The second workshop of the Japan-UK Joint Research Project

Achieving a Sustainable Low-Carbon Society

Symposium and Workshop



13-15 June 2007
London, UK

defra
Department for Environment Food and Rural Affairs

環境省
Ministry of the Environment

UKERC
The meeting place

Tyndall Centre
for Climate Change Research

Embassy of Japan
in the UK

Department for Environment, Food and Rural Affairs
Nobel House
17 Smith Square
London SW1P 3JR
Website: www.defra.gov.uk

Published by the Department for Environment, Food and Rural Affairs.

Printed in the UK, November 2007, on material that contains a minimum of 100% recycled fibre for uncoated paper and 75% recycled fibre for coated paper.

The second workshop of the Japan-UK Joint Research Project

Achieving a Sustainable Low-Carbon Society

Symposium and Workshop

13-15 June 2007
London, UK

defra
Department for Environment
Food and Rural Affairs

Table of Contents

Co-chairs' Summary

Introduction to Low-Carbon Societies

Dr. Shuzo Nishioka

Executive Director

National Institute for Environmental Studies (NIES)

Japan

Dr. Jim Skea

Research Director

UK Energy Research Centre (UKERC)

UK

During the first anniversary of the Kyoto Protocol in 2006, the UK and Japan launched the joint research project "Low-Carbon Society Scenarios Towards 2050". The focus for the development of the joint research project between the UK and Japan was on deepening our understanding of the need to reduce greenhouse gases to achieve low-carbon societies and using the scientific evidence base delivered through the submission of country level emission scenarios. Further specific objectives were set for the UK-Japan collaboration to explore:

- Identifying and understanding the necessity for deep cuts in global greenhouse gas (GHG) emissions toward 2050;
- Reviewing country-level GHG emissions scenario studies in developed and developing countries;
- Formulating win-win strategies to align sustainable development and climate objectives;
- Studying methodologies to achieve low-carbon societies – visions; pathways modelling the future society; technological, institutional, behavioural and financial mechanisms;
- Identifying gaps between goals and the current reality;
- Sharing best practices and information; and
- Identifying opportunities for cooperation.

The first workshop produced an analysis of the various models and modelling techniques that are being used internationally. This has provided a strong base to build on in assessing the policies and measures that can act as drivers in making a transition to a low-carbon society. A definition for a low-carbon society was proposed during this workshop, alongside a common understanding of the necessity for low-carbon societies and early action to choose low-carbon pathways. It was demonstrated that a low-carbon society should:

- Take actions that are compatible with the principles of sustainable development, ensuring that the development needs of all groups within society are met;
- Make an equitable contribution towards the global effort to stabilise atmospheric concentration of carbon dioxide and other greenhouse gases at a level that will avoid dangerous climate change through deep cuts in global emissions;
- Demonstrate a high level of energy efficiency and use low-carbon energy sources and production technologies; and
- Adopt patterns of consumption and behaviour that are consistent with low levels of greenhouse gas emissions.

Co-chairs' Summary

One concrete outcome of the first workshop was a collaborative international modelling project. This innovative process, with strong developing country participation, emphasised long-term deep reductions in CO_2 and other GHGs. Comparative model runs based on common scenarios have been performed by twelve national teams:

For example, a key conclusion from the Japanese 2050 Low-Carbon Society Research was that Japan has the technological potential to reduce its CO_2 emission by 70% compared to the 1990 level, while satisfying the expected demand for energy services in 2050. This included reductions in both final energy demands and primary energy supply, and incorporated the residential sector, land-use planning and transportation. Further steps were needed to achieve this:

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

In designing the second workshop a greater focus was placed on the implementation of policies and measures to achieve low-carbon societies. In order to explore the feasibility of different approaches in achieving low-carbon societies, our objectives for the second workshop were:

1. To demonstrate and raise awareness of the benefits of transitioning to a low-carbon society through sustainable development:

   a. Demonstrating that a low-carbon society can be consistent with policies relating to the environment, economy, development, access to energy and energy security;

   b. Involving a wider range of stakeholders (including business leaders, policymakers, academics and NGOs) to assist with raising awareness of the low-carbon society concept and disseminating low-carbon society information, and to provide expert input on the practicalities of transitioning to a low-carbon society; and

   c. Sharing expertise and further building analytical capacity relating to low-carbon society visions and modelling.

2. To develop recommendations on how to close the gap between the business-as-usual and low-carbon society scenarios:

   a. Identifying feasible contributions that large sectors could make in achieving a low-carbon society;

   b. Exploring what low-carbon cities may look like and showcasing existing examples; and

   c. Drafting policy options to achieve a low-carbon society with reference to timeframes and the need for swift action.

3. To develop the framework for a map of low-carbon society activities.

In addition to this it was decided during the design phase of the second workshop that it should address a wider range of Low-Carbon Society scenarios which would focus on the similarities and differences between them. It was also decided that the second workshop should be more outcome orientated and should address a broader stakeholder engagement, including leaders from business.

How do we Expect the Results to be Used in the Future?

- informing high-level discussions in international processes such as Gleneagles Dialogue and United Nations Framework Convention on Climate Change (UNFCCC)
- informing national policy formation and policy learning
- basis for engaging range of stakeholders
- promoting the inclusion of climate risk assessment in government and corporate strategy
- building capacity in developed and developing countries and reinforcing international collaboration between energy/climate researchers.

Open Symposium

13 June 2007
The Mermaid Conference and Events Centre, London

1. Welcome and Introductions

Welcome Address

Ian Pearson

Minister of State,
Climate Change and the Environment

Department for Environment Food and Rural Affairs

UK

A year ago, nearly to the day, I was due to be in Tokyo to open the first Japan-UK symposium on low-carbon societies with the then Japanese Environment Minister Madam Koike. I was a foreign minister at the time – but after the major reshuffle in May that year I became the UK Climate Change Minister and could not make that event. However, I am now pleased to be here with Ambassador Yoshiji Nogami, admittedly a year later than originally planned, and on the other side of the globe, to welcome you to the second symposium: "Achieving a sustainable low-carbon society".

The workshop last year argued for the need for global emissions of greenhouse gases to be markedly reduced by the middle of the century to combat climate change. It presented a vision of how developed countries could practically reduce their emissions by at least half by 2050 and how developing countries could play their part through developing sustainably. It defined a low-carbon society as one that:

- takes actions that are compatible with the principles of sustainable development, ensuring that the development needs of all groups within society are met;
- makes an equitable contribution towards the global effort to stabilise atmospheric concentrations of carbon dioxide and other greenhouse gases at a level that will avoid dangerous climate change through deep cuts in global emissions;
- demonstrates high levels of energy efficiency and uses low-carbon energy sources and production technologies; and
- adopts patterns of consumption and behaviour that are consistent with low levels of greenhouse gas emissions.

The results from that workshop have been used to inform discussion on a high level in forums such as the G8 Dialogue Ministerial meeting in Mexico last October and the United Nations Framework Convention on Climate Change in Nairobi in November last year.

Last week's G8 meeting recognised the need for emissions to stop rising and for substantial reductions to be made thereafter. The G8 also agreed to consider seriously the decisions made by the European Union, Canada and Japan which include at least a halving of global emissions by 2050. They committed to achieving these goals and invited the major emerging economies to join them in that endeavour.

Welcome and Introductions

So this meeting is clearly very relevant. Building on last year's workshop it will look at practical steps to realising low-carbon societies. For this second workshop, on *achieving a sustainable low-carbon society*, a range of experts have been brought together, including researchers from various disciplines, national and city-level officials and members of international organisations and industry representatives who see addressing climate change as a business opportunity as well as an environmental necessity. I am encouraged to see this level of participation. Today, at the symposium, are the people who have the ability to make things happen – that is, the business community. Indeed, what today's participation shows is that climate change is not only a purely environmental issue – it also provides an opportunity for growth through sustainable development.

It is imperative that we make the most of all the wealth of expertise and experience available here. This workshop has the chance to be pioneering, to push back traditional boundaries of communication fixed around nations, industrial sectors and international businesses.

The latest Intergovernmental Panel on Climate Change assessment provides a stronger link between human activities and climate change. It clearly demonstrates the need for urgent action to cut greenhouse gas emissions and adapt to the unavoidable impacts of climate change. It, and the Stern Review, show us that it is possible to make deep cuts in emissions at modest cost and that the economic costs of inaction are significantly greater, posing a significant threat to future development.

Our strength and credibility internationally relies on our commitment and leadership at home – In the UK, we are one of the few countries on course to achieve its Kyoto Protocol target.

In March, we launched our draft Climate Change Bill, the first of its kind anywhere in the world from a government. It proposes legally binding targets to reduce CO_2 emissions by 60% by 2050 and 26-32% by 2020. By providing a credible and long-term legal framework, we will enable business and individuals to plan and invest with greater confidence and clarity in order to really deliver the changes needed to move to a low-carbon economy. The introduction of five-year carbon budgets, set 15 years ahead, also provides the balance between certainty and flexibility to manage this transition.

And last month saw the launch of the Government's Energy White Paper. The measures in this put us on track to meet our carbon emission goals – cutting UK emissions by more than a quarter by 2020 relative to 1990 levels, even though the economy will have doubled in size in the same period.

The next two years will be critical in tackling climate change. Japan will host the next G8 presidency and the work done through these workshops will play their part in that. The first formal report on progress under the Gleneagles Plan of Action will also be presented to the G8 summit in 2008. This will include a report on how G8 countries have met their commitments to increase the speed with which greenhouse gas emissions are reduced. We must, therefore, take the opportunity presented by these series of workshops to send strong messages on: the necessity and feasibility of low-carbon societies, the role of sustainable development and existing measures and the need for early action in de-carbonising our societies.

The Japan-UK collaboration on low-carbon societies has been very productive and is a brilliant example of how, by working together, we can produce a real insight into addressing the challenges of climate change mitigation, adaptation and development.

Welcome and Introductions

Over the course of today, the workshop co-chairs, Professors Jim Skea and Shuzo Nishioka, will facilitate mixed discussion. A fascinating programme is arranged for you, outlining the latest science, economics, finance, and importantly sustainable development aspects of transitioning to a low-carbon society. It looks at what can be done at city level, what can be achieved by businesses, and what policies could help us transition to a low-carbon society.

In summary, it is my great pleasure to open this symposium and workshop on *Achieving a low-carbon society*. To the experts here, I ask you to be honest over the next three days. At this workshop I want you to share your ideas, to share your concerns and to propose solutions on how we transition to a low-carbon way of living. Climate change is undoubtedly the most important problem our generation must tackle and the world of climate change is very busy at the moment. I want you to think of what can we do differently – how can this collaboration between Japan and the UK add most value. I do not see this as a workshop for reiterating standard positions, but rather I see it as an opportunity to think imaginatively about the long-term future of society. I am sure that the expertise in this room will provide some very interesting results.

Finally let me say how much we have enjoyed working with our Japanese colleagues on this programme and we look forward to continuing our productive collaboration. Let this workshop set an example for the future; let us leave a footprint of ideas, thoughts, policies and action rather than of carbon.

Welcome and Introductions

Opening Address

H.E. Yoshiji Nogami

Japanese Ambassador to the UK

Good morning, Minister Ian Pearson, Dr. Jim Skea, Dr. Shuzo Nishioka, and Ladies and Gentlemen.

It is a great honour for me to say a few words today on the opening of this symposium for "Achieving a Sustainable Low-Carbon Society". This occasion brings together a select group of policymakers, business leaders and researchers of the highest calibre, so the deliberations should be very worthwhile indeed. May I express my appreciation to the UK's Department of Environment, Food and Rural Affairs (Defra), the UK Energy Research Centre (UKERC) and the Tyndall Centre for Climate Change Research, as well as Japanese Environmental Ministry and National institute for Environmental Studies (NIES) for their hard work in organising this event.

Tackling climate change is one of the key topics on the agenda between Japan and the UK. This January, Prime Minister Abe visited the UK and discussed with Prime Minister Blair a number of issues of global significance. In the Japan-UK joint statement issued on that occasion, we identified four key issues on which we will work together, namely international security, climate change, international development, and science, technology and innovation. In tackling climate change, we agreed to work together on an international framework to stabilise the concentration of greenhouse gases in the atmosphere, and recognised that such a framework should be equitably designed so as to trigger a faster shift towards a low-carbon society in all the countries that are major producers of harmful emissions. We also agreed to cooperate to ensure that, during the course of Japan's presidency of the G8 in 2008, we achieved a step change in this regard. Furthermore, we determined to undertake joint research on science and technology geared to the development of a low-carbon society.

In Heiligendamm last week, we were able to obtain very significant outcome in terms of agreeing to consider various issues including 50% reduction in greenhouse gases by 2050 and resolving to call on all parties to participate in the UNFCCC conference in Bali with a view to achieving a comprehensive post-2012 agreement. In order to maintain the momentum, the next challenge is to establish a concrete framework for formulating that agreement.

As a matter of fact, just before the Heiligendamm summit, Prime Minister Abe issued an "Invitation to Cool Earth 50", which is a Japanese initiative for tackling climate change. Prime Minister Abe proposed working towards three goals: Firstly, achieving a 50% reduction in emissions from the current level by 2050; Secondly, forging a flexible and diverse international framework in which all the major emitters including USA, China and India feel able to participate; and Thirdly, mounting national campaigns with such themes as "1 person, 1 day, 1 kg".

Through these proposals, Prime Minister Abe is stressing that the existing ideas alone cannot achieve substantial reduction of emissions. And Prime Minister Abe specifically mentioned that we need to change our way of life so that we can achieve growth in a manner that accords with the protection of the global environment. Quite simply, this means we need to achieve a low-carbon society, which requires a drastic change in the way we operate. All of us here today have unique areas of expertise which we can call upon to help make this vision a reality.

In 2008, the HOKKAIDO TOYAKO (G8) summit will take place in Japan. At the HOKKAIDO TOYAKO summit, there will be the informative report from the Gleneagles Dialogue, and climate change will definitely be a significant item on the agenda. We need to move forward to an international agreement, building on the achievements of the Heiligendamm summit and the Bali UNFCCC conference. I understand that the outcome of this workshop will be reported to the Gleneagles dialogue in Berlin and to the conference in Bali. Moreover, I hope the HOKKAIDO TOYAKO summit next year will benefit from the deliberations at this workshop.

Let me conclude my speech by wishing the discussions will be fruitful and will provide you with the opportunity to widen and deepen your friendships as well. Thank you very much.

2. The Low-Carbon Society in an International Context

The Latest Assessment of Climate Change Mitigation from the Intergovernmental Panel on Climate Change (IPCC)

Dr. Bert Metz

Netherlands Environmental Assessment Agency
and Co-chair IPCC Working Group III, Mitigation of Climate Change

Key message

The key message from the Fourth Assessment Report of the IPCC is that to achieve stabilisation at low levels of greenhouse gas concentrations in the atmosphere, global CO_2 emissions have to peak within the next 10-20 years and then decline steeply. If we manage to have these emissions start declining in the next 10 years, then a maximum global mean temperature increase of about 2°C above pre-industrial is still feasible. If turning around global CO_2 emissions will take 25 years it is likely we will face a 3°C warming in the long term, which will result in much more serious impacts of climate change. Mitigation efforts over the next two to three decades will, therefore, have a large impact on opportunities to achieve the lower stabilisation levels.

The range of stabilisation levels, even the lowest ones, can be achieved by the deployment of technology currently available as well as technology expected to be commercialised in coming decades. This assumes that appropriate and effective incentives are in place for development, acquisition, deployment and diffusion of technologies and for addressing related barriers.

What are current trends?

Between 1970 and 2004 global greenhouse gas emissions have increased by 70%, CO_2 being the largest contributor. With current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades. IPCC SRES scenarios predict a 25-90% increase of GHG emissions in 2030 relative to 2000.

How can emissions be reduced?

In all sectors there are many technologies available today to reduce GHG emissions. Examples for the energy supply sector include: energy efficiency; fuel switching; nuclear power; renewable energy (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of CO_2 Capture and Storage (CCS).

Other technologies still under development will be commercialised in the near future. Examples for the transport sector include: second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries. Putting all technological options together, IPCC concludes that by 2030 the global economic mitigation potential is sufficient to offset the projected emissions growth or bring emissions below current levels.

The Low-Carbon Society in an International Context

A wide variety of climate change mitigation policies is available for governments to realise the mitigation of climate change. Applicability of national policies depends on national circumstances, their design, interaction, stringency and implementation.

An effective carbon-price signal is critical to realise significant mitigation potential in all sectors. Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to invest in low-GHG emitting products, technologies and processes. Such policies could include economic instruments, government funding and regulation. For stabilisation at around 550 ppm CO_2 eq (parts per million carbon dioxide equivalent) carbon prices should reach 20-80 US$/t$CO_2$ eq (tonnes of carbon dioxide equivalent) by 2030 (5-65 if "induced technological change" happens). At these carbon prices, large shifts of investments into low carbon technologies can be expected. For comparison: carbon prices in the EU Emissions Trading Scheme (EU ETS) over 2005-2006 have fluctuated between $10-40/ t$CO_2$.

Technology policies are also of great importance. The lower the stabilisation levels the greater the need for more efficient RD&D efforts and investment in new technologies during the next few decades. Government support is important for effective technology development, innovation and deployment through financial contributions, tax credits, standard setting and market creation. However, government funding for most energy research programmes has been declining for nearly two decades: they are now about half of their 1980 level.

Non-climate policies can influence GHG emissions as much as specific climate policies. Climate policy alone is unlikely to solve the climate problem. The development path of countries has a major influence on GHG emission levels. There are many non-climate policies, such as tax, fiscal, energy security, health and other policies that can deliver significant emission reduction if climate change concerns are integrated.

The Working Group III contribution to the Fourth Assessment Report can be downloaded from www.mnp.nl/ipcc

Further information:

IPCC Working Group III Technical Support Unit at the Netherlands Environmental Assessment Agency: ipcc3tsu@mnp.nl

Low-Carbon Societies and Sustainable Development

Rae Kwon Chung

Director, United Nations Economic and Social Commission for Asia and Pacific

Fast economic growth of Asia and the Pacific depends heavily on imported energy. Thus energy security is one of the most critical issues facing the region. Achieving a low-carbon society is directly related with energy security of the region.

The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) have been promoting the "Green Growth" paradigm, focusing on the need to improve the ecological efficiency of economic growth. UNESCAP is promoting the need for countries in the region to shift towards an ecologically efficient pattern of growth.

Green Growth has been promoted to replace the "Grow first, clean up later" approach by focusing the concept of ecological efficiency of economic growth. The Green Growth approach aims to achieve sustainable development by improving the eco-efficiency of growth.

In fact, the Green Growth approach based on the concept of eco-efficiency is also a strategy for achieving low-carbon societies in the Asia and Pacific region as energy efficiency and climate action are the key factors of ecological efficiency. UNESCAP is focusing on the following five areas in promoting Green Growth:

1. Ecological tax reform to close the gap between market costs and ecological costs;
2. Promoting the sustainability of infrastructure to improve the physical foundation of society;
3. Improving the sustainability of consumption by changing lifestyle patterns;
4. Promotion of green business by presenting eco-efficiency as business opportunity; and
5. Developing an Ecological Efficiency Indicator (EEI) to measure the eco-efficiency pattern of economic growth.

In scaling up the investment for low-carbon societies, what is critical is not the amount of money, but how to frame a financial mechanism which can present investment for low-carbon societies as commercially viable and profitable. Once investment for low-carbon societies could prove to be profitable, then money will flow in. Thus, we should focus on how to make the investment for low-carbon societies profitable.

One of the financial mechanisms we can improve is the Clean Development Mechanism (CDM). If we could multiply the Certified Emissions Reductions (CERs) from solar and wind power CDM 10 or 100 times, then the investment for solar and wind power could become profitable.

We could even use CDM as a mechanism to generate net emission reductions from Non-Annex 1 if we could discount the CERs from CDM. If only one million tonnes of CO_2CERs were sold out of 2 million tonnes of CO_2CERs, then unsold one million t CO_2 will become a net global reduction of CO_2 emission.

CER discounting could be an alternative option for Non-Annex I action after 2012. We could expect emission reduction from Non-Annex I even without imposing any target on them. Thus it could provide a breakthrough to resolve the deadlock which is blocking the progress on climate change regime after 2012.

How Finance Can Enable a Low-Carbon Society

Jean Acquatella

Economic Affairs Officer of the Sustainable Development and Human Settlements Division

Economic Commission for Latin America and the Caribbean (ECLAC)

Restructuring Finance for Low-Carbon Societies

The Alternative Scenario modelled by the IEA for the World Energy Outlook 2006 shows that emissions reductions of 16% or 6.3 giga tonnes CO_2eq by 2030 can be achieved without incurring additional investment relative to the IEA reference or business-as-usual scenario. However, delivering these potential emission reductions requires shifting part of the total energy sector investment from supply expansion to demand side (energy efficiency).

Whilst energy supply side investment is routinely undertaken through commercial project finance, expanding capacity for demand side investment will require innovation and structural change within the finance sector. Most energy finance facilities are ill prepared to handle barriers associated with energy efficiency programmes such as financial constraints on individual consumers, high implicit discount rates, partial information on energy performance of end-use appliances, the need to organise a large number of individual actions, and partial information on the potential savings to demand side investment.

The new energy finance facilities need to work in conjunction well designed and enforceable efficiency standards, regulation and energy pricing policies, alongside specific facilities geared to energy efficiency needs. Without these clear and long term regulatory signals, it is unlikely that markets will mobilise the required level of demand side investment. Energy efficiency financing should be regarded a priority in any restructuring of energy sector investment.

Current Mechanisms that Leverage Financing a Low-Carbon Society

The Challenge for the Clean Development Mechanism (CDM)

The project pipeline for CDM to 2012 is expected to generate 2.0 billion tCO_2e of certified emissions reductions. This will represent US$20 billion of additional funding for mitigation in developing countries to 2012 – based on a certified emission reduction cost of US$10 per tonne, approximately US$4billion per year. If we compare this amount, however, with the expected US$20-30 billion annual estimated incremental cost of low-carbon investment in developing countries, we can see that CDM, at this point, is only contributing a minor share of the total amount of investment required to reduce future emissions in developing countries.

Removal of barriers, such as high transaction costs, technology risk and policy uncertainty, alongside an expansion in CDM, can deliver the necessary structural changes that can enable an increase in the scale of investment through CDM.

Global Environment Facility (GEF)

Since its inception in 1991, the Global Environment Facility has provided US$6.2 billion in grants and has generated over US$20 billion in co-financing from other sources. However the facility is too small relative to the scale of the investment required. According to the World Bank a two-to-three fold increase would be required for the GEF to support a market penetration program in developing countries for energy efficiency and renewable energy technologies in the next ten years. A ten fold increase would be needed to finance a strategic global programme to support cost reduction of pre-commercial low-carbon technologies.

Towards a Global Carbon Market

Trading on the EU Emissions Trading Scheme (EU ETS) is now worth US$8 billion per year, trading on other voluntary carbon market schemes (i.e. Chicago Carbon Market Exchange etc.) are now worth US$2 billion. The global carbon market shows a very large growth potential with the planned expanded coverage of power and industrial sectors in the EU ETS, the opportunity for linking the emerging regional carbon trading schemes into a single market, and as the large global emitters join in carbon trading.

Long-Term Signals and Drivers of Investment

To support the further expansion of financing mechanisms for low carbon investment, it is important that clear and long-term signals on the development of a post 2012 framework are in place. A key driver of investment in clean energy technologies will be the stability of a carbon price signal. In creating a stable global price for carbon it will be necessary to remove broad based energy subsidies and tariff barriers, whilst ensuring that environmental costs are internalised in energy prices. Market mechanisms, such as carbon taxation and emissions trading, can deliver strong incentives to drive future investment in clean technologies.

Innovation in the Development of Mechanisms and Finance

In conclusion, to support cost-effective reductions of global GHG emissions, a transformation in the scale and incentives for international finance flows for clean energy, climate change mitigation and energy efficiency investments is required. Developing a long-term global GHG emissions reduction goal is of key importance to the strengthening of carbon finance after 2012. The linking of carbon finance to policy and programmes in the context of national, regional or sectoral emissions reduction programmes, rather than individual projects, is necessity for scaling up the impact of mitigation activities in the post-Kyoto period. The leadership of public, multilateral and private finance institutions will be necessary to pilot and demonstrate the feasibility of the new schemes required by a comprehensive carbon financing framework after 2012.

The Low-Carbon Society in an International Context – Summary

The main aim of the second workshop was to examine the practical steps needed to develop low-carbon societies. The focus was to be largely on feasibility, through an analysis of current low-carbon society activities, locally, nationally, regionally and internationally. In creating a definition of a low-carbon society at the first workshop, a common understanding of the necessity and the feasibility of decarbonising our societies was achieved.

Mitigation efforts over the next two to three decades will have a large impact on the levels at which stabilisation of GHG emissions occurs. Stabilisation of global GHG emissions, even at the lower range of concentrations, can be achieved with existing technology as well as those we expect to be commercialised within the coming decades. This is dependent on the necessary incentives being in place throughout each stage of the innovation cycle.

Critical to creating the conditions for scaling up the level of investment in emerging clean technologies is the development of investment financing that is aligned to a global price for carbon. The establishment of a global price for carbon can create conditions where investors can take advantage of the co-benefits of financing the development of low-carbon technologies whilst offsetting costs against reductions of GHG emissions. It is vital that low-carbon financing is strengthened in order that the transition to a low-carbon society can be both environmentally and economically feasible. Low-carbon financing needs to be flexible and long-term in order to create the stability in future investment.

3. The Low-Carbon Society – Making it Happen

Low-Carbon cities

Andy Deacon

Climate, Energy and Air Quality Strategy Manager

Greater London Authority

City level action

The fight to tackle climate change will either be won in cities such as London, or it will not be won at all. Cities are responsible for 75% of all the world's carbon emissions. What London does to cut its emissions, and by working with other cities to do the same, could make a real difference to tackling climate change.

Cities are taking action. The New York City government has retrofitted with carbon-saving installations 200 million square feet of its own buildings, and has 2,000 hybrid vehicles in its own fleets. Barcelona's solar ordinance requires all new buildings above a certain size to use solar energy for hot water systems. This measure has led to a 15-fold increase in solar thermal sales and use in five years. Many cities are introducing standards for sustainable construction that are often higher than national or regional levels, including Melbourne and Berlin.

London's city action plan

In order to calculate what investment is needed for London's low carbon future, different carbon scenarios to 2026 need to be considered. Different technology scenarios have been costed and the costs have been benchmarked and agreed with widespread stakeholder involvement. For the hybrid scenario, it has been estimated that £8.5 billion of new investment will be required over the coming 20 years. Delivery mechanisms have been discussed with the investment community and a substantial investment appetite has been identified. Onward work involves looking at a buying co-operative, a rental scheme, and a project facilitation service and green fund.

Savings by measure, across both the domestic and commercial sectors, thermal efficiency measures and more energy efficient lighting and appliances are likely to deliver as much as 4 million tonnes in the current environment – and as much as 9 million tonnes with the right regulations and incentives in place. Changes to London's energy supply will also exert a strong influence on ability to cut CO_2. Combined Cooling Heating and Power could save as much as 6.2 million tonnes annually, given the right policy support. Even with existing regulations, cuts of more than 2 million tonnes are possible. There is significant potential for energy from biomass and waste. Behavioural change – simple things like turning off lights and appliances, are often underestimated but are capable of delivering significant reductions – as much as 1.7 million tonnes from the domestic sector. Within the transport sector – London is looking at travel demand management and modal shift, as well as promoting the rapid uptake of low carbon vehicles and fuels.

International collaboration

In conclusion, significant efforts have been made to evaluate and implement potential solutions in order to improve the air quality of our mega cities and to reduce the CO_2 produced. As the urgency for action increases, large cities need to build wider and stronger links with other cities across the world. Our work through the C40 large cities climate leadership group is one example of this. Internationally, other bodies such as Local Governments for Sustainability (ICLEI) and the World Mayors' Council on Climate Change are bringing city leaders together to promote action on climate change. City governments must lead by example with measurable outcomes, as this sends messages to businesses and citizens alike. Political leadership and public action are crucial to give business the confidence to accelerate the development and use of low-carbon technologies.

The Contribution of Business to a Low-Carbon Society

Graham Smith

Senior Vice President

External Affairs and Environmental Affairs,
Toyota Motor Europe

Chairman, Low Carbon Vehicle Partnership

There is now little serious scientific doubt that climate change is happening and that human activity is the major factor behind the changes. It is also becoming increasingly apparent that the cost of inaction will vastly outweigh that of action. More positively, however, it is also becoming clear that by meeting these challenges and developing appropriate solutions, new markets and commercial opportunities will emerge. By recognising environmental challenges, investing in innovative technologies and introducing sustainable practices ahead of government regulation, business can take advantage of these opportunities. For Toyota, as an example, the challenge is to reuse direct and indirect emissions from our plants, products and services and at the same time, developing new technological solutions which appeal to consumers and provide mobility to millions.

But here we face a dilemma. The ultimate objective of economies is growth, delivering, as it does, improved human welfare. However, with this growth come the impacts of transport. There is an increased demand for transport services and also demand for mobility – in other words, more journeys and more vehicles making those journeys. As one would expect, this increased motorisation results in increased negative environmental and economic impacts – greenhouse gas and other emissions, congestion, accidents and noise. As these negative consequences increase, many of the benefits of mobility are undermined – limiting or even preventing free movement and restricting growth.

The assumption would seem to be that you can have either a clean environment or economic growth with rising demand for mobility, but not both. But the challenge we face is, indeed, to deliver both – to deny this paradox by simultaneously delivering economic growth and a cleaner environment. There is only one way to achieve this – we cannot deny society its demand for mobility, but we can improve that mobility through the continuous application of innovation and creativity.

As well as reducing the harmful effects of automobiles on the environment, we are constantly mindful of the need to minimise our overall environmental impact. And we demand this approach of our suppliers as better environmental performance also means better financial performance.

Reducing emissions through existing measures, such as increased efficiency, will take us a step closer to a low-carbon economy. But on its own, it will not meet the challenges we face. New, low-carbon technologies are needed. In pursuit of what we call the "ultimate eco-car", we are developing a multi-path approach. Hence, we invest in a variety of technologies: gasoline, diesel, alternative fuels and electric vehicles. For Toyota, hybrid technology is the common thread for the present and future and we are convinced that hybrid is truly the core technology because it can be applied effectively to improve the efficiency of all these power trains, including fuel cell.

However, vehicle technology alone will not provide a 'silver bullet' to reduce road transport greenhouse gas emissions. This will require an integrated approach, including the increased use of lower carbon fuels, such as biofuels. There is also an important role for motorists to adopt smarter driving techniques which can improve vehicle efficiency by close to 10 per cent. Drivers also need to use their cars responsibly, sticking to speed limits and making use of walking, cycling, public transport and tele-working where appropriate. With nearly one third of car journeys travelling less than two miles, the opportunities are considerable. Good infrastructure and planning policies designed to reduce the need to travel can also have a longer term effect.

The Low Carbon Vehicle Partnership (LowCVP) has argued strongly for information and education campaigns to encourage low-carbon vehicle purchase and smarter driving. We were delighted that the Department for Transport recently commenced its Climate Change Communications campaign. We are also pleased that the Government has taken up our recommendations for a Low Carbon Transport Innovation Platform and support to encourage fleet demonstration of new technologies in the UK. The Partnership has also provided key support in the establishment of Cenex, a public-private centre of excellence that is working alongside LowCVP to bring forward new technologies.

One of the Partnership's early achievements was to broker the introduction of a voluntary agreement between the Government, environmental groups and the car industry, to develop and display a fuel economy label on all new cars. The label is banded to indicate the CO_2 emissions of the car, with the bands being linked to Vehicle Excise Duty.

Only by working together can a low-carbon society be assured, one which is to the benefit of all concerned.

The Low-Carbon Society: Making it Happen – Summary

The threat of global climate change will require an international response. Cities around the world are responsible for approximately 75% of global carbon emissions, therefore collaboration between cities and action at individual city level can have a significant impact on the success of both the mitigation of, and adaptation to, the impacts of climate change.

Significant efforts are being made in our cities to deliver solutions that both address our environmental concerns whilst bolstering economic growth. However, this needs to be supported by strong political leadership and real public action. It is vital that our businesses are given strong enough signals in making a transition to a low-carbon society so that new and emerging products and markets can be taken advantage of and developed to the scale required. Equally, citizens of our cities need to be encouraged to adopt low-carbon lifestyles. Policies should address the need to deliver the necessary incentives for business to invest in low-carbon technologies and should raise awareness of the impact our lifestyles have, thereby enabling the necessary shift in behaviour in our cities.

Transport and mobility presents one of the key challenges to delivering low-carbon cities. With continued economic growth comes improved human welfare and an increase in demand for transport services and mobility. This increase of motorisation exacerbates the negative environmental and economic impacts from the transport sector. As negative impacts increase, our levels of mobility become undermined, often resulting in posing limitations on transport infrastructure.

Whilst the use of existing technologies and measures will contribute to the development of low-carbon cities, they will not be sufficient for the challenge we face. Therefore, an integrated approach that takes into account the new emerging technologies alongside innovative policies and measures across the transport sector is required. In creating the conditions for an integrated approach to transport and mobility, new markets and commercial opportunities will be delivered that business can take advantage of. Equally important is enabling citizens to make the transition to low-carbon transport solutions, through the development of sustainable mobility transport systems and by promoting the use of walking, cycling, public transport and flexible working.

4. The Key Elements of a Low-Carbon Society

The economics of achieving a Low-Carbon Society

Su-Lin Garbett

Stern Review Team

Her Majesty's Treasury

UK

The intensity of projected impacts of climate change increase as temperatures rise and an increase of five degrees would have devastating results. We are already committed to a temperature rise of 0.5-1°C above pre-industrial times and business as usual would give serious risks of exceeding 5°C.

When estimating impacts, it is essential to take into account risk and uncertainty, and models should not be taken too literally. However, new science gives us the ability to incorporate the economics of risk, and the magnitude of effects in the middle of the plausible range can be used.

Delaying mitigation is dangerous and costly and given the costs of impacts, taking urgent action is good economics.

Stabilising below 450ppm CO_2e would require emissions to peak by 2010 with a 6-10% p.a. decline thereafter. If emissions peak in 2020, we can stabilise below 550ppm CO_2e if we achieve annual declines of 1 – 2.5% afterwards. A 10 year delay almost doubles the annual rate of decline required. The cost of the trajectory consistent with 550ppm CO_2e stabilisation averages 1% of GDP per year. Costs will not be evenly distributed and there will be opportunities and co-benefits.

The key principles of climate change policy include: carbon pricing; R,D&D; and related market failures and behavioural change. Objectives such as growth and energy security, are consistent with other policy goals.

Carbon markets can grow, but to be effective, require good design. A key instrument both for the EU and potentially globally is the EU ETS, which is a powerful basis on which to build global carbon markets. Global carbon markets could grow by five times if we included electricity generation and heavy industry from the world's top 20 emitters. Trading is a potentially powerful instrument for establishing a global carbon price.

But to actually deliver the efficiency benefits of a trading market, they need to be based on:

- Scarcity – fundamental for the market to work;
- Credible, long-term trading periods – needed for confidence that the scheme will be in place for a long time, with predictable structures for change;
- Open, deep and liquid markets – expanding across sectors and countries is necessary for efficiency and the automatic transfer of financing across borders; and
- Efficient allocation methods – free allocation may be important for transition costs, but it can distort incentives, and raise overall carbon emissions and therefore prices, so should only be temporary.

But a carbon price alone won't deliver because of policy uncertainty and barriers to new technologies in energy markets. The private sector plays a key role in determining how technologies are developed and deployed but given the knowledge spillovers (learning externalities) they have less incentive to invest. Costs come down with scale and experience, so policies (incentives and regulation) should support markets for these technologies, especially in their early stages of development. Existing technologies have benefited from this support. Clear review process and exit strategies are needed as well as stability to nurture developments. Technology co-operation can reduce duplication and costs, and increase the scale of action by spreading risk.

Regulation has several important economic roles: supporting implicit prices for carbon; accelerating technology; and overcoming other barriers. Economists often dismiss them too quickly although modern theory is beginning to clarify their role. Information is important to help people make sound decisions. There is a need to promote a shared understanding of responsible behaviour across all societies to promote collaboration, and encourage political momentum for action.

Policy requires urgent and international action, pricing for damages from greenhouse gases, supporting technology development and combating deforestation. International co-operation needs to be built in order to address the following and spread awareness of other countries actions:

- Agree stabilisation level – resultant emissions pathway;
- Determine equity consideration;
- Address national emissions targets (by 2050, 60-90% emissions reduction by developed countries – on course by 2020);
- Reduce costs through global carbon price (transfers through trading building coalitions);
- Address deforestation and technology policy; and
- Enforcement mechanism is the will of the domestic population – responsible behaviour.

Our understanding of the risks of climate change has advanced strongly and we understand the urgency and scale of action required. Unless emissions are curbed, climate change will bring high costs for human development, economies and the environment. Limiting concentrations is possible and the costs are modest relative to the costs of inaction. We know that the technologies and economic incentives for effective action are available or can be created. We are in a much better position now to use our shared understanding to agree on what goals to adopt and what action to take. Decisive and strong international action is urgent: delays mean greater risks and higher costs.

The Role of Technology in a Low-Carbon Society

Professor Jae Edmonds

Senior Staff Scientist and Technical Leader of Economic Program
at the Pacific Northwest National Laboratory's (PNNL) Joint Global Change Research Institute at the University of Maryland

USA

The Global Energy Technology Strategy Programme (GTSP) is a research programme designed to address climate change issues within the context of an international, public/private collaboration. The objective of the programme is to assess the role that technology can play in managing the long-term risks of climate change. A recent GTSP report summarises some of highlights of almost a decade of GTSP research and can be found at http://gtsp.battelle.org. Some of the key findings from this body of work include:

1. Climate is a long-term problem, with implications for actions today

It is a century scale problem which casts a shadow all the way back to the present. It is impossible to frame an effective and efficient public policy for the present without an understanding of climate change and its unique characteristics. Climate change is not just the "acid rain" or "stratospheric ozone" problem with a different name. Stabilizing CO_2 concentrations at any level means that global CO_2 emissions must peak and then decline forever. The 450ppm global CO_2 emissions trajectory is already at the peak.

2. Stabilising the concentration of CO_2 means fundamental change to the global energy system

The global energy system must ultimately become increasingly carbon neutral if the concentration of CO_2 is to be stabilised. Ultimately, the global energy system must cease greenhouse gas emissions entirely. The rate and timing of that transition will determine the anthropogenic climate change to which the world must adapt.

3. Technology will play a central role in addressing the growing mitigation challenge in the near-, mid- and long-term.

The challenge of scale grows exponentially over the century. Daunting technology deployment challenges lay in the immediate future. However, successful accomplishment of near-term goals must be followed by the accomplishment of increasingly ambitious emissions mitigation. Greenhouse gas concentrations can be stabilised with any technology set. Emissions can always be reduced by reductions in the level of human prosperity. So, feasibility is not in question. What is in question is cost.

The role of technology is to help manage the cost of stabilising greenhouse gas concentrations. The better emissions mitigating technologies perform, the lower the social cost of stabilisation, and the fewer resources that will need to be diverted from other useful ends to changing the global energy system. Every emissions mitigation regime must start with the then existing suite of technologies. But, technologies can change and improve over time.

The Key Elements of a Low-Carbon Society

Improving the suite of technologies available to address emissions mitigation over time will be important because the challenge of emissions mitigation grows exponentially, not linearly, over the century. Thus, unlike a traditional environmental pollutant problem in which a single set of changes can be made to address the problem, climate change will require ever tighter constraints of the global energy system, creating an ever larger premium on energy technology advance. This in turn argues for investments to both improve the existing suite of technologies, but also for investments in very basic science to lay down the foundation for whole new generations of technology to be deployed in the middle and latter part of the 21st century. Such investments could create entirely new technology options to address ever-growing emissions mitigation challenge.

Technology systems

The GTSP conducted extensive research into the potential role of six technology systems both in their present form and as they might evolve. This set of technologies was chosen for its potential to a play an increasingly significant role in a climate constrained world. That suite included: *CO_2 capture and storage, Biotechnology* (including soil carbon; sequestration via reforestation and afforestation; growth of crops for their energy content; and potential advances from the biological revolution in science), *Hydrogen systems, Nuclear energy, Wind and solar, and End-use energy technologies* including building, industry and transportation technologies. Each of these technology systems faces its own unique set of challenges to large-scale deployment in a climate-constrained world.

The GTSP found that the more diverse the suite of technologies that could be deployed to reduce GHG emissions and the better the performance of those technologies, the lower the cost to society of limiting anthropogenic climate change. While energy technology is central to addressing climate change, the GTSP also found that a technology strategy complemented a broader response to climate change including scientific research, emissions limitation, and adaptation to climate change.

Technology deployment in a climate constrained world

The mere existence of technology is insufficient to ensure its deployment in the global economy. Because climate change is a long-term, global public goods problem, competitive market forces alone do not reflect the social value of GHG emissions. Stabilising GHG concentrations requires that a value be placed on GHG emissions. Since the atmosphere is indifferent to the source of GHG emissions, minimising the social cost of stabilizing GHG concentrations requires that all emissions see the same social value or price. The fewer the exceptions to that rule, the lower the social cost of stabilisation. Leaving any major emissions source unvalued, implies greater social cost for stabilisation. For example, leaving land-use change CO_2 emissions unvalued not only raises the social cost of stabilisation, but also lays the foundation for a mid-century environmental disaster.

Cost minimisation also implies a rising price of greenhouse gases as time passes. The price of carbon starts low and rises through a series of regular doublings that result in an eventual global CO_2 emissions peak and perpetual decline thereafter.

Near-term carbon prices depend on both the concentration at which CO_2 is stabilised and the degree and timing of accession by the world's nations. Meeting the goal of stabilising CO_2 concentrations at 450 ppm or below requires virtually all nations of the world to participate in an aggressive emissions mitigation regime by 2020. Greater flexibility in the timing of participation of the world's nations exists if the concentration of CO_2 is limited to 550 ppm. However the risks of dangerous anthropogenic climate change, and therefore the associated impacts, among others, on human society, are greatly increased.

Changing Energy Consumption: Why it happens and how it can be made to happen

Dr. Harold Wilhite

Senior Researcher

Centre for Development and the Environment

University of Oslo

Norway

Though consumption is something that has concerned me and a handful of other social scientists over the past 25 years, most attention in the energy research and policy communities has been given to how to move towards greener production. However, over the last few years there is a growing acknowledgement that the ways we consume energy must also change if rapid decreases in greenhouse gas emissions are to be achieved. The little work that has been dedicated to consumption research in the energy world to date has been dominated by economists and psychologists. Many economists share the illusion that consumption is something that is done by individuals operating in a social vacuum. In their models, they reduce life and energy choices to a rational process of individual utility maximisation. When the energy policy world began to realise that this model was not working, psychologists were brought in – not to examine the economists – as they well might have done, but to work on attitudes how to motivate individuals to save energy. Both of these conventional approaches premier the individual and downplay the importance of the social and cultural contexts in which energy is used. Deep changes will not be achieved without a perspective that acknowledges the social dimensions of consumption; that is to say the contribution of things like social and family relations, social conventions, shared ideologies and material landscapes. Applying a socio-cultural perspective to energy use and energy savings would emphasise that demand comes not only from individual consumers, but is structured by the range of choices available. No amount of taxes or price increases on automobiles or fuel will affect mobility practices unless the consumer has an alternative; for example, we cannot expect people to take a bus that never comes or purchase a smaller refrigerator if it is not available on the market. In short, energy demand should be re-conceptualised as a product of both choosers and the set of choices available.

Another important point is that people are not interested in energy per se, but rather in the services that it provides, such as light, heat, entertainment, comfort and cleanliness. Energy policy needs to broaden its focus from technical and market efficiency to an examination of how energy service needs can be achieved in the least energy intensive way. Taking mobility as an example, such a policy would not only emphasise energy efficient automobiles, but would encourage more robust public transportation systems, infrastructures for bicycles and in general more holistic city planning.

Finally, there is the point that new practices will not materialise out of thin air. The socio-material world we have created, in the form of buildings; energy and transport infrastructures; and household technologies all contribute to scripting of the ways we use energy. Air conditioning is an example. Its use is growing rapidly around the world. The explanation is not that people have elevated their demands for thermal comfort, but because the constructed world that they inhabit no longer allows for comfortable natural cooling. Building designs, materials and infrastructures have paved the way for air conditioning. A policy aimed at device efficiency will only make a small dent in future thermal energy demand. What is needed is retention of local knowledge on passive cooling and changes in urban and building construction practices. A policy interested in deep reductions must take a holistic and long-term approach to change.

Alignment of climate change issues with sustainable development goals

Professor P. R. Shukla

Public Systems Group at the
Indian Institute of Management

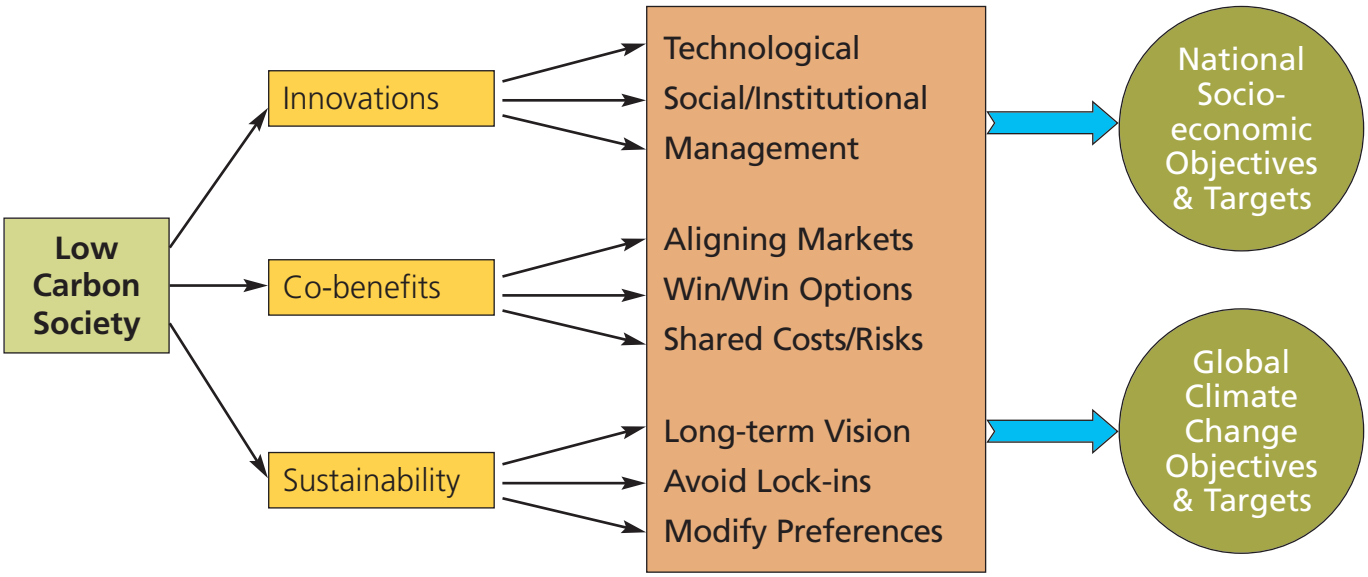
Ahmedabad

India

Low Carbon Societies can be seen as a "Development Pathway" with dual goals. National socio-economic objectives and targets can be tackled, while addressing global objectives for the stabilisation of greenhouse gas concentrations in the atmosphere.

The concept of Sustainable Low Carbon Societies involves developing the mutual efficiency of social/economic indicators and climate quality. This collaboration could be developed through: Innovations (technology, institutions, International and regional cooperation; Targeted technology and investment flows; Aligning stakeholder interests; Focusing on inputs (and not only outputs) and Long-term perspective to avoid lock-ins.

A roadmap for a Low Carbon Society can be drawn with the intention of delivering a global efficient frontier, balancing cost-effectiveness, equity and sustainability goals (UNFCCC). The specifics of the roadmap would differ across countries.



Sustainable Low Carbon Society: An Analysis for India

In order to mainstream climate change in national development, climate policies and actions need to be aligned with millennium development goals (MDGs), national development targets and agreed goals under extant international agreements. Resilience to vulnerabilities and adapting to changing climate parameters should also be developed.

For example: The MDG1 is to eradicate extreme poverty and hunger, with targets to halve, between 1990 and 2015, the proportion of people with income below $1 a day and those who suffer from hunger. India's national plan intends to double the per capita income by 2012, reduce poverty ratio by 15% by 2012 and contain population growth to 16.2% between 2001-2011. These goals intersect with climate change mitigation as higher income increases access to services, food, fuel, information, thus enhancing mitigative and adaptive capacity. Higher climate variability would enhance the risks of meeting these goals.

Drivers of India's low-carbon society scenario (550 ppmv equivalent) involve a number of factors. The carbon emission target is a 70% reduction over the base case by 2050. Energy device efficiency targets are based on demand and supply and a sustainable portfolio of measures have been calculated to meet the emissions target. Dematerialisation involves a change in building materials and design, and policy packages relating to sustainable development. The practice of Reduce (demand), Recycle and Reuse (3R) will also contribute to dematerialisation. Infrastructure investments should be made to avoid lock-ins and to shift demand (e.g. transport modal split). R&D and technology transfer should assist a leapfrog to the efficiency frontier, and include innovations to shift the efficiency frontier. Planning and governance would facilitate a change in lifestyles and behaviours through institutions, laws and policies.

The bio-diesel sector in India involves multiple dividends and conflict. There is potential for this sector to intersect with both MDG 1: to eradicate extreme poverty and hunger and MDG 7: environmental sustainability. Jatropha plantations and oil extraction plants have the potential to provide rural employment/farm income (from waste lands), energy security (as imported fossil oil is replaced), environmental benefits and water and food security.

Another example is the co-benefits of the South-Asia Energy-Water Cooperation. The Integrated South-Asia Energy-Water Market is expected to produce significant savings in Energy, CO_2 and SO_2. The co-benefits include more water for food production (MDG1), 16 GW additional Hydropower (MDG1&7), flood control (MDG1&7) and lower energy prices would enhance competitiveness of regional industries (MDG1).

Regional solutions are key to the success of uniting the goals.

In conclusion

In order to move from a climate-centric to a development-centric paradigm a number of measures need to be taken. In the short-term, climate change mitigation needs to be aligned with development goals and lock-ins need to be avoided. In the medium-term, innovations and actions need to be developed and deployed in order to deliver co-benefits. And in the long-term preferences need to be influenced and climate policy signals need to be created in order to achieve stabilisation.

Stabilisation through Sustainability: The Post-Kyoto Regime

The burden sharing metaphor has posed climate stabilisation as a zero-sum (or negative sum) game, thus inviting conflicts. Sustainability makes it a positive-sum game that would induce cooperation. A sustainability roadmap provides a practical way-out from the climate-centric commitments (as in 'Grand architecture') that have prevented cooperation, and the non-binding ambitious goals (federalism or 'Madisonian' approach) which cannot produce credible and stable policy signals. Even in sustainable low-carbon societies, stabilisation would require climate focused policies, both for mitigation (beyond energy) and adaptation.

The key elements of a low-carbon society – Summary

The consensus building from the Stern Review is that delaying mitigation of climate change is dangerous and costly while taking urgent action is good economics. To this end, key policy activities identified as important factors for achieving low-carbon societies include those related to carbon trading, technology and behavioural change.

Carbon trading is a potentially powerful tool and the design of carbon markets is central to its success. It is important to recognise that carbon pricing alone will not deliver a low-carbon society.

Technology will play a central role in addressing the growing mitigation challenge in the near-, mid- and long-term and will help manage the cost of stabilising GHG emissions. Scale-up of existing technologies and development of new technologies needs considerable channelling of investment funds. Of the technology systems available, six have been identified with great mitigation potential; though several must be deployed as none is the proverbial "silver bullet".

The challenge of achieving a low-carbon society also needs to account for changes in human behaviour – for example energy research should look at consumption as well as production. It is important to consider the social and cultural contexts in which energy is used and acknowledge the social dimension of consumption. Energy demand needs to be re-conceptualised as a product of both choosers and the set of choices available – i.e. what low-carbon alternatives are available to individuals? Consumers are not interested in energy per se, rather the services energy provides thus policy should concentrate on services.

A link to sustainable development will assist developing countries in becoming low-carbon societies with efficiency of both social/economic indicators and climate quality. The objectives of low-carbon societies need to be aligned with structures such as national development targets and the Millennium Development Goals. A case study on India has been presented to show how this is being undertaken.

5. Interactive Session

The interactive session provided the participants with the opportunity to share their opinions on a broad range of low-carbon society questions. Participants responded to a set of multiple choice questions using hand-held monitors and the results were displayed as graphs on an overhead screen. The design of the session allowed participants to change their answer during the discussion, and it was thus possible to observe how the discussion steered people's opinions.

The following two questions were closely related:

What do you think the change in global greenhouse gas emissions will be in 2050 compared to current levels?

What do you think the change in global greenhouse gas emissions should be in 2050 compared to current levels?

1. cut by 50% or more
2. cut by 25-50%
3. cut by 5-25%
4. about the same
5. increased by 5-25%
6. increased by 25- 50%
7. increased by 50% or more
8. don't know

There was a big difference between what people thought the change in emissions *will* be and what it *should* be. Most people agreed that there should be a significant cut, however there was a greater level of disagreement on what the level of emissions reductions will actually be. Only half believed that cuts would actually happen, with a few voting for ambitious cuts but the majority voting for a small cut or even an increase in emissions. It was noted that this reflects the realisation of how hard it is going to be to decrease emissions. Although most of the people present thought that cuts were necessary, it was clear that confidence in the formal negotiations process was low, especially given that not all countries are on board.

A comment was made that it is important to create the confidence that change will happen. Strong concern was expressed over the slow speed at which international action was taking place. It was noted that urgency was not reflected in the international processes and that extreme weather events and human disasters from the impacts of climate change would eventually drive political will.

The next question drew attention to a persistent theme throughout the workshop. ***Will behavioural change or technology contribute more to greenhouse gas emission reductions by 2050?***

Scale range for responses: 1 = behaviour; 10 = technology.

Initially, the response to this question displayed viewpoints quite evenly balanced between behaviour, technology and a mixture of the two. A comment was made that there is plenty of technology already available, and, therefore, it is the behavioural issue which needs to be solved. Other participants proposed that behaviour depends on a price for carbon, and it will be through market signals that change will occur – if the price is right then technology will be adopted. As the discussion proceeded, there was a wave change in opinion away from technology and towards behaviour. The relative roles of technology and behaviour in achieving a low carbon society were a recurrent theme throughout the workshop, providing much discussion. Overall, it was generally acknowledged that there is no "silver bullet" and it will be a combination of the two that will produce the desired results.

The last question related to different actors and their responsibility to initiate the transition which could deliver low-carbon societies. Participants were asked which demographic had the most responsibility to initiate low-carbon development.

The initial results were as follows:

Government 53%

Business 32%

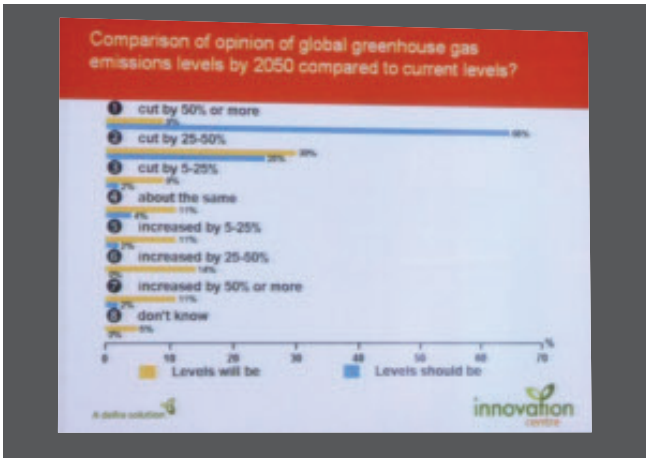
Individuals 17%

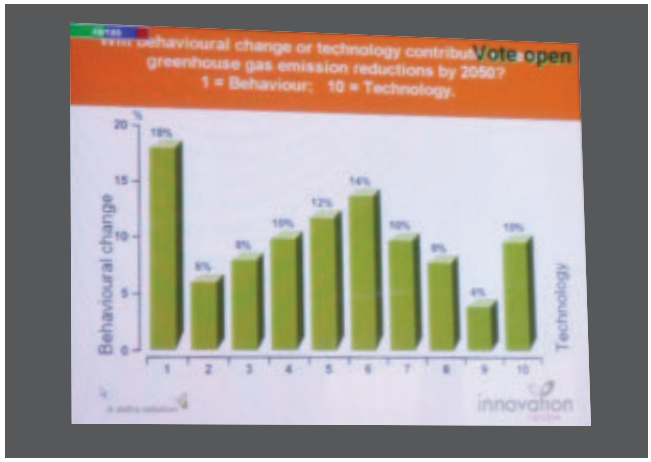
It was suggested that 'individuals' is not a useful category as the other two are comprised of individuals, and a replacement could have been social networks. Some participants felt that it was within business that the people with the most influence were situated and that it was businesses that have the ability to make or break policy. However a different viewpoint was put forward that although all three play a role, when it really starts to hurt, it will be governments that implement the policies and this will be the key to success. Business can deliver, but frameworks are needed and the Government could play a major role in providing these frameworks and incentives to help business deliver. It was also suggested that voluntarism also has a role to play, however policies are needed from government. These viewpoints on the importance of government were clearly influential, as is reflected in the final results:

Government 60%

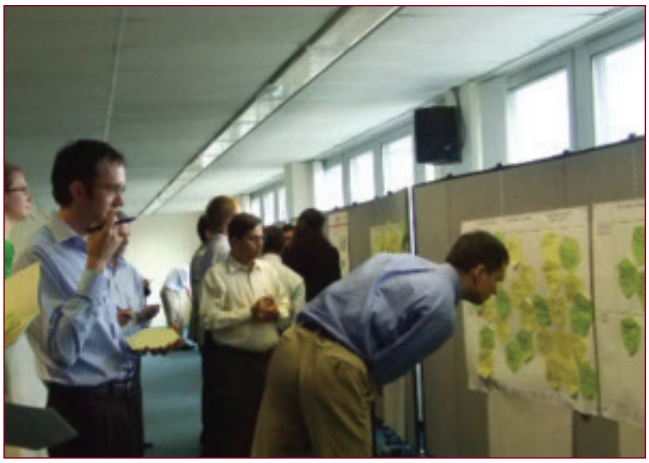
Business 22%

Individuals 18%





Expert Workshop



14-15 June 2007
The Mermaid Conference and Events Centre, London

1. Building on Previous Low-Carbon Society Workshops

Low-Carbon Society Modelling

Dr Neil Strachan

Policy Studies Institute (PSI)

UK

Dr Junichi Fujino

National Institute for Environmental Studies (NIES)

Japan

Low-carbon society scenarios are described societies consistent with reducing roughly 50% GHG/CO_2 of global emissions by 2050 compared with the base year (1990 or current), satisfying adequate service demand and proposing possible combinations of technological and social innovations based on favourable socio-economic future visions. In order to move from scenarios to modelling, there is a need to quantify future socio-economic scenarios, identify possible countermeasures toward low-carbon societies and verify favourable combinations to realise them.

Low-carbon society modelling tools quantify and qualify future trends, potentials and actions. The models all have strengths and weaknesses, different coverage, different scales and special features. Development and climate need to be aligned for the transition to a low(er)-carbon society as global development along a high carbon path is untenable and stand-alone decarbonisation is costly. In addition most sustainable development actions are climate friendly and mainstreaming climate change in development actions reduces welfare losses.

The UKERC Annual Energy Modelling Conference (AEMC) was held in Oxford in December 2006. This was an open symposium with UK energy policy stakeholders followed by a technical modelling workshop. Particular emphasis was on developing country participation and a key output was to define comparative modelling runs which will be a direct research output to the UK-Japan research project *Developing Visions for a Low-Carbon Society (LCS) through Sustainable Development.* Workshop summary. All presentations can be found at: http://www.ukerc.ac.uk

The main outcome of the AEMC was to use models of different scales and types to investigate the restructuring of energy systems under long-term low-carbon societies. This involves technology pathways, behavioural responses, economic implications and required policy measures. Similarities to earlier collaborative modelling projects were acknowledged (e.g. IMCP, EMF), and to scenario descriptions of low-carbon society futures (e.g., Tyndall Centre). Key differences were also identified such as: the broader goal of combining findings on economic and technological implications with assessment of required policy measures; an emphasis on long-term deep reductions in CO_2 (and other GHGs); an emphasis on developing country participation, including institutes previously less integrated into modelling networks; and a mixture of country vs. global and top-down vs. bottom-up models.

A limited set of scenarios were agreed including the base case, the carbon price ($10/t$CO_2$ in 2013 rising exponentially to $100/t$CO_2$ in 2050) and "Carbon plus": (carbon price plus additional measures to achieve low-carbon societies). Common input parameters included the same targets, all physical parameters in common units, commonality on quantitative parameters and description of qualitative inputs. The academic publication of this modelling exercise will be forthcoming in a special issue of Climate Policy. There will also be analytical input into the G8 Gleneagles dialogue when Japan holds the G8 presidency in 2008.

Building on Previous Low-Carbon Society Workshops

The UK MARKAL-Macro (M-M) modelling for the 2007 UK Energy White Paper is indicative to provide a low-carbon society result. MARKAL is a widely-used, technology-rich dynamic optimisation model as well as an integrated energy systems model. The new UK MARKAL model has been substantially rebuilt, with validation and transparency on data and assumptions. The M-M maximises overall discounted utility and has its initial calibration to the UK energy system in year 2000. The model then optimises in 5-year time steps through to 2050. A full range of scenarios and sensitivity analysis is carried out in a systematic 'what-if' framework.

There are fifty-three scenario sets in the UK Energy White Paper, including the UKERC vs. BERR (Department for Business, Enterprise and Regulatory Reform) assumptions, and the standard vs. M-M model. These scenarios differ in: constraint stringency – with 20%, 40%, 60% CO_2 reductions; low and high global fuel prices, restricted innovation (2020 and 2010 levels); high and low technology cost estimates (by technology class); no nuclear or no nuclear/no CCS; and renewable sensitivity (RO and technology costs). They are based on key policy drivers, NOT a formaluncertainty analysis.

Initial findings show that a 60% reduction in UK CO_2 emissions entails radical changes in technology portfolios, resources and infrastructure use. This long-term transition requires a strong CO_2 price signal with a central M-M model estimate of £105/TCO_2 by 2050, within a scenario range of £65/TCO_2 to £176/TCO_2. The resultant impacts on the UK economy are more modest with a range of annual GDP losses in 2050 from 0.3% to 1.5% (equivalent to £billion7.5 to £billion42.0). Higher cost estimates are strongly influenced by pessimistic low-carbon technology assessments. Numerous trade-offs illustrate the very considerable uncertainties in future UK low-carbon scenarios, e.g. no dominant technology class within the future electricity portfolio (i.e. coal CCS vs. nuclear vs. large scale renewables).

How to link modelling and practical steps to achieve a Low-Carbon Society

Professor Yuzuru Matsuoka

Graduate School of Global Environmental Studies

Kyoto University

Japan

This research looks at environmental options towards a low-carbon society in Japan with the aim of proposing options for long-term global warming policy. There are two stages to making a low-carbon society scenario; the first of these on *designing a low-carbon society* is presented here. Work on the second stage on *constructing a policy roadmap toward the low-carbon society* is just starting.

A) Design of a low-carbon society

Creation of narrative storylines of future low-carbon societies

Criteria for selection of a scenario was that there was plausibility of combining basic socio-economic factors and that it was straightforward to see analogues to other combinations. Within this, three factors were considered as key elements of future direction – social contexts (quick-changing or nearly steady-state society, eco-centric or techno-centric, individualism or collectivism); future goals (environmental targets such as a 70% reduction of CO_2 emissions, socio-economic targets, such as annually 1-2 percent increase of per capita GDP, moderation of regional and generational inequality); and technical innovations.

In this case we selected two societies (i.e. scenarios) containing major features of the society which were easy to grasp – see table:

Senario A “Doraemon”	Scenario B “Satsuki and Mei”
Vivid, Technology-driven	Slow, Natural-oriented
Urban/Personal	Decentralised/Community
Techno-centric Centralised production /recycle	Self-sufficient Local production for local consumption
Comfortable and Convenient	Social and Cultural Values

Changes in social indicators and various assumptions made in both scenarios are within the ranges of existing major studies of Japanese future society projections, such as the outlook planned by the Cabinet Office. In reality, however, the future Japanese society may be a mixture of elements from both the scenarios.

Description of sector-wise details of the future low-carbon societies

Assumptions are made on annual growth rate of per capita GDP, a decrease in market regulation, and industrial structure. The changes in services demand that are directly related to energy consumption, such as heating, transportation, and built environment management, etc. have been set by assuming the changes in lifestyle of the representative people in each scenario – including demography and urban structures.

Quantification of the macro economic and social aspects of the low-carbon societies

It is difficult to design a future society as an extrapolation of the current system as the visions may be drastically different from today (in terms of institutions, people's preference, and industrial structure). To treat this problem quantitatively, several groups of models were used. These included models to quantify the snapshot view of future society (inter-sector and macro economic models; energy technology bottom-up models; energy supply model; and transportation demand model), and dynamic models showing the inter-temporal relations of the system (population and household model; and building dynamics model).

Identification of policy measures and packaging the measures

Six hundred technology options expected to have potential for deployment and diffusion in the future are put in a database (the Environmental Option Database) to allow the exchange of information between the each sectors experts and the scenario team. Coupling the database with element models we can examine feasible combinations of energy supply and demands to satisfy 60-70% CO_2 emission reduction target and future social visions quantified in the previous step.

This table summarises the results. For Scenario B, a 70% reduction of CO_2 emissions can be achieved by means of a 45% reduction of final energy consumption through rationalisation and appropriate choice of energy supply options with satisfying, and improving current service demand levels. For Scenario A, these values are changed to 70% reduction of CO_2 emission, and 40% of final energy reduction. For both cases, fossil fuel dependency will be drastically reduced.

Year		1990	2000	2050 Scenario A		2050 Scenario B	
CO_2 (M+C)	Generation	284.0	311.5	127.7	(41%)	85.2	(27%)
	CCS			42.4		0.0	
	Emission	284.0	311.5	85.3	(27%)	85.2	(27%)
					(30%)		(30%)
Energy (MTOE)	Primary	446.0	523.5	334.1	(64%)	264.0	(50%)
	Final	292.0	380.2	225.8	(59%)	209.3	(55%)
	Fossil fuel dependency		80.0%	59.8%		51.0%	
GDP (tril.JPY)		467.9	519.5	1080.3	(208%)	700.7	(135%)
Population (Mill.)		123.6	126.9	94.5	(74%)	100.3	(79%)

(%) is a ratio with 2000 (%) is a ratio with 1990.

We also estimated the annual implementation cost of introducing low-carbon technologies to achieve 70% emission reductions in 2050. The additional costs of low-carbon technologies are 1.0-1.8 trillion yen for Scenario A and 0.7-1.6 trillion yen Scenario B.

The work so far has presented detailed visions of Japan's social and economic structure in 2050 and identified and quantified CO_2 emission reduction measures in order to realise 60-80% reductions consistent with the future visions.

The next stage of this work, which we expect to report at the next workshop, is to establish Japan's roadmaps toward a low-carbon society (including social, economical and technological innovation strategy).

B) Construction of a policy roadmap toward the low-carbon society

- Design of policy roadmaps toward the low-carbon society
- Feasibility analysis of the roadmaps considering uncertainties involved in each policy option
- Analysis of robustness of the roadmap caused by societal, economical and institutional acceptability and uncertainties

We will then transfer this experience to other countries, especially, building capacity and supporting of Asian countries activity on developing individual countries' own roadmaps toward low-carbon societies.

Building on Previous Low-Carbon Society Workshops

Building on Previous Low-Carbon Society Workshops – Summary

A low-carbon society will be achieved through a combination of social and economic factors, and by technological innovations and behavioural change. Modelling allows us to qualify and quantify trends, potentials and actions in order to identify effective combinations and hence best advise policy. Following on from the first low-carbon society workshop, work has been carried out on how to combine the factors and create models of different scenarios.

The UKERC Annual Energy Modelling Conference, held in December 2006, focussed on using models to investigate the restructuring of energy systems under long-term low-carbon societies. A key output was to define comparative modelling runs and analysis of this modelling will be a direct research output to the UK-Japan low-carbon society project. An example of a model being developed to provide a low-carbon society result is the UK MARKAL model – which has been used in the recent Energy White Paper.

A project at Kyoto University has been linking modelling to Japan's vision of a low-carbon society. Different narrative storylines have been designed with a mixture of social contexts, future goals and technical innovations to create 'societies'. The next stage will be to use the models to construct a policy road-map, which would involve design, feasibility and analysis.

2. Case Studies of Low-Carbon Societies

Dongtan eco-city

Professor Jeremy Watson

Director

Global Research, Arup

A snapshot of Dongtan

Arup has partnered with Shanghai Industrial Investment Corporation (SIIC) on integrated master planning for the world's first sustainable city. Dongtan will be situated on Chongming Island, the third largest island in China, near Shanghai at the mouth of the Yangtze river and currently a large area of mostly agricultural land. Shanghai Municipal Government is planning to turn Chongming into an eco-island, with Dongtan as a model eco-friendly area. At three-quarters the size of Manhattan, Dongtan will be developed on 630 hectares of land as a sustainable city to attract a range of commercial and leisure investments.

Dongtan – the Research Opportunity

Arup has proposed an Institute for Sustainability, providing commercial and learning opportunities with a unique position to study the sustainable development of Dongtan, sharing lessons with the wider community. Seeing opportunity for collaboration between UK and Chinese academics, Arup and EPSRC (Engineering & Physical Sciences Research Council) in concert created a network of UK and Chinese academics through meetings in the UK and Hong Kong. EPSRC has allocated £1.5M to funding these networks to work on a research agenda for sustainability.

Generic research challenges in Sustainability

- Sustainable economic and business models
- Community engagement for sustainable society supported by economic development
- Climate change
- Biodiversity and ecology
- Transport
- Data capture and analysis
- Infrastructure: waste, water and energy
  - Water – creation of a sustainable water environment
  - Low carbon/energy
- Systems integration

Institutes for Sustainability: Mission

There is a vital need to train new types of Economist, Planner, Manager, Engineer, Technician and Citizen capable of understanding sustainability issues, synthesising and implementing sustainable solutions and living sustainably. Essential requirements are to measure and learn from the performance of sustainable designs at individual building and city system levels, to develop necessary technologies whilst respecting ecosystems and heritage. It is vital to develop new economic models which recognise that resource constraints can be tempered by business opportunities arising from the exploitation of traditional and emerging technologies to design and manufacture components and systems for sustainable solutions.

Shiga Prefecture

Professor Koji Shimada

Ritsumeikan University

Japan

Shiga Prefecture's feature

Shiga Prefecture is facing various problems including the issue of water quality in Lake Biwa, and increasing CO_2 emissions resulting from population growth and the manufacturing industry. Action is, therefore, essential, and Shiga's scenario illustrates how such environmental trends can be ceased and how the vision of a sustainable society may be realised by 2030.

Environmental targets for the year 2030

The reduction of GHG emissions by half, recovery of water quality in Lake Biwa; recovery of the area of reed communities; doubling of the beautiful lake areas; and reduction of landfill waste by 75%. To achieve these targets, the scenario incorporates: the establishment of a low-carbon society; revival of the Lake Biwa environment; and the establishment of a recycling system.

In order to meet the targets, it is necessary to find a path to maintain healthy activities under strict environmental restrictions based on mutual support between citizens, businesses and local government. There are numerous efforts and actions laid out which need to be taken by the players. Policies to promote the efforts and actions include voluntary environmental action plans, regulations on environmental impact, subsidy schemes for advanced efforts, enlightenment and education and regulations on land use and construction. A tri-parties beneficial policy model is proposed where the three parties share not only environmental benefits but also economic gains, hence "sustainable tax systems" and "sustainable finance" will play pivotal roles in the mechanism.

Socioeconomic assumption

Dominant social trends leading up to 2030 have been identified. These take into account factors such as the population, number of households, macro economy, and employment rate.

Estimation systems

Measures have been identified within five categories of energy consuming sectors: households, business operations, industry, passenger transport, and freight transport. Each activity level has then been quantitatively represented and the emission reduction contribution by each measure has been calculated.

Required policy

In terms of low carbon societies, the research outcome shows that there is a technological potential to halve CO_2 emissions by 2030. Whether it comes true or not is heavily dependent on a political will to formulate a required policy package.

The Tyndall Cities Programme

Sebastian Carney

Manchester University

UK

The Tyndall Cities Programme is producing a UIAF (Urban Integrated Assessment Facility), which embeds climate impact assessment and emissions accounting models within the social, environmental and technological context of scenarios of change at the global and national scales. In order to achieve this, the UIAF will include an economic model to estimate the impacts of global change on the economy of the urban region over the 21st Century. These econometric projections will be used to drive spatially explicit simulations of land use change and population location. These results will then be used as inputs into the impacts models to estimate the impact on water resources and generate maps of flood and heat impacts. The same land use and population projections will be considered alongside other possible technological changes (e.g. increases in operating efficiency) as well as changes to industrial and domestic consumption – which may be driven by climatic changes (e.g. increasing temperatures driving the use of air conditioning units) – to establish their implications for energy use and emissions and identify mechanisms for reducing citywide GHG emissions. There is extensive involvement with key stakeholders in the study region (Great London) in the design and focus of this work, including the Greater London Authority (GLA).

London

Andy Deacon

Climate, Energy and Air Quality Strategy Manager

Greater London Authority

In February 2007, the Mayor announced London's first comprehensive plan to cut carbon emissions across the city.

The Mayor launched four programmes which will form the basis of the Plan:

- A Green Homes Programme
- A Green Organisations Programme
- A Green Energy Programme
- A Green Transport Programme

He announced that £78 million will be reprioritised over three years within existing Greater London Authority finances this year to launch these programmes.

The Action Plan also shows that, without action, London's carbon emissions will grow from 44 million tonnes to 52 million tonnes by 2025.

- Green Homes Programme – Homes are responsible for 38 per cent of emissions. The plan sets out how annual domestic carbon dioxide emissions can be reduced by 7.7 million tonnes by 2025. By making homes more energy efficient, the average London household could save £300 per year off their fuel bills, as well as cutting emissions. The Mayor announced that he will be offering cut-price loft and cavity wall insulation, available across the whole of London to every home that can benefit from it. The offer will be totally free for people on benefits and we will particularly look to ensure that older Londoners can take advantage.
- Green Organisations Programme – London's employers, both commercial and public sector, are responsible for 33 per cent of the capital's emissions. If all of London's employers introduced simple changes like turning off lights and IT equipment at night, emissions would be cut by over three million tonnes a year. Modest improvements to the energy efficiency of London's commercial and public buildings would cut emissions by a further two million tonnes. If all of the actions in this Plan were implemented they would save employers up to 20 per cent on their energy bills.
- Green Energy Programme – decentralised energy. It will not be possible for London to achieve its carbon reduction targets without a fundamental change in how energy is generated and supplied. The Action Plan sets a target to move a quarter of London's energy supply off the National Grid and on to more efficient, local energy systems by 2025.

- Green Transport Programme – Transport is responsible for 22 per cent of London's emissions. The plan sets out how annual transport emissions can be cut by 4.3 million tonnes. CO_2 emissions from road transport would fall by as much as 30 per cent if people simply bought the most fuel-efficient version of the car they want.

This means stabilising London's emissions in 2025 at 60 per cent below 1990 level. Without action, London's annual carbon emissions would instead grow from 44 million tonnes to 52 million tonnes by 2025. This means that by 2025 London must produce 33 million tonnes less of CO_2 than its current levels – an annual emissions reduction of four per cent a year. 20 million tonnes of this reduction can be achieved through the actions set out in this Plan. A further 13 million tons requires additional national and international action. The Action Plan sets out that the problem is not that new technologies are required but that the government needs to introduce comprehensive carbon pricing to encourage the faster take-up of existing energy efficiency measures.

3. Delivering the Elements of a Low-Carbon Society

Transport

Dr. Yuichi Moriguchi

Director

Research Centre for Material Cycles and Waste Management

National Institute for Environmental Studies (NIES)

Japan

A) Facts and trends in Japanese transport

Transport contributes about a quarter of Japan's CO_2 emissions; of this 90% is from motor vehicles. Underlying drivers such as increasing passenger car size and growing traffic volumes (both passenger cars and freight) tend to push emissions higher.

B) Overview of transport sub-project in Low-Carbon Societies 2050

Environmentally Sustainable Transport (EST) scenarios are developed which achieve CO_2 reduction targets in 2020 and 2050 by the combination of a technological innovation and a demand change. The 2020 EST scenario is forecasted depending on technological innovation, for there seems to be little feasibility of the demand change in the near future. The lead-time for changes in both the producing capacity and the purchase behavior is taken into consideration. The 2050 EST scenario is developed with back-casting approach. The gap between the emission of business-as-usual case and EST target is the amount of reduction required by demand management.

Scenarios were produced to see the effect on CO_2 emissions. Even the extreme scenario of high, rapid penetration of hybrid vehicles does not sufficiently reduce CO_2 emissions – implying that demand management is also needed on top of technological innovation.

Using a Kaya-type identity showing the combination of countermeasures (fuel economy, low-carbon energy, load factor; modal shift, accessibility; demand management) we can show that by improving each driver by 20% we can reduce emissions by 70%.

C) Assessment of transport technology

Information of automotive technical information is put into a database and the well-to-wheel CO_2 emissions can be assessed. There are significant differences depending on the choice of fuel supply power-train – for example although CO_2 emissions from fuel-cell electric vehicle (FCEV) are less than hybrid vehicle (HV), FCEV has problems to be solved such as fuel cell durability, FCEV cost and the way to produce and supply hydrogen. Therefore, widespread use of HV's is thought to be one of the feasible and effective measures in 2020.

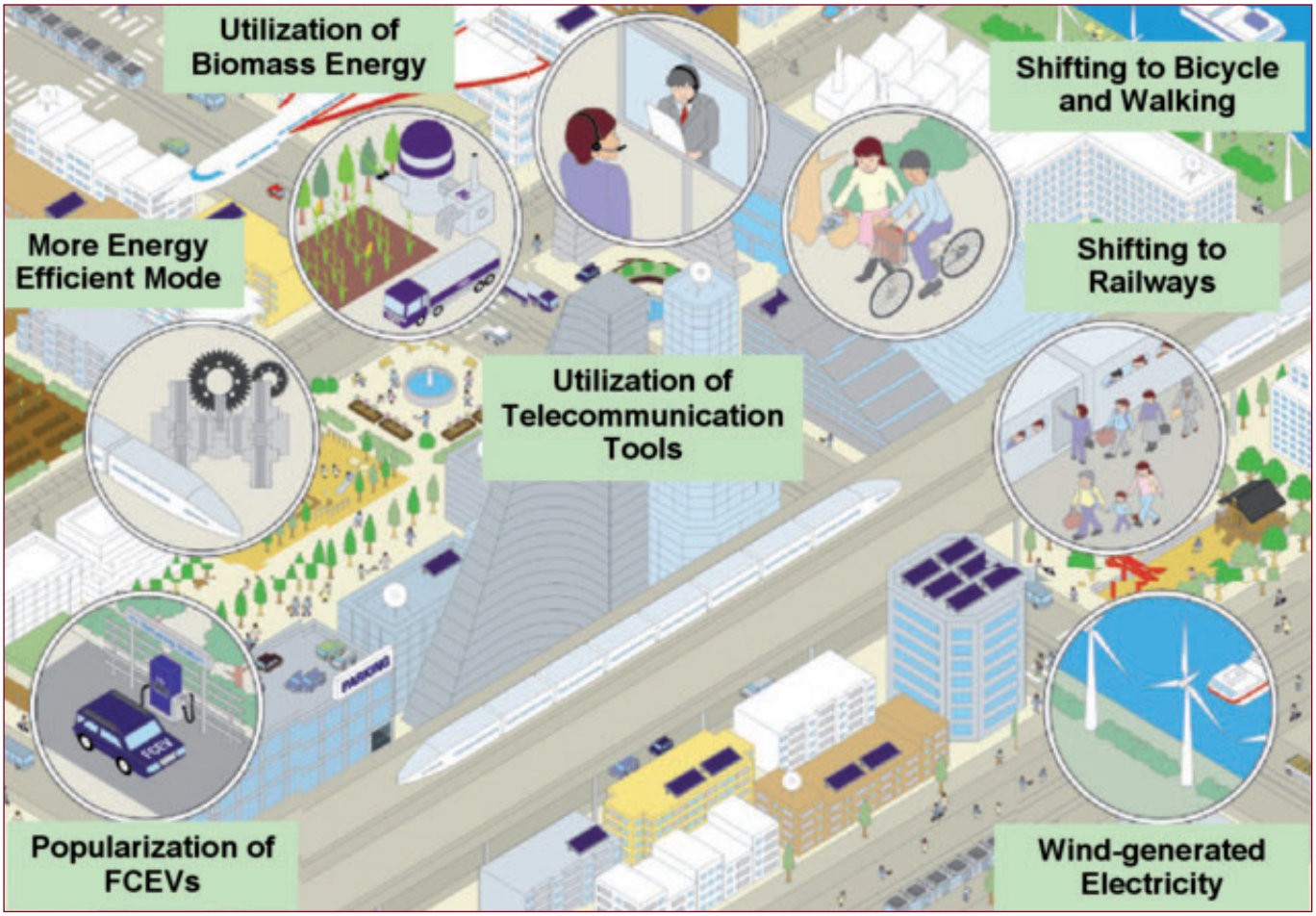
D) Spatial, demographic, and behavioural aspects

Current demographics and future population share are important factors as there is a difference between rural and urban areas in modes of transport. High population density is needed for competitive public transport and if the population density is not large enough there may be no benefit on life-cycle CO_2 comparing public transport with private vehicles (including required infrastructure).

In competitive areas, then, privatisation is successful, less so in rural areas. If load factor is small then public transport is not efficient in CO_2 emissions (compared to high efficiency vehicles).

E) Transport vision towards 2050

A combination of various countermeasures are needed up to 2050, including technological innovation and changes in mobility.



There are many uncertainties looking to 2050, including demographics of an ageing society; demand for high speed travel; preferences on vehicle-size; globalisation vs. regionalism; price of fossil fuels (especially oil); the way to produce and supply hydrogen; and the investment balance between road and public transport.

There are opportunities for the transport sector to contribute to the low-carbon society. For 2020 an increase in the penetration of hybrid electric vehicles and for 2050 a combination of countermeasures. Some examples of best practice might be increasing numbers of hybrid and fuel-efficient vehicles on the market and increasing support for public transport. Transport policy should have linkages with other policy goals such as accessibility for transportation in the rural areas.

Buildings

Professor Robert Lowe

Bartlett School of Graduate Studies

University College London

Professor Tadj Oreszczyn

Bartlett School of Graduate Studies

University College London

Buildings account for up to half of all carbon emissions in Annex I countries, and are an expanding sector, as half of the global population are now urbanised. Buildings are widely seen as a key short-to-medium term opportunity to save energy and carbon.

The good news is that technologies exist to deliver factor ≈10 buildings with very high quality environments. These technologies have been deployed effectively in a small number of buildings worldwide and can be applied both to new and existing buildings.

The bad news is that, unless employed with the greatest care, these technologies do not work well. The design performance is only achieved when all systems in the building work right. A well-performing building is a complex low-entropy system and almost all unintended interventions in low-entropy systems degrade their performance.

The largest field trial of low-energy housing in the UK, the Stamford Brook development, proved to have thermal envelope defects. A convective bypass associated with the party wall cavity appears to exceed all other heat loss mechanisms and means that terraced and semi detached houses performed worse than equivalent detached houses. This problem is solvable, but until it was investigated in detail, awareness of the problem was limited to a handful of researchers. In a similar vein, infra-red images of external walls demonstrate that the design U value (around 0.2 W/m^2K) was exceeded over much of the external area. This problem appears rather more difficult to solve without significant changes to existing construction methods.

Carbon dioxide emissions from buildings will not reduce without widespread and continuous measurement and analysis of building performance, much better feedback throughout the design-construction-operation chain and performance feedback for policy makers. Feedback is powerful – it is possible to see progressive reduction in primary energy use in a building that has high levels of feedback – so energy consumption can be decreased.

There is a large global demand for high quality buildings and a latent demand for comfort, space and services (I.T. etc.). Better performance, more wealth and falling energy price enables the realisation of this demand. It has been shown that although there has been a decrease in dwelling heat loss, energy consumption has increased. From 1970 to 2001, there was a 4-fold reduction in carbon intensity of space heating, which was largely offset by a 5-fold increase in affordability of comfort.

The increase in affordability is reflected in trends in UK conservatory use 1991 to 2004. Similarly, limited studies of better insulated houses in Japan show that they have higher energy use than conventional houses. A decades-long trend to increased affordability of domestic air conditioning in Japan, which mirrors the increase in affordability of space heating in the UK, has led to large increases in the ownership and use of domestic room air conditioners in Japan.

Take-back probably declines with increased levels of insulation and increased internal temperatures. This suggests that energy efficiency reduces asymptotic emissions but speeds the process of saturation and large interventions are, therefore, needed to achieve absolute reductions in demand.

In conclusion

We have been too successful at selling buildings to policy makers as a quick, easy win. We need to get across the idea of slow, difficult, but necessary, wins and we need concrete action to achieve them. For this action to take place it is necessary to:

- build human capital. Construction and operation of buildings are deeply embedded activities. Skills and knowledge throughout the workforce are essential to their success, even more so in periods of rapid change;
- build knowledge. Evidence is required for designers, builders, owners and operators, as well as for policy makers;
- build institutions and systems. Building control systems, systems for measuring and reporting performance, building, monitoring and reporting exemplars as well as building educational systems;
- build the supply chain. Construction is a collective activity and to make it possible to build the best buildings, other people need to be able to supply the best components and systems. State of the art technology has to be easily and universally available;
- build the context. Building energy efficiency will only deliver carbon reductions if: technological improvements go hand in hand with fiscal measures to prevent most of the benefit being taken as comfort and to redirect the effort being put now into developing the goods and systems and services that will support the consumption patterns of the mid 21st century.

Behavioural Change

Professor Tim Jackson

RESOLVE

University of Surrey

UK

Embedded Carbon and Lifestyle

In all lifestyles exists an unavoidable carbon footprint. From the food we eat to the homes we live in, the carbon from actions we undertake plays a role in global climate change. Addressing the embedded carbon in our lifestyles, alongside conventional emissions, could assist in reducing global GHG emissions significantly. This is dependent upon realising the potential for societal change in the use and development of cleaner products and services.

Behavioural change does imply some level of burden upon individuals to recognise and then act upon their individual carbon footprint. Creating the conditions in which individuals can make the transition to a low-carbon lifestyle is vital.

In order to stimulate behavioural change, a more comprehensive suite of options for the consumer is required. By limiting the choices people have for cleaner consumption, we are creating barriers to more sustainable ways of living. Equally, there is a limit to which consumers are willing to make any transition in the absence of programmes and measures that deliver positive incentives.

Technology Innovation and Behaviour Change

The interaction between technology innovation and consumer demand plays an important role in creating the conditions that instigate behavioural change. Technology innovation is largely dependent on the demand for new goods and services from consumers, whereas behavioural change requires technology innovation. Both technology innovation and behavioural change require a degree of institutional change. Encouraging the development of greener products and services is an important step in delivering sustainable options to consumers.

Equally important is supporting consumers to make the transition to a low-carbon lifestyle. Education is a key means to enabling individuals to take advantage of emerging low-carbon products and services. Energy efficiency and performance labelling can be a powerful tool in raising the awareness in consumers on the impact of their individual carbon footprint and of the co-benefits that exist in a low-carbon lifestyle.

How can we Instigate Behaviour Change to Low-Carbon Lifestyles?

Governments have a key role in developing the frameworks and policies under which low-carbon lifestyles are promoted. Polices should enable the transition to a low-carbon lifestyle by:

- removing existing barriers that inhibit behavioural change to sustainable lifestyles;
- providing viable alternatives to existing lifestyle choices;
- providing information to consumers on the products and services they use; and
- delivering the necessary facilities and institutions

Policy-making should also take into account the need to provide business with the certainty in which green markets can be encouraged. Creating a long-term vision of future green markets can do much to stimulate the development of cleaner products and services and, thereby, broaden the range of options available to consumers.

A greater focus on the engagement of communities in creating a wider range of sustainable living options is also required. Community action can do much to instigate local societal change, whilst providing models which can form the basis for action in other locations. Dissemination of information on low-carbon options for sustainable living should also be supported, especially in the media and community networks.

Involving sectors and frontrunners in the transition to a low-carbon economy

Frans Vollenbroek

Interdepartmental Programme Energy Transition (IPE)

Dutch Ministry for the Environment

The Netherlands

Transition to a low-carbon economy requires radical innovations. This includes development of leapfrog technologies, institutional changes and substantial investments in new infrastructures. Our experience is that a top-down approach does not work in this process, since incumbents tend to resist. Therefore, the government of the Netherlands developed an alternative way of working with stakeholders, which is called *the transition approach*.

The transition approach is characterised by a deliberate strive to reach a certain goal, in our case: a low-carbon economy.

The first step

in the approach is to invite stakeholders – businesses, NGO's and academia – to develop long-term perspectives. These may be different for each stakeholder since they have different interests: businesses may see competitive edges; NGO's may recognise that the goals fit into their mission; and academia may look forward to the fact that their knowledge may be used.

The second step

is to explore the paths which may be used – or could be paved – to get closer to the goal. In practice this has been done through a number of Platforms, i.e. 1) Green Raw Materials, 2) Sustainable Mobility, 3) Chain Efficiency, 4) New Gas and Clean Fossil Fuels, 5) Sustainable Electricity and 6) Built Environment. These Platforms consist of all stakeholders mentioned above and are established by the government. In order to steer the process, an inter-ministerial group was set up consisting of six Ministries. The results of the work of the Platforms are portfolios of transition paths. These are described in the transition action plan (May 2005). In the future, new paths may be added and others may disappear, depending on the results and what we have learned.

The role of the government is to support the transition paths by funding R&D and to deploy instruments that create incentives for innovation. That may be (temporary) subsidies, co-financing of pilots, tax credit, etc. But it is not just about money: the transition approach is also about mutual trust, creating room for experiments, co-operation between different academic disciplines and businesses. This makes the transition approach a bottom-up process, demand driven and flexible. Last but not least, it is about rewarding frontrunners. Frontrunners are often very motivated to explore new solutions and bring these to the market. By doing so, they challenge the incumbents to participate in the process. However, frontrunners are often confronted with barriers: regulatory, financial, lack of network, etc. Therefore, a frontrunners desk has been established. This desk serves as a one-stop shop where frontrunners can ask for help.

Delivering the Elements of a Low-Carbon Society

The first results are promising: the transition approach has created a lot of dynamics and a great number of projects have been started, one example being the climate neutral greenhouse. Another result is the support from the sectors to the ambitious goals of the new government, among which 30% CO_2 reduction and 20% renewable energy in 2020. This means that the perception that the transition to a low-carbon economy is a threat to their business is replaced by confidence in the power of innovation.

For more information, see: http://www.senternovem.nl/EnergyTransition/

Catalysing a shift in the development pattern: a programmatic approach

Jose Alberto Garibaldi

Energeia and Department for Environment

Food and Rural Affairs

UK

The world will be spending around 20 trillion US$ between 2005 and 2030 on energy infrastructure, with developing countries making up barely more than half of this spending; and China alone constituting almost a third from developing countries. Over the past decades, public and private energy technology R&D investment has been decreasing, due to energy sector characteristics, poor clear long term signals, and an inappropriate regulatory environment. Carbon pricing and international technology cooperation will both be needed if such a change is to include developing countries (DCs). However, there will also need to be a shift in how the DC's approach the low-carbon technology discussion, if they are to stop losing opportunities.

Currently, the Clean Development Mechanism (CDM) has been a key incentive for the shift in developing countries' interest towards low carbon development. In its more conventional form, it is unlikely, however, it will reach the scale and scope needed to make a global investment difference, considering the portfolio of technologies required. Certified Emissions Reduction (CER) returns provide responses tailored to CDM characteristics and country implementation capacities, while high investment and transaction costs preclude development of other substantive technology niches. Thus, only projects with high GHG content (including methane and waste) and/or rather short term payoffs (including tried and tested technologies rather than pre-commercial ones) are likely to enter the market with CER support. As a consequence, climate friendly technologies enter in the margins, rather than as mainstream; policy and CDM constraints force dual development patterns, where renewable and cleaner technologies are introduced side by side with old inefficient plants,while existing instruments fail to build upon local co-benefits.

Long term policy challenges show the limits of such an approach. In Latin America for instance, glacial shifts will affect the Andean countries current generation reliance on hydropower, forcing them to expand their planning horizon beyond their current ten years, or risk drastic generation losses in a very short time. The southern cone will need to examine if it will expand with wind in the southern Andean passes or with unreliable Bolivian gas; or the large cities from Mexico and Sao Paulo to Lima and Bogotá, decide whether they invest in low carbon technologies and planning or continue a, so far, unsustainable expansion.

Emerging economies might find they benefit from the current common but differentiated responsibilities principle if they shift emphasis from marginal instruments to expanded internal political and policy leadership. Such an approach can create conditions for expanded use of large scale programme-based approaches to the CDM and increased carbon market revenue while addressing domestic energy long term challenges. This will require new market players adapting to changing conditions: from innovative international policy loans by IFIs, blended with flexible domestic instruments and finance (including secondary guarantees, programme-based carbon revenue collateral, venture capital and/or structured carbon finance); to the development of low carbon methodologies as common pool regional resources and sub-national and city based expand to address currently untapped opportunity. Regional financial and policy advisory organisations will be crucial to catalyse change. Last, but not least, these can respond to a common interest from developing and developed countries in sustaining the carbon markets, and create conditions for DC's contributions to the atmosphere from the expanded scope of their gains.

Delivering the elements of a Low-Carbon Society - Summary

There are several elements important to delivering a low-carbon society – including engaging important sectors such as transport and the built environment, and understanding how human behaviour change can contribute. It is also important to learn from existing successful examples, such as the transition approach from the Netherlands, and also to understand how finance and investment can help to shift development pathways.

The transport sector contributes a large share of greenhouse gases; motor vehicles are a significant part of this sector, particularly in urban areas. The transport sector needs to be transformed to achieve a low-carbon society, an example of work in this area is Japan's Environmentally Sustainable Transport (EST) scenarios which involve a combination of technological innovation and demand change with targets for 2020 and 2050. Local circumstances are important and include factors such as fuel choices, demographics and the balance between public and private transport.

The built environment is another sector with a significant contribution to greenhouse gas emissions. GHG mitigation measures in this sector should be seen as important in both the short- and long-term. Technology already exists which can considerably increase the efficiency of buildings, however it needs to be employed correctly; and as the demand for comfort can counteract efforts to increase building efficiency, measures such as controls and fiscal incentives may also be needed.

Behavioural change is necessary to achieve low-carbon societies. To address and decrease the carbon embedded in our lifestyles implies action from individuals; conditions need to be created to offer better choices to individuals. While Governments will play a key role in developing frameworks and policies, focusing on businesses and communities will also be crucial to realise behavioural change. The interaction between technological innovation and behavioural change implies that institutional change is required.

To help achieve the transition to a low-carbon society lessons should be learned from existing frontrunners. The transition approach used in the Netherlands is an example of this, comprising of a bottom-up approach engaging stakeholders (businesses, NGOs and academia) to develop long-term perspectives. The second step explores the paths which may be used to get closer to the goal. The role of the government is to support the transition paths in a number of ways, including rewarding the frontrunners.

It is important that countries recognise the co-benefits that exist in implementing national policies and programmes. Development can deliver necessary global GHG emissions reductions whilst remaining cost effective and can aid the need to secure access to energy as a development priority. As the current principle of the UNFCCC of common, but differentiated, responsibilities plus the flexible mechanisms in practise rewards pro-active action, it will pay for developing countries to put in place wide ranging low-carbon and climate resilient policies and measures, to take advantage of the increase carbon revenue and resilience that this might bring.

4. Outcome of Breakout Sessions – Prioritising Policy Measures

Breakout Group Session on Policy Measures for Achieving Low-Carbon Societies

During the breakout sessions, participants were asked to brainstorm for policy measures and actions that could help achieve a low-carbon society. The measures were then sorted according to six different sectors: Built Environment; Transport; Agriculture and Forestry; Lifestyle; Services and Retail; and Energy (Power Generation). Participants were then split into syndicate groups, each representing one of the six sectors.

The ideas that had been generated from the brainstorm were clustered into themes, then each theme was restated as a hypothesis or Policy Proposal. The group then prioritised the Policy Proposals based on the criteria of feasibility and impact.

Each syndicate group then split into four teams of 2-3 people to explore the rationale for the Policy Proposal in detail and develop lines of argument. The teams were asked to consider the following questions:

1. Why is this important to achieve a low-carbon society?
2. Why will this not just happen naturally?
3. Why should government intervene?
4. What could, or should, government do to help?
5. What evidence exists, or is needed, to support this argument?

The discussions of each proposal were then summarised into posters which were displayed and assessed by other participants, with one of the poster authors available to answer questions. Comments were captured on the posters and participants were then asked to vote for which policy proposals they thought were most likely to make a feasible and significant impact.

From this exercise, participants identified six areas of policy that should be viewed as priority areas for development in order to move towards low-carbon societies:

- Develop frameworks that create financial incentives for enhancing the deployment of Carbon Capture and Storage, in particular international regulatory mechanisms to enable demonstration projects such as cap and trade systems and a global carbon market.
- A comprehensive programmatic approach to global forestry and soil carbon stocks, taking into account a long-term carbon price to provide incentives for sustainable land use management.
- Establish a fiscal framework that discourages low sustainability developments and helps to prevent the degradation of rural land.
- An approach to transport policies that promote more sustainable mobility through carbon pricing in the transport sector in all areas such as; infrastructure, personal vehicle use and public transport.
- Create long-term regulatory measures that provide incentives for the design, construction and use of more energy efficient homes whilst addressing the need for enhanced RD&D in the built environment.
- Develop schemes, such as carbon labelling, which raise people's awareness of the impacts that their consumption choices have on their carbon footprint. Personal carbon allowances could play a role in raising awareness and promoting action, but the operation of any scheme needs to be assessed carefully.

5. The Future of the Japan-UK Collaboration on Low-Carbon Societies

The Future of the Japan-UK Collaboration on Low-Carbon Societies

Naoya Tsukamoto

naoya_tsukamoto@env.go.jp

Director of Research and Information on Global Environment

Ministry of the Environment

Japan

The third Japan-UK workshop "Roadmap to Low-carbon World" will be held in Tokyo from 13 to 15 February, 2008. The main stream that flows behind the joint research project is the dialogue on climate change started from Gleneagles G8 Summit, through Heiligendam, and to Tokyo. As a major scientific forum, the third WS is expected to answer two questions.

- Where 50% reduction potentials exist?
- What is the relation with Sustainable Development?

The idea of low-carbon societies are now very popular among people who, no matter what his/her profession or personal interests are, look into the opportunity and quality of life of the future generations. On the contrary, as many nations belonging to Annex I group under UNFCCC are struggling to achieve around 5% GHG reduction, the majority of the citizens might not believe that here exists serious scientists who are working hard on more than 50% reduction by 2050. Proliferation of the idea of low-carbon societies in the society has just started but needs more efforts. Stakeholders of the society, such as parliament members, business persons at each sector, citizens and NGOs, have started to ask practical questions on low-carbon societies.

The Future of the Japan-UK Collaboration on Low-Carbon Societies

So, the strategic objectives of the third WS are set as indicated in the above slide.

The third workshop is expected to demonstrate the various existing country visions to low-carbon societies by a compilation of country low-carbon society scenarios; help dialogue among wider stakeholders; share experience of real changes that have happened; and to demonstrate best practices. It is also expected to discuss sustainable low-carbon development. The third workshop will focus both scientific development of low-carbon society study, i.e. methodologies for creating visions, roadmaps, and concrete actions by stakeholders and will stimulate communication among stakeholders.

Appendices

Appendix i

PRESS RELEASE on 13th June 2007

UK and Japan – working towards a low-carbon society

Environment Minister Ian Pearson today highlighted the importance of reducing greenhouse gas emissions at the start of a three day workshop on moving to a low-carbon society.

The workshop, *Achieving a Sustainable Low-Carbon Society*, is a collaboration between the Department for Environment, Food and Rural Affairs (Defra) and The Ministry of Environment Japan (MoEJ) to help establish the practical steps necessary to make low-carbon societies a reality.

It has three main objectives:

- To demonstrate and raise awareness of the benefits of moving to a low-carbon society through sustainable development;
- To develop recommendations on how to close the gap between the business-as-usual and low-carbon society scenarios;
- To develop the framework for a map of low-carbon society activities.

Ian Pearson said:

> "To achieve real global change, developed economies need to show leadership at home – particularly in supporting the move to a low-carbon society.
>
> "Japan is one of our key partners in paving the way towards a low-carbon society and our two Prime Ministers remain at the forefront of efforts to secure international agreement on a future framework. This close partnership is reflected at every level and UK-Japan collaboration on this vital issue is the strongest it has ever been.
>
> "The UK-Japan collaboration on low-carbon societies shows what we are able to achieve together and will provide the opportunity to take a decisive step forward in the battle to combat climate change."

Japanese Ambassador to the UK, Yoshiji Nogami said:

> "Tackling climate change is at the top of the agenda between Japan and the UK. This January, Prime Minister Abe and Prime Minister Blair issued the Japan-UK joint statement. In this statement, we identified climate change as one of four key issues for us to work on together. We also agreed to work together on joint research on science and technology for a low carbon Society as well. We see 2008 is very crucial from the viewpoint of formulating the post 2012 framework, and in that context, G8 summit in Japan next year is very challenging. I welcome the significant inputs and contribution from this joint project to that process in order to tackle climate change together."

Mr Pearson is speaking at the event along with Mr Nogami. Around 35 business leaders, 15 government officials, 30 leading academic experts and 10 representatives of international organisations are attending the conference which aims to build on the foundations set by the first workshop in Tokyo last year.

The results from the workshop will be used to inform discussion in fora such as the G8 Dialogue Ministerial meeting and the United Nations Framework Convention on Climate Change (UNFCCC).

Case studies of low-carbon cities including Dontang Eco-city (China) and Sseesamirembe Eco-city (Uganda) will be presented at the workshop. These cities mark the forefront of sustainable development and are important in ongoing research concerning low-carbon societies.

Waste and Resource Evidence Strategy 2007-2011

Notes to editors

1. The first Japan-UK *Low-Carbon Society* conference was held 14-16 June 2006 in Tokyo. An executive summary from this workshop can be accessed at:

http://www.defra.gov.uk/environment/climatechange/internat/pdf/low-carbon-societies.pdf

2. *Achieving a Sustainable Low-Carbon Society* comprises a one-day symposium and discussion to demonstrate and raise awareness of the necessity, feasibility and benefits of moving to a low-carbon society through sustainable development. This precedes a two-day workshop to demonstrate and raise awareness of the necessity, feasibility and benefits of moving to a low-carbon society through sustainable development.

End...

Public enquiries: 08459 335577

News releases available on our website:

www.defra.gov.uk

Defra's aim is sustainable development

Appendix ii

List of Invited Participants

Acquatella, Jean Jose	UN Economic Commission for Latin America and the Caribbean
Aghazadeh, Khoei Javad	Ministry of Foreign Affairs, Iran
Alonso, Ana	Shell International
Ambrose, Beth	The Climate Group
Anderson, Dennis	Imperial College
Axelsson, Hakan	Vattenfall AB
Bolitho, Andrew	Department for Environment, Food and Rural Affairs, UK
Bosteels, Tatiana	London Climate Change Agency
Botting, Duncan	ABB
Bradley, Robert	World Resources Institute
Bradley, Mark	Oxygen Marketing Ltd
Brutinel, Marina	E3G Third Generation Environmentalism
Carney, Sebastian	Tyndall Centre (Manchester University)
Chung, Rae Kwon	UN Economic and Social Commission in Asia and the Pacific
Cornelius, Stephen	Department for Environment, Food and Rural Affairs, UK
Cowan, Anitra	Australian High Commission
Dadhich, Pradeep Kumar	Tata Energy Research Institute (TERI), India
Deacon, Andy	Greater London Authority
Dhakal, Shobhakar	National Institute for Environmental Studies, Japan
Drummond, Hazel	Department for Environment, Food and Rural Affairs, UK
Dubeux, Carolina	Centro Clima/COPPE/UFRJ (Brazil)
Dummer, James	Solar Green Tourism
Edmonds, Jae	Joint Global Change Research Institute, USA
Evans, James Warren	The World Bank
Feierstein, Mitchell	Cheyne Capital Management (UK)
Foxon, Tim	University of Cambridge, UK
Fujino, Junichi	National Institue for Environmental Studies, Japan
Gaches, Joanna	Department for Environment Food and Rural Affairs, UK
Garibaldi, Jose	Department for Environment Food and Rural Affairs, UK
Grubb, Michael	Imperial College/Carbon Trust
Halsnaes, Kirsten	UNEP Risoe Centre
Jackson, Tim	University of Surrey, UK
Jiang, Kejun	Energy Research Institute, Canada
Jones, Aled	University of Cambridge, UK
Jones, Hugh	Carbon Trust, UK
Kainuma, Mikiko	National Institue for Environmental Studies, Japan
Klaassen, Ger	DG ENV, European Commission
Kojima, Toshiro	Ministry of the Environment Japan

Appendix ii

Kraines, Steven	University of Tokyo, Japan
Krantz, Randall	World Economic Forum
Laguna, Israel	National Institute of Ecology of Mexico
Lal, Murari	CESDAC, India
Larmouth, Sarah	Department for Environment, Food and Rural Affairs,UK
Lewis, Memoria	ML Consultants, UK
Lowe, Robert	University College London, UK
Mabey, Nick	E3G, Third Generation Environmentalism, UK
MacLeod, Jason	IBM
Marquard, Andrew	University of Cape Town, South Africa
Matsuoka, Yuzuru	Kyoto University, Japan
Mckenzie Hedger, Merylyn	European Environment Agency
Metz, Bert	IPCC Working Group III
Mongan, Edwin	BHP Billiton
Moriguchi, Yuichi	National Institute for Environmental Studies, Japan
Morrison, Tanya	Shell International
Mottershead, Chris	British Petroleum
Mukherjee, Sinjini	Department for Environment, Food and Rural Affairs, UK
Nagata, Yutaka	CRIEPI, Japan
Nakura, Yoshio	Ministry of the Environment of Japan
Narberhaus, Michael	WWF-UK
Nishio, Masahiro	National Institute of Advanced Industrial Science and Technology, Japan
Nishioka, Shuzo	National Institute for Environmental Studies, Japan
Nunumisa, Beenunula Eyenunula	Sseesamireembe Eco-City, Uganda
Oreszczyn, Tadj	University College London, UK
Pfeifer, Stephanie	Institutional Investors Group on Climate Change
Ri, Karin	Hermes Pensions Management
Rose, Steven	U.S. Environmental Protection Agency
Russ, Peter	Joint Research Centre, European Commission
Saha, Tonima	Department for Environment, Food and Rural Affairs, UK
Saito, Masahiko	Embassy of Japan, UK
Sakai, Daisuke	Embassy of Japan, UK
Sakamoto, Toshi	Department of Trade and Industry (DTI), UK
Sakurai, Yasuyoshi	Royal Institute of International Affairs, UK
Sato, Misato	University of Cambridge, UK
Sato, Akiko	Climate Strategies, Imperial College
Schulz, Niels	Imperial College, UK
Senior, Bill	British Petroleum

Appendix ii

Shimada, Koji	Ritsumeikan University, Japan
Shrestha, Ram	Asian Institute of Technology
Shukla, Priyadarshi	Indian Institute of Management, India
Simpson, Paul	Carbon Disclosure Project
Skea, Jim	UK Energy Research Centre
Slater, Tom	Department for Environment, Food and Rural Affairs, UK
Smith, Graham	Toyota Motor Europe NV/SA
Smith, Rosie	Department for Environment, Food and Rural Affairs, UK
Stephenson, Michael	IBM
Strachan, Neil	Policy Studies Institute, UK
Takaoka, Masato	Embassy of Japan, UK
Tang, Kenny	Oxbridge Climate Capital
Taylor, Gary	Climate Change & Business Centre, New Zealand
Tonooka, Yutaka	Imperial College Centre for Environmental Policy, UK
Totoki, Kenji	Embassy of Japan, UK
Tsukahara, Sachiko	Ministry of the Environment of Japan
Tsukamoto, Naoya	Ministry of the Environment of Japan
Verhagen, Patrick	Holcim Group Support Ltd
Vollenbroek, Frans	Ministry of Environment, Netherlands
Warrilow, David	Department for Environment, Food and Rural Affairs, UK
Watson, Jeremy	Arup
Watson, Jim	University of Sussex and Tyndall Centre, UK
Weiss, Martin	Federal Environmental Agency, Germany
Wheatley, Megan	UK Business Council for Sustainable Energy
Whitney, Graham	IBM
Wilhite, Harold	University of Oslo, Norway

Appendix iii

Achieving a Sustainable Low-Carbon Society

Symposium and Workshop, London 13-15 June 2007.

Executive Summary

Key Findings

The key findings from the second workshop of the Japan-UK Low-Carbon Society Collaboration were:

- Climate change represents a significant threat to humanity and the global environment. Urgent action is needed to reduce global greenhouse gas emissions significantly (by at least 50 per cent by 2050) and adapt to unavoidable impacts of climate change.
- A range of country studies has already demonstrated that it is both technically and economically feasible to achieve deep cuts in greenhouse gas emissions by 2050 – as much as 60-80 per cent in developed countries. The costs of transitioning to low-carbon societies are far less than costs associated with inaction.
- The scale of the problem is such that a wide range of stakeholders – from government; business; and civil society, both as individuals and organisations – need to be engaged in finding solutions. Creating visions of low-carbon societies can help to educate and motivate people and organisations
- International action will require bold and innovative measures. The workshop identified the need to:
  - Develop long-term policy signals for business through strengthening carbon pricing e.g. through taxation and enhanced international trading;
  - Enhance international RD&D in integrative and transformational technologies; and
  - Mobilise investment resources for low-carbon development in developing countries.
- Well designed low-carbon strategies are an important aspect of sustainable development that can deliver significant co-benefits in terms of the local environment, economic growth, access to energy and energy security.
- Changes in human behaviour and lifestyle are essential to achieving low-carbon societies. This requires policies and frameworks to provide consumers with the opportunity to make low-carbon, and to remove carbon-intensive, choices.
- Existing technologies and those close to commercialisation can make a major contribution to carbon emission reductions. Emerging technologies must also contribute significantly in the medium to long term. The interplay between technology and behaviour needs to be taken into account.
- A significant share of global greenhouse gas emissions is due to cities. Existing initiatives and projects at city-level around the world show that effective action can be and is being undertaken.

Appendix iii

Introduction

Achieving a Sustainable Low-Carbon Society was the second in the series of Low-Carbon Society workshops hosted and organised by The Ministry of the Environment of Japan (MoEJ) and the UK Department for Environment, Food and Rural Affairs (Defra), the UK Energy Research Centre (UKERC), the National Institute for Environmental Studies (NIES), and the Tyndall Centre for Climate Change Research. 63 experts from 20 countries and 15 international organisations contributed to the workshop; 20 business representatives also attended the symposium.

Global greenhouse gas emissions will need to peak within the next 10-15 years followed by reductions of at least 50 per cent by 2050 if we are to avoid dangerous climate change. Developed country emissions will need to be reduced significantly. As much as a 60-80 per cent reduction in emissions from developed countries by 2050 are feasible, both technically and economically. In addition, developing country emissions will need to follow a pathway that allows continued growth and development whilst making the transition to a low-carbon society.

Climate change is now recognised as an economic as well an environmental problem. The costs of strong and urgent action both in mitigation of and adaptation to climate change are vastly outweighed by the future costs of inaction. According to the Intergovernmental Panel on Climate Change (IPCC) expected macro-economic costs of moving to low-carbon societies are less than 0.12 percentage points reduction of annual global GDP growth.

Any delay in *mitigation* (i.e. interventions that reduce the sources or enhance the sinks of greenhouse gases) causes significant cost increases. Stabilising at a level below 450 parts per million (ppm) of carbon dioxide equivalent (CO_2e) would require global emissions to peak in the next 10 to 15 years. A 10 year delay almost doubles the annual rate of the required reduction.

Equally, even with strong international action to tackle climate change some level of *adaptation* will need to be a key part of any future development strategy. Policies will need to take into account the potential for future costs associated with damages from emissions of greenhouse gases, whilst supporting technology development and combating deforestation.

Workshop outputs

Policy recommendations

Participants identified six key areas of policy that should be viewed as priority areas for development in order to move towards low-carbon societies:

- Develop frameworks that create financial incentives for enhancing the deployment of Carbon Capture and Storage, in particular international regulatory mechanisms to enable demonstration projects such as cap and trade systems and a global carbon market.
- A comprehensive programmatic approach to global forestry and soil carbon stocks, taking into account a long-term carbon price to provide incentives for sustainable land use management
- Establish a fiscal framework that discourages low sustainability developments and helps to prevent the degradation of rural land.
- An approach to transport policies that promote more sustainable mobility through carbon pricing in the transport sector in all areas such as; infrastructure, personal vehicle use and public transport
- Create long-term regulatory measures that provide incentives for the design, construction and use of more energy efficient homes whilst addressing the need for enhanced RD&D in the built environment.
- Develop schemes, such as carbon labelling, which raise people's awareness of the impacts that their consumption choices have on their carbon footprint. Personal carbon allowances could play a role in raising awareness and promoting action, but the operation of any scheme needs to be assessed carefully.

Appendix iii

Further work and research

We found that there are research activities focused on country-level and city-level actions to evaluate the feasibility of low-carbon society scenarios, and that a new modelling comparison framework has been developed. Further research is needed – among the ideas discussed at the workshop were:

- To develop a low-carbon society road map to clarify role of policy options and timing in a physical, financial, and economical manner,
- To investigate the harmonisation of policies (emissions trading, common technology standards) to enhance development of low-carbon societies, and;
- To further identify the existing networks of stakeholders working on low-carbon society activities, such as governments (both national and sub-national level), business and research communities, NGOs and civil society.

Next steps

A third low-carbon society workshop will be held 13-15 February 2008 in Japan with the aim of demonstrating feasibility of low-carbon societies through establishing methodologies for creating visions and drawing roadmaps, and raising awareness. The third workshop will focus on scientific achievement of the low-carbon society study, explore integration of low-carbon societies and sustainable development, and mobilise wider dialogue among stakeholders. It was proposed and accepted by the participants that a compilation of visions of low-carbon societies by various countries will be prepared for the third workshop. Work on developing the policy recommendations and mapping of low-carbon society activities will continue with the aim of delivery at the G8 summit in Japan mid-2008.

International Steering Committee
London, United Kingdom
June, 2007

Notes

International Steering Committee

Co-chairs:
Shuzo Nishioka (NIES, Japan)
Jim Skea (UKERC, UK)

International Steering Committee
Andrew Bolitho (Defra, UK)
Stephen Cornelius (Defra, UK)
Junichi Fujino (NIES, Japan)
Jose Alberto Garibaldi (Energeia, Mexico)
Kejun Jiang (Energy Research Institute, China)
Mikiko Kainuma (NIES, Japan)
Sarah Keay-Bright (UKERC, UK)
Jonathan Pershing (World Resource Institute, USA)
P.R. Shukla (Indian Institute of Management, India)
Naoya Tsukamoto (MoEJ, Japan)
David Warrilow (Defra, UK)
Jeremy Watson (ARUP, UK)
Jim Watson (SPRU and Tyndall Centre for Climate Change Research, UK)
Martin Weiss (Federal Environmental Agency, Germany)

The UK Department for Environment, Food and Rural Affairs (Defra) and the Ministry of the Environment of Japan (MoEJ) are working together on the joint research project "Low-Carbon Society Scenarios Towards 2050". The focus for the development of the joint research project between the UK and Japan was on deepening our understanding of the need to reduce greenhouse gases to achieve low-carbon societies and using the scientific evidence base delivered through the submission of country level emission scenarios. Further specific objectives were set for the UK-Japan collaboration to explore:

- Identifying and understanding the necessity for deep cuts in greenhouse gas (GHG) emissions toward 2050
- Reviewing country-level GHG emissions scenario studies in developed and developing countries
- Formulating win-win strategies to align sustainable development and climate objectives
- Studying methodologies to achieve low-carbon societies – visions; pathways modelling the future society; technological, institutional, behavioural and financial mechanisms
- Identifying gaps between goals and the current reality
- Sharing best practices and information
- Identifying opportunities for cooperation

The full report can be found at http://www.ukerc.ac.uk/

Contact person: Stephen Cornelius (Defra), steve.cornelius@defra.gsi.gov.uk
Zone 3F, Ergon House, 17 Smith Square, London SW1P 3JR

Nobel House
17 Smith Square
London SW1P 3JR

www.defra.gov.uk

PB12826 November 2007

defra
Department for Environment
Food and Rural Affairs