the case where GDP per capita is object and total emission is constraint is given attention most and requires the further research in the future, since it does not contradict with a definition of Low Carbon Society. It is also suggested that if changing the direction of the path with low carbon technology development takes time and cost, institutional arrangement would be additionally necessary in addition to market mechanism where optimal solutions are found on constraint.

1. INTRODUCTION: What is LCS and how to approach this in this paper

What is Low Carbon Society (LCS)? One of the definitions of LCS is that made in NIES (2006). A Low Carbon Society; 1) takes actions that are compatible with the principle of sustainable development, ensuring that the development needs of all groups within society are met; 2) makes an equitable contribution towards the global efforts to stabilize atmospheric concentrations of carbon dioxide and other green house gases at a level that will avoid dangerous climate change through deep cuts in global emissions; 3) demonstrates high levels of energy efficiency and uses low-carbon energy sources and production technologies, and 4) adopts patters of consumption and behavior that are consistent with low levels of GHG emissions.

There can be several ways to interpret such definition into quantitative term, but in this paper, Low Carbon Society is described by using phase diagram with several numerical indicators from IPAT equation where environmental impact (I) is calculated from Population (P), Affluence (A) and Technology (T)[1]. In this manner, the goal, achieving LCS, is rather mechanically translated into objects and constraints; the three objects (i.e. GDP, GDP per capita and non-economic indicator such as happiness index) and the two different types of constraints (i.e. emission and emission per capita). Each choice on objects and constraints of LCS results in each different argument and logic.

2. PROBLEM DEFINITIONS and RESEARCH QUESTIONS

2.1. Problem Definition 1: Economy is not everything for Low Carbon Society

In Japan, the two scenarios toward Low Carbon Societies in 2050 were illustrated (Nishioka, 2008: NIES, 2008a: NIES 2008b); Scenario A as active, quick-changing, and technology oriented society and Scenario B as a calmer, slower, and nature oriented society. To connect the past,, the present and the future, the historical data of GDP/capita, CO2 emission/capita and population since 1950[2] and the results of the two future scenarios in 2050 are integrated in Figure 1. The two questions are worth considering from this figure.

The first question is about whether the object of Low Carbon Society is GDP or GDP/capita. As in Stern Review and the Green Golden Rule (Chichilnisky, 1995), GDP rather than GDP/capita has been the main object for discounted utilitarianism which is widely used approach by economists[3]. This tradition can go back to the underlying moral principle for legal and social

[1] For history and academic discussion on IPAT equation, read Chertow (2001)
[2] Data from Gapminder (2009)
[3] Regarding the level of aggregation, Stern Review team (2007) wrote as follows;
"Much of the discussion of values in this note and in the literature takes place at a high level of

reforms in the 18th century, proposed by Jeremy Bentham, *the greatest happiness for the greatest number*, where the happiness can be interpreted as GDP/capita and the number as population.

Meanwhile, in Millennium Development Goals (MDGs, United Nations (2008)), the indicators are more related to per capita; the economy of each individual rather than the aggregated national economy is the object. Human Development Index (HDI), as summary measure of human development, also adopts GDP per capita (UNDP, 2009)

Does Low Carbon Society have priority over GDP for the whole economy or over GDP per capita for each individual? The rationale to pursuit GDP per capita could be based on human development and happiness for each individual. Meanwhile, one rationale in the economic theories for setting GDP as object (to maximize) would be that our society behaves so within the current market system. And maximizing GDP and GDP per are not always consistent to each other.

The second question is about whether the main object of Low Carbon Society can be measured by economic indicators such as GDP and GDP/capita. In Figure 1, Scenario A results in much higher GDP and GDP per capita than Scenario B, mainly because of the higher GDP growth rate. However it might be the case that a society might prefer Scenario B, regardless of its lower GDP and GDP per capita. For instance, Karl Polanyi, in his book, *The Great Transformation*, pointed out three general types of economic systems that existed before the society was embedded into free market economy: redistributive, reciprocity and householding. (Polanyi, 1944).

What are the indicators to properly illustrate Low Carbon Societies in addition to economic ones (i.e. total GDP and GDP/capita)? This has not been answered yet.

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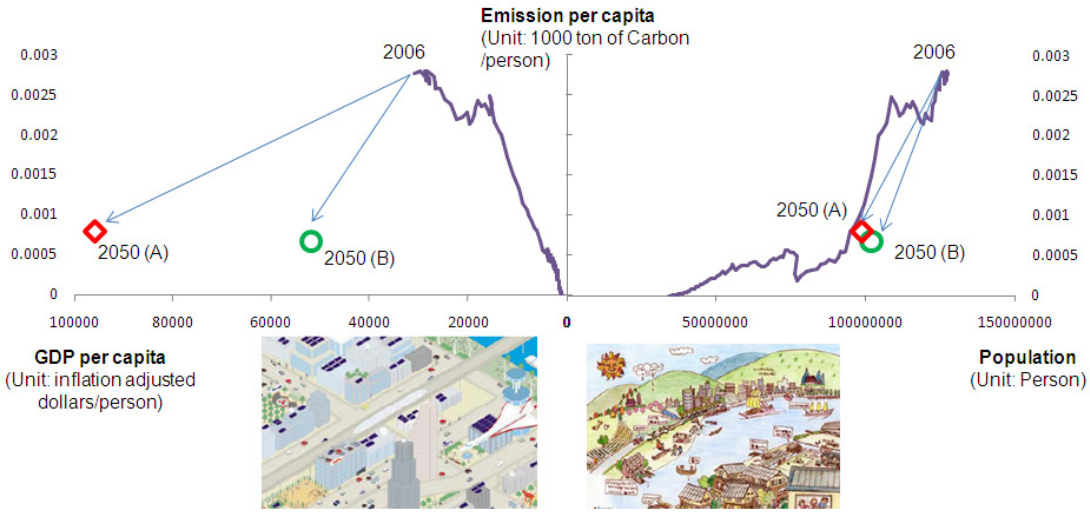
aggregation. Thus it considers total world consumption or income or aggregate country level income. There is often little distinction between different kinds of goods or allocation of individuals' income across different periods of their lives. And in much of the formal modelling the attention to within country distribution is very limited".



Scenario A : VIVID	Scenario B : SLOW
Technology-driven	Nature-oriented
Urban/Personal	Decentralized/Community
Technology breakthrough Centralized productoin/recycle	Self-sufficient Produce locally, consume locally
Comfortable and Convenient	Social and Cultural Values
2%/year GDP per capita grouth	1%/year GDP per capita grouth

Figure 1. Historical path and future scenarios in Japan toward Low Carbon Societies in 2050[4]

2.2. Problem Definition 2: Speed on the Constraint or Liberation from it?

Low Carbon Society would have a constraint on total GHG emissions. In numerical modeling, the optimal solution is often found on the constraint, especially when the objects and constraints are assumed to be in trade-off relation. For instance, if the limit of GHG emissions is 50 giga ton of CO2 equivalent, the optimal solution for the economic growth would be also when 50 giga ton is emitted. However, this depends on the assumptions. For instance, Figure 2 shows three paths (Business as Usual, Low Carbon Technology and Intensive Low Carbon Technology) and the constraint on emission, starting from t = 0 (A0, B0 and C0). On the path of BaU, the economy cannot grow after t = 1 (i.e. A1), since A2 is beyond the emission constraint. Thus, from A1, the economy has to make transition to the path with Low Carbon Technology. When t = 2, it can be in the same position of B1 (i.e. A2') or B3 (i.e. A2''). If the latter is the case it can be said that taking the path closer to the constraint is more optimal, because it is quicker to arrive at the same location. However, if the former is the case, taking the path away from the constraint is faster for the rapid growth of GDP. When t = 1, if the speed of GDP growth is what to be maximized, A1 is better than

[4] GDP per capita in 2050 of Nishioka (2008) is converted into Purchasing Power Parity by the values in 2000 of Nishioka (2008) and Gapminder (2009).

B1 and C1. However, for the later periods, C1 might be the best; the direction away from the constraint is important especially when transition into more low carbon technology takes some cost.

Regarding technology transfer, low carbon infrastructure, lock-in effect and technology leap-frog, it is often said that developing countries have more opportunities than the developed ones, since they have late-comer advantage as their society, economy and technology have not been locked in unsustainable ways. For instance, suppose that developing countries stands on A0 and developed countries in A1 in 2010. If the goal is to reach C6 and changing the directions between the three paths would take time and cost, then developing countries could move on C1 and reach C6 and even might reach the goal quicker than the developed countries. The important message here is that if developing countries take the same paths that developed ones had already passed, then they would also have to be running on the constraint. Also notice that if developed countries help developing ones to take the path of intensive low carbon technology, then developed countries can push the constrain from their own paths.

In addition to the issue of the cost of transition, the assumptions on objects and constraints determine if trade-off would appear or not. For instance, the slope in the upper-left of Figure 6, later discussed, shows the trade-off between total GDP and total emission, while the slope in Figure 7 represents the trade-off between GDP per capita and Emission per capita. Thus, if the object is GDP per capita and the constraint is total emission, then the trade-off between them might not necessarily exist.

Will a Low Carbon Society be a society right on the threshold which does not violate the constraint, or a society liberated from such constraint? In this paper, the latter, the path to avoid the constraints, are further analyzed.

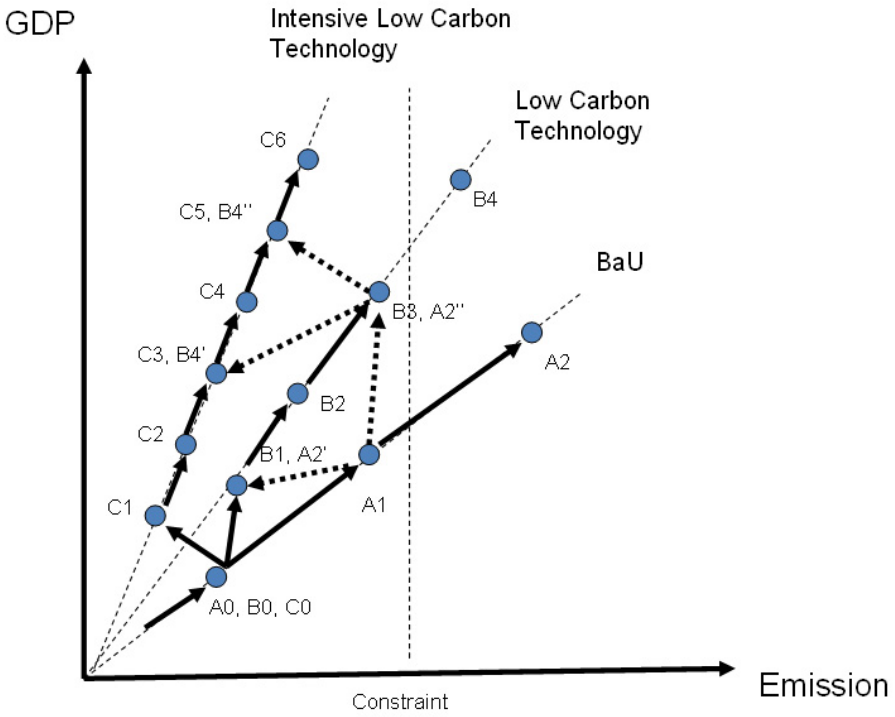


Figure 2. Paths and constraint

2.3. RESEARCH QUESTIONS

Considering these problem definitions, the following two research questions are derived.

Research Question 1: Starting from IPAT equation, what are the basic indicators, objects and constraints to shape the arguments of Low Carbon Societies?

Research Question 2: What are the historical paths of several countries and what can be said for their future paths toward Low Carbon Societies?

3. DATA and METHODOLOGIES

As for methodologies, the concept of IPAT equation is employed as the start of the argument by decomposing the emission (i.e. environmental impact) into each variable (i.e. population, affluence and technology) and has been developed into the use of phase diagram to geometrically analyze

paths from the past to the future, while defining the object of the model (e.g. GDP, GDP per capita). IPAT variables are employed in this paper because each variable in IPAT equation is in scalar value so that several variables can be shown simultaneously in phase diagram and also because the equation is very similar to the structure of Input Output Analysis and Life Cycle Assessment (LCA), which model the material balance of economic system[5].

Most of the data are obtained from Gapminder (2009), such as GDP/capita (in Purchasing Power Parity), CO2 emission per capita and population, since it has the consistent dataset covering many countries, many different types of economic, environmental and social indicators and long time series (e.g. from 18th century for GDP/capita). Especially preparing the data for longer time scale is important, because time scale would define the nature of argument.

For instance, historical data on population is shown in Figure 3 (with logarithmic scale).

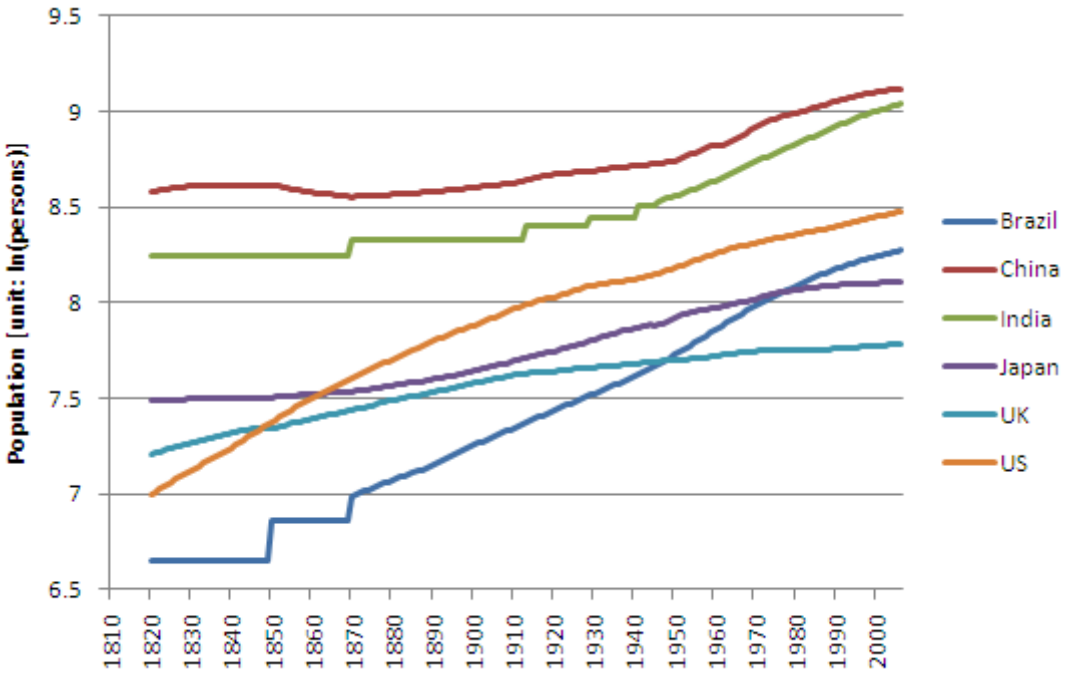


Figure 3 Historical Population

In the end of 20th century, the rates of population growth in China and India are higher than those of US, UK and Japan. However, if we consider the whole 19th and 20th centuries, this is not the case. For example, that of US is much higher than that of China. And those of China and UK are similar to each other. Notice that in logarithmic scale, the slope corresponds to growth rate (of population).

[5] For details about these similarities, see Heijungs (2001) and Heijungs and Suh(2002)

4. ARGUMENTS and RESULTS

4.1. IPAT equation and Basic Indicators for LCS

As IPAT equation has been chosen to derive basic indicators to be used in this paper, first this equation is explained in this section. IPAT equation is described as follows[6].

$$\text{total } CO_2\text{emission} = \text{Population} \times \text{Affluence} \times \text{Technology intensity}$$
$$= \text{population} \times \frac{\text{total GDP}}{\text{population}} \times \frac{\text{total } CO_2\text{emission}}{\text{total GDP}}$$

These indicators in IPAT equation correspond to main variables in economic models such as General Equilibrium.

In addition to these variables, land per capita would be important variable for considering Low Carbon Societies, partly because the visions of LCSs are strongly related to how they use lands as seen in the illustrations of two different scenarios in Figure 1, and partly because land has been one of the principal elements among economists from the past, such as François Quesney who made Tableau Économique in 1759 and to the present such as ecological footprint. Also in LCS-RNet annual meeting in bologna in 2009, it was pointed out that terrestrial policy is one of the key issues to achieve low carbon society (LCS-RNet, 2009).

Figure 4 shows territorial size of each country (unit: square kilometer) divided by population in arithmetical scale. Variation of quality of land (e.g. suitability for farming, living and extracting other natural resources) is not considered at all for simplification, but, solely from this figure, it could be possible to reason that the decrease of land/person is saturated in UK, India and Japan with current technology, China is getting close to it, while lands of Brazil and US have more capacity for population.

[6] For details and variations of IPAT equation, see Chertow (2001)

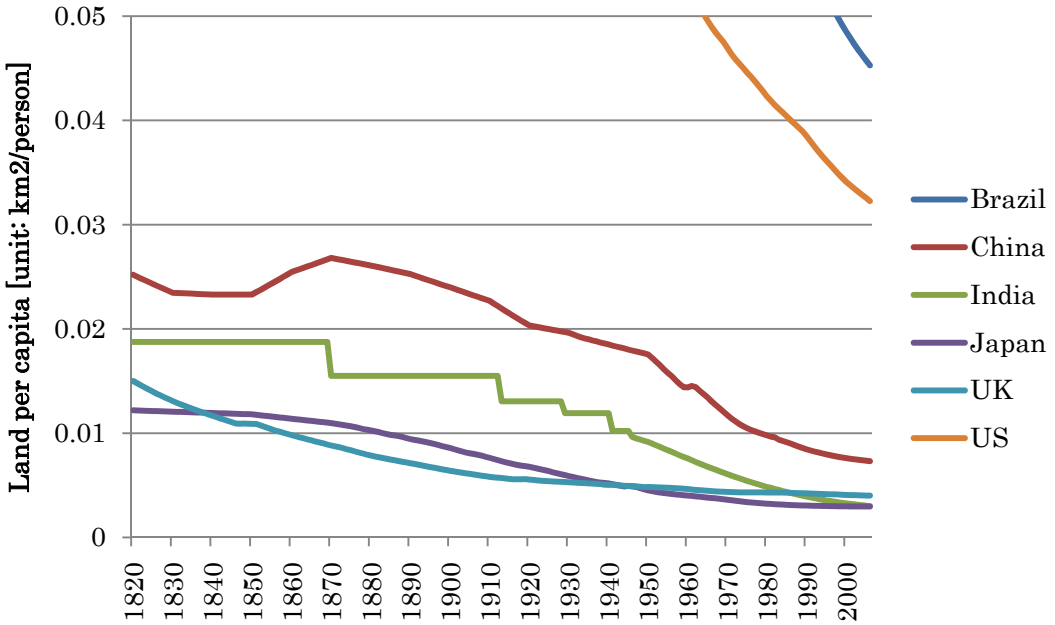


Figure 4. Historical Data of Land per capita

4.2. Framing Objects and Constraints

As already discussed in the first of problem definition, the three different kinds of objects are set for considering the paths for Low Carbon Societies; GDP, GDP per capita and indicators such as Human Development Index and Satisfaction with Life Index (named Social Indicators[7])..

As for the constraints, emission (e.g. unit: ton) and emission per capita are chosen. Indicator of land, square km per person, is important both as amenity (i.e. object) and constraint, but the further numerical analysis on land is out of the scope of this paper.

How can one choose between the constraints; total emission and emission per capita? If the carrying capacity of GHG absorption in the environment is the start of the logic, one would choose total emission as the constraint. If he starts from the logic that GDP per capita shall be the same for any individual thus one might say that the constraint on emission shall be also based on per capita and emission per capita would be proper. Meanwhile, this paper also will introduce a case where GDP per capita is the object while total emission is the constraint (Case C in Table 1, discussed later).

[7] These social indicators are also affected positively by GDP/capita, for instance, since HDI consists of life expectancy index, education index and the value calculated from GDP per capita. Thus social indicators do not mean that they exclude economic ones but rather that economic indicators are embedded in social ones.

Base on these objects and constraints, the five different cases are analyzed as illustrated in Table 1.

Table 1. Five cases with different objects and constraints

	OBJECT	CONSTRAINT	Low Carbon TECH	OTHER VARIABLES
Case A	Total GDP	Total emission	Yes	Population
Case B	Total GDP	Emission per capita	Yes	Population
Case C	GDP per capita	Total emission	Yes	Population, Affluence
Case D	GDP per capita	Emission per capita	Yes	Population, Affluence
Case E	Social indicator	-	-	-

For Case E, the biographical path of population, affluence, technology and impact is not analyzed and discussed, but it is shown in Figure 5 that the correlation between GDP per capita and social indicators is not always clear (e.g. Japan) As shown in Figure 1, visions toward low carbon societies would not be depicted solely by economic indicators. While taking into account of the limitation of economic indicators to illustrate low carbon societies, Case A-D will be further analyzed in the following sections, by setting the objects of societies as GDP or GDP per capita.

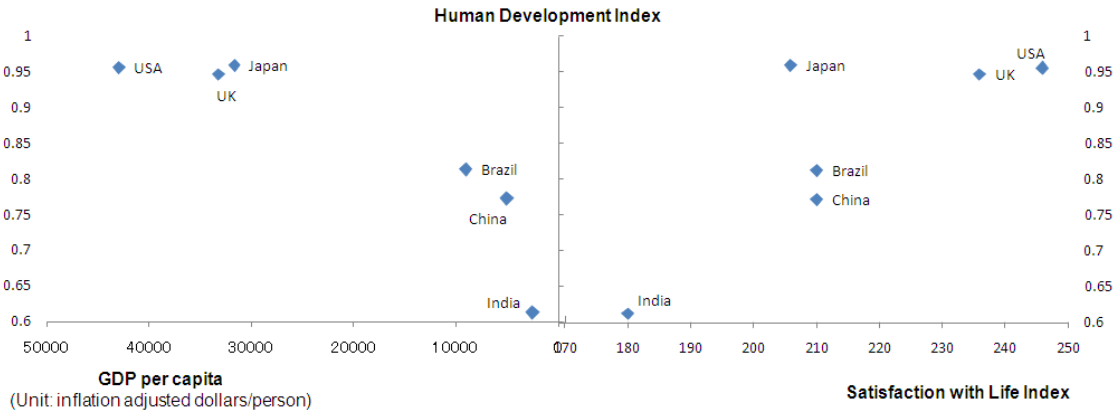


Figure 5. Correlation between GDP/capita and social indicators[8]

4.3. Historical and Future Paths toward LCS

For an example, paths for China and USA are shown. First, Case A and B are analyzed and discussed in Figure 6.

[8] GDP per capita (PPP) comes from Gapminder (2009) for the year 2007, Human Development Index comes from UNDP (2009) for 2007, and Satisfaction with Life index from White (2007) for 2006.

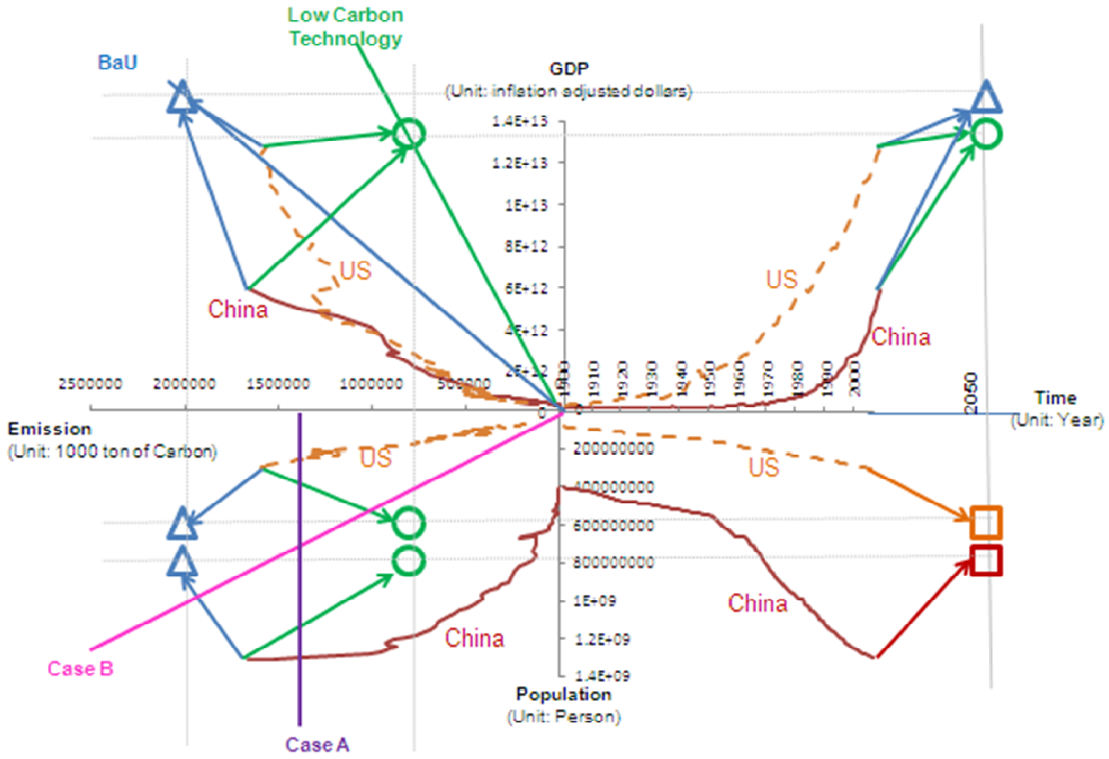


Figure 6. GDP is Object for society (Case A and B)

The path of each country is drawn for the past (1900-2006) and for the future (to 2050). Targets of GDP and population in 2050 are on the right side of the figure. The efficiency of technology is given by the slope in the upper left part. In the bottom left part of the figure, the constraint of total emission is parallel to y-axis (for Case A), while that of emission per capita is the slope (for Case B).

The behavior of this figure is based on the assumption that GDP and technology affect total emission, not population, since GDP itself is given exogenously regardless of population. This can be expressed by changing IPAT equation into *I = GDP*Technology* because *Population*Affluence = GDP*.

This could lead to an unsustainable outcome for the constraint of emission per capita (Case B); if other things (e.g. GDP and technology) are the same, the more population, the less emission per capita. And more population enables more total GDP, emitting more emission.

For the constraint of total emission (Case A), when the target of GDP is set, technology is the only variable that can be adjustable to meet the object. From this logic, it can be said that Low Carbon Society can be achieved by Low Carbon Technology and the target of total GDP, not by other socio-economic elements such as population and affluence. The problem of this case is that the target, total GDP, cannot be continued to increase if technology development is saturated.

Next, Case C and D are shown in Figure 7.

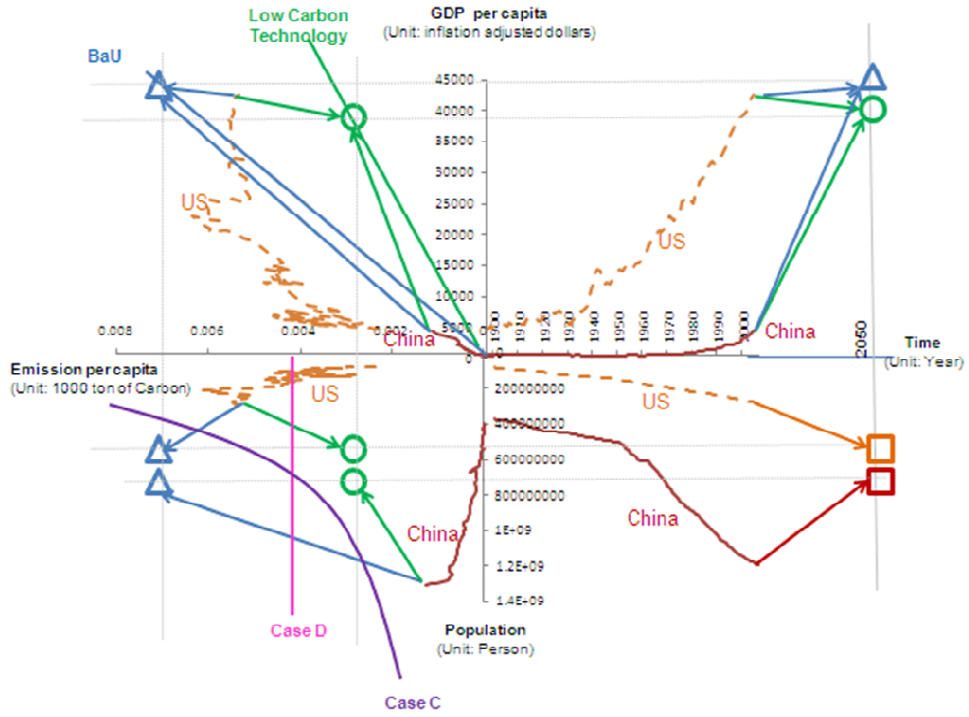


Figure 7. GDP per capita is Object (Case C and D)

Targets of GDP per capita and population in 2050 are on the right side of the figure. The efficiency of technology is given by the slope in the upper left part. In the bottom left part of the figure, the constraint of total emission is the curve (*A*P<constraint*) (for Case C), while that of emission per capita is parallel to y-axis (for Case D). When GDP per capita, not total GDP is set as target, the situation is different from case A and B. For the constraint of emission (Case C), not only technology but also population are the elements to be adjusted to achieve the target, affluence. Notice that perusing affluence does not necessarily go together with the growth of total GDP. For the constraint of emission per capita (Case D), only technology affects whether the constraint is satisfied or not. The problem of this case is the target, affluence, cannot be continuously increased because of the constraint.

The outcomes of the logics for these four cases are summarized in Table 2.

It is important to notice that the strategies on population changes very widely based on the assumption on object and constraint. These results suggest that not only GDP and technology but also socio-economic indicators such as affluence and population shall be properly integrated in consistent visions and strategies toward Low Carbon Society.

From the view that the carrying capacity of the climate is well expressed in total emission which shall be the constraint, Case A and C are feasible, while Case B and D focus on the equity of responsibility.

From the assumption that economy behaves to maximize GDP regardless of visions

toward low carbon societies, Case A and B are feasible, while Case C and D considers more on individual rather than the economy as a whole. GDP per capita can be also interpreted into the human rights to develop.

From the notion that trade-offs which might arise from the efficiency of technology shall be disappeared in objects and constraints, Case B and C are feasible, since population can be increased or decreased to get liberated from the constraint. Meanwhile, if one thinks that standing right on constraints are the mother of efforts, development and progress, then Case A and D would be better.

From the logic that the carrying capacity of land is limited and less population is better, then Case B is not proper.

Thus, for instance, Case C satisfies the principles of the carrying capacity of the climate and land (i.e. total emission and land per capita have to be lower than certain threshold), human rights to develop (i.e. GDP per capita growth is not constrained), but not necessarily the nature of the free market to maximize GDP.

Table 2. Strategies of Technology and Population for each different object and constraint

	OBJECT	CONSTRAINT	Technology	Population
Case A	Total GDP	Total emission	More efficient	Not Affecting the Object
Case B	Total GDP	Emission per capita	More efficient	More Population
Case C	GDP per capita	Total emission	More efficient	Less Population
Case D	GDP per capita	Emission per capita	More efficient	Not Affecting the Object

5. CONCLUSION and DISCUSSION

Research questions have been answered as follows.

Research Question 1: Starting from IPAT equation, what are the basic indicators, objects and constraints to shape the arguments of Low Carbon Societies? Answer: as for the indicators, in addition to IPAT variables, another indicator, land per capita, is important for Low Carbon Society. For object, in addition to total GDP and GDP per capita, social indicators such as Human Development Index and Satisfaction with Life index are worth considering. For constraint, the rationale of constraint on emission (ton) and emission per capita (ton/capita) shall be given consistent logic between them, regarding the carrying capacity of climate and equity issue.

Research Question 2: What are the historical paths of several countries and what can be said for their future paths toward Low Carbon Societies? Answer: Not only GDP and technology but also socio-economic indicators such as affluence and population shall be properly integrated in

consistent visions and strategies toward Low Carbon Society.

The four combination of the two objects (i.e. total GDP and GDP per capita) and constraints (i.e. total emission and emission per capita) are analyzed in phase diagram. For instance, the case of GDP per capita as object and total emission as constraint (Case C) satisfies the principles of the carrying capacity of the climate and land, human rights to develop, but not necessarily the nature of the free market to maximize GDP.

Also it is worth considering about if the optimal solution toward Low Carbon Society can be found on the constraint or away from such constraint. If changing the direction of the path with low carbon technology development takes time and cost, institutional arrangement would be additionally necessary in addition to market mechanism where optimal solutions are found on constraint.

The two problems were defined in this paper; 1) Economy is not everything for Low Carbon Society and 2) Speed on the Constraint or Liberation from it? These problem definitions were not solved fully in this paper. However, the research questions and answers lead to the starting point for the discussion on these problems. Especially, the case C where the object is GDP per capita, the constraint is total emission and the population is going to decrease is interesting setting for the future research, since this assumption does not seem to contradict to the one of the definitions of Low Carbon Society cited in the beginning of the paper. The challenge of such society would exist in how to balance between social object (i.e. GDP per capita), nature of market to maximize total GDP, environmental carrying capacity of the climate and land (i.e. total emission and square kilometer per capita) and human population.

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