


10th  EU Hitachi
Science & Technology Forum
2007

**Energy, Environment &
Sustainable Society:**
Its impact on European citizens
11-13 May 2007, Paris

SUMMARY REPORT

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F O R E W A R D



It is a great pleasure to present the summary of the proceedings of the 10th EU Hitachi Science & Technology Forum on "Energy, Environment and Sustainable Society: Impact on European Citizens", which was held in Paris with about 150 participants from European countries, the USA and Japan, just suitable for celebrating 10th anniversary.

The main objective of the EU Hitachi Science & Technology Forum is to contribute to the public policy debate in Europe by providing a platform for discussing societal issues related to science and technology in the daily life of European citizens.

This year's Forum theme on "Energy, Environment and Sustainable Society: Impact on European Citizens" was very topical. Over the past year, the issue of global warming and more particularly the impact that energy production and consumption has on the environment, has been in the forefront of the global political agenda.

For example, environmental issues were at the top of the agenda during G8 meeting in July 2006, also there have been three scientific and expert meetings organized by IPCC in recent months to announce the results of their assessment reports, and in addition there have been several European Council meetings and summits at which environmental issues and energy efficiency have received top billing. All these recent developments once again highlight the timeliness of this year's Forum topic.

We had three sessions to discuss the issues of energy production, energy consumption and transportation in relation to the environmental problems. The Forum format was further improved by introducing three group sessions for the each session enabling various discussions from policy-making, NGO and user perspectives.

I would like to thank to all speakers, moderators, Forum members and all other participants for their contribution to the Forum. Especially, I would like to address a special thanks to the Forum general moderator, Dr. Jean Freymond, who conducted again this annual meeting in a very professional way.

A handwritten signature in black ink that reads "Junzo Kawakami". The signature is written in a cursive, flowing style.

Dr. Junzo Kawakami
Executive Vice President and Executive Officer, Hitachi, Ltd.
Hitachi Group Chief Technology Officer

left to right:
 Dr. Shigeru AZUHATA, Dr. Pierre BEUZIT, Mr. Guy BLOCK,
 Prof. Ryoichi YAMAMOTO, Mr. Bill DUNCAN,
 Dr. Jean FREYMOND, Mr. Maurizio TOMASSINI,
 Mr. Helmut TSCHAFFON



What is the EU Hitachi Science and Technology Forum?

The EU Hitachi Science & Technology Forum is a platform dedicated to promoting dialogue between European citizens and decision-makers. It brings together professionals from a wide range of sectors and backgrounds to discuss societal issues related to science and technology in the daily life of European citizens. Since its launch in 1998, annual meetings have been held at locations across Europe on topics relevant to the European policy debate.

Participants are European business-people, engineers and scientists who have all participated in long-term internships at Hitachi laboratories or plants in Japan, together with representatives from Hitachi's businesses in Europe and invited guests and experts.

The Forum has two objectives. Firstly, it provides a platform to address and discuss societal issues related to science and technology in the daily life of European citizens. Secondly, it provides a yearly occasion for Forum members to network with friends and colleagues.

The topics and venues for the annual meetings have been:

- 1998 Juan-les-Pins:
R&D in SMEs, comparison between the EU and Japan
- 1999 Germany:
Information technology and its benefits to society
- 2000 Dublin:
Electronic commerce and its impact on society
- 2001 Brussels:
Life sciences and their impact on European society
- 2002 Budapest:
Water Issues and their impact on European society
- 2003 Antwerp:
Energy and its implications for European society
- 2004 Stockholm:
Transport and IT: impact on European society
- 2005 Athens:
Technology and its impact on the city of the future
- 2006 Warsaw:
ICT for safety, trust and security: its impact on European citizens

This tenth Forum, held at the Hotel Le Meridien Montparnasse in Paris from 11th-13th May, attracted over 150 delegates.

To allow Forum members greater involvement in the organisation of the event, a Working Group is created, appointed for one year. Thus, the Forum is run by its members, on topics selected by its members, for the benefit of its members. A newsletter, European Connexion, is also published as a link between Forum members and Hitachi, and as a tool to promote the Forum proceedings.

Since 2001, at the request of Forum members, the meetings have included a presentation on current Hitachi R&D developments. Hitachi executives from the EU and Japan have attended the Forums and answered questions related to Hitachi's activities.

The Forum relies on the support of experts who have a keen interest in European societal issues and contribute to its success through a strong personal commitment. These individuals comprise the Forum Fellowship (see backpage). The chairman of the Forum Fellows is Dr. Junzo Kawakami (Executive Vice President & Executive Officer, Hitachi Ltd.). Hitachi, with the active participation of Forum members is committed to contribute to European Society by helping to shape policies which will improve the daily life of their fellow European citizens. In this respect, the EU Hitachi Science & Technology Forum works to clearly bring the benefits of new technologies to all Europeans.

EXECUTIVE SUMMARY

The 10th EU Hitachi Science & Technology Forum brought together around 150 scientists, engineers, executives and policy-makers around the theme "Energy, Environment and Sustainable Society: its impact on European citizens". The Forum addressed policy approaches in combating climate change, focusing on options in relation to energy supply, energy consumption and sustainable transport.

The Forum heard that time is running out to put the world onto a sustainable path. All environmental, energy and social indicators are critical:

- Already over 6 billion, the global population is set to reach 8 billion by 2030 - equivalent to adding another four European Unions - and 9 billion by 2050.
- If left unchecked, global emissions of carbon dioxide will increase by 137% by 2050 pushing atmospheric concentrations to a level which scientists agree will have devastating effects for our planet.
- Biodiversity is under increasing stress. Species and habitats are disappearing at an alarming rate and over 70% of the world's fisheries are over-exploited.
- Natural resources are being depleted rapidly and if we were to continue our current lifestyle we would need 2-3 Earths to sustain it.

The way society addresses global warming and sustainability today will have profound effects on how citizens, in Europe and around the world, live in the next decades. Consensus among scientists is that we have at most a 10-15 year window in which to act to avoid catastrophic and irreversible climate change.

Viable solutions **are** within our grasp, but need to be implemented **now** if we are to avoid unacceptable costs and risks in the future. A good plan begun today will serve us better than a perfect plan begun tomorrow. The Forum called for immediate efforts to decarbonise electricity production through greater use of renewables, nuclear power and carbon capture & storage (CCS). It also called for a concerted effort on energy efficiency, which has the potential to deliver 15 gigatonnes of CO₂ reductions by 2050. This is equivalent to 60% of current global emissions and enough to reduce the need for new power generation capacity by one-third. Transport can benefit from biofuels, hybrid vehicles and fuel cells.

The Forum urged governments, businesses and citizens to work together to find future strategies for energy and

transport that are clean, clever and competitive. **There is no "silver bullet"** – no single technology, no single fuel, no single policy holds all the answers. We have to keep all our options open, making the most of existing technologies – including energy efficiency and optimisation – while seeking breakthroughs in promising areas such as CCS and zero emission vehicles.

Business has a key role to play in seeking out a more sustainable path, the Forum concluded. It must **step up investments in climate-friendly technologies**, and lead by example in their application and use. With new technologies and more liberal energy markets, for instance, many European offices and factories could generate much, or even all, of their energy requirements on-site and sell the surplus back to the grid. **Green purchasing networks** can help companies understand the financial and ecological value of green procurement. And **teleworking** can improve productivity and improve employees' motivation as well as help cut congestion. Business must lead, rather than follow, the policy debate, and work more closely with the public sector and consumers to increase awareness and acceptance of green solutions.

Governments should provide a **stable and consistent policy environment** for the development of low-carbon technologies, together with **long-term incentives** for their deployment and use. Regulation can help shape the market but over-regulation should be avoided at all costs. **Market mechanisms**, such as emission trading, road pricing and congestion charging, will be key, internalising costs so as to provide a level playing for innovative technologies and business models. **Awareness campaigns and consumer information** – such as a transparent system of energy labelling – should also be addressed. Governments must lead by example in their purchasing and investment decisions and their own use of energy.

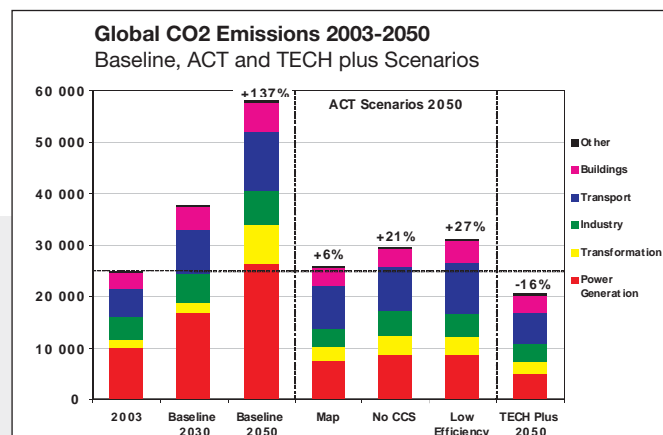
The scale of the challenge is unprecedented. While technology holds part of the solution, we must work first and foremost to **change people's attitudes**. The current feeling of "What can I do about it?" needs to be replaced by one of "All efforts can help". **New institutions and modes of governance** are required which bring together business, governments, NGOs and others to focus attention and ensure the limited resources are used effectively. **Burden-sharing between developed and developing countries** is also a key issue. Here too, new international frameworks are required to make collaboration more effective.

INTRODUCTION

Around 150 participants attended the 10th EU Hitachi Science & Technology Forum held in Paris, France from 11th-13th May 2007. The theme for this year's Forum was "Energy, Environment and Sustainable Society: Its Impact on European Citizens". As usual, the gathering attracted a diverse range of scientists, engineers, executives and policy-makers.

Dr. Jean Freymond, Director of the Centre for Applied Studies in International Negotiations (CASIN), Geneva, served as Forum General Moderator, drawing linkages between the presentations and encouraging participants to engage in a constructive analysis of the issues. In his opening remarks, Dr. Freymond welcomed Forum members and contributors to Paris for the 10th annual meeting, a notable landmark for the Hitachi Science & Technology Forum. True to its motto, Hitachi never ceased to be a great inspirer, Dr. Freymond said. He expressed gratitude to Hitachi for what it had achieved through the Forum so far. Particular thanks were due to Dr. Michiharu Nakamura, Executive Vice President of Hitachi, for his support for the Forum over the last ten years. The subject of this year's topic – sustainability and climate change – had increased significantly during the planning period: there could be no better time to discuss such a topic.

Dr. Junzo Kawakami, Executive Vice President & Executive Officer, Hitachi, Ltd., welcomed participants to Paris. Dr. Kawakami is the Chief Technology Office, responsible for business integration in the Hitachi Group, and has taken over Dr. Nakamura's role as Chair of the Forum Fellows. Global warming is now at the forefront of the political agenda, Dr. Kawakami noted. Discussions in the G8, the EU, and the Intergovernmental Panel on Climate Change (IPCC) have ensured energy efficiency receives top billing. Thus, this year's Forum was especially timely. The Forum is a platform where representatives from NGOs, academia, industry and government can discuss openly, Dr. Kawakami noted, and Hitachi was very proud of its achievements. He welcomed the guest speakers, moderators and participants and hoped that they would all have a constructive Forum.



Source: International Energy Agency - Energy Technology Perspectives 2006

KEY NOTE SPEECHES

Global Perspectives: Scenarios and Strategies to 2050

Mr. Neil Hirst, Director, Energy Technology and R&D Office, International Energy Agency

Mr. Hirst said that he was delighted to have the opportunity to address the Forum on this important issue. Society's approach to global warming and sustainability will have a profound effect on the way energy is produced and consumed in coming decades. Mr. Hirst presented the IEA's vision of how technology can transform the future of the energy economy. The analysis was originally prepared at the request of the G8 Heads of State for their meeting at Gleneagles in 2005.

The analysis was based on a series of scenarios: one which assumed "business as usual"; a second, ACT, which assumed accelerated use of technology (primarily through proactive action by governments); and a third, "TECH Plus", which assumed greater technical breakthroughs. Only technologies which when fully commercialised could reduce CO₂ at a cost of \$25/tonne or less by 2030 were considered. "The baseline, business-as-usual, case is very depressing", Mr. Hirst warned. Under this scenario, global CO₂ emissions would rise 137% by 2050, to almost 60 gigatonnes (Gt) per year. Developed countries would increase emissions by 70% and developing countries by 250%. Growth in electricity generation from coal was a large contributor to the latter.

Under the ACT scenario, emissions would increase just 6% above their 2003 levels, primarily as a result of 'decarbonising' electricity production. This was achieved through a combination of greater use of renewables and nuclear power, and application of carbon capture and storage (CCS). OECD emissions were 32% below the 2003 level, while emissions in developing countries were 65% higher. Certain variations of ACT were less optimistic, however. No use of CCS would result in a 21% increase in emissions, and failure to deliver on energy efficiency could result in increases of 27%. TECH Plus, on the other hand, would result in net decrease in emissions of 16% compared to the 2003 baseline.

Energy efficiency is the absolute top priority, Mr. Hirst emphasised. Improved efficiency could save around 15 Gt¹ CO₂ by 2050, equivalent to 60% of current emissions. Efficiency improvements could halve the expected growth in electricity demand and reduce the need for generation capacity by one third. In a scenario with less progress in efficiency, CO₂ emissions increased more than 20%. Furthermore, slower progress in efficiency improvements increased the supply-side's investments and costs in reducing CO₂ emissions. At present, however, improvements are running at around 1% per annum, just half the rate required to meet the TECH Plus target.

¹ 1 gigatonne = 1,000 million tonnes (109)

CCS is crucial for continuing use of coal in a CO₂-constrained world. Without it coal-fired generation in 2050 would drop below today's level. There is an urgent need for more R&D and for full-scale CCS demonstration plants. Renewables have a big part to play; generation could quadruple by 2050. Nuclear could also gain a more important role in countries where it is acceptable. The problem area is transportation, where decarbonisation is much more difficult. Gains could be made through efficiency improvements, and technologies such as biofuels and hydrogen could have a big impact in the longer term.

"Current policies will not bring us on a path towards a sustainable energy future", Mr. Hirst concluded. A cleaner, clever and competitive energy future is possible, practical and affordable. Using technologies with an acceptable additional cost, it is possible to return global CO₂ emissions to today's level by 2050 and to halve the expected growth in both oil and electricity demand. But this requires urgent action to promote, develop and deploy a full mix of energy technologies. Collaboration between developed and developing countries will be essential and may require new international frameworks.

Safeguarding Nature in a Globalised World

Mrs. Kathryn Fuller, Chairman of the Board, Ford Foundation

Mrs. Fuller congratulated the Forum on reaching its 10th anniversary and for choosing such an important topic. Hers would be a non-technological talk, from the perspective of the conservation community and NGOs, and as an American. It was important to get a sense of what was at stake. "The Natural World is disappearing before our eyes", Mrs. Fuller maintained. From 6 billion now, the world population is expected to grow to 8 billion by 2030 and 9 billion by 2050 - too many and too many poor. Escalating population is leading to increasing pressures on all types of natural habitats. Species are disappearing a hundred times faster than before humans. Levels of CO₂ in the atmosphere are increasing, with adverse effects for forest, water and marine environments. Huge areas of forest are being lost, and with it habitat for large numbers of animal species, some of which are not yet known to science. The Amazon, in particular, is under increasing threat, with 14% already converted to farmland. In Brazil only 3% of the Amazon Basin is set aside in protected areas. Rainfall is falling and a tipping point could soon be reached which would lead to the forest drying out. In the northern hemisphere, rivers are under threat. Oceans are suffering from tourism and global warming. Beaches, coastal wetlands and seagrass beds are all suffering. An estimated 70% of fisheries are overexploited or under strain, and much of the catch is wasted through bycatch. Yet protection of marine areas is still a novel concept.

Increasing population, more consumption, globalisation: these factors are converging to stress the natural world. When the conservation movement, such as WWF, started in the early 1960s its main focus was on protecting endangered species and their habitats. Since then it has gone on to embrace a wider role, in capacity building and training. More recently it has extended further, working with communities in and alongside wildlife to encourage conservation approaches. Since the 1990s there has been increasing engagement with politicians, banks and the wider marketplace. For instance, WWF has worked with Unilever to setup the Marine Stewardship Council to certify a number of important fisheries, including Alaskan salmon. Often cause and effect is not what it seems. In Africa, for instance, WWF undertook to combat the rising trade in 'bush meat' in the Congo Basin. It appeared this trade was linked to rising demand in faraway towns. WWF improved protection in the national parks, but found that one of the main drivers was new roads opened up for logging. It then worked to certify the logging operations, but found that many of the poachers were displaced fishermen who had moved inland from the coast, and were not linked to logging at all. Hence, the fate of Atlantic fisheries can affect the welfare of chimps deep in the rainforest – the chain is truly complex! Business leaders have been working on global warming for many years, long before the publicity arising from recent reports. Results are impressive; for example the guidelines adopted by banks in relation to clean asset management. Nevertheless, much more remains to be done.

In the United States, too, states and cities are taking matters into their own hands, despite the lack of leadership at federal level. This can not go on, however. "The US has to get its own house in order if it is to deal with India and China", Mrs. Fuller maintained. There is increasing recognition of this in the Congress and the Bush Administration has now acknowledged climate change as a serious issue. Summing up, Mrs. Fuller said: "It can be hard to be optimistic but we have no choice. Individuals around the world have to make choices in their daily lives. **Society will be defined not only by what we create but by what we refuse to destroy.**"

Innovations for Sustainable Society

Mr. Yutaka Yoshimoto, General Manager, New Energy and Industrial Technology Development Organisation (NEDO)

NEDO is an affiliate institute of the Ministry of Economy, Trade and Industry (METI), dedicated to innovation. It was set up in 1980, in the wake of the last energy crisis, with a mission to encourage the development of new energy and energy efficiency technologies. Today it is Japan's largest R&D support organisation, with an annual budget of around €1.5 billion. Hitachi has been and remains one of its largest contributors.

In Japan, industrial energy efficiency has improved by around 30% over the last 30 years. This is a major achievement, and puts Japan number 1 in several sectors. NEDO has contributed to this, through the Moonlight Programme, which has been running since 1978. Another important initiative is the Sunshine Programme, which pioneered technologies for photovoltaic power generation. Many competitive PV panel makers have been setup in Japan as a result. As well as technological innovation, meeting the requirements of global warming requires policy innovation so as to make the best use of existing technologies. Innovative approaches, such as Europe's 'cap & trade' scheme, have yet to be applied in Japan, and we have much to gain through sharing such experiences.

NEDO is now turning its attention elsewhere in Asia, working in China and India to help industry become more efficient. For the future, global cooperation is key. NEDO can help with networking between the research, industry and policy communities in Japan and Europe, and in certain cases also with grant funding.

Recent Activities on Eco-Innovation in Japan

Professor Ryoichi Yamamoto, Institute of Industrial Science, University of Tokyo

Professor Yamamoto's presentation focused on a review of Japan's activities in sustainable production and consumption, and the opportunities for green purchasing. "The Earth is at a tipping point", Prof. Yamamoto maintained. Work by Japanese and international scientists suggests we are approaching the point of no return for global warming. By some estimates, we have less than 10 years to avert great risks to the climate. Prof. Yamamoto had had the pleasure of meeting former US Vice President Al Gore recently, who had expressed the view that policy-makers and business leaders lacked a sense of urgency on climate change. As well as climate risk, there is material risk. On current trends, by 2050 the world will need several times more than the known resources for many metals.

Eco-innovation and spreading eco-technology are essential to achieve the goals of the Kyoto Protocol and the Asia-Pacific Partnership. For instance, it is estimated that there will be 400 million 'new middle class' in the Asia-Pacific region by 2009. This represents a \$1.2 trillion market and if they purchase non-environmentally preferable goods and services the additional environmental burden will be enormous. Hence, there is an urgent need to promote eco-products and green purchasing in the region.

Japan's response includes an Eco-Innovation Strategy, coordinated by METI, and a Technology Development Roadmap, coordinated by NEDO. In 2004 the Japan Eco-Materials Forum formulated six 'vectors' for materials to be

considered eco-friendly. These are that: materials are from resources with a green resource profile; production processes have minimal environmental impacts; high productivity is exhibited in the applied product; minimal hazardous substances and wastes are produced; high recyclability; and high environmental treatment efficiency. Activities include an eco-materials handbook, an eco-products directory, and an annual eco-products exhibition.

Green purchasing networks (GPNs) are an important means of disseminating this knowledge. Such a network has been operational in Japan since 1996. It promotes the concept and practices of green purchasing, and provides guidelines and information necessary for practising green purchasing. GPN now has over 2800 members (corporations, government agencies and NGOs) and is one of the largest environmental organisations in Japan. Its success has led to the setting up of the International Green Purchasing Network based on the Japanese model. Its first international conference was held in Sendai, South Korea in 2006.

In conclusion, Mr. Yamamoto noted that companies are increasingly aware of the environmental impact of materials and products. Governments across the world have already started green purchasing and have met with considerable success. An appropriate legal framework is necessary to secure green purchasing. Businesses should practice green purchasing as well as supply eco-friendly products. International sharing of good experiences, information and know-how will contribute to dissemination of eco-innovation.

Hitachi's Technology for Energy, Environment and Sustainable Society

Dr. Shigeru Azuhata, General Manager, Hitachi Research Laboratory

Dr. Azuhata reiterated comments made by other speakers on CO₂ emissions and trends. Progress towards the Kyoto targets was patchy, Dr. Azuhata noted. In 2002, emissions were up 8% in Japan, 13% in the US, and 20% in Canada compared to their 1990 levels, rather than the net decreases required. EU emissions were down 2.5% overall (compared to a target of 8% for 2012), but this masked big differences between member states. World electricity production is increasing rapidly and is expected to double by 2030, to approximately 35 TWh.

In power generation, coal is the most CO₂-intensive option. This is a very mature technology and improvements follow the law of diminishing returns. It has taken around 10 years to achieve a thermal efficiency increase of 5%, using integrated coal gasification and combined cycle (IGCC). Installation of CCS would cut efficiency by 10% and so set the technology back ten years or more.

Japan has the third largest nuclear generation capacity after the US and France, and currently has the world's largest construction programme. Hitachi has constructed eight nuclear reactors in Japan over the last 20 years and is currently building others to its latest ABWR design. Japan is also a big investor in photovoltaic systems, with around 38% of installed capacity worldwide. Hitachi produces systems for a wide range of applications that can be incorporated into buildings, fencing and streetlamps. In wind power, Japan has around 2% of installed capacity. Here frequency control is the main issue and Hitachi is a leading supplier of advanced technology for power conversion and control.

In transportation, Hitachi is active in hybrid electric vehicles (HEVs), especially battery technology, and traffic information systems. The company has also developed the New Energy Train which uses hybrid technology and regenerative braking. The challenge here is in the battery system: a train carriage is about 40 times heavier than a car and so requires much more power from the rechargeable batteries. Finally, Hitachi has an active environmental policy and aims to be emission neutral by 2015.



Session I:

Energy Supply for Sustainable Society

Energy Supply and Demand to 2050: How to Cope with the "Factor 4" Target?

Mr. Richard Lavergne, Secretary General, French Observatory of Energy

Mr. Lavergne focused on France's experiences in setting a 'Factor 4' goal for reducing carbon emissions. Kyoto offers only a very partial response to the issue of climate change, Mr. Lavergne explained. Total reductions will be less than 3% by 2012 for those countries which ratified it. Yet, as Mr. Hirst had set out, according to IEA estimates global emissions need to be reduced by 50% by 2050. Indeed, developing countries' emissions are accelerating: in 2004 the IEA had projected that they would meet the level of developed countries by 2022, but this has since been brought forward to 2014.

The key issue here is burden sharing. If emissions are considered on a per head basis, then developed countries such as France, Japan and the US are disadvantaged (low population, high emissions). On the other hand, a measure based on emissions per unit of GDP disadvantages developing countries (low GDP, growing emissions). For France, convergence of emissions on a per head basis implies a reduction by a factor of six, but convergence based on per unit of GDP implies a reduction by a factor of only 1.3. In 2005, under the Energy Law, the government decided to follow a middle course, targeting a reduction in emissions by a factor of 4 (~6/1.3) by 2050.

The Energy Law set a number of objectives to meet this goal. These include targets for reducing the energy intensity of the economy as a whole, as well as improvements in energy efficiency and greater use of renewables. A Factor 4 Group was set up to look at how to meet these targets and manage the transition. The Group brought together stakeholders from government, industry, NGOs and civil society, and Mr. Lavergne was one of two rapporteurs. It followed a scenario approach similar to that used by the IEA.

Timing is very important, Mr. Lavergne noted. The curve could follow a number of paths: act too late and the efforts required will be far too costly; the same could apply if we act too soon before economic solutions are available. There is a need to arbitrate between several complementary approaches. Moving towards a less carbon-based energy mix, dissemination of efficient and/or new technologies, and changing attitudes of citizens and businesses all have their role to play. Such a strategy also has to operate within global constraints.

The Factor 4 Review concluded that all energy options must remain open: fossil, nuclear, renewables and efficiency all have a role to play. Investing in energy efficiency and renewable energies amounts to a 'no regrets' precaution for the future. Other focus areas should be boosting energy

efficiency in all sectors, saving electricity during peak consumption, and effecting a structural change in attitudes to transport. Delaying action or following the current course is just not acceptable. Technological breakthroughs are urgently needed in very low emission technologies, use of hydrogen, and carbon capture and storage. The Group developed a series of recommendations to address these issues, covering strategy, consistency in public policies, and mobilising sectors and stakeholders.

More than 40 years of hard work lay ahead of us, Mr. Lavergne warned. The first 15 are critical and we can't afford to delay action.

E.ON-Project "50plus": The Future of Highly Efficient Coal Fired Power Plants

Mr. Helmut Tschaffon, Technology Policy, New Technologies, E.ON Energie AG

Mr. Tschaffon's presentation focused on the technical challenges for the next generation of highly efficient coal-fired power plants.

The future environment for power generation is extremely challenging, Mr. Tschaffon noted. Power companies are looking to balance competitiveness with security of supply and environmental factors. In addition, they need to improve efficiency and achieve substantial reductions in CO₂.

Over the last 50 years, the net thermal efficiency of power plant has increased by about 12 percentage points, to around 45%. This was primarily through developments in materials technology, in particular the introduction of austenite steels which can tolerate operating temperature up to 600 degC. A move to nickel-based alloys could push efficiency further, to over 50%. But the introduction of CCS, as required to combat climate change, could knock 10-13% off overall net efficiency. This penalty is a huge barrier for the widespread rollout of CCS.

Europe leads the world in the development of ultra-supercritical (USC) 700 technology, although there is still a long way to go in solving the technical challenges. To investigate these issues Eon is planning the world's first USC power plant. It will use innovative technology to tackle the challenges of a 700deg steam cycle. These include a super-heater and reheater, tubes and pipes, and new types of valves and a completely new turbine. Design work is currently underway and construction is expected to start in 2010, with start-up by 2014. The budget is currently more than €700 million.

The USC is just part of a technology offensive by E.ON that puts the focus on CCS, next generation nuclear plants, off-shore wind farms, and increasing end-use energy efficiency.

Power Generation ... The Path Forward

Mr. Yves Menat, President & General Manager, GE Energy Products Europe

Setting the scene, Mr. Menat recapped on the global trends and challenges. Population is increasing, with an estimated 2 billion more people by 2030 (equivalent to 4 European Unions). Fuel prices are high and volatile, while uncertainty surrounds public energy policy. Reserve margins are falling and electricity demand is growing. In Europe, the next grid failure will most likely be in the summer, when loads are increasingly high due to air conditioning. "How do we grow ...and still be responsible?", Mr. Menat asked.

Answering his own question, Mr. Menat emphasised that "There's no silver bullet". No single policy, fuel or technology can provide the answers to these problems. But there ARE answers. Technology diversity is critical. "The point of R&D is to make the cost of carbon competitive at whatever level it will be", he explained. Mr. Menat then outlined the development challenges facing each of the main energy options: gas, coal, renewables, nuclear, and services.

The path forward, Mr. Menat concluded, requires a mix of continuing investment in technology, excellence in project delivery, a stable public policy environment, and increased public awareness. Policy is particularly important from industry's point of view. The US has not ratified the Kyoto Protocol but many US states and cities are beginning to act themselves. The EU has taken action but could still do better.

"This is an interesting and a very exciting period for the power industry", noted Mr. Menat, "and there is much work still to do. In power generation, ten years is tomorrow, so there is no time to lose".



left to right:
 Mrs. Kathryn FULLER, Dr. Dolf GIELEN,
 Sir Stephen GOMERSALL, Mr. David HAVERBEKE,
 Dr. Björn C. HEINLEIN, Mr. Neil HIRST, Mr. Erl WILKIE,
 Mr. Yutaka YOSHIMOTO



Session II:

Energy Consumption towards a Sustainable Society

Buildings, Appliances and Industry: Energy Demand Trends and Opportunities

Dr. Dolf Gielen, International Energy Agency

Building on the previous IEA presentation by Neil Hirst, Dr. Gielen's presentation focused on energy demand and the opportunities available through energy efficiency.

Europe produces around 75 EJ/yr² of energy and consumes around 50 EJ/yr (the remaining 25 EJ being accounted for through conversion losses, etc). However, Europe accounts for less than 20% of world energy use, so solutions have to be global. Around 35% of consumption is in industry, a further 35% in transport and 25% in residential. The balance is in commercial and other uses. Commercial and residential use has increased by around 20% since 1980, whereas industrial use has actually decreased by about 10%.

Electricity accounts for an increasing share in final demand, partly because of industrial change (shift from manufacturing to service industries) and partly due to technological change (e.g. growth of computers and other electronic devices). Echoing other speakers, Dr. Gielen emphasised that improved energy efficiency is the most important contributor to reduced emissions. It could potentially contribute around 32 Gt CO₂ reductions by 2050; this compares with total emissions today of 26 Gt CO₂. Use of proven technologies can result in major savings, but there are many market imperfections which stand in the way. In rented housing, for instance, improving a building's energy efficiency is in the interest of the tenants (who pay the bills) but not in the interests of the landlord (who makes the investment).

Buildings is an important sector and in Europe accounts for around 18% of total CO₂ emissions. The largest application is space heating, which on average accounts for around 50% of consumption, followed by water heating and appliances at 19% each. Potential savings by 2050 amount to around 600 Mtoe in the service sector and 1200 Mtoe in the residential sector. Electricity savings potential from buildings alone equates to around one-third of the global total.

End-use efficiency is of key importance, Dr. Gielen concluded. Space heating, water heating, appliances, lighting, and industrial uses all offer opportunities for major energy savings. System efficiency is also an important factor, in areas such as electric motors, steam systems and process integration.

² 1 Exajoule = 10¹⁸ Joules, which is equivalent to around 50 million tonnes of oil equivalent (Mtoe)

How to Save 86 Million Tonnes of CO₂ in Europe Each Year

Mr. Dominiek Plancke, Senior Vice-President, Philips Lighting

Continuing the efficiency theme, Mr. Plancke focused on the opportunities available through a very commonplace technology – lighting.

Lighting accounts for 19% of all electricity consumption worldwide. Yet in the traditional filament bulb, around 95% of the energy used is transferred to heat. Substituting this technology for more energy-efficient equivalents has the potential to save around 20 Mt CO₂ per year. The energy saved is worth around €5-8 billion per year and equivalent to the output of 25 power stations.

Opportunities include: using new types of gas discharge lamps in road lighting; advanced fluorescent lamps in office lighting; and a variety of technologies (compact fluorescent, energy-saving halogen, solid state lighting) in domestic lighting. These new lighting solutions save electricity and cut energy bills, generally by between 60-80%. In addition, the new technologies bring other benefits, such as better visibility and working conditions. Philips has invested in such technologies over an extended period and offers a wide variety of products for each of these markets.

Switchover to energy efficient lighting is slow, however, and at present rates will take a long time to reach full penetration. Governments and industry must do more, through awareness campaigns and partnerships, to accelerate the take-up of new solutions. Regulation could also have a role, e.g. by banning the least energy efficient technologies, such as mercury vapour lamps currently used in most road lighting.

Energy Consumption: Impact and Solutions

Prof. Jean-Claude Sabonnadière, Adviser to the President, INPGrenoble

Prof. Sabonnadière focused on the opportunities available through zero- and low-energy buildings.

Analyses such as those by the IEA and the French Factor 4 study show that residential buildings, together with transport, is one of the two major target sectors for reducing energy consumption.

Governments around the world have set various objectives for zero emission and energy-positive buildings. Germany, for example, foresees a 'low energy house' as being one with an energy rating of around 140 kWh/m² per year, compared to the current average of around 290 kWh/m².a. A passive house would have even lower consumption, of around 30 kWh/m² p.a. Countries such as France, Switzerland and Canada are looking at similar goals. The United States has

left to right:

Mr. Yoshiaki ICHIKAWA, Mr. Sanjeev KUMAR,
Mr Dominiek PLANCKE, Mr Nick MABEY,
Intense discussions during group sessions

set a goal for 70% energy savings by 2020 (compared to 2000) with the remaining 30% generated onsite. Substantial advances have already been achieved. In Switzerland, for example, the oil consumption to meet the heating needs of an average house had reduced from 21 litres in 1970, to 11 litres in 1998. Better design and efficiency improvements could reduce this further, to 4 litres. Studies by the German-based PassivHaus Institute show that reductions in heating energy of 70-90% are quite feasible.

Proper insulation of walls and roofs, glazing and windows, and energy recovery can all contribute. What's more, low- and zero-energy houses are becoming more attractive and acceptable, as indicated by Prof. Sabonnadière's numerous examples from Sweden, Belgium and Germany. These techniques are increasingly applicable for retrofitting and refurbishment, as well as new build.

The next step would be to move to energy positive houses, which generate their own electricity and sell surplus back to the grid. Technological advances, as well as liberalisation of energy markets, mean this could soon become a reality. Demonstration homes have already been built in Germany and the United States.



Session III:

Transportation in a Sustainable Society

Transportation in a Sustainable Society: Technology

Prof. Roderick Smith, Chairman of Future Railway Centre, Imperial College, London

As it was Sunday morning, Prof. Smith said he would begin his presentation with a parable. A boy came home to find that his house was on fire. He expected his neighbours to help him put out the fire, but they would not because it was keeping them warm. So the boy urinated through the front-door instead. When that didn't work he began to drink water so as to be able to urinate faster, but at the same time the neighbours were throwing gasoline on the fire and making it worse.

The parallels, said Prof. Smith, were stark. At present, our policies against climate change are weak, like drinking water and expecting it will help to put out the fire. While at the same time trends in developing countries are enflaming the situation, threatening to totally swamp any minor effects we might have.

Transport presents a huge challenge for climate change, Prof. Smith maintained. In Europe, energy consumption in transport has risen by 30% since 1990, whereas in all other sectors it has fallen or remained constant. The number of cars, passenger journeys and freight miles travelled are all increasing. Congestion has now spread to the skies, with developments such as low-cost airlines leading to an explosion in air travel. The challenge, Prof. Smith explained, is in decoupling demand for transport from economic growth. "We travel more and travel further as we get richer. We also travel faster, which requires more energy."

Similarly, we need to decouple growth from the ever-growing demand for resources. "We have an economic system that demands growth", argued Prof. Smith. Growth of around 3% p.a, the long-term average in developed countries, means the economy doubles in 23 years. Growth of 10% p.a., as experienced in China over the last decade, means the economy doubles in 7 years. The relationship is not linear but exponential – each doubling means we use more resources than in all preceding periods put together. Already we need 2.5 Earths to sustain our lifestyle: something has to give. Returning to transport, Prof. Smith was pessimistic about the way forward. He saw "no significant radical prospects to tantalise us". Alternative fuels, such as biodiesel, could reduce CO2 emissions but in practice reductions are small on a life-cycle basis. The hydrogen economy would require major infrastructure changes and is still a long way off. Demand management, such as speed limits, congestion charging and road pricing, could contribute and will rely on information technology. And whatever we do locally, in Europe, is likely to be swamped by the insatiable demand for transport in developing countries.

Can Road Transportation Become Oil Free?

Dr. Pierre Beuzit, Chairman of Alpheia

Mr. Beuzit was more optimistic about the prospects for sustainable transport solutions. There were three important avenues, he believed.

Firstly, we need to continue to improve vehicle efficiency. The global efficiency of a vehicle with an internal combustion engine (ICE) is only around 20%. Improvements could be achieved through new camless engine designs, reducing the weight of vehicles (reversing the trend of the last 20 years), improving aerodynamics, and cutting losses related to tyres. Hybrid vehicles, which combine an ICE with electric power, could achieve savings of around 30%. The major issues are in relation to batteries, and overall costs.

A second area is alternative fuels. Biofuels, such as biodiesel (produced from rapeseed) and bioethanol (produced from sugar cane and other crops) can realise major savings in CO2. Resources (i.e. land) are limited, however, especially in Europe, and costs remain high compared to conventional fuels. A better option could be synthetic fuels, produced from biomass through a gasification process. With a potential of 30% substitution, this would yield CO2 savings of up to 85% and should be viable by around 2015.

The third area is electric vehicles. Options here include: 'plug-in hybrid', which uses electricity from the grid to charge a vehicle battery; pure electric-powered vehicles with electricity supplied either by batteries or by fuel cells. The hydrogen required for fuel cells could either be supplied directly, or could be produced on board using a reformer. There are major technological obstacles in both routes, and viable solutions are unlikely before 2020.

So, in answer to his question "Can road transportation become oil free?", Mr. Beuzit saw the best route as being: gasoline and diesel hybrids through to 2010; biofuels and tailored fuels through to 2015; and hydrogen fuel cell vehicles for the longer term.

Reports by the Group Sessions Moderators

Session I: Energy Supply for Sustainable Society

Group I.1: Role and Expectations of Governments and Decision-makers

Contribution by Dr. Björn C. Heinlein, Clifford Chance

When discussing the role and expectations of government and decision makers, there are many issues to take into account. As well as being environmentally compatible, a sustainable energy supply also has to be low-priced, reliable, customer-friendly and efficient. Thus, the question arises whether governments should prioritise these goals, for example is ecological compatibility more important than the security of supply? Or is a low price more important than environmental compatibility? In this context, do governments have to incentivise market participants, e.g. to increase the share of renewable energies, or to accept further development of nuclear power? And would the goal of a more sustainable energy supply be reached better through regulation or through market forces?

The Working Group identified four action areas:

1. Governing/supporting the development of a more sustainable energy supply: Governments have a unique role in being able to bring together experts from different areas and sciences to solve the problems we face with respect to a more sustainable energy supply. Most likely, this should be linked to some form of government funding. However, it was expected that decision makers in larger companies would also have to take their share, in particular they will have to help experts to focus the essentials.

2. Educating people: For such a complex issue public education is essential. This would, for example, involve making people aware of the various energy options and the problems associated with each. Governments and decision makers need to tell the "whole true story" even though it may be "an inconvenient truth". This means education should be objective, free of any ideologies and false hopes. Schools are a good place to start, while the media will be important in reaching the wider population.

3. Regulated versus competitive economy: Is a governed economy preferable to a competitive economy in tackling these issues, the Working Group asked? It was broadly agreed that a mixed model was the way forward, but that to reach the sustainability objective market forces may need to be constrained. Over-regulation should be avoided. Thus, regulations should not impose detailed rules concerning energy supply. Furthermore, even when regulation is enforced the implementation of any rules should require enough time to show whether they work. Therefore, the European Commission's approach, which amended Directives at short notice, giving market forces not enough time to react, was seen very critically. With respect to regulation, it was more or less common sense that an incentive-based approach would be preferable to one based on controls.

4. Global view: The problems of sustainable energy supply require governments and decision makers, for example large entities, to work together on an international level in a much better way. Thus, governments and companies would have to resist focusing on just "their" own benefits. Supra- or international associations would thus have to work out alternative solutions with respect to a sustainable energy supply so that each jurisdiction / nation would be able to implement the solution that best fits to its special situation. We can't afford to discuss for too long, however; the time for clear actions is here.

Group I.2: Role and Expectations of NGOs and Think-tanks

Contribution by Mr. Nick Mabey, E3G

Tackling Catastrophic Climate Change

NGOs' views on energy supply technologies are based on the urgency of the action needed to prevent a high risk of catastrophic climate change. Current scientific opinion suggests this requires global temperature rise to stay below 2 degrees Celsius. This will require a different approach to energy supply technologies:

- Climate change must be seen as a vital interest for countries - a security issue which must be addressed to preserve fundamental prosperity and stability. It is not just another environmental issue which can be traded-off against economic growth.
- Global emissions will need to peak in the next 10-15 years, reversing current strong growth trends, and to fall by over 50% by 2050. All countries will need to act to achieve this.
- Achieving a 2C world will require a fundamental shift in energy system investment over the next 30 years, with \$20 trillion in energy investment shifting from high carbon supply to low carbon supply and energy efficiency. The net cost of this shift is estimated to be under 1% of GDP, and in some scenarios could be positive. But these changes will create winners and losers among companies and countries, and huge opportunities for those with the right low-carbon technologies.
- At its heart climate change is an issue of justice and equity. The poorest people in the poorest countries are the first to suffer the impacts of a changing climate, and have done least to cause the problem. Developed countries are responsible for around 80% of CO2 emissions in the atmosphere, despite the fast growing emissions in some developing countries.
- Global political agreement to solve climate change will only be possible if issues of equity are recognised, and developed countries take the lead as they agreed to under

the Kyoto Protocol. Essentially this will require developed countries to decarbonise their economies by 2050.

The Role of NGOs on Climate Change

NGOs have been communicating the science of climate change and lobbying on policy solutions for well over twenty years. Many of these messages have now been mainstreamed in governments and other institutions. Hence, for the future NGOs will increasingly focus on changing public attitudes and cultural perceptions - areas where they have a strong added-value.

NGOs will work with individuals to promote personal low carbon choices. They will work to generate more political space for policy makers to make tough decisions about cutting emissions – for example on personal transportation - and fight vested interests that resist action. And they will work to promote new social norms which make high carbon behaviour unacceptable, even in the absence of laws: for instance, making office blocks blazing with light through the night unthinkable; making binge flying seem as anti-social as binge drinking.

NGOs will increasingly target younger age groups to explain the future costs of being locked into high carbon infrastructure choices – roads, airports, coal power stations without CCS – by current decision makers and voters. Infrastructure that they will need to refurbish or replace at high cost to meet climate change targets in the future. They will build campaigns and a political dialogue around intergenerational equity; especially in Europe and Japan where the population is ageing and young people face high tax costs to fund pension commitments.

NGO Views on Energy Supply Technology Choices

Despite high levels of agreement in many areas, NGOs have some conflicting views on energy supply technologies, and this sometimes dilutes the effectiveness of their public messages.

NGOs all agree on the need to take a systems view of the issue – focusing on how to deliver low carbon energy services to consumers and industry - not just supply technologies. This puts increasing efficiency and reducing wasteful consumption at the heart of the NGO approach. They also generally agree on the need to maximise the use of renewable energy sources. Indeed, NGOs can take much of the credit for creating the current \$40 billion per annum renewable energy industry from nothing in the last 15 years. All NGOs also want to see clearer and cleverer incentives from governments for innovation in new low carbon technologies; long, loud and legal signals which encourage risk taking.

The critical areas of disagreement between NGOs centre around whether renewables can be the whole solution to low

carbon energy supply in the next 30 years. There is currently no off-the-shelf all-renewable energy system (excluding large hydroelectricity which is fully exploited or limited in many countries), and renewables are unlikely to replace projected coal power station build in China, India and the US in the next 30 years. Some NGOs see coal with carbon capture and storage as the only feasible solution in China and India in the medium term. Others are opposed as they see this as pulling investment from renewables, and have fears over the integrity of carbon storage. It is likely that the debate over the environmental impact of carbon storage will become highly charged in the next 2 years as major CCS plants are commissioned.

The vast majority of NGOs see nuclear power as too slow and expensive a solution to make a major impact on climate change, and there are strong concerns over the carbon emissions from the uranium cycle if a large expansion of plants was undertaken resulting in the use of low grade ores. Most NGOs also object to nuclear energy on the grounds of waste disposal risk, safety and proliferation risks. Despite this many would in theory entertain its acceptability if it was the only option to control climate change, but few believe this is the case.

Biofuels present probably the most intense dilemma for NGOs, as they throw up very difficult trade-offs between carbon saving, biodiversity and global food security. Though most NGOs see corn-based ethanol as being irrelevant for climate change and damaging to food security, the acceptability of tropical sugar cane and palm oil-based fuels is more debated. Efforts are underway to define sustainability standards for biofuels, but these are unlikely to solve all the disputes. Second generation biofuels based on cellulose will solve some issues, but still remain controversial in terms of land use and biodiversity impacts.

Conclusion - NGO Approaches

In summary:

- NGOs want action at a scale and pace to fit the scientific facts of climate change and see tackling climate change as economically and technically feasible. The challenges lie in generating the political will and organisation to make the necessary changes.
- NGOs take a whole system view which balances the need for low carbon energy supply with the need to increase efficiency and decrease demand.
- NGOs need to develop a more robust view on the supply-side mix if they are to carry on being influential in the next stage of the climate change debate.

Group I.3: Role and Expectations of Industry and Consumers

Contribution by Mr. Bill Duncan, Advizors.EU

The goal here should be to maintain and improve living standards through economic growth, but without a parallel increase in environmental impacts.

To do this we have to look to what the Working Group called "triple value":

- Economic value: competitiveness of production and distribution systems;
- Societal value; security of supply and affordability;
- Environmental value: minimized impacts on materials and emissions.

Business exists to create and deliver value satisfaction to its customers and thereby generate profit for the shareholders. Both these criteria must be met for sustainability. At the same time, a new paradigm is emerging whereby customers and shareholders are beginning to demand increases in environmental and social responsibility from industry.

The Working Group made the following observations and recommendations:

1. **Stable policy framework:** Progress will be difficult and fragmented if there is no supportive policy framework. This means that we need long-term stability for goal setting with consistent legislative and regulatory actions.
2. **Need for incentives:** Government intervention will be needed to reduce risk and encourage innovation and R&D, as well as to support early commercial scale up projects. Mid- to long- term incentives, such as tax breaks, soft loans and fast-track planning permits will accelerate change.
3. **Plan for action:** A business plan approach, rather than an administrative mindset, will be essential to create and deliver against development roadmaps and time-critical targets.
4. **Evolution over time:** Industry would welcome the setting and progressive raising of standards over time provided that the incentive-based approach is maintained and the need for a level competitive playing field is respected.

There will be little point in new initiatives if existing legislation is not fully enforced and best practice not mandated. Industry, for its part, needs to reposition itself as a key partner of the policymakers – being proactive not reactive – so as to create a shared vision and promote the concept of shared risk.



Within a supportive policy context we can actively get to work to make real change happen.

The Group suggested:

1. Use an integrated approach to explore and develop all technology options (clean coal, gas, renewables, bio-energy, nuclear and even energy-from-waste). Don't try to pick winners, as this has been proven to simply create losers.
2. Build green purchasing networks or other coalitions in order to maximise industry or consumer leverage and challenge upstream suppliers to deliver improvements.
3. Rethink the entire supply side of electricity production and distribution to facilitate effective regional networks. This could include both mega- and micro- scale plants, cogeneration and renewable energy so as to provide flexibility in meeting future needs.
4. Recognize that, in the two speed planet we inhabit, we must encourage and actively support the developing nations to adopt and rapidly deploy the best available techniques.
5. Recognize that, in the developed nations, the existing built infrastructure, with its long capital investment cycles, will constrain our ability to make "overnight" changes in the energy supply mix. Nevertheless, radical change should be the central long-term goal.

In conclusion, the Group felt that achieving a "factor 4" improvement might take 50 years but the first 15 of these will be the most critical. We really must focus on the key issues for the long term, and resist the temptation of the "nice to do", which may be politically easier to digest in the short term. Urgency must be shown at all stages of this lengthy process. A good plan begun today will serve us better than a perfect plan to be begun tomorrow.

Reports by the Group Sessions Moderators

Session II: Energy Consumption towards a Sustainable Society

Group II.1: Role and Expectations of Governments and Decision-makers

Contribution by Mr. Guy Block, Lawfort

This Working Session focused on five main subjects: (i) the renewables targets set out in the European Commission's recent Energy Package, (ii) similar targets relating to energy efficiency, (iii) the competitiveness of biomass, (iv) the current status of hydrogen technologies, and (v) energy research and development, with a view to address clear signals on the expectations from policymakers. In this respect, one of the main questions to address was whether, with current growth rates of energy consumption (average 1.5% annually in Europe), sustainable energy policies could be developed. As a preliminary remark, participants insisted on the need for policymakers to make more efforts on education and communication of actions and measures related to developing a sustainable society. This is linked with the need for clear and sound "road maps" as described below.

Firstly, the European Council of March 2007 set a target for **renewables** of a 20% share in the EU's overall energy production by 2020. Some participants questioned to what extent the European policymakers have ensured that sufficient new generation capacity can be effectively installed to meet this target. Another question relates to whether this target should be indicative, as is the case today, rather than binding and enforceable. Consensus exists as to the need to address climate change as a global issue and public administrations should lead by example (even through low-level actions such as switching off lighting in public buildings at night).

Secondly, the EC has set an **energy efficiency** objective to save 20% of the EU's energy consumption, compared to current projections, by 2020. Carbon capture and storage (CCS) is one of the potential measures. Current technology level could allow for implementation of these techniques, but insufficient support and lack of coordination in policymaking hamper the breakthrough of these technologies. Policymakers should send clearer signals about sustainability, so as to replace the current feeling of "what can I do about it" by one of "all efforts can help".

Thirdly, **biomass** is generally considered to constitute a promising source of sustainable energy. However, limited availability of primary sources of biomass might hamper the development of this source of electricity production. In particular, prices of raw biomass materials are currently rising. As such, the promotion of biomass should be carefully balanced between renewable energy and sustainable food consumption.

Fourthly, **hydrogen** constitutes today an important potential solution for evolving towards a sustainable society. Two main obstacles appear in the evolution towards a hydrogen

society. First, hydrogen appears difficult to use for large-scale applications. Second, to qualify as sustainable energy, hydrogen must be produced by renewable sources of energy. In particular, when comparing technologies and their economic competitiveness, the whole range of externalities (such as emissions along the entire cycle/production chain, overall efficiency, noises, indirect pollution, etc.) has to be internalised. Participants noted that since the efficiency "at the wheel" of an oil-driven car is generally around 20-22%, a technology based on hydrogen (generally with an efficiency of about 40%) becomes clearly competitive once all costs are internalised. Greater efforts should be made to internalise costs so as to create a level playing field.

Fifthly, **energy research** has been at the centre of the debate, both at international and European levels for several months now. There is a need for visibility and standardisation in technology development so as to enhance investors' confidence. Major research programmes (such as those funded under the EU Framework Programmes) should be organised through public-private participations, considering the required long-term approach of energy investments. In this respect, the recent European Council explicitly encouraged the Commission in its intention to present a European strategic plan for energy research and development.

In conclusion, the Working Group felt that the objectives set today were reachable but were concerned about the appropriate means and solutions to achieve them. Therefore, '**roadmaps**' must be developed with clever targets and ambitious deadlines, be it at international, regional, national or local levels taking into account local circumstances. Since energy projects must usually be financed by external sources (banks), the frameworks under the roadmaps must be sufficiently clear and foreseeable to allow financing. In the meantime, all available information on climate change related issues should be communicated by governments and policymakers. Considering the nature, the scope and the urgency of the matter at stake, public awareness should also be fostered.

Group II.2: Role and Expectations of NGOs and Think-tanks

Contribution by Mr. Sanjeev Kumar, WWF

Climate change is one of the most dramatic and far reaching challenges that humanity has faced. At the heart of the problem is humanity's unfettered energy consumption which is having a disastrous impact on the overall health and well being of all forms of life. The problem manifests itself in two main forms. Firstly, the demand for products and services that consume energy does not take into sufficient account its environmental implications. This is caused by a variety of aspects, such as prices that do not incorporate true environmental implications, the price of some environmentally detrimental products is lower than the more benign



During the group sessions,
Prof. Jean-Claude SABONNADIÈRE



products, and there is often a lack of clear, independent information sources especially at the point of sale.

The second aspect is more challenging in that much of the energy consuming decisions are made for society by often unmovable infrastructures such as houses, communities and manufactured products. This places a limit on the options available to society to become more sustainable. For example, individuals in a household can switch from low to high efficiency lights but they often find it difficult to change the fabric of their walls to increase their thermal efficiency or the size of windows to maximise daylight and thus reduce energy consumption. These limitations are placed on households by architects, town planners, the construction industry and, importantly, our expectations and perceptions of what the future demand and usage of homes will be.

It is difficult to predict how houses will look and be used in 10 years time. It is even more difficult to guess how a house will be used over the next 50 or 120 years, which are the ages of many houses we see in Europe today. Architects and builders in the 1890s could not foresee that by the year 2000 the houses they built would become sophisticated electricity grids catering for televisions, wireless internet connections,

fridge freezers, cookers, etc. It is difficult to predict the future but this does not mean that society is powerless to take action now and live in a more sustainable way.

Transparent information, robust regulatory frameworks, education, awareness and effective incentives that empower change are the main ingredients for a more sustainable society. A better understanding of the likely impacts of climate change is also essential as it will have different consequences for different societies.

Labelling the energy, environmental and operational performance of products is a fundamental piece of the jigsaw. This allows consumers to consider a whole host of aspects such as aesthetics, cost and impacts at the point at which they are likely to make a purchase. Labels need to be simple, common across products, and use the same measurements. This should go some way to addressing the perverse signal that the most polluting options are also, in many cases, the cheapest. Training and awareness of retail sales staff is the other side of the coin. If stores have another marketing message to influence consumer purchases then they are likely to phase out inefficient products, thus improving the availability of more sustainable products. Even so, it is essential for manufacturers to develop "sexy" sustainable products to increase their take up and thus go some way to reducing their price over time through volume purchasing.

Education and robust regulatory frameworks direct the activities of engineers, architects and builders to construct more sustainable infrastructures. Regulatory frameworks create a legal minimum requirement for activities such as the design and construction of new buildings, thus going some way to institutionalising sustainable living by pushing the relevant industries. The same is true for manufacturers of appliances. Over time and with greater awareness, there is a possibility that a market for "green" houses could develop which incorporate low-energy demand and reduced environmental impacts within the overall value of a house. Such developments would enshrine the economic value of a house alongside the environmental benefits of sustainable living. However, the main challenge is in improving the existing stock of buildings, which places the cost and pace of change solely on the households.

Time is the major barrier when asking households to take ownership of change. There is often little time to understand the issue and also the advice given. This element of distrust is a critical barrier which can only be overcome through impartial advice and guidance. This is a vital role for NGOs and consumer organisations as they are required to provide simple awareness of problems together with unbiased solutions. Time is also needed to allow lifestyles to accommodate sustainability. Time is needed to allow cost-effective purchases of manufactured products. As important, time is needed by engineers to design good quality, attractive low

energy products. However, time is a luxury that policy makers and regulators do not have. This is because of the often long lead times in designing policy and then in the time that it takes these measures to influence infrastructures and households. Our climate cannot wait that long....

Group II-3: Role and Expectations of Industry and Consumers

Contribution by Mr. Yoshiaki Ichikawa, Hitachi, Ltd.

The discussion started by reconfirming the basic statistics, which were similar in both the EU and Japan:

- The contribution to global warming is shared almost evenly by the energy consumption of industry, household/office, and transportation;
- Industry has achieved a slight decrease, however the other two sectors are recently increasing with an alarming rate;
- Electricity is the main concern, whose proportions has grown compared to gas and oil.

Through this confirmation we identified our main scope of discussion as the electricity use in households (transport being dealt with in a separate session afterwards).

We noted that improvement measures show wide variations between European countries:

- Italy has serious problems with the lack of generation capacity (imports 25% of electricity requirements), while having a legal ban for building new power stations.
- France is "happy" with its nuclear position being an energy exporting country, but an unplanned trend of building new houses in some French regions could increase fossil fuel/transport problems due to failure to address local public transport demand.
- Germany has a new trend where solar & other micro-generation has taken off due to ease in selling surplus of power (from households) to power companies.
- Switzerland may face a problem when the permission to operate 4 nuclear power stations runs out in the near future.
- Costs of power vary across Europe, which has caused some companies to move to lower cost locations. Liberalisation and turning electricity into a traded commodity causes companies problems (the energy price for tomorrow cannot be ensured).

Life cycle thinking seems to be an important part of the solution. "Is it better to choose an electrical equipment with a longer life-time or a shorter one?" The former is generally appreciated by environmental evaluation while the latter has an advantage by introducing new technology, which could be more energy efficient. One participant addressed his company's product strategy as an example answer; relatively short lifetime is applied but the products are taken back and

some parts of the product are reused while new energy-efficient parts are integrated into the newly assembled ones.

The **role of education** was also touched on. It was noted that the behavioural changes for energy consciousness are the key to accomplish our role. A large regional difference in the EU concerning levels of awareness was pointed out; Scandinavian countries and Germany are relatively high compared to other regions.

On the **role of consumers**, various ideas were proposed. One participant compared the issue to successful dieting, where detailed information on calories associated with each meal was key; the same principle could apply to cut energy consumption of a household. In addition, it was noted that the energy labelling schemes currently used for appliances do not provide the consumer with any quantified indicator on energy consumption. For example, an "A" label for a washing machine does not give you any idea of the amount of the electricity bill. Participants strongly supported the idea of compact sensors or meters that can be equipped in the household to provide information on the real-time energy consumption of each appliance.

As an extension of this topic, **the energy bill** was discussed. This is usually reviewed once a year but it would be much more helpful if it contained more details and was used as a monthly feedback. Just as people usually have financial advisors to optimize their savings and expenditure, they could have an "energy advisor" to advise them on their personal conduct/lifestyle (e.g. switch the light off) and actions to make the home more energy efficient.

On the **role of industries**, some were already mentioned in the previous discussion (sensors, indicators). In addition to these, other drastic proposals came out such as moving their energy intensive sites to a northern part of EU, or even underwater. Regarding the information provision from industry, the disclosure of each company's carbon footprint was appreciated through which consumers and industrial customers could choose environmental-friendly product and services. During this discussion we found that nobody actually knew the carbon footprint of their own country per capita, which again indicated the serious lack of awareness.

Reports by the Group Sessions Moderators

Session III: Transportation in Sustainable Society

Group III.1: Role and Expectations of Governments and Decision-makers

Contribution by Mr. Maurizio Tomassini, Institute of Studies for the Integration of Systems

The Group questioned the role of governments and decisions makers to push towards sustainability in transportation, and how the different actors interact in introducing relevant innovations in the process. One input was the recent report of the IPPC, which made recommendations to policymakers for adopting mitigation measures to cope with the climate change.

The group agreed that, in particular, innovative **transport demand management** strategies should have top priority to direct users to a less-intensive use of private vehicles. Part of the innovation should come from a new organisation of the working system; **teleworking** was mentioned as an example of measures that could be implemented immediately. Discussion led into the development of the concept of inverting the current situation of travel patterns "many to one" into "one to many", for instance promoting home deliveries in place of the current shopping habits.

This and other mitigation options are faced with many barriers, such as consumer preferences and lack of policy frameworks. Governments should promote alternative solutions inside their organisations as an awareness raising step, favouring legislation accompanied by provision of incentives to private actors, in parallel with intense information and education campaigns that can reduce car usage and lead to an efficient driving style.

Other recommendations debated within the group concerned the necessity of a different use of space in the urban context. **Urban planning** is a must to organise cities in a way to reduce the demand for travel. The current model of large cities has been recognised as quite inefficient; multi-centric conurbations should be developed in the longer term. Meanwhile, space in cities should be assigned in favour of alternative transport modes to private vehicles, such as cycling and walking, car sharing and pooling, and on top of all, collective transport.

This opened the issue of privatisation of public transport sector, which is strongly pushed by the European Commission to favour competition. The experiences in UK have been judged negatively in terms of offering an alternative that is fully accessible for everybody. Solutions based on profitability have already lead to social exclusion.

Internalising the costs of transport is another important issue. The group agreed that decision makers should implement the legislation and the fiscal measures appropriate to assign the correct cost to each transport mode. However, the issue of social equity has to be considered, leading to

ask for a more efficient approach on public/private financing of public transport.

The Group concluded on the need for better integration between modes of transport but wondered if highly dense conurbations are the right scale on which to decide and implement innovative measures. Governments should encourage efficient solutions such as modal shift, considering the different situations and should not push in one single direction.

In conclusion, the group urged "Western" governments to lead the way for developing countries. They should act as strong promoters for the adoption of "proper" mobility management choices, making clear the negative consequences of adopting solutions that have been taken as models of development.

Group III.2: Role and Expectations of NGOs and Think-tanks

Contribution by Mr. Erl Wilkie, Cycling Scotland

NGOs and Think Tanks in Transport

The Group began by discussing the roles of NGO's and Think Tanks within the transport milieu.

The transport issue is one of behavioural/lifestyle change. Therefore the role of NGOs and think tanks is to explore and advise changes in lifestyle, and also to lobby government and industry. This works most effectively when the positive benefits of change are explored – for example in cycling promoting the health and cost benefits are the best messages to highlight.

Selling the benefits to the individual is the most effective way because climate change affects everyone, people assume that everyone else can make the effort and they will not have to, so only by highlighting the fact that change may be good for them will people begin to alter their lifestyles. Nevertheless, some participants felt that there would not be an effective level of change without a significant shock to make people face the gravity of the problem.

What are the NGOs and Think-tanks preferred solutions?

They can help to create high quality sustainable transport solutions – ranging from improved integrated public transport, more sustainable freight methods, and perhaps most importantly, private cars which use sustainable fuels. Urban planning can also help, by planning residential and office space close together and shortening the distances staff need to travel.

Although the solutions are ambitious in themselves, the fact that we are heading for global disaster means that we will have to look at the most radical solutions, which may mean taking things even further than outlined above. Workshop

members felt that greater pressure was needed on the public, as expecting people to change out of choice was unrealistic. Statutory measures, such as congestion charging, can provide the necessary push to get people on the road to lifestyle change.

Technology could also be used to reduce the need to travel, by improving broadband internet connections. This would allow more people to work from home. Business meetings could be replaced with video conferencing, though generally this would only be a suitable alternative to small meetings, and larger conferences would still need to be conducted outside cyberspace.

NGOs and Industry: Cooperation or opposition?

Delegates agreed that NGOs can influence industry – as has been the case in renewable energy. Industry should look as vehemently as possible at these solutions, as focusing solely on short-term profits will create more problems in the long term. In the automobile industry, for instance, whilst technological solutions are needed, companies should work alongside NGOs to promote more responsible use of cars as part of their corporate social responsibility. Indeed, some felt that the automobile industry was now in a position that it would have to develop more sustainable products to avoid sliding into obsolescence.

How can we improve the relationship between NGOs and Industry? One way could be to establish common ground within their individual aims and objectives. Delegates cited an example of Hewlett Packard being advised by an NGO that its copy paper supplier was using illegal logging. The company acted swiftly on the NGO's advice and immediately ceased trading with that supplier.

Another example cited was an environmental NGO working with large retailers to put information about the carbon footprint of goods on packaging. The NGO fulfils their aim of awareness raising, and the retailer improves their public image and achieves media coverage for its innovations. The two organisations work together in ways that are mutually beneficial.

Are NGOs and Think-tanks positions/solutions realistic?

In the present environmental situation, the solutions are absolutely necessary, so if they are not currently achievable then we need to find ways in which they become so. Science and technology should be used to further these aims. As stated elsewhere at the Forum, there is no "silver bullet". The problem is incredibly complex, and so too will be the solution. It is the responsibility of everyone - NGOs, think tanks, industry, consumers, scientists and individuals - to work together and to act now. The public should be provided with all the facts, however grim, as they will not alter their lifestyles to help fix the problem unless they fully understand the issues facing them.

How can NGOs and Think-tanks influence public opinion?

Using surveys to gauge public opinion, NGOs would potentially be in a strong position to lobby governments and decision-makers, as public opinion drives political decisions and these are the issues people base their votes upon. Nevertheless, many delegates worried that without statutory measures individuals would not sufficiently alter their lifestyles in time, and that industry would not willingly risk profits.

In summary, the workshop agreed that everyone will have a role to play in tackling climate change. Individuals must change their lifestyles; government must legislate to kick-start that change; science must develop greener technologies; industry must use these technologies. Only with commitment from all parties will the issue be addressed properly and effectively.

Group III.3: Role and Expectations of Industry and Consumers

Contribution by Mr. Stephen Stacey, Toyota Motor Europe

The group's discussion ranged widely but at least in retrospect debated a central question: should personal choice of mobility mode be limited or guided and, if so, how and by whom? There was general agreement that the evidence of human responsibility for climate change was sufficiently persuasive to make the question worth asking, even if neat answers remained elusive.

Price and choice

The discussion began by trying to answer a question. One of the speakers in the previous session had implied that citizens needed to change their attitudes to mobility if catastrophe was to be avoided. What needed to be done, it was asked, to effect this change? One answer came loud and clear: manipulate prices. Price could have a marked impact on demand for personal mobility. Ensuring that mobility incurred higher costs would deter unnecessary journeys. Some doubted whether this would in fact be the case. At first the London congestion charge might have affected the demand for mobility, it was suggested, but the impact had now weakened. Other evidence was offered indicating that consumers could adapt to paying more for their mobility. Users of trains in Japan appeared not to be discouraged by the relatively high price of tickets.

By contrast, price might have an impact on fuels. Alternative fuels would become more attractive as the price of fossil fuels climbed. Would this trend be mirrored in changing modes of transport? It might in urban areas where there is more choice. Congestion plays a part here, too. Heavy traffic deters car use, especially for the shorter journeys typical of cities. Outside urban areas there is less choice. There may be less congestion and journeys are often longer than in cities.

Prof. Roderick SMITH,
Mr. Stephen STACEY,
Dr. Junzo KAWAKAMI

Infrastructure and choice

This prompted reflections on infrastructure and planning. Public transport should be an integral part of city planning. Also town planners needed to think harder about the broader design of the built environment. Shops should not be expelled to the city peripheries; employees should not have to commute long distances; and children should not be obliged to travel far to go to school. In this way, the demand for mobility would be reduced. Choice of transport mode should still be a matter for individuals. Indeed 'good' transport offers might help them to make the 'right' decisions.

On some international routes, for example Paris-Geneva and Brussels-Paris, the train had largely or entirely supplanted the aeroplane. For these and other journeys, tickets were readily available and reasonably priced. But not every part of the railway system was as accessible. Indeed, to talk of an international 'system' was still an exaggeration. Much had to be done to make longer journeys seamless over borders and over modes. However, it was thought that comfort could be taken from some current developments.

Is the consumer always right?

This is not to say that the consumer is always right. If the pace of change in demand is to be accelerated, perhaps governments have to be more active in constraining 'wrong' behaviours. But how might they do this and what are the limits to governmental constraint?

This prompts a more fundamental question: how much mobility is really needed? Should we not see mobility as a subset or form of 'communication'? Perhaps companies should encourage their employees to replace at least some business travel by air with tele-conferences. Experience around the table varied but on balance it was thought that such a change would not make companies less effective and might make them more so.

We should not forget freight transport here. Is the volume and intensity of freight transport today really required? Do consumers actually need strawberries transported many hundreds or thousands of kilometres? Should they be encouraged to want them? And continuing in this theme, should air transport be so cheap that passengers give no thought for the environmental consequences of their travel? We should reflect on the way our societies are developing and what this means for transport demand.

Needs and wants

What sort of cars do consumers want? There was some evidence that increasing numbers expect to be offered environmentally sensitive ones. Surveys suggest that the environmental sensitivity of cars was moving slowly up the list of purchase criteria. There was a long way to go and fiscal and non-fiscal incentives could have a role to play in stimulating rapid take-up of these cars. Environmental sensitivity not



engine power ought to be a dominating feature of advertisements.

But monetary carrots and sticks were not the only way to induce change. Education had its part. Just as fur-wearing had largely disappeared in Europe as a result of campaigning by NGOs, so educating consumers about the dangers of global warming and the measures they might take themselves could also prove effective.

Affordability and the developing world

Finally, we were reminded to think not only of the developed but also of the developing world. New technologies may be effective in enhancing the environmental sensitivity of mobility but they would have to be affordable in the wider world, too, if global climate change was to be redressed.

Hitachi's Commitment to European Science and Technology

Sir Stephen Gomersall, Chief Executive for Europe, Hitachi

A presentation on Hitachi's activities in Europe is now a regular feature of the Forum programme, with Sir Stephen's presentation this year focusing on Hitachi's research capabilities and activities.

Sir Stephen noted three important developments. Firstly, Hitachi aims to increase the share of income from overseas markets to at least 45% by 2009. This will involve a deeper engagement in R&D in all of the major overseas markets – Asia, Europe, and the USA. Secondly, Hitachi is defining itself as a supplier of social infrastructure and digital products for tomorrow's society. Although still a broad-based, technology intensive supplier to a wide variety of business markets, it is focusing increasingly on its core strengths in IT, power, transport, building, and automotive technology. Thirdly, as well as increasing the ratio of sales, Hitachi is stepping up its total involvement in Europe by further localising its businesses, increasing its research effort and partnerships in Europe for the delivery of systems and solutions meeting specific European requirements. Sir Stephen cited numerous examples of this over the course of the last year and in the near future, all of which illustrate a conscious decision to move production and R&D closer to overseas markets.

Hitachi's European research is conducted in six principal locations: Cambridge, UK, dealing with research on advanced electronic/optoelectronic devices, in nanotechnologies and spintronics; Sophia-Antipolis, France, for mobile computing and communications; Dublin, Ireland, carrying out research in advanced computing and information technology; Milan, Italy, where the Hitachi Design Centre is working on strategic product design, web and graphic design and user interaction scenarios. Recently, automotive research centres have been created in Munich and Paris, working on fuel and control system and car navigation system projects.

Hitachi believes that this involvement in European research is essential because Europe is a standard-setter for many technologies and industries in which the company is a key player. A very good example is in climate change mitigation, which is the focus of this year's Forum. In power plant technology, for example, Hitachi is actively participating in European projects to develop highly efficient lignite-fired power plants with the lowest CO₂ emissions.

Many other areas of the new European Framework Programme for R&D – ICT, nanotechnology, health, safety, transportation – are within Hitachi's core business areas, and participation in the programme enables the company to construct networks with European R&D centres of excellence. We are witnessing a two-way process whereby the European market and science base is acting as a magnet for Hitachi businesses; and Hitachi, by bringing in new technologies developed outside Europe, may contribute to advances in

the environment and information society fields, through the involvement in European programmes and investments and partnerships in Europe.

The importance of rail as a way of promoting sustainable transport and reducing CO₂ emissions is growing steadily. Hitachi has engaged in the development of high-speed and hybrid trains powered by a diesel engine and battery. This technology can increase the sustainability of European society, and will create new business opportunities in Europe for Hitachi as well. To increase the roll out of this technology, the company plans to strengthen its R&D activity in Europe to customize the technology to the European market.

A second example is the smart sustainable home of the type discussed by Professor Sabonnadière. Hitachi designers and researchers in the EU and Japan are developing a new smart home concept that combines energy saving and home security features. This solution will be based on a sensor network that allows the home owner to control domestic energy consumption. Users will be able to monitor the energy consumption of their houses remotely, through either the Internet or their mobile phone. A complementary security system is also being developed.

For a century, Hitachi's strength has been based on its DNA in quality manufacturing and research: but this is also in the process of globalisation. The company currently employs 6000 researchers in six corporate and 30 company R&D centres, mainly in Japan. Over the years, many technologies have been fostered in its own research laboratories from conceptualisation through to practical realisation. However, collaboration with research institutions and corporate partners has become more crucial. Hitachi research laboratories are often the catalyst between universities who are responsible for basic research, and business units who are responsible for commercialisation. In Europe, relationships with universities focus on five clusters of research topics.

In conclusion, Sir Stephen noted that part of Hitachi's mission is to contribute to European society and standards by sharing technologies, and further developing them, together with European partners and specialists. The company's European businesses are being increasingly localised and enriched by collaboration with European companies and universities. Sir Stephen looked forward to increasing and intensifying these in the years ahead.

Discussions continue during breaks

Closing of the Forum

Closing the meeting, **Dr. Freymond** noted that anybody who was not already convinced by the arguments on climate change would certainly be so after this Forum. It was clear that the way we address these issues will impact our way of life for many years ahead.

Technology is part of the solution, Dr. Freymond continued. But can it provide the answers in time? Can it provide answers that are radical enough? Is their enough funding for the research required? Industry has a key role here. Companies have a responsibility to bring to market all technologies which offer viable solutions.

Policy approaches is also a key part of the debate. Taxes, regulations and awareness had all been mentioned. The role of the state versus the market remains a key question; we have to be careful about giving the state alone too much power, Dr. Freymond cautioned. Rather, new modes of governance are required which allow governments, companies and NGOs to work together, exploiting the strengths and advantages of each. These new models should also allow us to take account of the needs of developing countries.

Dr. Freymond expressed his gratitude to the speakers, moderators and participants. "In the Forum, Hitachi has a flag it can be proud of", he concluded.

Echoing these remarks, Dr. Kawakami thanked all attendees for their wonderful presentations and fruitful discussions. The Forum had discussed energy and environmental issues from many standpoints. "Europeans are very concerned about sustainability", Dr. Kawakami noted, "as are the Japanese. The Forum contributes to this global communication." He wished all participants a safe journey home.

Working Group 2008

The working group was set up in 1999 to give the Forum members the opportunity to become more personally involved in the selection of the Forum topics, and subsequently in shaping the Forum agenda. The current working group consists of the following members:

Linda Geux
Winston Hoeijmans
Guillaume Leborgne
Fabrice Llabres

Acknowledgement

Firstly, I would like to thank all the distinguished speakers and moderators who have participated in the 10th Forum; their professionalism and expertise have greatly contributed to the success of this year's event.

Secondly, I would like to express my deepest appreciation to Dr. Jean Freymond who once again kindly accepted to be this years Forum general moderator. His professionalism and dedication during the event were exemplary.

Thirdly, my gratitude also goes out to the Forum Fellows and the Working Group members who helped us to shape the Forum agenda and fine tune organizational aspects in order to further enhance the impact of the Forum. During the Forum preparation process, we also received great support from Dr. Pierre Beuzit whose recommendations proved to be invaluable in re-modeling the structure of this year's Forum.

Finally, on behalf of all Forum participants, I would like to extend my sincere appreciation to Dr. Michiharu Nakamura, for his excellent chairmanship of the Forum over the past 5 years. His constant support and commitment to the Forum have been vital in enabling it to grow in stature. We wish him every success in his new assignment.

Ko Takahashi

General Manager
Hitachi Corporate Office, Europe



Speakers and Moderators

Dr. Shigeru Azuhata	General Manager, Hitachi Research Laboratory, Hitachi, Ltd.
Dr. Pierre Beuzit	Chairman of Alpeha
Mr. Guy Block	Partner, Head of Energy Law Department, Lawfort
Mr. Bill Duncan	Managing Director, Advizors.EU
Mrs. Kathryn Fuller	Chairman of the Board, Ford Foundation
Dr. Dolf Gielen	International Energy Agency
Sir Stephen Gomersall	Chief Executive for Europe, Hitachi
Dr. Björn C. Heinlein	Counsel, Clifford Chance
Mr. Neil Hirst	Director, Energy Technology and R&D Office, International Energy Agency
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Dr. Junzo Kawakami	Executive Vice President and Executive Officer, Hitachi, Ltd.
Mr. Sanjeev Kumar	Coordinator, WWF
Mr. Richard Lavergne	Secretary General, French Observatory of Energy
Mr. Nick Mabey	CEO, E3G
Mr. Yves Menat	President & General Manager, GE Energy Products Europe
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Mr. Stephen Stacey	General Manager, Government Affairs Division, Toyota Motor Europe
Mr. Maurizio Tomassini	Associate Consultant, Institute of Studies for the Integration of Systems
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Mr. Yutaka Yoshimoto	General Manager, New Energy and Industrial Technology Development Organisation (NEDO)

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