



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
IPCC Working Group III — Mitigation



**”IPCC Expert Meeting On Industrial Technology
Development,
Transfer And Diffusion”
21-23 September, Tokyo, Japan**

sponsored by
Ministry of Economy, Trade and Industry (METI), Japan

Meeting report

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1. Introduction

1.1 Goal and Background

This meeting summary report presents the major findings and discussions from the Expert Meeting on “Industrial Technology Development, Transfer and Diffusion”.

The Intergovernmental Panel on Climate Change (IPCC) is in the process of preparing the Fourth Assessment Report (AR4), which will assess the scientific, technical, and socio-economic information relevant to understanding human-induced climate change, its potential impacts, vulnerability to it, and options for adaptation and mitigation. Working Group III (Mitigation of climate change) will again address the mitigation (reduction) of the emissions of greenhouse gases. The writing team will start in October 2004 and its report (Contribution to the Fourth Assessment report of IPCC: Mitigation of Climate change, in brief: WG III AR4) will be presented to the Panel for approval in June 2007.

Several IPCC expert meetings have been organised in order to support the scientific, technical and socio-economic input to the WG III AR4. In this context, the 21st IPCC Plenary session (November 2003) decided to hold an expert meeting on “Industrial Technology Development and Transfer” as a support to the AR4 of WG III. The Japanese Government, through Mr. Shigetaka Seki of METI, kindly offered to host this meeting in Japan (21-23 September 2004). More information about the background to the Meeting can be read in Annex 5. This meeting should be seen as a step in a process of further improving the relationship of IPCC and Industry, and of further improving our understanding of technology development, transfer and diffusion processes, in support of the preparation of the AR4 of Working Group III.

Industry, through generation of electricity, emissions generated by use of its products, and the manufacture of products, influences a significant part of worldwide greenhouse gas emissions. Industry plays an important role in potential responses to climate change. Industry decisions on investments, operation of equipment, product development, and technological innovation will have an enormous impact on future greenhouse gas emissions. Industry investments in capital exceed governments’ investments by far. Industry spending on R&D and technological innovation is also significantly larger than the R&D funding by governments and most of the envisaged "solutions" to climate change need to be realised by industry.

In the AR4 Report mitigation of greenhouse gas emissions from industry will again be covered. It is important to assess driving factors affecting CO₂ intensive energy systems and what roles different actors can play in such processes. Companies are producing and developing technologies and products that contribute to and help to mitigate future greenhouse gas emissions. In addition, many companies are already considering and implementing mitigation of greenhouse gas emissions in their decisions. In some countries mitigation of climate change has become an important driver for the government's energy and environmental policy, which is affecting private sector decisions. The AR4 will need to reflect these developments.

The objectives of the meeting were:

- To identify key drivers on industrial technology development, transfer, deployment and diffusion to be addressed in the AR4

- To contribute to building the conceptual framework for the assessment
- To gain access to industrial information networks being relevant for the scientific assessment of climate change mitigation and improve the use of publicly available data sources from industry in the AR4
- To explicitly involve experts working in industry in the WG III AR4 process as lead authors, contributing authors and expert reviewers.

The main content questions to be addressed were:

1. What are the driving factors of Industrial Technology Development?
2. What are the factors that drive or limit the process of transfer and diffusion of technologies?
3. How to make accurate estimates of future cost and future market potential of technologies?

The meeting focused on three sectors that produce a major portion of global greenhouse gas emissions, and hence have a large potential for mitigation technology:

1. Energy-intensive industry (e.g. cement, metals, chemicals);
2. Energy-intensive consumer goods (e.g. passenger cars and fuels, air conditioners and lighting equipment);
3. Electricity production and energy carriers (e.g. fossil, nuclear, renewables, less carbon intensive fuels, efficient conversion, hydrogen).

1.2 Organisation

The organisation of the Meeting was undertaken by a Programme Committee, consisting of 11 members with IPCC or industry background (see page 2 of this report) under the chairmanship of Prof. Ogunlade Davidson, co-chair of IPCC Working Group III. During April-August 2004 the Expert Meeting was organised by John Kessels from the Technical Support Unit of Working Group III and a local organising committee chaired by Shigetaka Seki (METI). In addition, the Global Industrial and Social Progress Research Institute (GISPRI) assisted in logistics and organisation of the Meeting in Japan.

Invitations and a call for abstracts were sent out in April to broad groups of technical experts, identified via IPCC, the International Chamber of Commerce (ICC) and the World Business Council for Sustainable Business Development (WBCSD). Every organisation or company with relevant experts requesting participation was allowed at least one registration. Environmental NGOs were also invited. The abstracts were supposed to focus on one or more of the three main questions and one or more of the three sectors mentioned in the previous section. The Programme Committee assessed all abstracts and successful authors were requested to submit a full paper for presentation at the Meeting in Japan. A total of 38 abstracts were submitted and 30 full papers were conveyed to the expert meeting. These papers will go through a peer review process with a view to publication in the Meeting Proceedings in early 2005. The drafts of these papers are listed in Annex 3 of this report and are available to the authors of the WG III AR4 on their closed website.

1.3 IPCC Expert Meeting venue and participants

The Expert Meeting took place at the Toshi Center Hotel, Tokyo, Japan, 21-23 September 2004. During the three days 86 participants from 21 countries (Australia, Belgium, Brazil, Canada, Chile, China, France, Germany, Hungary, India, Japan, Macedonia, Mexico, Netherlands, Norway, Sierra Leone, South Africa, UK, USA, Zambia and Zimbabwe). A list with the names and affiliations of all the participants is in Annex 2.

The Meeting was attended by the Chairman of the IPCC and the two Co Chairs of WG III. The breakdown of experts included a total of 5 Coordinating Lead Authors (CLAs) and 16 Lead Authors (LAs) from WG III who will be involved in writing the AR4. The CLAs and LAs will be writing in various chapters of the AR4 including the introduction, framing issues, energy supply, transport and its infrastructure, industry, short and medium term mitigation from a cross-sectoral perspective, and short and medium term mitigation.

The Meeting also included a total of 14 experts from academia or research institutions, 12 experts from Government institutions, 20 from industry, 12 from utilities and two from environmental non-governmental organisations. The industry and utility experts were from companies that included Toyota, General Motors, Nippon Steel, ExxonMobil, Rio Tinto, RWE, AREVA, Anglo America, Eskom and Petrobas. There were also experts from several international industry associations that covered the electricity, aluminium, nuclear, fertilizer, steel, cement, gas and chemical sectors.

2. Expert Meeting and Plenary and Breakout Groups

2.1 Opening Plenary Session

The Expert Meeting was chaired by Ogunlade Davidson co-chair of WGIII. The meeting was over three days and consisted of a series of plenary presentations on the first day followed by breakout group meetings attended by industry experts. On the final day all the breakout groups gathered together to report back and discuss their findings.

Hiroshi Saito, the Director General in Charge of Technology at the Ministry of Economy Trade and Industry (METI), opened the Meeting. In his speech he stressed the importance in Japan of technology in mitigation of GHG emission reductions and that this is reflected in the AR4 as well as consideration given to post Kyoto scenarios.

The Co-Chair of Working Group III, Professor Ogunlade Davidson and Chairman of the Meeting, then explained the Meetings purpose and objectives. He outlined the background and rationale for the Meeting and emphasized the important role that industry plays in technology transfer. He hoped that the industry experts at the Meeting would assist in identifying the key drivers and limiting factors to technology transfer and some options on how to improve transfer and diffuse industrial technology.

Dr Pachauri, the IPCC Chairman emphasized the important role technology will play in AR4. He stressed that mitigation would be driven by technology in the future with no sector better understanding technology than industry. Industry also has the expertise to identify the best technological pathway forward to supply sustainable energy to the 2 billion people without access to electricity. He went on to conclude that with estimates of up to \$10 trillion to be invested in the

power sector between 2001-2030 it is important to identify the best pathway forward in the transfer and diffusion of industrial technology that will mitigate greenhouse gas emissions.

Hiroyuki Watanabe, the Senior Managing Director of Toyota Motor Company gave in his keynote address a historical overview of the technological development of the automobile and some future predictions of automobile technology development. He expressed that such technology evolutions and revolutions will have to contribute to the mitigation of climate change and new business creation. He also outlined the international growth in numbers of automobiles with Toyota expecting in 2050 a growth in ownership of up to 3.24 billion vehicles in comparison with 740 million in 2000. An explanation of the well to wheel efficiency improvements in vehicles was outlined with a prediction of continual improvement in hybrid and fuel cell technology with the ongoing development of more compact and lighter cars. He illustrated this by describing the Toyota Prius hybrid vehicle. An important driver in developing this technology is the METI fuel cell vehicle development roadmap that has an initial goal of 50,000 fuel cell vehicles by 2010, growing to 5 million by 2020 and full market commercialisation by 2030 with 1,500 million vehicles.

Greg Tosen, the General Manager of Eskom's Research, Development and Demonstration Group discussed some of the existing and new technologies that Eskom is developing to supply the energy needs of South Africa. These technologies included clean coal power generation, gas fired power generation, re-powering, in situ coal gasification, carbon sequestration, wind power, concentrated solar power, hydroelectric power and nuclear. Many of these technologies could be assisted by the use of the Clean Development Mechanism. He suggested the additional revenue from carbon credits with some technologies would contribute to the decision making of Eskom management on whether to implement and proceed with investment in a particular technology.

Teruaki Masumoto, the Vice Chairman of the Federation of Electric Power Companies in Japan and Chairman of the subcommittee on Global Environment of the Japan Business Association explained the important role that electric technologies will play in the mitigation of GHG emissions. He illustrated electric technologies roles with examples of advanced heat-pump technology replacing existing air conditioning and heating devices stock, improving thermal efficiency at the electricity production stage with Advanced Combined Cycle (ACC) and Integrated Gasification Combined Cycle (IGCC). He suggested increasing transfer and diffusion of these technologies through an international framework focussing on multilateral technological partnerships and cooperation through the development of a technology database.

Brian Flannery from ExxonMobil, also a Lead Author in the AR4, identified several key commercial drivers needed for successful development and commercialisation of innovative technologies for GHG mitigation. Those drivers included performance, cost, consumer acceptance, safety, enabling infrastructure, regulatory compliance and to take account of all associated environmental impacts. An important point he stressed was that the weakest driver or element will determine the strength and hence commercialisation and widespread use of a technology, i.e. failure in any of these dimensions will prevent widespread commercial use. Dr Flannery also outlined a private sector view on key roles for private and public sectors in bringing technologies to market. These stressed the need for companies to bear the risks and capture the rewards of commercialising technologies and for governments to establish proper enabling frameworks including rule of law, protection of intellectual property and maintaining a safe and secure environment for workers and communities. Finally, he illustrated that investments over many dec-

ades are required even for successful energy technologies to come into widespread commercial use. Over such long periods many factors will change, including relative prices of input materials and competition from other services and products. Hence it is impossible to pick technological winners and losers based on information available at any particular time.

Taishi Sugiyama from the Central Research Institute of Electric Power Industry (CRIEPI) and a lead author in the AR4 outlined a new conceptual framework for the AR4 assessment. His suggestion was a combination of existing IPCC assessments on long-term scenarios and the short term technological mitigation potential in a manner that produces useful information for policy makers involved in designing climate technology policy. He outlined six key driving factors that needed to be incorporated into the scenario analysis, including political salience of the climate change issue, overlapping environmental issues, limitations on facilities and infrastructure, national interests in technology and energy security and lastly the regional resources of a region as this will impact on the viability of a technology. The interplay of these factors could lead to regions making different technology choices.

Cedric Philibert from the Energy Efficiency and Environmental Division of the International Energy Agency (IEA) discussed the challenge of stabilizing global CO₂ emissions and how it would require major changes in energy systems. He stated that all low carbon technologies needed to be used to reach the lowest possible emission levels. He outlined the need to include developing countries and to provide incentives for research, development and dissemination of new technologies; technology-focussed policies would help but not replace policies directly directed to cut emissions. Lastly, emphasis was made that the development and evolution of new technologies are unpredictable and that this uncertainty needs to be considered by negotiators when they are developing future international regimes.

Jae Edmonds and Jose Moreira then explained the concept and application of crosscutting themes for technology in AR4. They prepared a guidance paper on how to consistently and systematically assess technologies in the AR4, notably WG III, taking into account different dimensions including system boundaries, timeframe, and regional differences. This guidance paper is being finalised and will be conveyed to the writing team of WG III AR4.

Upon completion of the plenary session the participants were split into three breakout groups that focused on the three biggest sectors for greenhouse gas emissions from industry.

1. **Energy-intensive industry** (e.g. cement, metals, chemicals);
2. **Energy-intensive consumer goods** (e.g. passenger cars and fuels, air conditioners and lighting equipment);
3. **Electricity production and energy carriers** (e.g. fossil, nuclear, renewables, less carbon intensive fuels, efficient conversion, hydrogen).

The three breakout groups were asked to address three questions:

1. What are the driving factors of industrial technology development?
2. What are the factors that drive or limit the process of transfer and diffusion of technologies?
3. How to make accurate estimates of future cost and future market potential of technologies?

On the third day the three breakout groups all met together to summarise their finding.

2.2 Energy Intensive Industry

A working group of experts intensively discussed the various aspects of technology transfer and diffusion in the mining, aluminium, iron and steel, cement and fertilizer sectors. Eight papers were presented to provide background and examples of the key drivers facing industry in technology development, transfer and diffusion. The group was co-chaired by the two Coordinating Lead Authors from the Industry chapter in the AR4, Lenny Bernstein and Joyashree Roy. Lynn Price a Lead Author in the Industry Chapter was the rapporteur.

Robert Chase from the International Aluminium Institute (IAI) discussed how aluminium companies are implementing a global response to mitigating greenhouse emissions. To accomplish this, the IAI with its members have developed common standards through an initiative that comprises 9 voluntary objectives and 22 performance indicators. This initiative covers 70% of world aluminium production in developing and developed countries. The goal is to have an 80% reduction of Perfluorocarbon (PFC) emissions per tonne of primary aluminium in comparison with 1990. To achieve this, IAI members have introduced new technologies internationally, monitor progress through an IAI benchmarking program, and emphasize increased aluminium recycling and use of aluminium in transport vehicles to reduce emissions from that sector. Progress is also continually monitored through an Annual Industry-wide Survey. The 2004 Survey showed that the Industry had achieved a 73% reduction in PFCs per tonne of production in 2003.

Jon Davis from Rio Tinto discussed lessons learnt by the mining industry in the commercialisation of new technologies. Interestingly he pointed out that initially many of the technologies were not immediately adopted and in some cases took decades to be implemented due to the high financial risks associated with failure. Of 43 projects in the industry, 16 failed at a cost of \$20B. Reasons for failure included poor project phasing, no continuity in project team, turn-key fixed price project, major new technology, and poor management. The key lessons to the successful introduction of a new technology are to carefully trial the technology and demonstrate it as well as have excellent and consistent project management. He stressed that the lessons learned are applicable to the field of carbon capture and storage where current visions emphasize a few large-scale demonstration projects, but where he feels small, medium, and large demonstrations are needed to build confidence and avoid large-scale failures.

Yanjia Wang from Tsinghua University discussed four case studies from the coal, pulp and paper, textile and steel industries in China. The four case studies illustrated problems related to intellectual property rights (IPR), project economics, acquisition of “software” to accompany hardware, and lack of information dissemination after a successful pilot project. She suggested the three key ways to improve technology transfer are to improve communication between the supplier and receiver, build a platform or database for sharing information and expanding the system for technology selection and assessment.

Francisco Aguayo from El Colegio de Mexico introduced the concept of “technological regime” which is the complex of scientific knowledge, engineering practices, business and production process practices, standards, regulations, and institutions. He explained that technological change involves all of these elements, is usually incremental, new technologies typically develop in niches and continue to develop while diffusing. He identified a number of aspects that he believes will reduce the speed of technology transfer to carbon free technologies, including the fact that the current energy system is based on hydrocarbons and the status and inertia inher-

ent in established systems will restrict the uptake of carbon free energy technologies. He explained to overcome these barriers depends on capital turnover rates, local absorptive capacity, the economic environment, and industry's ability to identify alternative and complimentary pathways that over time will result in greater adoption of carbon-free energy technologies.

Mr Okazaki from Nippon Steel discussed how the Japan steel industry had through its voluntary initiative taken several technological actions that were resulting in reduced greenhouse gas emissions. This included utilization of waste plastics and tires, development of eco products such as high tensile steel to increase the energy efficiency of automobiles, and utilization of waste products such as blast furnace slag. He also described international collaboration in technology transfer by introducing energy saving technology into developing countries, such as the Japanese effort to disseminate coke dry quenching (CDQ) and top pressure recovery turbines (TRTs) in China. Nippon Steel is participating in a METI international collaboration effort as well as the International Iron and Steel Institute CO₂ Breakthrough Program.

Bhunu Swaminathan from the International Fertilizer Association (and the Fertiliser Association of India) gave the background of the global fertilizer industry (accounts for 1-2% of global energy use and GHG emissions) and of the evolution of ammonia production technology and how, due to environmental legislation and cost considerations, high levels of energy efficiency and process reliability had been achieved. In developing countries there are now many efficient ammonia plants as a result of changes in global demand for fertilizers, national strategies for food security, transport costs and distribution of raw materials. She also stated that to continually refurbish or build new ammonia plants requires understanding of some key drivers such as regional differences, labour costs, qualifications of professionals and compatibility of equipment. She stressed that a predictable regulatory framework, accessible documentation of real-life performance of new technologies, and ability to secure financing are key technology transfer enabling factors.

Casey Delhotal from the United States Environmental Protection Agency (US EPA) explained the importance of modelling to demonstrate the cost and diffusion of methane abatement technologies for an economy. The US EPA has developed marginal cost abatement curves for 100s of non-CO₂ mitigation options that can be used by both "bottom-up" and "top-down" modellers to assess the mitigation costs and savings over time for the coal, natural gas and solid waste sectors. She pointed out that experience indicates there can be policy barriers to technology diffusion such as concerned citizens groups, the rate of return and vintaging issues can affect adoption rates, and that innovation takes place as technologies are used and such changes can vary by regions.

Dr. Izumi from Taiheiyo Cement Corporation explained how the Japanese cement industry has developed technologies that use the wastes and by-products of society as alternative fuel and raw materials. Although there is a slight increase in electricity consumption as a result of having to pretreat the wastes, the outcome is a reduction of total GHG emissions when such wastes, particularly fossil-originated wastes, are co-processed in cement manufacturing instead of simply being incinerated. He believes these processes are key technologies to reduce GHG emissions whilst tackling waste issues, are also applicable in developing countries, and that Japan can assist interested cement companies in developing countries with the technical expertise in transferring the technology.

2.3 Energy Intensive Consumer Goods

A breakout group of experts intensively discussed the various aspects of technology transfer and diffusion in the automobile, energy efficiency and consumer good areas. Eight papers were presented. The group was co-chaired by Bert Metz, Co Chair of WG III and Diana Urge-Vorstz a CLA for the Chapter on the residential and commercial and mitigation options (including services) in the AR4 assessment.

Masayuki Sasanouchi from Toyota discussed CO₂ reduction in the transportation sector. A key factor to recognise in the use of vehicles is rising incomes are directly linked with vehicle purchase. In developing countries there are also similar and additional issues such as ambient air quality.

Toyota is developing several technologies and takes a parallel approach by examining fuel cells, hybrid, electric vehicle and other options. This approach is taken for reasons of competitiveness with not only external competitors but also internal divisions, and also because no company, as he stated “have no right to press consumers in a particular direction”. This means that companies prepare options from which consumers can choose, and that reduction of greenhouse gas emissions and other environment issues is just one consideration in the consumer’s choice of vehicles. Further, the approach will be able to realize the balance between environmental performances and other ones (e.g. drivability, safety and comfort), and faster achievements of R&D. He also stated that it is important to compare the reduction cost amongst technologies such as between the automobile, industry, forestation, sequestration, and other industries.

Suzana Kahn Ribeiro presentation was on the potential CO₂ reduction through the use of hybrid buses in Brazil. She pointed out that the buses are used widely in developing countries with many bus companies privately owned. She argues for a hybrid bus approach, in which five issues must be addressed to make progress in reducing transport emissions with buses. The five issues to consider are perceptions of advantages; simplicity of application; ease of understanding; product credibility; and reversibility of use.

George Hansen from General Motors identified several drivers that influence the automobile industry including a competitive environment, social factors, safety, environment and regulatory factors. Linked with this is that mobility is essential to economic growth and improved living standards with direct links between vehicle ownership and Gross Domestic Product (GDP). If business as usual trends for automobiles continue it is likely there will be a doubling of GHG emissions by 2050. Therefore the introduction of new transportation technologies is critical. He stressed that it is important not to choose one technology over another and to avoid regulations that lock-in obsolete technologies.

James Sweeney discussed options for hydrogen use in light duty vehicles. He argued that the governmental policy driver for technology development/implementation is not only climate change. In the case of hydrogen technologies in the United States energy security, local pollution and mitigation of climate change all play a role. If critical R&D challenges can be overcome in the creation of fuel cell vehicles, and in economic, safe production, storage and distribution of hydrogen fuels, then hydrogen has a huge potential to reduce emissions in the transportation sector. With breakthrough technological advances in fuel cells and hydrogen storage on-board vehicles, hydrogen could become a substantial energy carrier similar to electricity. But

the barriers are huge and there has to be an appropriate feedstock that does NOT accentuate the problem and/or technologies to capture and permanently sequester carbon dioxide. At the moment the current cost estimates for feedstocks indicate that coal (gasification and sequestration) and natural gas are the most economic. He suggested that hybrid vehicles will provide a major competition to hydrogen vehicles during the next several decades and may well be a more cost-effective way of reducing carbon-dioxide releases, absent the needed technological progress.

John Nyboer addressed the issue of how one might critique policies and programmes designed to enhance technology development and diffusion. Given that models are often used in such analyses, he noted that most current models are either bottom up, which tend to underestimate costs and overestimate technology diffusion, or top down, which tend to do the opposite. He described CIMS, a hybrid model his research group developed that endogenously simulates technology evolution over time based on the behaviour of decision makers. He explained how 'discrete choice' modelling helps to empirically define parameters for this hybrid model such that technologies used to provide goods and services are chosen based on an understanding of the behaviour of consumers in industrial, commercial, residential and transportation sectors.

Natasa Markovska illustrated with case studies the key role that capital plays in the transfer of technology. In the case of Macedonia it was also important to recognise that a supportive infrastructure for technology development and transfer as well as public awareness amongst consumers and industry was needed for successful technology transfer.

Sheng Zhongyuan discussed the energy saving potential of China. He pointed out that technology improvement and economic structure change are difficult to achieve over the short term. He argued that China is not as inefficient compared with Japan as assumed, because of mistaken assumptions about exchange rates. He also pointed out that there is massive potential for energy efficiency savings in China with the right technological incentives. Finally, Shigetoshi Seta said with the linking of energy and the economic growth it is important to recognise the use of technological innovation through structural life style change.

The discussion from participants identified several drivers and limitations to transfer and diffusion of technology. The point was made that companies do research and development on technologies to gain a competitive advantage. Multi-national companies that invest in various countries, operate manufacturing plants and market goods and services play a key role in technology transfer and capacity building in both developed and in developing countries. Again it is competitive advantage, typically in proprietary technology and know how embodied in management systems, that provides competitive commercial opportunities for new investment by companies. Therefore the use of science and technology can be a key proprietary intellectual property right asset for individual companies, and with the proper enabling framework a key driver for technology dissemination and capacity building.

There was a general agreement that the transfer and diffusion of technology must take into account regional disparities for technology development and dissemination. Technologies will be driven by a number of factors within a region, such as the existing legal and market framework and availability of resources in a country at the local or regional level. Access and use of these resources will also be dependent on a region or country having the appropriate infrastructural delivery systems. It was pointed out that because of these factors, technology development and transfer issues will remain different between developed and developing nations and result in im-

plementation issues. There was also the point made that the best technological pathway for one country might not be for another country, such as a preference for hybrid vehicles rather than using biofuel vehicles.

Some key elements for effective technology transfer and diffusion identified were a clear legal framework with protection of property rights, free movement of capital, goods, people and services, and maintenance of safe stable conditions for workers and communities. Across many developing countries the legal system and property rights can differ tremendously in this regard. Other elements included competitiveness as a market driver and consumers purchasing power differences within a country.

The group also discussed the cross cutting model of Jae Edmonds and Jose Moreira. The paper is excellent in defining important input and performance components of technologies that must be considered in assessing how they might compete and emerge in regional global markets. However, the model was perceived as being very data hungry and not yet having an adequate analytical framework with a suggestion that it needed further revision to be effective. Finally, factors related to consumer choice and appeal often play an important role in technology change, and it is unclear how such factors, beyond the strict financial costs should be included in an assessment.

Private sector participants expressed the view that it is not possible to establish accurate costs and market shares for future technologies, or to rely on specific scenarios to assess likely success. Once a new technology begins to penetrate regional markets on a large scale, it will interact with other competing technologies and affect the relative costs of various critical inputs, such as the supply of primary energy from gas, coal or renewables. As well, technologies can rarely be assessed on a single global scale; critical factors differ from region to region that affect relative costs and potential market penetration. In addition, to the extent that a new technology begins to displace other providers, they will react to compete and to re-establish market share. Thus multiple competitive interactions, dependent on numerous participants in the market and the availability and relative price of primary and secondary inputs will affect ultimate costs and penetration rates of innovative technology. Hence, it is considered to be more important to identify and characterise key factors that affect the production and performance of innovative technologies, than to seek to predict accurate costs, for example through particular scenarios.

2.4 Electricity Production and Energy Carriers

A working group of experts intensively discussed the various aspects of technology transfer and diffusion in the electricity production from the gas, coal, nuclear and hydro sectors. Nine papers were presented to provide background and examples of the issues facing industry in technology development, transfer and diffusion. The group was co-chaired by Greg Tosen from Eskom, South Africa, and Jose Moreira a review editor in the energy supply chapter of the AR4 assessment.

Two papers discussed the important role of nuclear power as a mitigation option. Ravi Grover from the Department of Atomic Industry in India and Nicole Dellerio from AREVA, France identified several key factors needed for technology transfer in nuclear technology. This included environmental safety, GHG mitigation and the use of new nuclear technology that allows for the possibility of producing hydrogen. Nicole Dellerio stressed the need for common interna-

tional regulations and institutions coordination in the management of risk, security and environmental protection in the nuclear industry. Ravi Grover brought out the growth in electricity demand in India and the plans to meet a part of this demand based on nuclear power. He said that nuclear growth is hampered by restrictive trade practices in the nuclear industry and there is a need to have a fresh look at these practices.

Jurgen Engelhard from RWE Power AG stressed that any long term CO₂ reduction strategies must consider a sector's specific requirements and the technical as well as economic possibilities of introducing new technologies and the lead times this will require. An example he gave was the research and development of CO₂ capture and the hydrogen turbine. It was also important to recognize that any introduction of new technology in his industry sector would be measured against economic efficiency, security of supply, investment certainty and the expense of developing energy-efficiency power plant.

John Scowcroft from Eurelectric with Emmanuel Matsika from the Centre for Engineering in Zambia identified in their presentations the Clean Development Mechanism (CDM) as a key technology driver for technology transfer in developing countries. They also stressed that if the CDM was to be successful the rules and procedures needed to be simplified and designed in a more business-friendly manner to encourage new technology investment in developing countries.

Two papers on the use of natural gas raised two important issues. The first is the use of Liquefied Natural Gas (LNG) would have a high potential for CO₂ emission reductions if countries such as China or India replaced oil or coal with LNG. There is also a desire in Japan to transfer LNG cryogenic energy utilization technologies to developing countries. The second issue raised was the efficient utilisation of natural gas through distributed generation. Japanese gas utilities are working on developing a model that will allow for distributed energy networks based on co-generation and utilizing natural gas and they believe this model could also be applied in developing countries.

Ildo Luis Sauer from Petrobras outlined several actions that Petrobras as a developing country power company was doing to enhance energy efficiency and mitigate greenhouse gas emissions. This included a renewable energy project portfolio, fostering the use of natural gas for power generation and the production of biofuels on a large scale in Brazil.

Xiliang Zhang from China discussed how China was encouraging the deployment of renewable energy technology. He said it was important to recognise that China was developing a feed-in tariff and renewable energy portfolio standard based on European experiences. In addition, the Chinese Government is giving direct economic incentives to renewable energy development and deployment as well as supporting research and development in technology transfer.

Many of the papers identified common drivers with electricity sector experts recognizing that the developments needed in energy technology require continuous technical improvements through more research and development especially industrial-scale testing in demonstration plants to assess new technologies performance, cost and environmental impacts. Unlike by many participants in the other breakout groups, the use of CDM was seen in this breakout group as an important driver for developing countries in the transfer and diffusion of mitigation technologies.

Several other common crosscutting themes for all presentations in this group were the need to take advantage of indigenous resource endowments. It was also important that new low emissions technologies, and even CDM projects, be cost competitive with alternative technologies or approaches. The common theme throughout the presentations in this breakout group is that technology transfer and technology diffusion by industry will be governed by concerns regarding economics and competitive advantage.

3. Synthesis and Recommendations from all Breakout Groups

In the concluding session, rapporteurs Lynn Price, John Scowcroft and Diana Urge-Vorsatz a Co Chair from the Energy Intensive Consumer Goods breakout group, presented the findings of their groups. There were several common drivers and limitations to industrial technology development, transfer and diffusion identified in the breakout groups.

Industry understands that the substance of the assessment of AR4 is the responsibility of the CLA and LAs. However, it is hoped that the issues and recommendations identified by the breakout groups will improve the assessment of AR4. The following key drivers were identified:

1. **Competitive Advantage:** Many of the industry representatives attending the Meeting work within an open market. The common elements needed to create and use innovative technology included a company being able to maintain their competitive advantage through open markets that allows for protection of intellectual property rights. It was pointed out that companies spend hundreds of millions in research and development to develop better products and as such they want to protect that advantage when they introduce the technology to the market place. Such protections are essential to preserve the ongoing ability to innovate through costly research and development.
2. **Regional Differences:** Participants recognised that there are regional differences and that it is important to understand this when transferring technology. This is particularly important if industries have different definitions of regional differences. For example while a fuel cell/hybrid vehicle may be a possibility in some countries it might be more sensible to use bio-fuels in other countries.
3. **Country Specific Characteristics:** It was pointed out that country's current economic and political infrastructure differs as well as natural resource endowments. Other specific characteristics include limited infrastructure/support services, weak economic conditions with slow economic growth and high deficits, or prevailing corrupt practices by officials. In many countries there was also limited availability of intellectual skills in various fields, such as engineering and management. The scale of facilities can differ and in one presentation the example of China's steel industry was given where there are thousands of small industries in steel making instead of a few in other countries such as Japan.
4. **Intellectual Property Rights:** This was a major issue across all the breakout groups. The IPR issue is seen by many as a key obstacle to get advanced technologies to countries that need it, and to maintain the ability to invest in R&D for future innovation. Companies need to ensure that their investment in the research, development and commercialisation of new

innovative technologies is protected under rules of law as explained under item 1 ‘competitive advantage’.

5. **Improve information links:** The participants at the Meeting were supportive of continuing some form of interaction between the IPCC and the industry representatives attending the Meeting. In addition to the input from Consultants and Academics, it is also important to have access to the expertise and databases of Industry through links with their relevant Associations. It was also recognised that there is a need to improve information on technology options that can help enterprises to have a fully informed choice on the best technological option for them. When preparing future projections or scenarios, it would be desirable to take account of technological realities and limitations by consulting relevant industries on the actual scope for improving their sustainability performance through technical and operational changes/improvements. One suggestion was to develop multilateral partnerships and exchanging of information with a clearer scenario on the implications of the selection of different alternatives.
6. **Leapfrogging opportunities:** It was unclear to whether this concept actually did work and why and how leapfrogging can be encouraged. In some cases, especially where competing in global markets, companies investing in growing developing countries have the opportunity to build modern grass roots facilities that do embody advanced design and manufacturing capabilities that often exceed capabilities in older facilities in developed countries. On the other hand the initial roll out of truly innovative technologies and products may require immediate access to skills, resources and markets that are not readily available in developing countries. It was suggested that some case studies and success stories would be useful to show best practice to the rest of the world. The point was also made that IPR and leapfrogging were linked and the difficulties in making IPR work when there was a lack of rule of law in a country that fails to penalize firms that replicated technology that was patented.
7. **Education and information awareness:** One of the drivers and also limitations identified was the lack of information between suppliers and users. This has implications for the transfer of technology in developing countries with inadequate information of workers or consumers using the technologies and products. A further issue raised was the likelihood of their being gaps in the literature for the AR4 authors and how industry could assist in the supplying of relevant and eligible information.
8. **Regulatory Frameworks:** Companies work within a regulatory framework and countries differ in their legal and regulatory frameworks and capacity and practice to enforce regulations. However, there are some common elements and that includes the use of government incentives, government commitment to GHG emission reductions, energy security issues and economic development strategies. The point was also made across many of the groups that the rule of law and investment certainty was a factor influencing industry on where they established technologies.
9. **Consumer Acceptance:** A technology is dependent on consumers wanting it. The point was made that many companies respond to consumer demand and that environmental factors are one of many elements that a company will consider. Environmental stewardship is an important factor that was acknowledged by all the breakout groups. It is an important element for companies in responding to regulatory trends, compliance with their own environmental

policies and management systems, as well as growing middle class and environmental NGOs concerns in the design of their products. In this context it is important to take due account of the full life cycle of the material or product including all its applications, when seeking a justification for the resources utilized in their production. Another important element linked to consumer acceptance is marketing. Companies use marketing, as a tool to promote and encourage the use of their technology and it needs to be considered in any assessment of technology transfer and diffusion.

10. **Risk Management:** The perceived risk related to technical and economic performance (including safety) and market structure will impact on the development of a technology. A lack of infrastructure and incentives to manage risk are factors that will influence the transfer and diffusion of technology. It was recognised that companies have a responsibility to provide technologies that are safe for the environment as well as for workers and the wider community wherever they operate.
11. **Research and Development:** R&D is a key driver for companies to maintain their competitive position through the development and implementation of new technologies and products. Research and development is expensive and by its very nature is uncertain if a company will be successful in developing a new technology or product. Government's need to recognise the risk associated with research and development and need to be equitable in their distribution of funds for technological research. The example was given that while funding renewable energy technologies is needed it must also be recognised that clean coal and nuclear technologies also play a key role in mitigation of GHG emissions and should not be discriminated against.
12. **Technological Development Pathways:** Among some of the participants the question was raised on how to help decision makers make the appropriate choices on technological development pathways, without picking winners and losers. In China this is a major issue with various studies being undertaken on which pathway to follow in the development of the automobile as well as other technologies. The point was made that technology transfer would also be influenced by the role of human behaviour, regional resources, infrastructure and cultural differences with technological development pathways needing to be designed to reflect those differences. The diffusion of good operating practices can be as significant factor as the technology hardware itself in achieving improved performance.
13. **Cross Cutting Technology Conceptual Framework:** Many of the participants thought the Cross cutting technology framework paper presented in the plenary session by Jae Edmonds and Jose Moreira was a good start but there were concerns about the amount of information that would be required. Some participants felt it was cumbersome and would require a lot of data and could be a Herculean task. A suggestion was made to prioritise items in the framework to make it more efficient and less cumbersome.
14. **Costs and Technology Assessment:** This was a difficult issue to address. Industry takes into account a number of elements when deciding on cost estimates such as the technologies performance, cost to produce and manufacture, consumer acceptability, safety, enabling infrastructure, regulatory compliance and the technologies impact on the environment. Many of the industry participants do not believe it is possible to develop truly accurate estimates for future costs and market potential because significant technologies compete in many in-

teracting ways for raw materials and market share. Thus it is more important to develop better understanding of key characteristics of competing technologies, such as critical inputs and factors that affect relative performance, than to focus on limited scenarios that fail to reveal the complex interactions of modern markets. Some industry experts recommended that making accurate estimates of future costs and future market potentials of technologies is not possible. The different perspectives of the experts on the possible future market potential of technologies in the three sectors covered demonstrates the need for caution and additional research and analysis to provide a valid and consistent, qualitative and quantitative picture of estimating critical factors that affect costs, relative performance against competing technologies and future potentials of technologies. Scenarios that focus on particular pathways are of little value in assessing how competition among potential products and services plays out in modern markets. Industry participants warned that such scenarios often provide misleading information used to justify particular policy choices. However, there were participants that acknowledge that scenario analysis is a key driver in technology transfer.

Process Recommendations

A number of suggestions were made to improve communication of industrial information networks relevant for the scientific assessment of climate change mitigation and to explicitly involve industry input into the AR4 assessment process. One suggestion was that the IPCC use the CLA or LAs as focal points to maintain contact with the industry experts attending this meeting. In this way the appointed focal point could act as conduits to provide information and literature to the writing teams in the AR4 assessment. Another suggestion was that IPCC experts should actively solicit participation of experts from industry. Finally, as in this workshop, it is valuable to engage experts not only in participation at IPCC workshops but also in their planning.

All the breakout groups had volunteers to be Expert Reviewers and Contributing Authors in AR4 that will be followed up by the TSU. There also were offers from the Aluminium Institute, Eurelectric and the World Nuclear Association to identify experts within their membership suitable as Expert Reviewers or Contributing Authors. Participants also recommended more ongoing communication between the IPCC and the WBCSD, ICC, IPIECA and other associations.

To assist in identifying sources of industry information for the AR4 there were a number of suggestions by experts for sources of industrial information and they included:

- To continue contact with industrial experts at this meeting
- To use company-specific environmental/annual reports
- To use national-level annual surveys of industries
- To examine voluntary agreement program results
- To have follow-up meetings with industry to get feedback/additional information (industry representatives were enthusiastic about continuing to contribute to the IPCC process, and indicated a willingness to help pay for the costs of additional meetings)
- To gather information from industrial sector trade associations and organizations that have made projections and understand their particular sectors technology trends
- To use databases from IIASA, ICARUS, IEA
- To encourage participation of IPCC experts at technical workshops organized by industry associations

ANNEXES

In this part of the report supplementary material as discussed in the meeting is presented. It has been done in the form of annexes, which vary in length. In some cases it was possible to bring all the material to one section in the main part of the report.

Annex 1. Acronyms

AR4	Fourth Assessment Report
BAU	Business-As-Usual
CDM	Clean Development Mechanism
CDQ	Coke Dry Quenching
CEIT	Country with Economy In Transition
CLA	Coordinating Lead Author
CRIEPI	Central Research Institute of Electric Power Industry
ECN	Energieonderzoek Centrum Nederland
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GISPRI	Global Industrial and Social Progress Research Institute
GWP	Global Warming Potential
IAI	International Aluminium Institute
ICC	International Chamber of Commerce
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Authority
IPR	Intellectual Property Rights
LA	Lead Author
METI	Ministry of Economy, Trade and Industry
KP	Kyoto Protocol
PFC	Perfluorocarbon
TEAP	Technology and Economic Assessment Panel
TRT	Top Pressure Recovery Turbines
TSU	Technical Support Unit
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	United States Environmental Protection Agency
WBSCD	World Business Council for Sustainable Business Development

Annex 2. List of participants

Yoshihiro Ando

Toyota Motor Corporation
Japan

Francisco Aguayo Ayala

El Colegio de México
Mexico

Christopher Bayliss

International Aluminium Institute (IAI)
UK

Lenny Bernstein

L. S. Bernstein & Associates, L.L.C.
USA

Michael Bowman

GE Global Research
USA

Robert Chase

International Aluminium Institute (IAI)
UK

Jonathan Cobb

World Nuclear Association
UK

Emma Cornish

World Nuclear Association
UK

Ogunlade Davidson

Co-chair of WG III IPCC
Sierra Leone

Jon Davis

Rio Tinto Technical Services
Australia

Nicole Dellerio

AREVA
France

Casey Delhotal

US Environment Protection Agency
USA

John Drexhage

International Institute for Sustainable Development
Canada

Jae Edmonds

Pacific Northwest National Laboratory
USA

Juergen Engelhard

RWE Power AG
Germany

Brian Flannery

ExxonMobil Research and Engineering Co
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Ministry of Economy, Trade and Industry
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Michinobu Furukawa

Tokyo Gas Co.Ltd.
Japan

Jorge Gasca

Mexican Petroleum Institute
Mexico

Ravi Bhushan Grover

Department of Atomic Energy
India

George Hansen

General Motors
USA

Kimiko Hirata

Kiko Network NGO
Japan

Ai Hiramatsu

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Global Industrial and Social Progress Research
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John Kessels

TSU WG III IPCC
The Netherlands

Haroon Kheshgi

ExxonMobil
USA

Steve Kleespie

Rio Tinto
USA

Shigeki Kobayashi

Toyota Central R&D Labs
Japan

Pedro Maldonado

Universidad de Chile
Chile

Natasa Markovska

Macedonian Academy of Sciences and Arts
Macedonia

Teruaki Masumoto

The Federation of Electric Power Companies
Japan

Emmanuel Matsika

Centre for Energy, Environment and Engineer-
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Zambia

Bert Metz

Co-chair of WG III IPCC
The Netherlands

Grischa Meyer

VOLKSWAGEN Group
Japan

Leo Meyer

TSU WG III IPCC
The Netherlands

José Moreira

University of Sao Paulo
Brazil

Aki Mori

Global Industrial and Social Progress Research
Institute
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Ian Morison

Anglo America
South Africa

Hideki Muramatsu

Mitsubishi Material Corporation
Japan

Masakazu Nakamura

Japan Technical Information Service
Japan

Ikuo Nishimura

Tokyo Electric Power Company
Japan

Masahiro Nishio

Ministry of Economy, Trade and Industry;
National Institute of Advanced Industrial Sci-
ence and Technology
Japan

John Nyboer

Simon Fraser University
Canada

Hiroshi Ozaki

Japan Gas Association
Japan

Teruo Okazaki

Nippon Steel Corporation
Japan

Eiichi Onuma

Japan Cement Association
Japan

Kjell Oren

Norsk Hydro
Norway

Rajendra K. Pachauri

IPCC Chairman
India

Cedric Philibert

International Energy Association
France

Lynn K. Price

Lawrence Berkeley Nat.Lab
USA

Ashish Rana

Winrock International India
India

Joyashree Roy

Jadavpur University
India

Hiroshi Saito

Ministry of Economy, Trade and Industry
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Hoku Saito

Federation of Electric Power Companies
Japan

Toshiyuki Sakamoto

Ministry of Economy, Trade and Industry
Japan

Masayuki Sasanouchi

Toyota Motor Corporation
Japan

Ildo Luis Sauer

Petrobras Brasil
Brazil

Roberto Schaeffer

Federal University of Rio de Janeiro
Brazil

Zhongyuan Shen

National Development and Reform Commission
China

John Scowcroft

Eurelectric
Belgium

Shigetaka Seki

Ministry of Economy, Trade and Industry
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Shigetoshi Seta

Tokyo University of Agriculture and Technology
Japan

Taishi Sugiyama

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Industry
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Fertiliser Association of India
India

James Sweeney

Stanford University
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Ministry of Economy, Trade and Industry
Japan

Kanako Tanaka

The Institute of Energy Economics
Japan

Greg Tosen

Eskom
South Africa

Masatake Uezono
Citizens Alliance for Saving the Atmosphere
and the Earth (NGO)
Japan

Akio Ukai
Japan Gas Association
Japan

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Tsinghua University
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Fengqi Zhou
Energy Research Institute of National Development
China

Peter J. Zhou
EECG Consultants Pty Ltd
Zimbabwe

Annex 3. List of Papers presented

Opening Plenary Session

Hiroyuki Watanabe, TOYOTA	TOYOTA Challenge on Sustainable Mobility
Greg Tosen, Eskom	Technology and Climate Change Policy in South Africa
Teruki Masumoto, Vice- Chairman of Federation of Electric Power Companies	Electric Technologies to Address Requirement for the Ultimate Resource Productivity
Brian P Flannery & Haroon S. Khesghi, ExxonMobil, USA	An Industry Perspective on Successful Development and Global Commercialization of Innovative Technologies for Greenhouse Gas Mitigation
Taishi Sugiyama, CRIEPI Cedric Philibert, IEA	Scenarios of Technology and Infrastructure Transition in Energy Systems Energy Demand, energy technologies and climate stabilization

Energy Intensive Industry Breakout Group

1. Robert Chase and Eirik Nordheim, International Aluminium Institute The IAI Global Aluminium Sustainable Development Initiative
2. Jon Davis and Steve Kleespie, Rio Tinto Mining Industry Experience and the Commercialisation of Carbon Dioxide Capture and Storage Technologies
3. Mrs Yanjia Wang, Tsinghua University Barriers of Technology Transfer in China: Four Case Study Analyse
4. Jose Aguayo, El Colegio de Mexico Stepping off the Hydrocarbons Regime: The Challenge of Technological Transition
5. M. Nakamura, K. Kotani and T. Okazaki, JATIS and Nippon Steel Corporation Voluntary Initiatives of Japan's Steel Industry Against Global Warming
6. Bhunu Swaminathan, International Fertilizer Association Technology Transfer and Mitigation of Climate Change: the Fertilizer Industry Perspective
7. K. Casey Delhotal & Michael Gallaher, US Environmental Protection Agency Estimating Technical Change and Potential Diffusion of Methane Abatement Technologies for the Coal-mining, Natural Gas and Landfill Sectors
8. Akihisa Kanda and Eiichi Onuma, The Japan Cement Association Consideration of CO₂ from Alternative Fuels in the Cement Industry

Energy Intensive Consumer Goods Breakout Group

1. Masayuki Sasanouchi, Project General Manager, Toyota Motor Corporation A View from the Automobile Industry as a Manufacturer
2. Suzana Kahn Ribeiro, Federal University of Rio de Janeiro Potential Carbon Dioxide Reduction Due the Use of Hybrid Buses in Brazil
3. Dr John Nyboer and Dr. Mark Jaccard, Simon Fraser University Technology Diffusion in Industry
4. Natasa Markovska, Macedonian Academy of Sciences and Arts Driving Factors and Limiting Barriers of Technology Transfer in the Energy Sector in Macedonia
5. James Sweeney, Stanford University Options for Hydrogen Use in Light Duty Vehicles
6. George Hansen, Tom Marx and Terry Pritchett, GM Driving Technology in the Motor Vehicle Industry
7. Shen Zhongyuan, The Institute of Energy Economics Energy Saving Potential of China
8. Shigetoshi Seta, Tokyo University of Agriculture and Technology Efforts of the Japanese Chemical Industry to reduce Greenhouse Gas Emissions

Electricity Production and Energy Carriers Breakout Group

1. Dr. Juergen Engelhard and Dr. Johannes Ewers, RWE Power AG, Germany Clean Coal Technologies for Climate Protection: Utilize today's options and develop future potentials.
2. Dr. Hisashi Ishitani, Shiniichi Tada, Tomohito Okamura, Michinobu Furukawa, Keio University, Osaka Gas and Tokyo Gas, Japan Life Cycle Assessment of Liquefied Natural Gas
3. Ms Nicole Dellerio, AREVA, France Contribution of Nuclear Technology to Climate Change Mitigation
4. Xiliang Zhang and Cheng Rong, Institute of Energy, Environment, and Economy, China. Renewable Energy Technology Deployment in China: Opportunities and Challenges
5. Dr William Kyte, OBE, Powergen, UK, Dr John Scowcroft, Eurelectric Prospects for Technology to Address Climate Change
6. F. D. Yamba and Mr. E. Matsika, Centre for Energy Based Technologies With Particular Reference to Southern Africa
7. Ildo Luis Sauer, Gas and Power Director, Petrobras-Brazil The Experiences and Performance of Petrobras in the Rational Energy Use Area and Renewable Energy
8. Toshinori Shimamura, The Japan Gas Association Alleviating the Environment Impact by Networking the Natural Gas Fuelled co-generation Systems
9. Ravi Grover, Department of Atomic Energy, India Growth of Nuclear Energy in a Developing Country like India

Annex 4: Meeting Programme



INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
IPCC Working Group III — Mitigation



**Meeting Programme for IPCC
Expert Meeting on Industrial Technology Development,
Transfer and Diffusion
Date: 21-23 September 2004
Venue: Toshi Center Hotel, Tokyo, Japan**

Key Meeting Objectives:

- Identifying key drivers on industrial technology development, transfer, deployment and diffusion to be addressed in the AR4
 - Contributing to building the conceptual framework for the assessment
 - Gaining access to industrial information networks being relevant for the scientific assessment of climate change mitigation and improve the use of publicly available data sources from industry in the AR4
 - Explicitly involving experts working in industry in the WG III AR4 process (as lead authors, contributing authors and expert reviewers)
-

Meeting Programme

Tuesday 21 September

Session 1: Opening Session

0800	Registration Desk opens
0900	Welcome by representative of Japan Ministry of Economy, Trade and Industry and Professor Ogunlade Davidson IPCC-WGIII co-chair Welcome by representative of METI: Mr. Hiroshi Saito, Director General in Charge of Technology, Standardization and Environment
0910	Dr. R K Pachauri, IPCC Chairman Opening Address
0930	Dr. Hiroyuki Watanabe, Senior Managing Director, TOYOTA Motor Corporation <i>TOYOTA Challenge on Sustainable Mobility</i>
1000	Greg Tosen, Eskom, South Africa <i>Technology and Climate Change Policy in South Africa</i>
1030	Coffee/Tea Break
1100	Mr Teruaki Masumoto, Vice-Chairman, Federation of Electric Power Companies <i>Electric Technologies to Address Requirement for the Ultimate Resource Productivity</i>

- 1130 **Dr Brian P. Flannery, Exxon Mobil Corporation, Dr. Haroon S. Kheshgi, ExxonMobil Research and Engineering Company**
An Industry Perspective on Successful Development and Global Commercialization of Innovative Technologies for Greenhouse Gas Mitigation
- 1200 Lunch hosted by Ministry of Economy, Trade and Industry
- 1330 **Taishi Sugiyama, Central Research Institute of Electric Power Industry (CRIEPI), Japan**
Scenarios of Technology and Infrastructure Transition in Energy Systems
- 1400 **Cédric Philibert, Energy Efficiency and Environment Division International Energy Agency, France**
Energy demand, energy technologies and climate stabilization
- 1430 **Jaе Edmonds and Jose Moreira, Lead Authors for AR4**
Conceptual Frameworks for Technology Development, Transfer and Diffusion
- 1500 **Leo Meyer/John Kessels, Technical Support Unit for Working Group III**
Instructions to participants on how the Break out Groups will work
- 1530 Afternoon Coffee/Tea Break
- 1600 Break Out Group Sessions Begin
- 17.30 Close of Day One
- 1830 Reception hosted by the Keidanren-Japan Business Federation

Wednesday 22 September

Breakout Sessions All Day

- 0800 Meeting for stock take with Programme Committee and Co-Chairs of Break out Groups
- 0900 Break out Group sessions begin
- 1230 Lunch (Not provided)
- 1330 Break out Group sessions continue
- 18.00 Close of Day Two

Thursday 23 September

Break out sessions continue and Presentations to the Plenary with Discussion, Summary and Recommendations for further actions

- 0800 Meeting for stock take with Programme Committee and Co-Chairs of Break out Groups
- 0900 Break out sessions continue
- 1030 Coffee/Tea Break
- 1100 **Energy Intensive Industry Breakout Group Report back to the Plenary**
- 1200 **Energy Intensive Consumer Goods Breakout Group Report Back to the Plenary**
- 1300 Lunch (Not Provided)

- 1400 **Electricity Production and Energy Carriers Group Report Back to the Plenary**
- 1500 Summary with recommendations for further actions
- 1530 Chairman Professor Ogunlade Davidson closes the meeting
- 1545 Programme Committee and Co-Chairs Meeting

Break Out Sessions

Group One

*Chairs: Lenny Bernstein and
Joyashree Roy*

Rapporteur: To be decided

Energy-Intensive Industry (cement, refining, metals, chemicals)

Group Two

*Chairs: Diana Urge-Vorsatz and
Bert Metz*

Rapporteur: To be decided

Energy Intensive Consumer Goods (passenger cars, air conditioners and lighting equipment)

Group Three

*Chairs: Greg Tosen and Jose
Moreira*

Rapporteur: To be decided

Electricity Production and Energy Carriers (fossil, renewables, nuclear, Less carbon intensive fuels, efficient conversion, hydrogen)

Annex 5 Scoping Note to Meeting

Background

The Intergovernmental Panel on Climate Change (IPCC) is in the process of preparing the Fourth Assessment Report (AR4), which will assess the scientific, technical, and socio-economic information relevant to understanding human-induced climate change, its potential impacts, vulnerability to it, and options for adaptation and mitigation. In 2003, the outlines for its three Working Groups were prepared and approved by the 21st session of IPCC in Vienna (November 2003). The AR4 ("Climate Change 2007") will consist of three volumes¹:

1. The Physical Science Basis, by Working Group I;
2. Impacts, Adaptation and Vulnerability, by Working Group II, and
3. Mitigation of Climate Change by Working Group III.

In the preparation of these outlines it was recognized that Technology was one of the crosscutting issues, in particular as a key driver for the mitigation options. The AR4 of WG III should particularly address mitigation technology development and its transfer and diffusion. As mitigation technology is generally developed and produced by Industry, it was also acknowledged that the involvement of Industry in the AR4 of WG III is essential and would need reinforcement.

The 21st IPCC Plenary session therefore decided to hold an expert meeting on "Industrial Technology Development and Transfer" as a support to the AR4 of WG III. Dr. Shiketaka Seki of METI kindly offered to host this meeting in Japan (21-23 September 2004). This meeting should be seen as a step in a process of further improving the relationship of IPCC and Industry, in support of the preparation of the AR4 of Working Group III.

Introduction

Industry, through generation of electricity, emissions generated by use of its products, and the manufacture of products, influences a significant part of worldwide greenhouse gas emissions. Industry plays an important role in possible responses to climate change. Industry decisions on investments, operation of equipment, product development, and technological innovation will have an enormous impact on future greenhouse gas emissions. Industry investments in capital exceed governments' investments by far. Industry spending on R&D and innovation is also significantly larger than the R&D funding by governments and most of the envisaged "solutions" to climate change need to be realised by industry.

In the Fourth Assessment Report (AR4) mitigation of greenhouse gas emissions from industry will again be covered. It will not be sufficient to provide an overview of mitigation options and its potential. It is equally important to assess driving factors affecting CO₂ intensive energy systems and what roles different actors can play in such processes. Companies are producing and developing products that help to mitigate future greenhouse gas emissions. In addition, many companies are already considering and implementing mitigation of greenhouse gas emissions in their decisions. In some countries mitigation of climate change has become an important driver for the government's energy and environmental policy, which is affecting private sector decisions. The AR4 will need to reflect these developments.

Why Industry should have more involvement and input into the IPCC process?

This expert meeting will provide a forum for industry experts to engage the expert community advising on the mitigation of Greenhouse gases, and consider ways for enhanced industry input into the IPCC process.

¹ <http://www.ipcc.ch/activity/ar.htm#outline>

The IPCC scientific assessments provide policy relevant guidance primarily written for policy makers within Governments. Economic, technological and environmental policies that may be based on IPCC assessments could, therefore, have profound effects on industry. IPCC assessment reports receive worldwide coverage and are consequently used by current and future decision-makers and hence future customers of commercial products and services.

Evidently, it is important that the view of those experts involved in serving customers and competing in markets is represented in the IPCC assessment process. Participation of Industry will facilitate its decision makers' access to the latest information and thinking for their own strategic decision-making.

Previous IPCC work and industrial technology development, transfer and diffusion

IPCC has paid attention to technology transfer and to mitigation of greenhouse gases from industry. In the past, there has been involvement of industry experts in the preparation of the IPCC Assessment Reports² However, IPCC would like to considerably enhance this industrial involvement.

The Special Report on Methodological and Technological issues in Technology Transfer (IPCC, 2000) was a major effort to assess the literature on Technology Development and Transfer and understand the relevant processes and barriers, including those affecting the private sector.

The TAR WGIII report referred in various chapters to technology development and transfer and the role of the private sector (e.g. chapters 3, 5 and 9) and a few remarks can be made:

- Chapter 3 provides a view about the potential and cost to mitigate greenhouse gas emissions from various sectors. The role of industry and the private sector research and development was limited in the assessment and is not reflective of the large role that private sector R&D plays.
- Industry was not assessed as self-acting and self-deciding entities with their own way of making (strategic) decisions in which many considerations play a role and for which environmental issues form one of the many considerations.
- Further, it does not reveal the heterogeneous character of industry; there are many kinds of companies, ranging from energy-intensive to technology-intensive, from small to large (multinationals), from advanced to traditional, etc. Neither is it noticed that even within subsectors (e.g. car manufacturing, oil industry) there are significant differences, which are leading to different strategies to address climate change.

Objectives and scope of the expert meeting

The objectives of the Expert meeting on Industrial Technology Development, Transfer and Diffusion are:

1. Identifying key drivers on industrial technology development, transfer, deployment and diffusion to be addressed in the AR4
2. Contributing to building the conceptual framework for the assessment
3. Gaining access to industrial information networks being relevant for the scientific assessment of climate change mitigation and improve the use of publicly available data sources from industry in the AR4
4. Explicitly involving experts working in industry in the WG III AR4 process (as lead authors, contributing authors and expert reviewers)

² It needs to be mentioned that some experts working in industry were involved in preparing the TAR, the SRES, SRTT and the SR Aviation. In the preparation of the Special Report on CO₂ Capture and Storage and the Special Report on the greenhouse effect of substitutes for gases affected by the Montreal Protocol (HFCs and PFCs) more industry experts are participating.

The first and second objectives deal with contents. In order to have a successful meeting and useful results the meeting will focus on:

- A limited set of key issues/questions that are relevant for AR4 regarding the technology development and transfer processes – and in particular how the private sector practical experience can be integrated in more theoretical concepts (what can we learn from industry?)
- A limited set of industrial sectors /products– selecting a few where major GHG emissions occur, where major mitigation potentials exist, and where major technology development and transfer options may be considered.

The following key questions are considered:

1. **What are the driving factors of industrial technology development?** What are the current key driving forces in industrial technology development and why? What is the role of the private sector? What is the role of co-operation between industries in the development of technology to save energy and reduce greenhouse gas emissions, including an approach to make a life cycle assessment of industrial products? How important is technology development in corporate strategies? Is mitigation of future greenhouse gases a driving role, and if so, in which industry sectors, how and how much? Is there a common view on technology development? What differences exist in driving forces by region and by company? What are the key uncertainties in driving forces? How and how much depends on industrial technology development for one sector on technology development in other sectors? How are government policies affecting industrial technology development? How does geographical distribution influence industrial technology development?
2. **What are the factors that drive or limit the process of transfer and diffusion of technologies?** Are there views which are new or which were not sufficiently covered by the IPCC Special Report on Technology Transfer?³ In particular, what are the views of the private sector on technology transfer by investments into new market regions? What are the opportunities and barriers (including human and capital resources required) for transfer of technologies and what factors determine the rate of transfer of technologies? What are the key barriers for transfer of low carbon technologies and how can they be removed? What regional differences exist in transfer of technologies? What are the roles of the private sector?
3. **How to make accurate estimates of future cost and future market potential of technologies?** What elements need to be considered when estimating the cost and potential of technologies? What can be learnt from past estimates of cost and potential of technologies? How can new estimates of cost and potential of technologies be improved (e.g. by better considering fuel chain effects)? How to get reality checks with respect to estimates of cost and potential of new technologies? What is good practice in estimating cost and market potential of technologies? Is there a need to make regionalized estimates of cost and potential of technologies?

These three questions should apply to one or more of the following sectors/product areas:

- (i) **Energy-intensive industry** (e.g. cement, refining, metals, chemicals);
- (ii) **Energy-intensive consumer goods** (e.g. passenger cars, air conditioners and lighting equipment);
- (iii) **Electricity production and energy carriers** (e.g. fossil, nuclear, renewables, less carbon intensive fuels, efficient conversion, hydrogen).

Mitigation options that are primarily non-technical are excluded.

³ See Appendix I for a definition of Technology Transfer as it was used in the IPCC Special Report on Methodological and Technological issues I technology Transfer, IPCC 2000, ISBN 0521800082

To meet the third and fourth objective of the Expert Meeting, participants could be invited to give their input on the following questions:

- How to successfully involve industrial experts in preparation and reviews of the draft Assessment Report (lead authors, contributing authors, review editors, expert reviewers)?
- How insights from industrial information networks can best be used and tapped; what organizational arrangements (more expert meetings? Periodic communication with ICC, WBCSD, others) may help to keep the IPCC industry connection going?

Deliverables

The main deliverable of the meeting will be a meeting report that contains:

1. Overview of key issues to be considered in AR4 with respect to technology development, transfer and diffusion.
2. The papers that are brought to the meeting will be peer reviewed and therefore eligible for input into Working Group III and AR4.
3. Recommendations on using industrial information networks in the preparation of AR4.
4. A list of key contacts with expertise on industrial technology development, transfer and diffusion.
5. Recommended further actions.

Programme Committee

Name	First name	Company	Country
Dr. Bhombal	Hameed	Aditya Birla Group	India
Dr. N. Campbell	Nick	Atofina	France
Prof. O. R. Davidson (chair)	Ogunlade	Cochair of Working Group III IPCC	SIERRA LEONE
Dr. J.A. Edmonds	Jae	Batelle, Pacific Northwest National Lab	USA
Dr. A. B. M. Hoff	Ton	Energy research Centre of the Netherlands ECN	NETHERLANDS
Dr. H. Khashgi	Haroon	ExxonMobil Research and Engineering Company	USA
Dr. M. McFarland	Mack	DuPont Fluoroproducts	USA
Dr. J. R. Moreira	José	University of Sao Paulo	BRAZIL
Dr. G. Tosen	Greg	Eskom	SOUTH AFRICA
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Mr. J. Kessels (Secretary)	John	ECN	NETHERLANDS
Dr. L. Meyer (vice –chair)	Leo	RIVM	NETHERLANDS

APPENDIX I

In the IPCC Special Report “Methodological and technological issues of technology transfer”, IPCC 2000, Technology Transfer - in context of climate change – is defined as:

“A broad set of processes covering the flows of know-how, experience and equipment for mitigating (and adapting) to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research/education institutions. Therefore, the treatment of technology transfer in this Special Report is much broader than that in the UNFCCC or of any particular Article of that Convention. The broad inclusive term “transfer” encompasses diffusion of technologies and technology cooperation across and within countries. It covers technology transfer processes between developed countries, developing countries and countries with economies in transition, amongst developed countries, amongst developing countries and amongst countries with economies in transition. It comprises the process of learning to understand, utilize or replicate the technology, including the capacity to choose it and adapt it to local conditions and integrate it with indigenous technologies.”