REPORT

Integrated Research and Action for Development

Energy and Climate Summit - 2009

"MEETING NEW CHALLENGES"

3–4 February, 2009

Hotel Le Meridien, New Delhi

Integrated Research and Action for Development

About IRADe

(Integrated Research and Action for Development)

A 'think tank' that works with 'action tanks'

Integrated Research and Action for Development is a fully autonomous advanced research institute, which aims to do research and policy analysis, impart training and serve as a hub of network among various stakeholders. The institute focuses on research for effective action through multi-disciplinary and multi-stakeholder groups for executable solutions leading to effective governance. The key focal areas are:

- Environment and Climate Change
- Energy and Power System
- Impact of Policy Reforms
- Poverty Alleviation and Gender
- Action Projects with Communities
- Training and Capacity Building
- Policy Analysis and Knowledge Dissemination

Rural and urban development, technology assessment, etc. are some of the cross cutting issues that are not only embedded in research programmes but in Action, Training and Dissemination.

IRADe's Journey

IRADe engages with the ministries, public and private sectors, academic experts, NGOs and international agencies. IRADe has done important assignments from Ministry of Environment and Forest (MoEF), Ministry of New and Renewable Energy (MNRE), Ministry of External Affairs (MEA), Planning Commisssion, Department of Science and Technology (DST), Central Statistical Organisation (CSO), Self Employed Women's Association (SEWA), Standford University - USA, WINROCK International, The South Asia Network of Economic research Institutes (SANEI), United Nations Development Programme (UNDP), UNEP-Geneva, USEPA, British high commission, ENERGIA International - Netherlands.

IRADE has served as an independent evluator to assess the effiectiveness of different programmes and policies sponsored by government and quasi-government organization such as MNRE, Ministry of Power, REC on Solar, renewable and rural electrification schemes.

IRADe is designated as a **Centre of Excellence for Urban Development on "Urban Governance and Climate Adaptation"** by the Ministry of Urban Development (MoUD) and is recognized as a **Centre of Scientific and Industrial Research.**

The Executive Director is Dr. Jyoti Parikh who is also a **member of the Prime Minister's Climate Change Council.**

Report

On

Energy and Climate Summit 2009

Meeting New Challenges

Integrated Research and Action for Development (IRADe)

PREFACE

We organized this summit with a hope that it will generate multi-stakeholder debate in the area of energy and climate change. Climate change is already manifesting in a variety of ways. Is our energy sector ready with a response? We do know the responses needed for mitigation – viz. how to reduce greenhouse gases (GHG) from the energy sector. The list includes energy efficiency, renewable energy, fuel substitution, reducing gas leakages and power and energy losses, some of which are win - win solutions – i.e. they will generate additional benefits while reducing GHG emissions. The benefits include reduced energy costs, reduced pollution and waste and improved productivity and health among others. However, more challenging aspect is to anticipate climate change impact and to take precautionary measures to protect energy infrastructure from sea level rise, floods, different water regimes (hydro power), storms and cyclones – whose frequency and intensity may increase. As we are on the path of doubling, tripling and even quadrupling various industrial capacities and infrastructures to serve economy, these questions need to be addressed now, so that the decisions taken will ensure the safety and sustainability of the new infrastructure in future.

IRADe discussed coherent research agenda through these multi-stakeholder discussions and also a strategy to address these questions of great importance.

We are indeed fortunate and grateful to the Hon'ble Ministers from Ministry of Power and Minister of New and Renewable Energy, The Deputy Chairman Planning Commission who participated along with high level officials from various ministries, national and international experts and senior representatives from public and private sectors.

The enlightening viewpoints presented during the summit were the significant features of the event. I thank Shri C.D.Biswas, Mr. Vineet Kumar, Ms.Taruna Malhotra and Mr. Sanjjeev Nehraa for their help in putting these proceedings together. I also thank Shri J.K.Mehta, WEC-IMC for his assistance in preparing summit proceedings.

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ENERGY AND CLIMATE SUMMIT – 2009
COMMITTEES

Advisory Committee

Arora Arjun	Director General, Petrofed, Petroleum Federation of India
Bami PS	President, Indian Energy Forum
Chaturvedi P	Chairman, Centre for advancement of Science
Rashmi R. R.	Joint secretary, MoEF
Sharma R. S.	Chairman, NTPC
Parikh, Jyoti K	ED, IRADe

Organizing Committee

Govil K. K.	Senior Advisor, IRADe
Mehta J. K.	GM, WEC – IMC
Sahai Y.	Dir. (C & M), Petrofed
Singh Amarjit	Secretary General, IEF
Biswas C. D.	Member Secretary, IRADe

PURPOSE OF ENERGY AND CLIMATE SUMMIT -2009

Energy sector is closely linked with climate change. In July 2006, IRADe had organized an energy summit with the theme of "Implementing Integrated Energy Policy: The Way forward" inaugurated by the Prime Minister of India Dr. Manmohan Singh. It highlighted how each energy supply option has its inherent challenges, such as finite reserves, high costs, environmental impacts and expanding technology frontiers. To these factors, climate challenges have to be added. Although the developed countries are responsible for the current accumulation of Green House Gases (GHG) emissions, India as a responsible nation has shown willingness to contribute to the solutions. The Prime Minister's Council on Climate Change has finalized India's National Action Plan for Climate Change (NAPCC). The Plan has eight national missions. Among them are solar and energy efficiency missions. Much is written on what energy can do for climate change, but how will climate change impact energy sector is also important to understand.

KEY ISSUES AND QUESTIONS:

The key questions in the context of the growth of energy sector and climate change to be addressed are:

- How can energy sector contribute towards GHG reduction through power, coal, oil, natural gas, renewable, and nuclear sectors?
- What impacts and vulnerabilities are posed by climate change to energy infrastructure such as power plants, wind power generators, off-shore structures, pipelines, ports, and coastal industries? These would have to withstand storms, floods, cyclones, sea level rise, fluctuating water availability and higher temperatures that call for more cooling.
- What is the restructuring potential for "climate-proofing" of energy infrastructure in various sectors such as offshore oil extraction, LNG Ports, coastal pipelines, thermal power plants, wind power and so on?
- How would alternative water regimes affect Hydropower plans?
- What efforts are needed to make renewable and non-conventional energy commercially viable in the near future?
- How can energy sector help to fulfill the eight missions of National Action Plan on Climate Change (NAPCC) released by Prime Minister of India? Can energy sector firms help the poor under corporate social responsibility? (http://www.pmindia.nic.in/prelease/pcontent.asp?id=765)
- What are the implications for the energy sector of alternative positions in global negotiations for climate change? Can sectoral approaches succeed and under which conditions? Should norms for GHG emissions be compared per KWh, value of output, per ton of product such as cement or steel or per unit of energy used?
- What new technologies are needed on both demand and supply sides?

Climate change is a global issue, and sustainable development is the key concern for strategizing our responses. India has to also formulate its R&D priorities for the energy sectors keeping in view climate change issues.

PROGRAMME AT A GLANCE

Energy and Climate Summit -2009

"Meeting New Challenges"

Sovereign - I Hall, Hotel Le Meridien, New Delhi

3-4th February, 2009

Organized by: **Integrated Research and Action for Development (IRADe)**

3rd February 2009	
08.30 – 09.30	**Registration**
09.45 – 10.45	**Inaugural Session** **Dr. Kirit Parikh** - **Welcome Address** Member, Planning Commission **Shri Vilas Muttemwar** - **Special Address** Hon'ble Union Minister of State (Independent Charge) of the MNRE **Shri Montek Singh Ahluwalia** - **Inaugural Address** Hon'ble Deputy Chairman, Planning Commission **Shri Sushilkumar Shinde** - **Presidential Address** Hon'ble Union Minister of Power **Dr. Jyoti Parikh** - **Vote of Thanks** Executive director, IRADe
11.15 – 13.00	**Climate Change and Power sector** **Chair: Dr. Pramod Deo, Chairman, CERC** Mr. Rakesh Nath, Chairperson CEA & Former-Office Secretary Mr. A. K. Sharma, GM-Corporate Planning, NTPC Mr. S. K. Chaturvedi, CMD, Power Grid Corporation Mr. Tantranarayan Thakur, CMD, PTC India Ltd. Mr. P. K. Laheri, Director, Torrent Power
14.00 – 15.30	**Sectoral Analysis – Greenhouse gas Emission control** **Chair: Dr. Jyoti Parikh, ED, IRADe** Shri A. K. Mehta, Joint Secretary, Ministry of Urban Development Mr. Brian Dean and C. D. Biswas, ICF International and IRADe Mr. Rajat Gupta, Director, Mckinsey
16.00 – 17.30	**Climate Change and Coal sector** **Chair: Mr. C Balakrishnan, Secretary, Ministry of Coal** Mr. Manohar Sinha, Deputy Director General, GSI

	Dr. Anoop Singh, Indian Institute of Technology, Kanpur Dr. Ambuj Sagar, Indian Institute of Technology, Delhi Dr. Malti Goel, Former Advisor, Department of Science & technology
4th February 2009	
09.30 – 11.00	**Financing and Strategic Initiatives for Climate Change** **Chair: Mr. Shyam Saran, Special Envoy to PM.** Ms. Naina Lal Kidwai, Group General Manager and Country Head India, HSBC Mr. Naoki Sakai, Energy Specialist, Asian Development Bank Dr. Shailaja Sharma, Advisor Future Fuels and CO2, Shell India Mr. Manjeev Singh Puri, Joint Secretary, Ministry of External affairs
11.30 – 13.00	**Renewable options and Energy Efficiency** **Chair: Mr. Deepak Gupta, Secretary, MNRE** **Co – Chair: Dr. Ajay Mathur, Director General, BEE** Mr. Jens Burgtorf, Director, GTZ-IGEN Mr. A. K. Jain, Executive Director, Power Finance Corporation Mr. Gary P. Godwin, MD, UOP India Pvt. Ltd Dr. Tim Flannery, Environmental scientist, Australia Mr. Pradeep Chaturvedi, Chairman, Centre for advancement of Science Mr. Harish Mehta, Director, SuzlonMr. Saurav Yadav, World Bank
14.00 – 15.30	**Climate Change and Hydrocarbon Sector** **Chair: Mr. P. K. Sinha, Additional secretary & Financial Advisor, MoPNG** **Co-Chair: Mr. N. R. Raje, Director, CAER** Mr. Pramode Seth, Executive Director, Chief Corporate Planning, ONGC Dr. Cleo Paskal, Royal Institute of International Affairs, London Mr. K. K. Jajodia, Group Chairman, Assam Company ltd. Mr. Sanjay Das Gupta, Deputy General Manager, IOC
16.00 – 17.30	**Valedictory Session** **Chair: Dr. Kirit Parikh, Member, Planning Commission** Dr. T. Ramasami, Secretary, DST Sir Richard Stagg, HE British High Commissioner Mr. Suresh Prabhu, Member of Parliament Dr. U. D. Choubey, CMD, GAIL
Lunch Break: 1:00 – 2.00 P.M.	**Tea between session breaks**

ENERGY AND CLIMATE SUMMIT 2009

"Meeting New Challenges"

Executive Summery

Integrated Research and Action for Development (IRADe), organised "Energy and Climate Summit - 2009" on February 3-4 2009. The summit tried to cover many issues relating to the energy sector, and the climate change mitigation and adaptation. It is evident that the energy sector can actively take action to reduce emissions and address the climate change with energy efficiency and other measures,. The matter of concern is how climate change will impact energy sector, especially energy infrastructure. How the sector can safeguard against the natural disaster? What is the nature of fallback strategy, and what are the safety factors for infrastructure design? We are heading into an era where there is a paradigm shift in planning and strategizing economic growth, while maintaining equal importance to economic losses. Forecasting of occurrence of abnormal weather condition, energy saving/ conservation, reducing energy transaction costs, and limiting losses due to natural disaster such as floods, cyclones, hurricanes etc. will be as important as promoting growth. There is need for multi institutional activity, multi faceted approach of research development and deployment to formulate prudent solutions and implement solution to mitigate and adapt to climate change.

Senior Ministers and representatives of the government, private and public sectors and reputed experts from national and international organisations expressed their views and analytical observations on social, technical, scientific, financial, environmental, safety of ecology, and industrial infrastructures etc during the summit. The emerging thoughts from the deliberations and interactions were found to be highly relevant for groundwork to document way forward for action for development to meet forthcoming challenges of climate change and adapting the national energy security programme, to address climate impact. The details are as follows:

Inaugural Session

In his welcome address, **Dr. Kirit Parikh** said that in spite of the current economic downturn, India has to grow at 9 % per annum till 2030 to eradicate poverty. To sustain this growth rate, the Integrated Energy Policy projects energy mix requirement till year 2031-32. The cabinet, government of India has approved the Integrated Energy Policy document. It projects a requirement of up to 1,000 GW of power generation capacity by 2030, compared to the current level of 146 GW. During the process of economic growth India is expected to become a significant contributor of GHG emissions. The prime minister has committed that India, as a responsible nation, will not let its per capita GHG emission increase beyond average of OECD countries.

Honourable **Mr. Vilas Muttemwar** stressed on India's exemplary record in per capita GHG emission and reaffirmed the government's commitment of increasing investments in renewable energy. Renewable energy sources encompass a basket of technologies including solar, wind and biomass for both grid connected power and captive generation. The use of solar, and wind energy implies mitigation of carbon emission. The reduction of the use of fossil fuels particularly coal and oil as energy resources is a difficult task, and substituting of fossil fuel with the renewable

energy is a challenging task due to high energy intensity of fossil fuel. Significant R&D effort is needed to make use of renewable energy commercially viable. MNRE is initiating interest to promote international cooperation to facilitate transfer of technologies and exchange of information and knowledge with a view to improve the techno-economic viabilities of various renewable energy systems. They are also encouraging cooperation at the level of research organizations along with industry partners. Wherever feasible, cooperation through bilateral and multilateral arrangements is being facilitated. Currently, renewables account for approximately 9 per cent of India's total installed generation capacity.

Honourable Dr. Montek Singh Ahluwalia, Deputy Chairman, Planning Commission talked about his observation at World Economic Forum at DAVOS -2009, where constant references were made to climate change despite global economic meltdown. Next important climate change conference is scheduled at Copenhagen, and it is expected that an outline of solution and guidelines for post Kyoto scenario will be defined. Mitigation of climate change has been addressed in the government of India documents such as working group report on eleventh five-year plan, Integrated Energy Policy etc. The recent policy document on National action Plan on climate Change (NAPCC) specifies eight missions and each mission can be elaborated, planned, implemented, and operationalized. The climate change activities can be effective if some target for GHG emission is set. The objective of climate change projects can be evaluated on two sets of action i.e. mitigation, and adaptation. The other option is to agree how to distribute the emission and entitlement. The resources are to be distributed across the countries.

Honourable Minister of Power Sushilkumar Shinde stressed on the need of deliberation on the theme of the summit. India along with 189 nations has adopted the millennium declaration and set 2015 as the year for achieving the Millennium Development Goals objectives, and energy independence by ensuring 3 A's Accessibility, Affordability and Acceptability of energy resources. Energy plays a critical role in enabling the country to achieve economic goals. "Ministry of power" is fully committed to achieving the target of quality energy source i.e. electricity for all, at an affordable rate.

The Environment and climate are the concerns, which run side by side with energy production and distribution. The generation of electricity has been attributed to increase in the greenhouse gases in the atmosphere. The primary energy resource for power generation has been fossil fuel, and this scenario will continue. This sector is the largest single source of GHG emissions. The GHG emissions are carbon dioxides, oxides of nitrogen (NOX), small particles, and other air pollutants. The carbon concentration in the atmosphere has been of primary concern as this gas occupies major spectrum of GHG in the atmosphere.

The global warming can be maintained to a moderate global average temperature, provided the GHG concentration is kept within permissible limit. If carbon accumulation in atmosphere increases unabated then a catastrophic scenario may develop. This is the scenario we have to avoid. There are no other options but to control climate change to a moderate level now and gradually bring back to normal level. The Nation has been aware of challenges of climate change for many years. Our quest for energy security is equally essential to sustain accelerated economic growth. Major technological research and development (R&D) is required for sustainable development, and India can take initiative in this regard.

The summaries of all sessions are given below.

Climate Change and Power Sector

This sector is the largest emitter of greenhouse gases among all economic sectors. Some of the mitigation options in this sector are presented below:

Generation

- There has to be technological changes in the use of fossil fuels. The level of energy efficiency of existing power generation units (technology) in India is less than 35% efficiency, i.e. more than 65% of heat is wasted. Super-critical technology can substantially improve the efficiency of fuel's conversion to energy and power.
- Emphasis needs to be shifted from increasing plant load factors to increasing efficiency of the system.
- Indigenous development of Super-critical and Ultra-super critical Technology and materials required for the units and equipments.
- Rehabilitation and refurbishments of the old plants.
- The optimization of power plant operations, design of equipment and process and end users' saving should be attempted for power planning.
- There are new technologies of micro-turbines suitable for industries. There are advantages in having such captive power to provide generation efficiency.
- Clean Coal Technology (CCT) and Development of Integrated Gasification and Combined Cycle (IGCC) based power generation units.
- Economic Analysis of Combined operation of Carbon Capture and Storage (CCS) and IGCC.

Electrical Power Transmission

- Transmission and distribution losses can be curtailed with network planning and appropriate inter-phases.
- Development of High voltage DC transmission
- Promotion of captive power Generation with grid connectivity.
- Grid connectivity of power generated from captive and renewable sources.

Distribution

- Implementation of Decentralized distributed Power generation in the rural areas.
- Optimal loading of transformer and three-phase power supply.

Demand Side Management

- The Government of India has enacted Energy Conservation act 2001 to promote energy saving as one of its mission. The energy demand side management is to guide consumers on energy saving with use of energy efficient appliance and guide manufacturers and consumers on appliance quality with improved life cycle operation.
- Shift to energy efficient appliances in designated sectors through innovative measures and re-engineering to make the products more affordable.
- Investigation of mechanisms that would help finance demand side management programmes in all sectors by capturing future energy savings.

- Better technologies in illumination, transportation and conservation of power. New generation of lighting equipments, inverters as well as e-bikes and cars can certainly help in meeting the routine requirements with much less power than what is consumed in the present times.
- Management of reactive power in the distribution network has to be initiated.
- Greater use of renewal sources of energy viz., Wind, Solar, Bio and Sea waves could lead to much needed improvement. The share of renewal energy is insignificant, as technologies are priced high. The Governments world-over need to pay greater attention to this sector.
- Each individual needs to be proactive. There needs to be a change in thought of individuals and organizations as a whole to use electricity more efficiently and sparingly.

Infrastructure

- Climate proofing of the offshore installations is essential.
- Research is needed to study the impact of rise in sea level. The international law states that a nation has a jurisdiction control of sea surface up to distance of 200 miles. The rise in sea level and receding shoreline will create sea boundary disputes between neighbouring countries. International maritime power structure may alter due to submergence of small low-lying island.
- Uses of solar energy at the Industrial Installation and important building have to be promoted.
- Review of safety factors of infrastructure for all installations in the climate uncertainty prone areas is needed and augmented.
- Role of the regulator is very crucial in bringing about policies and changes in regulation, which will further enhance the renewable energy development in the country.

Sectoral Analysis- Greenhouse gas emission control

The theme of the session was primarily based on the role of policy and financial incentives to usher in latest technology and motivate industry, commercial installation to take up the greenhouse gas mitigation projects as sustainable development in addition to cost cutting drive. There is huge potential in urban areas, in buildings and other consumers, to mitigate emissions using the latest technologies and investing in cleaner projects. Investments will be forthcoming for sustainable development, in an enabling policy framework with the right incentives. Six primary production sectors are critical for GHG emissions mitigation. They are power sector, building, iron and steel, transport, Agriculture, cement. The energy efficiency measures have to be improved further backed by analysis and research in industry, buildings, transportation and agriculture. These efforts have to be augmented by managing terrestrial carbon sequestration, better investment in infrastructure development (public transport, low carbon freight transport and city design). In addition, one can also split consumers as in urban sector and rural sector.

- The industry should adopt advanced level of control system, automation, instrumentation and information processing. To make these investments effective, process re-engineering is needed with proper capacity building.
- The industry should be motivated for enhanced captive power generation based on renewable and national grid connectivity.

- Instead of addressing climate change separately, the approach needs to be holistic in a framework of sustainable development. Focus on Mission of Sustainable Habitat to organize cities so that they are energy efficient. (Solid waste management, desalination of natural water, optimisation transport systems and promotion of mass transport.)
- Low carbon technology promotion in India.
- Maintenance activities in the industry have to be streamlined for effective accrual of energy efficiency from the equipments. Life cycle analysis of process, infrastructures, and equipments is needed.
- A road-map is needed for implementing enhanced energy efficiency in small and medium enterprise (sponge iron, cement plant etc.)
- The major industry should review its working in the context of all missions documented in the National Action Plan on Climate Change.
- Clean coal technologies have a major potential, and the largest abatement potential lies in the power sector.

Climate Change and Coal Sector

The coal will remain as the primary fuel for India in future. as well. So the concern is that the efficiency of coal based units is very low and above all the Indian coal has very high ash content. Most of the coal reserves are located in the eastern part of India. There are many issues concerning coal, which need viable solutions. With reference to the theme of the summit, coal is responsible for maximum GHG emission as it is the primary fuel. Hence mitigation efforts of GHG emissions from anthropogenic sources are given attention on coal sector. Some of the activities are listed as under;

- Further research on Indian coal and imported coal is needed to evolve best practices to make coal suitable for advanced thermal power plant technology.
- Specifications of Parameters of deep coal Reserves are to be researched, for site-specific coal quality for underground coal gasification.
- Encouraged research on Underground coal gasification (UCG), for evaluating socio-Economic Impact of UCG
- Underground coal gasification (UCG) technology can play a vital role to mitigate environmental damage from mining and use of coal resources by reducing pollution in general.
- As per the estimate, approximately 35% coal reserves exist at 300-meter depth and beyond. These resources can be harnessed through UCG technology.
- For the development of consistent running programmes for application of UCG multidisciplinary approach is required. Pilot projects need to be carried out on a bigger scale.
- Three key policy requirements stated in one presentation are adoption of technology for efficient power generation, reducing emissions from use of agricultural pumps and up gradation of power distribution networks.
- IGCC and supercritical technologies are available in international market. These technologies can be adopted in India for improved and efficient power generation.
- The quality of indigenous coal is gradually deteriorating over the years. The processes of utilizing such coal and lignite have to be studied.

- Large-scale adoption of clean technology needs policy push beyond CDM and there is scope for international cooperation.

Financing and strategic initiatives

The enhanced energy efficiency is one of the missions that will benefit industry the most in terms of cost cutting. The process of enhancing energy efficiency will require investment apart from efficient workforce. The issues in the sector are (a) How to incorporate equator principle for sanctioning finance for projects (b) how to motivate and finance profitably small and medium enterprise (c) how to obtain low carbon technologies at reasonable prices and tune it to the Indian conditions.

- Identification and development of Climate Change related projects, for financing by Banks. Indian banks can have separate project proposal evaluation procedure, whether the project is climate friendly.
- Monitor the progress of RBI directives for Indian bank in line with equator principle for considering climate friendly features, for sanctioning project finance.
- Structuring optimal Public Private Partnership models where Climate Change related projects can be taken up and processed for financing by the bank.
- Augmenting enhanced energy efficiency in small and medium enterprise with financial instruments.
- There is a need for capacity building in the SME sector, particularly as they account for 60 per cent of the industry. Capacity building also needs to be undertaken with respect to CDM projects, validation of projects, independent agencies etc.
- To enable enhancement of sustainable development in developing countries, there has to be support in terms of technology transfer and financial resources from developed countries and international financial institutions.
- We need a collaborative approach based on a common and shared vision.
- On the financing side, banks are increasingly taking into account the effect of climate change in the form of draught, floods, change in rainfall, reduction in GDP, reduced standard of living etc while funding energy projects. The insurance mechanism for climate change feature must evolve.
- Companies that take environment into consideration generally tend to have better stock returns in the long term and attract equity and other investors.
- Venture Capital and private equity funding need to evolve for the sector, particularly the venture capital side as such funding is limited in nature. The early stage financing by such investors is critical to bring in new technologies and awareness about the long-term impact of climate change.
- Carbon credits principle needs to be looked at from a domestic perspective particularly as they have been set on a western carbon footprint.
- Global financing mechanism is needed to channelise the funds such as carbon credits.

Renewable Energy and Energy Efficiency Session

Mr. Deepak Gupta, Secretary, Ministry of New and Renewable Energy (MNRE) chaired and Dr Ajay Mathur, Director-General, Bureau of Energy Efficiency (BEE) co-chaired the Renewable energy and energy efficiency session. The key issues hampering the renewable energy sector,

as emerged from the discussion, are (a) cost of technology and cost of power, (b) reluctance among potential users as they find it cumbersome, (c) lack of penetration of technology and government initiatives in rural areas. The Ministry of New and Renewable Energy (MNRE) and BEE are working together to come up with measures to promote renewable energy in various sectors. The ministry is equally focused on taking on an industry-specific approach to increase the adoption of renewable energy. BEE is executing the enhanced energy efficiency mission in industry and the barriers are capital cost, lack of Information, and major concern whether technology will work or not. BEE has released Energy Conservation Building Code (ECBC) for Energy efficiency for buildings through improved building codes. The BEE is also targeting municipalities and the agricultural sector. It is working through energy service companies (ESCo) that are making investments and recovering costs from the energy savings achieved. Some of subjects to be considered for research are,

- Global energy demand is expected to grow at CAGR 2.1%. Fossil fuels are expected to supply 83% of energy and 95% of liquid transportation needs.
- Major barriers for the slow adoption of new technologies in the industry are capital cost, lack of information, and concern for whether technology will work or not.
- Three major tools for sustaining energy demand in future; practicing energy modesty, improving energy efficiency and developing renewable energy
- Biomass is also a potential fuel for energy conversion plants with carbon capture. Bio-char can provide a good potential for carbon sequestration and help in dealing with climate change, food, water, and energy crisis.
- Augmentation of Research on use of Algae for bio-fuel
- Energy efficiency and renewable energy have to develop together.
- Ministry of New and Renewable Energy (MNRE) and Bureau of Energy Efficiency (BEE) are working together and looking at sector specific interventions.
- Use of hydrogen as fuel, and fuel cell

Climate Change and Hydrocarbon Sector

The natural gas is the cleanest fossil fuel. The panelists agreed that the share of natural gas in Indian energy basket should be increased from 9 per cent (at present). The Reliance Industries, Gujrat State Petronet Ltd. (GSPL), Oil and Nature Gas Corporation (ONGC) have reported discoveries of gas in the KG Basin. Bio-diesel is another viable option for reducing emissions. The oil and gas companies in the country are working on efficiency improvements in operations. Indian oil is conducting R&D on fuel cells, advanced fuels & separation, and investing in renewable energy to reduce their carbon footprint. Indian Oil Corporation (IOC) is setting up a 21 MW wind project in Gujarat, and has also examined and optimised the synthetic processes for preparation of bio-diesel from various vegetable oils. The process has been patented and scaled up to the pilot level. The company has also commissioned India's first hydrogen compressed natural gas fuel dispensing station at its R&D center at Faridabad ONGC is going for pilot project on Enhanced oil Recovery with sequestration of carbon dioxide. ONGC has set up a 50 MW wind power plant at Jakhau in Gujarat. Dr. Jajodia motivated the delegates to take entrepreneurial challenges with innovative concepts to address the climate change issues.

- The oil and gas contributes about 45% of the India's energy mix, and 50% comes from coal and lignite, remaining 5% from hydropower and nuclear power.

- Hydrocarbon sector affects the environment at every step of the entire operational chain from (a) production that is extraction of mineral oil and gas, (b) the refining or the manufacturing and (c) the consumption by user such as transport.
- India's per capita CO_2 generation is very low as compared to Organisation for Co-operation and Development (OECD) countries but it is expected to rise almost by 60% by 2015.
- Three challenges and three opportunities during the time of climate change.
  a. Vulnerable energy infrastructure in coastal areas
  b. Vulnerable energy infrastructure in cold climates
  c. Legal infrastructure poorly designed for changing geophysical circumstances
- We have to achieve greenhouse gas reduction targets from operations by utilizing gas and reducing venting and flaring wherever possible.
- There is need of successful development of innovative and affordable technologies with low greenhouse gas emissions.

Valedictory Session

Dr. Kirit Parikh chaired the valedictory session where he presented the summary of the proceedings during the summit to the distinguished panelists, H.E. Sir Richard Stagg, British High Commissioner; Shri Suresh Prabhu, MP; Dr. T Ramasami, Secretary, Department of Science and Technology. Their observations on the issue are as follows,

- The energy security will depend on the enhanced energy efficiency, diversification of the current energy mix with increase in share of renewable energy, augment resource base with exploration, strengthening energy company, and climate proofing energy and allied economic infrastructure.
- Climate phenomena is like a prism, where climate occupies apex position, with energy, technology, and society/social choice put up at the base. An imbalance at the base causes climate change. The right combinations of base elements are needed to control the climate.
- The understanding of interaction of Climate with technology and energy are truly complex. We need to analyse what is the bandwidth of energy & technology spectrum because the energy policy must change with development of technology, demand & supply scenario, and preference of consumers.
- We have to develop a system for a decentralized solar power and use. There are no readymade solutions; we need to invent new and different scientific ways on our own.
- The public investments have a significant role to bring the global economy on a sustainable growth level.
- All the effective projects on climate change implemented in India will create confidence and provide inputs for the International negotiations. Indian government can take up "per capita emission" concept in the international negotiation from a moral prerogative perspective and evolve a realistic framework leading to a practical outcome.
- India has to pursue the solar mission like a developed country (Due to its geographical position India has benefit of sunlight). We must energize our existing solar mission.
- India cannot be a mute observer to the global concerns of climate change, even if it did not create the problem at the first place.

Recommendations

- Climate Change mitigations should be included in the Corporate Social responsibility (CSR)
- Institutionalized approach to combat Climate Change is required at the global level, so that it will facilitate exchange of information and appropriate authority will be aware of the development.
- There should be equity among the developing and developed nations on Climate change. The Developed nations should promote technology, as they have been able to develop infrastructure for technology development.
- CEO of Public Sector Undertakings (PSUs) must undertake responsibility of mitigation of emissions from their units. This will form a part of the MOU they sign with the government. Similar scheme should be deployed for private units.
- Use of renewable energy (biomass) in thermal power plant (including super critical plants) should be encouraged, and gradually increase its share as well.
- Development of intelligent grid and connectivity of non schedule generation capacity (such as solar and wind energy based power) is required.
- Incentives for Eco-housing system
- Mckinsey presentation indicates that for climate adaptation the expected investment on low carbon technology based systems will amount to 7% of GDP.
- The research on 2nd generation algal-based bio-fuels should be augmented. The algal-based bio-fuel requires water (need not be pure water) and carbon dioxide.
- The use of bio-char obtained from slow pyrolysis of agricultural waste can be used for restoring carbon of the Soil, and carbon sequestration.

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MINISTER OF POWER
GOVERNMENT OF INDIA
NEW DELHI - 110 001

04 FEB 2009

सुशीलकुमार शिंदे
SUSHILKUMAR SHINDE

MESSAGE

I am happy to learn about the "Energy & Climate Summit – 2009" being organized by the Integrated Research and Action for Development (IRADE).

The world recognizes that GHG emission from the developed countries have primarily contributed to climate change. We as a responsible developing country are committed not to allow our per capita emissions to exceed those of the developed world. Under the National Action Plan on Climate Change, the Ministry of Power is preparing the National Mission on Enhanced Energy Efficiency, so that, we pursue a pattern of sustainable growth.

I congratulate IRADE for this most timely event and wish the summit and the newly set up Global Climate Change Centre all the best.

(SUSHILKUMAR SHIINDE)

विलास मुत्तेमवार
VILAS MUTTEMWAR

सत्यमेव जयते

राज्य मंत्री (स्वतंत्र प्रभार)
नवीन और नवीकरणीय ऊर्जा
भारत सरकार
MINISTER OF STATE (INDEPENDENT CHARGE)
NEW AND RENEWABLE ENERGY
GOVERNMENT OF INDIA

MESSAGE

I am happy to learn that **IRADe** has organized "**Energy and Climate Summit 2009"** on February 3-4, 2009.

Energy is the key input for socio-economic development of any nation. The fast industrialization and rapid urbanization besides mechanized farming have generated a high demand of energy in all forms i.e. thermal, mechanical and electrical. To meet this ever-increasing demand, fossil fuels such as coal, oil and natural gas have been over-exploited in an unsustainable manner. The overexploitation of fossil fuels have been posing serious environmental problems such as global warming and climate change.

Climate change is a realty now. In the near future, the effects of climate change will impact all of us adversely, but will severely affect the poor. Changes in average temperatures, rainfall patterns and monsoon timings will affect India's entire environment, especially the nation's water resources, sea-levels and biodiversity, impacting a wide range of sectors, particularly agriculture.

The Government of India has recently announced the NAPCC (National Action Plan on Climate Change), which mainly focuses on mitigation of greenhouse gas emissions by adopting various means. NAPCC entails eight national missions representing multi-pronged, long-term, and integrated strategies for achieving key goals in the context of climate change.

Renewable Energy sources have emerged as a viable option to achieve the goal of socio-economic development and mitigate climate change. Apart from promotion of Renewable Energy, other issues of consideration are energy security, energy efficiency, energy pricing and the relationship of energy and environment.

I am sure that the Summit would deliberate on such issues with depth and sight which would help to generate awareness about climate change and benefit of new and renewable energy use.

I wish the summit great success and wish all the best to **"Energy and Climate Summit 2009"**.

(VILAS MUTTEMWAR)

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PRIME MINISTER'S OFFICE
New Delhi - 110101

January 28, 2009

I take this opportunity to congratulate IRADe for organizing the "Energy and Climate Summit" on February 3 & 4, 2009.

The challenge of climate change has brought together nations across the globe. This is a complex challenge. The world needs to mobilize all its technological and financial resources to meet this challenge. We have to find resources for adapting to climate change that has already taken place and which is likely to continue to take place in the coming years. There is the related challenge of mitigation which also involves substantial costs of making a strategic shift, from an economy based on carbon and fossil fuels to one essentially based on renewable energy sources. The requirement for substantial resources is being posed precisely at the time of an ongoing global and financial crisis. It is our view that investment in tackling climate change must become part of the solution to this crisis. Otherwise the much needed global effort on climate change may well become its casualty.

India has launched an ambitious National Action Plan on Climate Change with eight well-conceived National Missions. These Missions are aimed at adaptation and also at mitigation but without sacrificing our developmental goals. Quite clearly we can be more ambitious in our endeavors if there is an equitable and supportive global regime, particularly in respect of technology transfer and financial resources.

I am confident that the event will provide a productive forum for serious deliberations on climate change issues with a focus on practical solutions. I wish the Summit all success.

Shyam Saran

(Shyam Saran)

बी. के. चतुर्वेदी
B.K. CHATURVEDI

सदस्य
योजना आयोग
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28th January, 2009

MESSAGE

I take this opportunity to congratulate IRADe for organizing "Energy and Climate Summit-2009" a highly relevant theme for every human being.

All stakeholders have the collective responsibility to guide the economic growth in a sustainable manner, so that the future generation is not excessively burdened and the progress of civilization continues.

The Summit will bring many stakeholders to discuss the missions and challenges ahead. I am confident that the event will generate awareness about the tasks ahead in future.

I wish the Summit all success.

B.K. Chaturvedi

(B.K. Chaturvedi)

राघव शरण पान्डेय
सचिव
R. S. PANDEY
Secretary

भारत सरकार
पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय
शास्त्री भवन नई दिल्ली–११०००१
उपभोक्ता पिन कोड – ११०११५

Government of India
Ministry of Petroleum & Natural Gas
Shastri Bhawan, New Delhi - 110 001
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MESSAGE

I am very happy to learn that Integrated Research and Action for Development is organizing "Energy and Climate Summit – 2009".

The National Action Plan for Climate Change is released by the Prime Minister. It points out that the mitigation as well as adaptation are essential for the national missions. Both are needed for sustainable and accelerated economic growth.

I congratulate IRADe for organizing this event to addressing a challenging theme for their event. On this occasion, I convey my best wishes to all the participants, and hope that the deliberations are brought out as recommendations.

(R. S. Pandey) 27.1.09

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डा.टी.रामसामी
सचिव
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SECRETARY

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विज्ञान और प्रौद्योगिकी मंत्रालय
विज्ञान और प्रौद्योगिकी विभाग
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MINISTRY OF SCIENCE & TECHNOLOGY
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Technology Bhavan, New Mehrauli Road, New Delhi-110 016

MESSAGE

I am delighted that IRDe is organizing Energy and Climate Summit during February 3-4, 2009.

Climate Change can be truly traced to mismatched energy flows on to the planet. Questions have arisen as to whether mismatched energy flows are in some sense a result of inappropriate use of technologies based on high carbon high emission economies. With increasing awareness, a scientific approach to the selection and management of technologies for managing energy flows within the assimilating and energy capacities of mother Earth seems nearly the only way forward. Managing climate change calls for a life style that is consonance with nature and not a living style that is in dissonance with the ways of Nature.

I hope that Energy and Climate Summit will help us to turn to the ways of wisdom and connect the practice of science to the right philosophy for mankind.

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कोयला मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF COAL
शास्त्री भवन / SHASTRI BHAWAN

नई दिल्ली, दिनांक
New Delhi, Dated

No. Secy(Coal)/09

29th January, 2009

MESSAGE

I take this opportunity to congratulate IRADe for organizing "Energy and Climate Summit" on 3-4 February, 2009.

The fossil fuels like Coal will continue to be the backbone of the industry, particularly the power sector. However, Coal is an energy source with considerable environmental consequences unless adequate mitigatory steps are taken at all stages of mining and its subsequent utilization. Our efforts should be aimed at ensuring that Coal is used through the adoption of clean coal technologies in order to reduce the environmental impact to the greatest possible extent.

I am confident that the event will generate greater awareness about climate change and the tasks ahead. I wish the summit all success.

(C. Balakrishnan)

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WELCOME ADDRESS

Dr. Kirit Parikh, Member, Planning Commission

Shri Shinde ji, Shri Muttemwar ji, Shri Montek Singh Ahluwalia ji, Ladies and Gentleman,

I am delighted to welcome you to this summit as Chairman of IRADe.

We had set up IRADe in 2002 as a non-profit society for integrated research and action for development. Our belief is that policy research can be more effective if stakeholder perspectives are considered which can also help in consensus building and facilitate acceptance of policy conclusions. We also believe that research action help test ideas and brings into analysis ground realism.

This summit addresses an important issue on which wider stakeholder discussions are important. The threat of climate change poses many challenges particularly for the energy sector Manifestations of climate change are already visible. For example, extreme events, storms, flooding, dry spells, cyclones. Their frequencies and intensities may change. Since energy use is the main source of GHGs, if any action is required it would affect our energy strategy. Should we take any action? When? And what kind of action? This conclave is about these issues.

We have always argued, and rightly so, that India has not yet contributed to this threat of climate change. Our emissions have always been and are still very small compared to industrialised countries on a per capita basis. Even on an aggregate level today India emits only one fifth as much as China or United States. If one were to consider earth's absorption capacity for GHGs and allocate it on a per capita basis, then India's per capita emissions are still within that allocation. We have therefore not contributed to accumulation of GHGs in the atmosphere. Of course, this will change with economic growth.

The Integrated Energy Policy report has projected India's energy requirements for 2030 assuming growth rates of 8% to 9%. Our primary energy needs to grow from around 500 mtoe today to around 1800 to 2000 mtoe and our electricity capacity will have to increase to around 800000 to a million MW from the present capacity of 160000 MW. This will increase our CO_2 emissions to around 5 billion tonnes or around 3 tonnes of CO_2 per person. With appropriate policies we can reduce this emission substantially.

As a responsible member of the global community India has recognised that its GHG emissions cannot grow indefinitely and the Prime Minister has announced that –

> "*We are determined that India's per-capita GHG emissions are not going to exceed those of developed countries even while pursuing policies of development and economic growth*".

"*We must work together to find pragmatic, practical solutions, which are for the benefit of entire humankind*".

What are the implications of this?

The implications are worth noting. It implies a huge commitment. If global warming is limited to 2°C, it implies stabilisation at 450 ppm concentration of GHGs. This in turn requires 80% to 90% reduction by industrialised countries by 2050. Thus their per capita emission would be around 2.5 t of CO_2/year. In this scenario with ambitious energy efficiency measures and promotion of renewables, India will reach this level of per capita emission by 2030. Given current growth projection the country runs a risk to exceed this level by 2050 and thus India will have to take steps to curtail its emissions. Prime Minister's statement has put the ball in the court of industrialised countries. The more they reduce their emissions, the lower the limit India will accept on its emissions. India should no longer be used as an excuse by industrialised countries for delaying mitigation action.

The threat of climate change calls for action now and on many fronts.

Energy sector says large investments, requires long gestation lags and lasts for a long time. Thus we may need to take action now. The action we take will have to be guided by our vision. What is our energy vision? What kind of energy mix would enable us to limit our GHG emissions within the per capita emission of industrialised countries? Whatever scenario we point out to it will surely call for few things:

- Energy conservation and use efficiency.
- Demand side management to reduce energy needs
- A much greater share of renewables and other non-GHG emitting energy sources
- Development of new technologies
- Life style modification
    - Use of public transport in place of private motorised transport
    - Mass transport that provides energy efficient and time saving alternative to private transport.
    - Avoiding unnecessary air conditioning and space heating.

IEP scenarios have shown that with existing technologies we can reduce GHG emissions by 25% from a carbon intensive scenario by these actions. On many of these we need to act now and we have initiated many actions. We need to identify areas where energy efficiency and conservation can be done cost effectively and take policy measures that provide the needed incentives to do so to both consumers and producers. How do we improve energy efficiency of energy consuming appliances and equipment?

Which renewables are most promising? What technological developments are needed to expand their scope and acceptability? What policies are needed to accelerate such developments? How to accelerate adoption of renewables?

What new technologies can lead on to a sustainable, carbon free energy scenario? What are the options in the power sector and in the transport sector? What should be our R&D effort to focus on to make the options economically viable?

How do we inculcate attitudes that lead to lifestyle changes? What do we need to do to create awareness about the need for such changes? How do we minimise the perceived individual costs of such changes.

This summit organised by IRADe will focus on these issues. It is therefore very important as we need to chalk out our strategy. To be effective the strategy has to have a wider stakeholder concerns. We hope the summit will help build such a consensus.

This is consistent with IRADE's objectives, which are:

- To develop understanding that integrates multi-stakeholder perspectives concerning issues of development.
- To promote a wider consensus through research and analysis on effective policies among stakeholders and policy makers.
- To build capacities among professionals for multi-disciplinary, multi-stakeholder policy analysis.
- To promote ideas and initiatives for inclusive developments at the local and global levels.
- To promote research supports to developing countries for development and also to negotiate better international agreements.

I once again welcome you to this summit.

Thank you!

SPECIAL ADDRESS

Shri Vilas Muttemwar, Hon'ble Union Minister of State for New and Renewable Energy

Ladies and Gentlemen:

It is my privilege to be amongst you and I congratulate IRADe for organizing the event "Energy and Climate summit – 2009" on a theme which is highly relevant to India in the recent times and for future.

Global warming phenomena are evident and are showing its initial effect. The IPCC's reports confirmed that there is "new and stronger evidence that most of the warming observed over the last 50 years is attributed to human activities" and has warned about the complex nature of impact of climate change in every sphere of life. The whole world is currently under going the process of transformational change and policy adjustment because of challenges of global warming and climate change. "The developing countries are likely to be more adversely affected as compared to the developed countries due to the impact of climate change", according to various scientific assessments. Another great concern is the finiteness of energy resources. The rate, at which natural energy resources e.g. fossil fuels are being consumed, may result in energy scarcity for future generation. The great success of UPA government, under the dynamic leadership of Prime Minister Dr. Manmohan Singh has been addressing the issue of India's energy security goals in the context of maintaining benign environment. During his address to the nation on 15th August, 2008 from the Red Fort, Hon'ble Prime Minister has made his resolve amply clear by declaring his commitment to the cause of energy independence through fast track growth of renewable resources of energy – primarily solar , wind , biomass and hydro. Appropriate emphasis has been given to clean technologies that are clean coal technologies, nuclear, alternate source of energy and renewable energy. We are progressing systematically to increase their contribution in the national energy basket and shifting towards sustainable path of renewable energy based energy solutions. The National Action Plan on Climate Change released by the Prime Minister on 30th June, 2008 makes a clear statement of India's intent and resolve of controlling and reducing the carbon emissions in short, medium and long term. With the depleting reserves of fossil fuel, the nations across globe have consensuses on sustainable development, and the path of sustainable development is proposed with greater application of renewable energy for economic growth.

India is following planned approach to development with twin objective of socio economic growth and sustainability. India's commitment to the UNFCCC is reflected in the various initiatives such as energy conservation, promotion of renewable energy, abatement of air pollution, afforestation and wasteland development. A sound environment policy and law framework is also in place. At the Same time, Indian society's traditional respect for the ecology, rivers and natures remains as strongly rooted as ever in its quest for sustainable and climate friendly development.

My ministry is making all efforts to push accelerated development of all renewable energy resources and to realize our vast potential. The key drivers for renewable alternatives emerge from structural demand of energy and power in India, for example – more than seventy percent of population in rural areas, low per capita consumption of energy and electricity, low access to commercial sources of energy and quest for high growth of power sector to sustain 8 to 9% of growth rate of GDP. The challenges become more formidable as major percentage of crude oil, metallurgical coal, and natural gas is imported and their prices are volatile. Recently, the cabinet has approved Integrated energy Policy (IEP) framed under the chairmanship of Dr. Kirit Parikh, which project path of progress to achieve total energy security.

Renewable energy sources encompass a basket of technologies including solar, wind and biomass for both grid connected power and captive generation. The use of solar, and wind energy implies mitigation of carbon emission. The reduction of the use of fossil fuels particularly coal and oil as energy resources is a difficult task as 70% of our commercial energy supply depends on fossil fuels. The substituting of fossil fuel with the renewable energy is a challenging task, and it needs significant R&D effort to make use of renewable energy commercially viable. In fact, I consider it a great fortune for our country that we are endowed with abundant renewable sources. The renewable resources such as biomass are locally available and unlike fossil resources. Harnessing renewable energy does not require large infrastructure and logistic support.

India was one of the first few countries to realize the critical importance of the renewable energy and has dedicated exclusive ministry set up to promote clean, green, environment friendly renewable energy. What is needed in the climate change sector is the cooperation amongst a range of acts, including paradigm shift in technology transfer mechanism. We must now look to newer modes of technology diffusion and transfer, policy reorientation, green credit, waste minimization. Under the Kyoto protocol, market based mechanisms are expected to play an increasing role. In case of CDM projects, the industry has started looking both inwards and outwards for production of clean energy with focus on renewable energy. We have one of the largest programmes of renewable energy in the world. We are implementing a broad spectrum programme covering the entire range of new and renewable resources. My Ministry has given much-needed push to make renewable resources contributes significantly in the nation's energy mix.

As a result of the concerted efforts of my team, I am very happy to inform you that the achievements up to 31st August, 2008 are quite satisfactory – we have achieved about 13,000 MW of grid interactive installed renewable power, which is around 8% of the total installed grid capacity of the country, 230MW off grid and distributed renewable power, 1.4 million solar PV lighting systems-mostly in rural areas, 2.30 million sq meters solar collector area and 4.02 million family size biogas plants. We are fourth in the world as far as wind energy is concerned with around 9500 MW wind-power. We are second after China in biogas installations. I am indeed very proud to state that a major portion of our renewable power, i.e. around 8000 MW has been achieved during the last 4 & I/2 years of my tenure. This was possible only through a sustained push with a mix of policies and programmes and also the wholehearted support of private investors whose response to various fiscal and financial schemes of my ministry has always been extremely encouraging.

Wind energy is the best success story of Government's enabling policies boosting fast track investments leading to overall success of the wind sector. India's wind power potential was assessed at 45,000 MW by C-WET; the world's only wind energy technology institution, set up by my Ministry in Chennai. Out of the total achievements of about 9500 MW, about 45% is the share of one state – Tamil Nadu. Maharashtra, Karnataka, Gujarat, Rajasthan and Andhra are other important states. The wind turbine technology has been greatly indigenized, and is robust and mature in the country. India has emerged as a hub of manufacturing wind turbines with a capacity of over 3000 MW per annum, which is likely to increase further. The fiscal and financial concessions, especially the accelerated depreciation has led to a major push to the wind power development in India. However, I was quite concerned for entry of other serious players' i.e. foreign investors and independent power producers (IPP). This would encourage increased electricity generation, instead of primarily focusing on just capacity addition. This would throw open the wind sector to investors in a big way. Though this scheme is on a pilot scale for wind power projects up to 49 MW, I am very keen to upscale it to cover all the wind energy generation projects to be set up to December 2011. Another scope of investment in wind sector would be

re-powering of existing wind turbines. With advancement of technology, the re-powering would be achieved by installing wind energy generators of higher efficiency and capacity replacing old and small capacity wind Turbines. I am considering a scheme to give incentives the process.

India with its geographical advantage has best prospects for harnessing solar energy than most other countries. Solar energy can be deployed both in centralized and decentralized mode. It has the best capacity to provide energy access in rural areas. The exploitation of solar sources for power generation would result in considering saving of conventional electricity and use of fossil fuels. My ministry has been working for deployment, R&D and demonstration of solar energy technologies for grid connected as well as off-grid applications for the last 25 years. In January, 2008, I had announced a demonstration programme on Megawatt size grid interactive solar power generation to encourage setting up of solar power plants with solar photovoltaic and solar thermal technologies. Under this scheme generation based incentive (GBI) from MNRE up to Rs.12 per kWh for SPV and Rs, 10 per kWh for solar thermal power generation was proposed. 50 MW capacity solar power projects were proposed. Seven SERCs have announced tariff for solar power. I am very happy to inform the Forum that the National Action Plan on Climate Change has identified 1,000 MW solar power generations as one of the thrust areas under National Solar Mission. We are envisaging large-scale expansion of solar power capacity 2020. We are gearing up to provide to 20 million un-reached rural households to access light energy.

My ministry is considering various steps to boost vibrant manufacturing base for renewable energy industry. A number of manufacturers are involved in manufacture of various raw materials, components, devices and systems required by the renewable energy sector. Several companies have been successfully manufacturing products of international standards and regularly exporting to various countries in Europe, USA and Asia etc. I am of the view that manufacturing of renewable systems, devices, components and parts could be best done in India. India has embraced new & clean technology as the new investment mantra and in many cases leapfrogging Western manufacturing infrastructure. A far-flung, entrepreneurial Diaspora funneling world-class expertise and capital into the country is helping India position itself as the preferred base of manufacturing for clean technology.

Hence, I am very keen to offer the services of a SEZ- exclusively dedicated to Renewable Industry. I am confident that one such SEZ would soon be taking shape at Nagpur which would be having world class manufacturing base. Coupled with the world class facilities which are coming up at Multimodal International Cargo & passenger hub(MIHAN) at Nagpur, this SEZ would attract investments of several thousand crores in manufacturing strategically important input materials, process and test equipments, devices and systems components .

I am taking keen personal interest to promote international cooperation to facilitate transfer of technologies and exchange of information and knowledge with a view to improve the techno-economic viabilities of various renewable energy systems. We are also encouraging cooperation at the level of research organizations along with industry partners. Wherever feasible, cooperation through bilateral and multilateral arrangements is being facilitated by my ministry.

I once again welcome the delegates and extend my warm wishes for success of this Forum. I am sure that with cooperation from all of you, we would be able to push renewable energy sector to the similar heights as IT and outsourcing industry.

Thank you!

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INAUGURAL ADDRESS

Shri Montek Singh Ahluwalia, Deputy Chairman, Planning Commission, GOI

Global focus on climate change at various forums and negotiation has increased intensely. At World Economic Forum at Davos, constant references were made to climate change despite global economic meltdown. Next important climate change conference is scheduled at Copenhagen, and it is expected that an outline of solution and guidelines for post Kyoto scenario will be defined. Mitigation of climate change has been addressed in the government of India documents such as working group report on eleventh five-year plan, Integrated Energy Policy etc. The recent policy document on National action Plan on climate Change (NAPCC) specifies eight missions and each mission can be elaborated and operationalized. The climate change activities can be effective if some target for GHG emission is set. There is a parameter indicating if at global level average GHG emission is controlled at 2 Ton/ Capita, the climate change threat can be contained. The objective of climate change projects can be evaluated on two sets of action i.e. mitigation, and adaptation. Optimal strategy of effort and investment in two can be evaluated on the basis of trade off, on cost parameter.

Each country should have equal entitlement to emission, and this will bring a concept of uniformity and sustainability in development. UNFCCC recognizes this concept however there are problems during negotiation.

The per capita emissions in India will increase, as expected due to economic growth. India should focus on reducing energy intensity per unit of GDP. Control of per capita emission will require operationalization of breakthrough technology. These technologies and their operational cost are expensive, e.g. solar power. Transiting to these technologies is a costly investment. NAPCC has documented solar mission. It expects consistent effort and market will reduce the prices substantially. These developments are not feasible with singular national effort. If we take 2T per capita as target, USA will have to reduce 20T/ Capita to 2T per capita, similarly other industrial countries. Actual efforts required for mitigation on their part will be enormous, and actual resources unleashed to achieve target will be huge. It is prudent for India to keep our efforts in progress and keep in touch with global development to benefit from the association.

Target achievement of the carbon emission mitigation by the developed countries was low. The developed countries have not been able to achieve, as they desired. This does not absolve the developing countries about their responsibilities towards addressing climate change. The concern of the climate change is well established. The Post Kyoto strategies will depend upon the progress of the Copenhagen meet. Successful agreement is required to facilitate massive transfer of resources explicitly or implicitly at a scale, which the world has not witnessed. The transfer of resources should be so organized to incentivise the developing country to do what the developed countries desire. Scale of transfer of resources should commensurate with the desired outcome.

The other option is to agree how to distribute the emission and entitlement. The resources are to be distributed across the countries. Describing with an example, assuming current global

average carbon dioxide emission is 4t/ capita, and we desire to reduce it to 2 T/Capita in a particular time frame say 2030/ 40. Time path will define the procedure of future efforts. The procedure begins with listing each country on their average emission per capita and sorting them as countries having average emission above or below 2T/ Capita. Each country will have defined role. Below average will have surplus entitlement and they must use the resources on climate change related projects. The countries above 2T should pay for continuing at the level above the specified target.

There is a concept of uniform carbon cap and taxation to create carbon fund. The carbon fund be transferred to that country who needs the fund to work on climate related projects. There has to be fair burden sharing and share of fund. We are very very far from agreeing on this concept.

Indian planners recognize the real problem. There is a commitment to do feasible tasks to mitigate climate change by using optimal strategy. National action plan for climate change is a document to guide economic activities in the country in the purview of climate change. Now we have to operationalize National Action Plan on Climate Change (NAPCC) mission.

MNRE is doing significant work in this direction and furthering the development in the solar application. There is large scope of energy efficiency in the major industry.

India should publish their success in their effort to increase energy efficiency in the industries.

Thank you!

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PRESIDENTIAL ADDRESS

Shri Sushilkumar Shinde, Hon'ble Union Minister of Power

Ladies and Gentlemen:

I am happy to be present at this very important conference on energy and climate this morning and indeed delighted to discuss about issues of much relevance for present and for future as well. Being Union Power Minister for last three years, I have gone through various challenges of energy sector and understood the involved complexities and difficulties in power sector.

The theme of the summit – "Energy and Climate –Meeting new challenges"- is highly relevant to the whole world; particularly for India the issue requires urgent and immediate attention. India is facing enormous demand for energy corresponding to its massive population and economy. We are seeing exciting new development in energy & power sector like entering in the totally new era of nuclear power generation; which are the way forward towards energy independence –vital for sustainable development of the country. Our country, along with 189 nations, has adopted the millennium declaration and set 2015 as the year for achieving the Millennium Development Goals. And energy independence- Accessibility, Affordability and Acceptability of energy resources - plays a critical role in enabling the country to achieve these goals. My ministry "Ministry of power"- is fully committed to achieving the target of quality energy source i.e. electricity for all, at an affordable rate.

Power is a concurrent subject and the primary responsibilities as far as citizens are concerned vests with the states that have full responsibility for distribution. We in the ministry of power at the centre through our agencies and undertakings assist the states in the discharge of our primary responsibility of providing good quality uninterrupted 24 hours power supply at reasonable rates to all households and consumers in rural and urban India.

The electrical power is an essential item of the economic growth and social welfare. It does not have importance merely for economic development but it has a direct impact on the quality of life. The second green revolution with a functional cold chain for agriculture produce is possible with 24 hours of electricity. It is only with electricity that modern industrial and commercial activity is possible in rural India and that our rural India can get integrated with our dynamic urban economy. This would be the key to employment generation and poverty reduction and reducing the visible stress in our farming communities. It has been recognized all over the world that India has become one of the fastest growing economies. For supporting this growth trend, India plans to add 400,000 MW by the year 2020.This is to be done without compromising the ability of future generations to meet their need. Generation during the year 2007-08 is targeted at 710 BU i.e. growth of 7.0% over generation target of 663 BU for the previous year. However energy independence is not possible without focusing on the three pillars of sustainability, that is, economic, environmental and social. We have to care for the present – though obviously not at the cost of the future.

India with its large population faces a peculiar dilemma of availability and deliverability of electricity to the remotely scattered population. It is required to provide energy but the costs to produce and supply energy to remote areas generates a mismatch between accessibility and affordability amid environment and climate concerns. This brings us to a key question- what role should the developing nations play in using available cost effective, energy efficient and environment –friendly technologies and what is the role of the developed countries to make this available to meet the aspiration of developing nation to provide universal access to energy?

Policy- makers like us, therefore, have to create a harmonious balance of expanding the capacity to supply with the use of the most cost-effective methods of technology, funding and management, so as to match the quality of supply with "affordability". It goes without saying that the provision of energy has emerged as the most important tool for the economic development of the society. The anticipated demand needs to cater to higher economic growth rate projections to ensure that lack of electricity does not constrain growth. If there is no supply side constraint then economic growth may well turn out to be higher than expected. Ministry of Power has envisaged the establishment of an integrated National Power Grid in the country by the year 2012 with an inter-regional power transfer capacity of about 37,700 MW. The unequal interregional distribution of energy resources has necessitated the formation of National Power Grid to transmit power from resource rich to deficit area as well as facilitate scheduled/ unscheduled exchange of power. Working towards this plan, POWERGRID has implemented various inter regional schemes and inter regional power transfer capacity of about 17,000 MW is established by November, 2007. Four major power regions of the country namely, North-Eastern, Eastern, Western and Northern are now operating as one synchronous grid with total generating capacity of about 1,00,000 MW. This is facilitating free flow of power from surplus to deficit regions bringing much needed economy. However, at the same time we must give utmost attention to energy conservation and demand side management .We all know that energy saved is electricity generated and environment conservation as well. The electricity policy in consultation with state Governments and the Central Electricity Authority aims at accelerated development of the power sector, providing supply of reliable and quality power of specified standards in an efficient manner and electricity at reasonable rates to all areas while also protecting interest of consumers and other stakeholders. This we must do while keeping in view availability of energy resources, technology available to exploit these resources, economics of generation using different resources and energy security issues. Although our government is of firm belief that in this globalised world, the need is to have outward looking energy policy and effective domestic and overseas energy strategies for ensuring India's energy security. The nuclear deal was the step towards this. POWERGRID has been successful in facilitating private investment in transmission sector. Ministry of Power has notified guidelines for encouraging competition in development of transmission projects. Guidelines for tariff based bidding for transmission projects have also been notified by the Ministry. The Empowered Committee has identified 14 transmission projects for development through competitive bidding.

The Environment and climate are the concerns which run side by side with energy production and distribution. Specially, the importance of electrical power generation and distribution increases due to economic and environmental reasons. The generation of electricity has been

attributed to increase in the greenhouse gases in the atmosphere. The primary energy resource for power generation has been fossil fuel, and this scenario will continue. This sector is the largest single source of GHG emissions. The GHG emissions are carbon dioxides, oxides of nitrogen (NOX), small particles, and other air pollutants. The carbon concentration in the atmosphere has been of primary concern as this gas occupies major spectrum of GHG in the atmosphere.

Today the world faces the threat of global warming due to increase in accumulation of GHG in the atmosphere. This is a complex and global phenomenon. Its impact will be on all countries, but it is more acute for the countries nearer to equator and having low geographical profile. The rapid increase of GHG gas has to be controlled, mitigated, and maintained within scientifically established boundaries. The future challenge is in successful resolution of this phenomenon, and will depend on how global community tackles this trend of global warming.

The global warming can be maintained to a moderate global average temperature with an increase of two degree centigrade, provided the GHG concentration is kept within 550/ 700 ppm. If carbon accumulation in atmosphere increases unabated then a catastrophic scenario may develop. In this scenario the global average temperature increases by 5+ degrees centigrade. This is the scenario we have to avoid. This will result in arctic ice cap melting, Greenland ice cover melting, etc. Sea level may rise by 7 to 10 meters. We have to act now to avoid the situation. The countries near arctic may benefit as they will have better agricultural environment. There are no other options but to control climate change to a moderate level. The Nation has been aware of challenges of climate change for many years. Our quest for energy security is equally essential to sustain accelerated economic growth.

The pledge of government on social welfare expects each citizen of the nation to be provided with electricity. In 1947, only 1500 villages were electrified in India. Government of India had launched the following programmes for electrification of rural areas in the country from time to time:

Rural Electrification under Minimum Needs Programme (MNP)

- Pradhan Mantri Gramodaya Yojana (PMGY)
- Kutir Jyoti Scheme
- Accelerated Rural Electrification Programme (AREP)
- Accelerated Electrification of One lakh villages and One crore households
- Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)

Besides these, intensive electrification of 24,394 already electrified villages has also been achieved. The continuation of Rajiv Gandhi Grameen Vidyutikaran Yojana has been approved by the Government in the 11th Plan for attaining the goal of providing access to electricity to all households, electrification of about 1.15 lakh un-electrified villages and electricity connections

to 2.34 crore BPL households. The government has initiated RGGVY to provide the citizen in rural area with electricity. The social and economic commitment have environmental price. It is for the stakeholder to provide feedback to the government to guide the way to achieve economic development at the least cost to the environment. The demand of energy resources will grow with economic growth. The energy mix of future has to evolve from the guidelines of sustainable development.

While we stress the increase in power generation, we are also vigorously pursuing energy conservation measures. We enacted the Energy Conservation Act in 2001 and the Bureau of Energy Efficiency (BEE) was set up at the national level. Ecological Study of hydro reservoir has been taken up to assess the role of reservoir in GHG emission and its contribution to climate change. National Energy Conservation Awards scheme has motivated the progressive participating units to undertake serious efforts in saving the energy thereby preventing the anthropogenic climate change and saving the environment. The awarded power units collectively saved 308 MW of energy and in monetary terms 1843 crores per year by implementation of the energy efficient measures. Energy conservation initiatives have collectively saved 308 MW of energy and in monetary terms Rs.1843 crores per year by implementation of the energy efficient measures. This has given a major thrust to our efforts to increase energy efficiency in various sectors. As regards India, we are working towards developing consistent policies that will provide reasonable returns, to attract the needed investment in each of these areas. Both the public and private sectors have to play important roles here. We need to intensify the public–private partnership in ways that provide energy services to the consumers at the least cost. However, we recognize that in many areas and regions, the public sector and the government will continue to play an important role. Our government has recently adopted an integrated energy policy prepared under the chairmanship of Dr. Kirit Parikh which states that India needs to sustain very high growth rate over next 25 years with more than 5 % growth in primary energy supply for fueling growth if it is to eradicate poverty and meet its larger human development goals.

In India the coalmines are located in the eastern region. The oil reserves are also located in the north-eastern and off-shore region. India has past history of weather turbulences in the east coast like Orissa cyclone, hurricanes hitting Andhra Pradesh etc. The economic and social havoc caused by weather fury has been substantial. It is essential at the planning and design stage to consider the impacts and vulnerabilities are posed by climate change to energy infrastructure such as power plants, off-shore structures, pipelines, ports, and many coastal industries. These units have to withstand storms, floods, cyclones, sea level rise, and fluctuating water availability. The higher environment temperatures may affect the efficiency of the units. India depends upon import for fertilizers, oil, and even the indigenous fertilizer production depends on offshore structures. The climate proofing of industrial infrastructure has to be pursued rigorously

I had previously stated about my firm belief that cleaner power development technologies are must, and the need of indigenous thermal power generation to be developed and shared through international cooperation. If we believe that climate change is a genuine global concern, we should not leave the dispersal and proliferation of cleaner energy technologies to market forces and commercial interests alone. If we trust so implicitly in the market, clean technologies will

not be affordable or accessible to those countries and people, who need energy most, and are the fastest growing. The desired long-term reductions will be achieved at lower cost if climate considerations are incorporated into the industry's investment decisions at this stage rather than later. Earlier experiences of retrofitting have shown that benefits of new technologies are not fully realized. If our Infrastructure cannot sustain the impact of climate change, there is going to be a huge disaster. Continuing its endeavor for exploiting the conservation potential in different forms of energy in the operation of power plants, Centre for Energy Efficient Technology & Energy Management concentrates on saving different forms of energy by consistently monitoring the consumption patterns and adopting latest technology up-gradations. Some of the other energy conservation measures adopted are – complete implementation of on line energy management system, adoption of polymer coating technology for efficiency improvement, adoption of energy efficient variable speed drives, which are also yielding good results. NTPC is also in the process of adopting super critical technology for its future units of 660 MW & above ratings. NTPC has taken a number of dedicated and growth oriented measures for improvements in the areas of Environment Management in its various business units.

From thermal power plants using coal as fuel, emissions and management of Suspended Particulate Matter (SPM) is very important. NTPC has taken several initiatives for water management through water conservation and wastewater recirculation and re-use in its plants. To recycle and re-use waste water, NTPC has installed recycling systems for ash pond effluent called Ash Water Recirculation System – AWRS and for main plant effluent called Liquid Waste Treatment Plants – LWTP at a number of stations. Further, NTPC has installed Sewage Treatment Plant (STP) at all stations. POWERGRID has within the overall corporate ethics internalized the principles of sustainable development. An "Environmental and Social Policy & Procedures (ESPP)" has been developed and adopted in 1998 to address the environment and social issues. The policy outlines POWERGRID's approach and commitment to deal with environmental and social issues, relating to its transmission projects, and lays out management procedures and protocols to mitigate the same. The World Bank has awarded POWERGRID "Green Award' 2006" on the commendable work done in the field of sustainability and has also recognized POWERGRID' "Corporate Leadership in sustainability" in its report "Strengthening Institutions for Sustainable Growth – Country Environment Analysis for India": August, 2007.

Thus the power sector has taken many steps to gear itself to efficiently meet the challenge of meeting our needs.

This Summit I hope will focus on issues that will help us meet the challenge of climate change better.

Thank you!

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VOTE OF THANKS

Dr. Jyoti Parikh, Executive Director, IRADe

Hon'ble Minister Shri Shushil Shinde ji, Shri Montek Singh Ahluwalia ji, Shri Vilas Muttemwar ji, Dr. Kirit Parikh and ladies and gentlemen;

Good Morning!

We just heard the distinguished ministers, the decision makers of the Government of India. They have reiterated that the climate change can considerably alter energy sector, as we know today. We are very grateful to them that they recognize the role of think tanks in deliberating such issues to come up with recommendations and solutions for climate change mitigation would require changes in the composition of energy systems. As you know, we have discussed four types of options; e.g., (a) shift from coal to renewable energy or natural gas, higher energy efficiency of power plants and refineries, (b) reduce losses in power transmission and distribution, gas flaring during crude production and refining, and pipeline leakages. (c) Use different technologies like clean coal technology, gasification and renewable technology etc. (d) Re-examine the existing infrastructure which may not perform as expected with the same design criteria when temperature increases and water availability is uncertain e.g., thermal and hydro power plants. We also recognized that the natural disasters occurring once in one hundred years can occur more frequently and with greater intensity. This will impact energy infrastructure, e.g., transmission and distribution lines from impact of storms, coastal infrastructure from sea level rise, cyclones and floods, and hydropower from fluctuating water availability. The safety margins for designing industrial infrastructure should be reviewed to protect from higher frequency and intensity of storms and cyclones. We have some experience in responding to these in the past but they will occur now more frequently.

The projections for energy demand show that energy requirements may be doubling, tripling or even quadrupling compared to current requirements. The infrastructure and capacities in the energy sector will increase proportionately. The impacts of climate change on the energy infrastructure need to be addressed now, so that the decisions can be taken now to ensure safety and sustainability of the planned infrastructure underway.

The summit has covered most sectors of energy. We have invited relevant experts, decision makers and people from various walks of energy sector. Our endeavour was to have multi-stakeholder discussions, where government officials, private and public sectors and experts from national and international think tanks will deliberate. We appreciate your interest and support.

I am grateful to Hon'ble minister Shri Shinde for readily agreeing to preside and Shri Ahluwalia, Deputy Chairman, Planning Commission. We thank Hon'ble Minister Shri Vilas Muttemwar and his colleagues at Ministry of New and Renewable Energy (MNRE) who always supported our efforts. The co-operation of the Ministry of Environment and Forests, Ministry of Earth

Sciences, Science and technology, Ministry of Coal and Power viz. is acknowledged here. We thank public and private sector companies such as ONGC and Torrent power and international agencies like GTZ and Asian Development Bank who have supported us generously. We are also grateful to Assam tea, NTPC, PGCIL, Suzlon, HPCL, Shell and HSBC for their sponsorship despite economic downturn. We are also thankful to companies for putting up advertisements in the souvenir. We express thanks to World Energy Council, India Energy Forum, Petrofed and Powerline for supporting us in organizing the event. I thank our vendors and staff at Le-Meridien. Most of all, it is the IRADe staff who have made this event possible.

Thank you!

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Session Deliberations

CLIMATE CHANGE AND POWER SECTOR

3rd February, Session - 1

The second session on "Climate Change and Power Sector" was chaired by Mr. Pramod Deo; Chairman CERC.

Mr. Pramod Deo (Chairman, CERC) He emphasised synergy between supply side initiatives and Demand Side Management (DSM). Under the purview of Electricity Act 2003 he talked about the role of Electricity Regulators in overcoming barriers and facilitating development of renewable energy and mitigating GHG emissions by supply side initiatives and demand side initiatives. India's existing per capita carbon dioxide emissions are 1.05 tonne as against world average of 4.22 tonnes, There is a need to optimize fuel-mix strategy with limited hydro capacity, generation from fossil fuel and nuclear energy. He stressed upon the role of Electricity Regulators to prescribe mandatory percentage consumption of renewable energy, to set preferential tariff. He was of the opinion that the Government needs to work out a strategy towards integrated power facility development with low GHG emissions and carbon capture. He stressed upon following new initiatives:

- A market based mechanism to enhance cost effective improvements in energy efficiency in energy-intensive large industries and facilities, through certification of energy savings that could be traded.

- Accelerating the shift to energy efficient appliances in designated sectors through innovative measures to make the products more affordable.
- Creation of mechanisms that would help finance demand side management programmes in all sectors by capturing future energy savings.
- Developing fiscal instruments to promote energy efficiency.
- Introducing Renewable Energy Certificates (RECs) to enable renewable energy deficit States to meet their quota of Renewable Purchase Obligation (RPO) to achieve the national target of 5% for renewables under the National Action Plan for Climate Change

Shri Rakesh Nath (Chairperson, CEA) set the tone of the summit by summarizing the strategy of inclusive and sustainable power sector development keeping in view the demand of industry, economic, commercial, and social sector during eleventh, twelfth, and thirteenth five-year plan. Currently there is a ten percent energy shortage in the country. The per capita consumption of power in the country in 2005-06 as calculated by the Central Electricity Authority has been about 631 Kilowatt Hours and the targeted economic growth will drive consumption from1000 units per capita by 2012 to 1800 units by 2021, rise of 30% in addition to expected energy efficiency improvements. Due to potential climate change, this growth has to be achieved by reducing CO2 emission in supply and demand side per Kwh. India has many vintage power plants and these unit release high quantum of CO2 per unit. The projects incorporating energy efficient technologies are in progress to reduce the carbon dioxide emissions of new plants from 0.78 tons of carbon dioxide per megawatt to 0.58 tonnes. The 11th plan target for new capacity addition was in the tune of 78000 MW, and current progresses indicate that target of 66000 Mw will be realized. Clearances have been given in 11th plan for Hydropower development and order has been placed for 30000 MW so that these projects can come up in 12th plan. At least 25000 MW of these units will be commissioned by twelfth plan. Uncertainties persist due to climate change and adequate water availability. These may impact the generation of electricity from hydropower projects. The government is encouraging renewable energy use for power generation. The targeted power generation from renewables will be 2% of the cumulative power in twelfth plan and 3-4% by the 13th plan.

The prospective power generation capacity additions from the coal-based plants are 55000 MW in 11th plan, 70000 MW in 12th plan. In view of the commercial viability and climate change, the focus is on enhanced energy efficiency of theses new units. Indo German joint venture effort is under way for identifying energy efficient projects, hence they have undertaken mapping of 60 power plants. Many new units operate at high plant load factors within 20% deviations from design load. The approval of Super-critical technology for power generation will add (1) 40000 MW in 12th plan (2) 50000 MW in 13th plan. We have to evaluate the innovative technologies in the Indian context to decide appropriate decision process is going to be needed. He further stressed upon the need to improve efficiency of coal based plants and to retire the under performing stations. He advocated higher efficiency parameters with higher capacity technology. NTPC has already taken initiatives to install super-critical at coal pit-head. Bulk order of 11 Nos. super critical units being ordered to give impetus to this technology. IGCC plant by AP Genco through BHEL is also a step towards this end.

Mr. A. K. Sharma (General Manager, Corporate Planning, NTPC) explained the National Power Objectives that every household will have the access to electricity by 2012. Per capita consumption of power will increase to 1000 Units by 2012 and minimum 1 unit/ household/ day will be provided. Further he added that NTPC contributes more than one-fourth of India's total power generation with less than one-fifth capacity.

He explained the NTPC's vision on climate change is to go for higher generation by lowering the GHG intensity and approach of NTPC to climate change is by Introduction of new technologies, Enhancing efficiency of generation, Mixing of fuels and afforestation & other green measures, thereby the carbon dioxide emissions intensity can be reduced.

NTPC has taken initiatives by adopting NETRA focusing on Research and New Technology with adoption of higher efficiency units to go for higher efficiency with lower emission. NTPC has also adopted supercritical technology for its upcoming projects and is also making new benchmarks by improving efficiency through Renovation & Modernization.

Shri. Sharma apprised the delegates that NTPC has worked out a Fuel-Mix strategy up to 2017 for achieving 75,000 MW with Coal – 53,000 MW; Gas – 10,000 MW; Hydro – 9000 MW; Nuclear – 2000 MW and Renewable – 1000 MW. In a nutshell, he said that NTPC has been committed for sustainable power development as power producer of international repute towards greener tomorrow.

He said that NTPC is planning to add 1000 MW from renewable sources by 2017. They recently signed MoU for 500 MW of wind power in Karnataka & MoU with ADB for development of 500 MW from renewable sources.

Further, he added that NTPC has taken major initiatives for fast tracking its solar power development programme and hopes to set up 15MW solar capacity by 2012 and 50 MW capacity by 2014.

Mr. S. K. Chaturvedi (CMD, Power Grid Corporation) said that Economic development and energy production is capital intensive and depends on many resources. A State of the art technology is required to reduce GHG emissions. On a short term basis this is the emission reduction process from fossil fuel power plant. An attention is needed for ground water. Efficient transmission networks and integrated operations could reduce the GHG emission by increasing energy efficiency and by using coal-based plant optimally. He also stressed upon the point that emissions from power plants should be reduced.

He highlighted increasing demand in next 25 years. It is estimated that energy requirement and peak demand by the end of 2020 may well be in the vicinity of 1563 billion units and 2,60,000 MW against present figures of around 737 billion units and 1,08,000 MW respectively. He said that power sector has been facing a triangular contest between energy (electricity), economy and environment as economic development is directly dependent on availability of sufficient energy. Recognizing the urgent need to quicken the restructuring and liberalization of Indian Power Sector, Government of India, amongst many plans, has gone for setting up of many Ultra Mega Power Projects near pitheads and laying of long transmission lines.

He appraised the delegates that while 16% of world population lives in India, only 0.6% of oil and about same portion of gas reserves exists in the country. However, India is endowed with 6% of coal reserves of the world. As such current power scenario of India depends on the installed capacity with about 72% from coal fired thermal stations followed by 25% approx. from hydro and 2.6% approx. from nuclear plants respectively.

POWERGRID being the Central Transmission Utility of the country which is developing National Power Grid in India is committed for sustainable development and has integrated environmental and social management procedures into its corporate Operations through a comprehensive "Environmental and Social Policy and Procedures" (ESPP) document.

Although POWERGRID's operations do not involve emission of Green House Gases (GHG), it has already initiated action for introducing state-of-the-art technology which will help in reducing GHG emission indirectly if not directly such as by making all the offices and other installations Chloroflurocarbon (CFC) free, developing projects meeting the Clean Development Mechanism (CDM) requirement, facilitating bulk transmission of environmental friendly hydro power from North Eastern Region to Northern and Western Regions of the country.

Apart from this, we have taken many other initiative like development of 1200 kV A/C transmission system, ± 800 kV High Voltage Director Current (HVDC), Fixed Series Compensators (FSC) and development of strong inter-regional connections to facilitate mutual exchange of power amongst the regions. We have also introduced innovative tower design to reduce Right of Way requirement and use of multi-circuit towers to utilize existing corridors towards minimization of impact on national resources. Apart from taking massive afforestation initiatives towards conservations of natural resources, provisions like Rain Water Harvesting and collection of even used/waste water for its conservations and recharging of ground water has been made mandatory in buildings and sub-stations.

While concluding his speech he said that we have been making all out efforts to develop a strong and vibrant transmission network all across the country to transfer power in a environment friendly manner in saving the mankind from environmental catastrophe like Climate Change.

Mr. Tantra Narayan Thakur (CMD, PTC India Ltd.)

He apprised the delegates that Inter-Governmental Panel on Climate Change (IPCC) has clearly established an adverse impact of GHG emissions on climate. He said that it needed to be addressed with global and cooperative efforts on the basis of the principle of equity. The main thrust must be on reducing emissions and carbon footprints by societies and countries by following various mitigation processes. These include reducing GHG emissions, reducing the demand for energy and using energy more efficiently among others.

He said that our Prime Minister's initiative "National Action Plan on Climate Change (NAPCC) is testimony to the importance being attached to meet this challenge. The Prime Minister reaffirmed India's pledge that as it pursued sustainable development, its per capita GHC emissions would not exceed the per capita GHG emissions of developed countries, despite our

developmental imperatives. Enhanced Energy efficiency is among the eight 'priority national missions' created under NAPCC. Power sector can play a crucial role in achieving this mission.

He said, there is a possibility of across the board energy efficiency improvement of >25%. As per ADB Study 2004, almost 10,000 MW could be saved through energy efficiency and demand side management.

Power market has played an important role in optimal utilization of existing resources and would be increasingly relevant in the days to come. Improved supply and distribution efficiency are key result areas, which need to be followed vigorously. He apprised the delegates that PTC is buying wind energy from Tamil Nadu and selling it in Punjab.

PLF of thermal power plants has improved from about 70% PLF in 2001-02, to about 82% in 2007-08, a large measure of which may be attributed to power trading.

There is a need for a graduated shift from economic activity based on fossil fuels to one based on non-fossil fuels and from reliance on non-renewable and depleting sources of energy to renewable source of energy.

Development and utilization of renewable energy sources has been accorded high priority in India. Today, India has one of the largest renewable energy programmes in the world. With an installed capacity of more than 9500 MW, India ranks among the four leading nations in wind power production.

Small hydropower generation and Biomass power is being expanded. The world's largest bagasse-based cogeneration program is also being implemented. There is also considerable scope for extracting energy from urban and industrial waste and solar energy is emerging as a new thrust area.

There is a need to strictly implement the Renewable Energy quota or % specified by the concerned SERCs for procurement of electricity. Tradable energy certificates or green power market could help in promoting RE. He expressed that a Notional RPO% is desirable. The development of Market, which can effectively work to promote power from renewable, must be analyzed. He questioned whether Competitive bidding for renewable will work or commercialization of renewables for power generation? Despite apprehensions, decentralized generations are being financed (1) Biomass based (2) Solar based.

He informed that PTC has signed a MoU with BEE to undertake EE projects in Government buildings. There is a need for joint efforts – both from the Government and private sector to accelerate the process of undertaking EE projects – market can play a big role through ESCOs.

Shri Thakur has laid the stress on the following initiatives:

- Decentralised generation – biomass
- Wind power
- Solar

- Hydro
- Energy efficiency through ESCos

Mr. P. K. Laheri (Director, Torrent Power) started his speech with a story of using water by Mahatma Gandhi stressing each one of us draw from natural resources not beyond one's bare necessities as there is enough in nature to satisfy the need of each one of us but it is not sufficient to meet one man's greed as what applies to use of water also applies to drawing of energy from various sources.

He said that man-made carbon dioxide is the main contributor to the process of global warming. 95% of man-made carbon dioxide has come from the fossil fuels and USA is generating 21% of the world's carbon dioxide emissions equivalent to nearly 22 tons of carbon dioxide per person followed by 17% of the world's carbon dioxide by China. The shares of other major countries are Russia – 6%, Japan – 5% and India – 4%. If we could not reverse the trend quickly then we could face major environmental consequences such as rise in the level of sea by 3 feet to 20 feet, reduction in rainfall or irregular seasons, storms – intense cyclones & hurricanes, melting of snow glaciers affecting snow-fed river systems and many plants and animal species would be extinct on failure to adapt to new challenges.

He said, we cannot live without electricity and at the same time we cannot allow development leading to a catastrophe. He advocated to adopt multiple solutions both at collective as well as at individual level. Collective level includes transmission and distribution losses reduction, energy savings and better technologies.

- There has to be technological changes in the use of carbon base fuels. Current situation of having more than 60% of heat going waste, super-critical turbines could substantially improve the efficiency of fuel's conversion to energy.
- Transmission and distribution losses can be curtailed. There are new technologies of micro-turbines suitable for industries. There are advantages in having captive power provided generation efficiency parameters are maintained.
- Energy Audit/Saving – it is estimated that cutting down the wastages could save almost 25% to 30% of energy. Whenever, scientific audit is carried out, glaring gaps are found between actual requirement and avoidable use.
- Better technologies in illumination, transportation and conservation of power. New generation of lighting equipments, inverters as well as e-bikes and cars can certainly help in meeting the routine requirements with much less power than what is consumed today.
- Greater use of renewal sources of energy viz., Wind, Solar, Bio and Sea waves could lead to much needed improvement. The share of renewal energy is insignificant, as technologies are priced high. The Governments world-over need to pay greater attention to this sector.

SECTORAL ANALYSIS - GREENHOUSE GAS EMISSION CONTROL

3rd February, Session - 2

The third session "Sectoral Analysis – Greenhouse Emission Control" was chaired by Dr. Jyoti Parikh, Executive Director, IRADe.

Dr. Jyoti Parikh, (Executive Director, IRADe). She explained the need of low carbon technology in all economic sectors and find the path of sustainable development in energy intensive sectors such as urban area management and development, power, steel, cement and transport sector. These progress require high investment and development of expertise in the sector specific technology. She further mentioned the challenge of climate proofing of industrial infrastructure. there is huge potential in urban areas, in buildings and other consumers, to mitigate emissions by using the latest technologies and investing in cleaner projects. Investments will be forthcoming in an enabling policy framework with the right incentives.

Mr. A. K. Mehta (Joint Secretary, Ministry of Urban Development) said that there is a need of commitment by developed and developing countries to mitigate GHG emission from urban sector. The challenges for each nation is unique. Instead of addressing climate change separately, the approach needs to be holistic in a framework of sustainable development. He focused on Sustainable Habitat to organize cities so that they can be energy efficient.

He said that it is possible to explore win-win solutions, whereby reducing inefficiencies in urban services, building, transport and environment will automatically enable mitigation and abatement of greenhouse gases (GHGs) mitigation issues cover (a) Legal and regulatory regime (b) building

laws and bylaws (c) incentivising action for social participation (d) capacity building on supply and demand side (e) promotion of appropriate technology. When it comes to action on ground, planning for sustainable development will be necessary. For instance, reduction in water use (There should be a service delivery benchmark, considering the average per capita water requirement is 135 liter per day), a non-revenue sector would imply lesser requirement for capacity and reduce the requirement for energy in pumping more water too. There is a large potential in cutting energy use and greenhouse gases in the urban sector, which requires holistic planning. He highlighted the requirements under sustainable habitat mission (National Action Plan for Climate Change) for sectors like urban mobility (optimizing level of movement), solid waste management, urban planning and water. Urban planning is a challenging area. The various issues to be incorporated in the holistic planning are (a) Economic Planning (b) Investment planning (c)special planning (d) hazard Management (e) Environment management (f) civil issues like mobility. On ground water supply issue is complex, as there is no proven desalination process for water treatment, water leak detection, scheme for water auditing. In next two decades the urban population will double, hence the government and as document in NAPCC sustainable habitat is an important mission.

Details of Mission of the Ministry is given in http://urbanindia.nic.in/

ICF International and IRADe presentation by Mr. Brian Dean: This joint of ICFI and IRADe presentation was focused on the five major energy-consuming sectors (electricity, energy demand, transportation, iron and steel, and cement). He outlined the background of emissions in each and the possible mitigation potential and policy options, which can be explored. The use of the index of emission per tonne was stressed. Cement sector seemed to be on the right track as per this index, with lowering greenhouse gas emissions per tonne of cement production. Common policy options across all sectors were financial incentives, use of better technology, labeling environment safe products and equipment, enforcing building standards and setting up research and development units. Cross sector barriers to greenhouse gas mitigation were highlighted. These included lack of funds, infrastructure constraints, poor leadership, lack of skilled manpower and poor awareness among consumers.

Mr. Rajat Gupta (Director, Mckinsey) said that positive news for India is that 80 per cent of India's emissions of greenhouse gases are in just six generating and consuming sectors. The overall technical abatement potential is 45 per cent of the total BAU emissions in 2030. Achieving this abatement would also result in India becoming 25 per cent more energy secure, and lead the world with amongst the lowest emissions per unit of GDP.

He highlighted a bad news as well that the facts that most of the opportunity was either in negative cost or in projects that are difficult to implement. A need for a lifecycle approach was stressed, which would require sufficient incentives and regulation. Another major challenge would be the incremental capital needed in a capital starved economy. The investment requirement was projected at US$ 800 billion.

Lastly he mentioned that the abatement would come through a mix of lower carbon power; energy efficiency measures in industry, buildings, transportation and agriculture; managing terrestrial carbon better; and infrastructure investments (public transport, low carbon freight transport and city design).

CLIMATE CHANGE AND COAL SECTOR

3rd February, Session - 3

Mr. C. Balakrishnan chaired the fourth session on "Climate Change and Coal Sector".

Mr. Manohar Sinha (GSI) gave the presentation on "Harnessing Energy through Under Ground Coal Gasification (UCG) – An Option to Mitigate Climate Change". He spoke on Under Ground Coal Gasification (UCG) technology, its benefits and associated energy cost. India has total (Indicated & Inferred) coal reserve of about 247 billion Tonnes. The coal reserves are available between 300to1200 meters. As per the estimate approximately 35% coal reserves exists at 300-meter depth and beyond. These resources can be harnessed through UCG. The benefits of UGC are (a) no ash handling and disposal at plant site (b) less SO2 (c) less NOx (d) facilitate carbon capture (e) less cost of transport (f) no mine water recovery and surface hazards

UCG technology helps to mitigate environmental damages from mining and use of coal resources by reducing of particulate emissions, water pollution, ash production etc. It also has potential for Carbon Capture and Storage (CCS). GSI is working to identify potential coal blocks for UCG.

Certain physical, chemical, structural and resource characteristics must be present at the possible sites for the UCG applications. Few illustrative examples are Rajmahal-Birbhum, Singrauli, Talcher, Godavari and Ramnad lignite blocks.

For the development of reliable working programmes for application of UCG multidisciplinary approach is required, Pilot projects need to be carried out on a bigger scale. Data is available with us but technological and other issues are needed to be worked out.

Dr. Anoop Singh (Professor, IIT, Kanpur) gave a presentation on "Climate Change and the Indian Power Sector: An Assessment for Clean Coal and Other Policy Options" which was focused on policy options and requirements for adoption of Clean Coal technologies (CCT). He started by giving an overview of coal based power generation. He said that Coal based power generation capacity is 77199 MW and coal consumption is 330 MT and CO_2 emissions from these plants are 460 MT. Coal requirement for power generation is expected to reach 1475 million tonnes by the year 2031-32 and is expected to fuel about 78% of the electricity generation in the country.

He highlighted the key issues associated with the adoption of CCT from a study which was carried out by IIT Kanpur in collaboration with Cambridge University. He also highlighted stages through which an appropriate programme for CCT adoption can be formulated- policy formulation, description, design, programme design, financing and implementation and monitoring. He also gave a detailed description of involved stakeholders both public sector and private sector and issues relating to each stage.

He emphasized on three main key policy requirements:

1. Adoption of technology for efficient coal based power generation

2. Reducing emissions with use of efficient agricultural pumps

3. Upgradation of power distribution network

He told that large-scale adoption of clean technology needs policy push beyond CDM and there is scope for international cooperation.

Dr. Ambuj Sagar (Professor, IIT, Delhi) gave presentation on "Indian coal power and climate"

He explained the key issues for the coal power in India:

- Capacity addition: Significant growth projected for the upcoming decades; will need large capacity additions. In 2005-06: total installed capacity was 144 GW and cumulative generation was ~ 700 TWh and it is expected to increase capacity 800-1000GW; generation 3600 – 4500 TWh by the year 2030-31:

- Coal availability: He said that India has total coal reserves of ~ 248 BT, but all cannot be extracted. Presently India imports coal approximately 6% of total consumption and the projection are that it would increase to11- 45% by the year 2030-31 of total annual consumption. It is expected that Coal-based power generation would dominate and by 2030, 1-2 billion tons (BT) coal will be consumed in the power sector alone.

- Climate concerns: India is 4th highest in annual CO2 emissions but has low per-capita electricity consumption. The average power consumption in some regions are;

India: 500kW/capita;
World average: 2660kW/capita;
OECD: 8380kW/capita (2006 data)
Global CO2 Concentrations: 384 ppm

- Technology availability: He said that future technology pathways need to be considered:
  - Efficiency improvement & air pollution mitigation
  - Carbon émissions contraints

He stressed that the key advanced technologies (Supercritical, and ultra supercritical, pulverized coal based power generation, IGCC) available in the international market, can be adopted in India for improved and efficient power generation in India. He pointed out that commercial deployment of IGCC and supercritical technology in India are still 10-15 years away. He suggested that by demanding such technologies, India can avail advantages like access to international expertise, performance guarantee from international producers, reduced pressure for emission reduction on itself in climate talks and little relief in financial burden. He emphasized the requirement of imported coal for efficient adoption of advanced power technologies. Cost burden of transport of coal will impact commercial viability of advanced technologies. Thus the cost of viability rests on international producers.

Dr. Malti Goel (Former Advisor, Department of Science and Technology) gave presentation on "Perspectives in Carbon Capture and Storage in the Coal Sector"

She focused on efficient practices and technologies of the future for coal based power generation like in-situ coal gasification, IGCC and carbon capture and storage and sequestration.

She highlighted various types of sequestration processes in IGCC and supercritical technology of power generation and described pre-combustion sequestration, post-combustion sequestration, oxy fuel carbon capture and enhanced Coal bed methane capture process. She also pointed out the efficiency losses arising during power generation due to each.

She highlighted issues like lack of availability of appropriate technology and quality fuel for such applications in the country.

Chairman Shri. Balakrishnan summarized the session and appreciated the valuable information and analysis given by all the panelists.

FINANCING AND STRATEGIC INITIATIVES FOR CLIMATE CHANGE

4th February, Session - 1

Mr. Shyam Saran, Special Envoy to Prime Minister chaired the **session "Financing and Strategic Initiatives for Climate Change"**. He introduced the session saying that the world as a whole must make new strategies, in view of proposed shift in economic development driven by fossil fuel to suggested paradigm shift to renewable energy. How do we bring about that shift? The phenomena of climate change we are facing is not due to current emissions but the historical emissions done by industrially advanced countries. There is huge cost of adaptation due to current climate change and the likely climate change in future. So there are issues of equity and global burden sharing. The developing countries have a very narrow margin of safety for this phenomenon, but it does not have the capacity to finance the adaptation.

Ms. Naina Lal Kidwai (Group General Manager and Country Head India, HSBC) addressed her speech on the role of the bank in the subject of climate change and what they could do to help environment. How can we engage countries to go forward in this issue?

She mentioned the HSBC is guided by the "equator principle", which specifies the dos and do nots of the approval process of funding by the banks. To have a level playing field in India it is important to define similar principal for the domestic banks. Indian banking association has submitted a report on this aspect to RBI. The way we work is engaging with the companies in studying their scope of improvement and the document best practices for them. We have the benefit that analysts have been doing analysis on climate change and we can use the data for research acting on what it is needed at this hour. Mission for us is to bring forward the technology

and help commercializing it. Even on IPO, the energy audit process is recommended. It is not enough to do the right thing; we have to bring it to the non-profit level. The enterprise has to show yearly improvement. Helping energy efficiency will profit in the long run. The HSBC is working with SME sectors. She highlighted their experiences with foundry owners of Howrah, West Bengal where they could convince that path to development is though operational clean and best practices. From the business perspective it is important to understand the risks as a banking institution. Money is currently getting selective, it moves to the companies where best practices are being followed. Understanding the long-term impact of the climate change is important to us. India needs to engage in information systems on carbon credit. The entrepreneurs have to be made aware of these phenomena; it should make sense to them through matured communication. They will like it and they will get engaged. They have association with five institution to promote activities for mitigation of climate change such as WWF, Earth Watch.

Mr. Shyam Saran mentioned that the government has released National action plan on Climate Change. The NAPCC has eight missions and each of the missions is being elaborated. One of the mission is enhanced energy efficiency, and prior to India had energy conservation act. The government is setting up standards for energy efficiency. To begin with it will be voluntary. Later on market mechanism will be introduced to issue certificates on energy savings and use of renewable energy. These certificates can be traded. The progress in global research on renewable have slowed down due to recent economic down turn.

Mr. Naoki Sakai (Energy Specialist, ADB) gave the presentation on "ADB's Support for Combating Climate Change with Financing and Strategic Incentives". He said that ADB Commends Initiatives of Government of India for combating Climate Change by releasing NAPCC. ADB expects GOI to continue to lead the worldwide discussion on climate change because Climate Change can affect the Poverty in Asia. He also gave an overview of impact of climate change on rainfall patterns, Himalayan glacier, mangroves, sea levels, agriculture, GDP and living standards. ADB provides concessional financing on projects on social importance and climate change in one of them. They had discussions with Ministry of finance and Ministry of New and renewable energy.

He explained the Role of Asian Development Bank in Climate Change Financing and described the ADB's Long-term Strategic Framework. He also explained the ADB's Climate Change Program and Energy Efficiency initiative and said that to help make mitigation and adaptation actions affordable and more competitive for climate change, we have recently established additional financing schemes to mobilize concessional funds, catalyze private sector capital, and maximize the use of market mechanisms.

He said ADB's Carbon Market Initiative provides upfront financing and technical support for mitigation projects. ADB also established the Future Carbon Fund to enable clean energy project developers to gain benefits even for the post-2012 GHGs reductions. This will encourage more investments now in energy efficiency and renewable energy.

Summarizing the ADB initiative and their sensitivity of way forward he described (a) Identification and development of Climate Change related projects with these concessional financing facilities.

(b) Further consultation with private sectors and structuring optimal PPP models where ADB can provide competitive lending, grant, equity. (c) Support project developers for application of CDM and post CDM. (d) Mobilizing larger size of concessional financial resources in consultation with the Government of India

Dr. Shailaja Sharma (Advisor Future Fuels and CO2, Shell India) gave presentation on "A New International Framework for 2009". She said that the way we produce and use energy today is not sustainable. A new direction is needed. She said that very effective actions are required to mitigate the climate change as recommended by Dr. Nick Stern (a) Global emissions to fall by at least 50% relative to 1990 by 2050 (b) Agreement by developed countries to take on immediate and binding national targets of 20% to 40% by 2020, and to commit to reductions of at least 80% by 2050. She told the Countries with Kyoto targets are comparable to those with non-Kyoto targets. We must support and promote smaller activities instead of waiting for major movements. She emphasized on CCS technology and suggested some key elements that need to be present in the near term:

- CCS recognised within the UNFCCC Clean Development Mechanism (CDM);
- International CCS certification, that delivers a (tradable) certificate for one tonne of CO2 stored underground and supports the CDM;
- A funding framework for the demonstration phase of CCS, consisting of -
- Recognition of CCS within existing and new clean technology funds (e.g. the fund recently proposed by the G8);
- Recognition of extra-national CCS demonstration projects within national and regional funding arrangements e.g. EU CCS Demo funding amendment to the ETS Directive.

Mr. Manjeev Singh Puri (Joint Secretary, Ministry of External affairs) said that there is general acceptance to the statement that India should follow the development path in compliance to sustainable development. India lives in a global environment and as a responsible nation it abides by the international framework of co-existence. Climate change is a global issue, and it affects adversely most of the countries, which includes India. Collaborative effort is needed to mitigate GHG emission and adaptation to climate change.

Can the technologies (low carbon technologies) developed for energy efficiency, renewable by the advance countries for preventing climate change is openly available to all at reasonable/-reduced cost? This will be an IPR issue.

Global financing mechanism is needed to channelise the funds such as carbon credits. International negotiation meetings for setting norms and framework are resulting into stalemate. The developed countries try to dominate and expect the developing and not so developed countries to follow their directives. It is very difficult to update them on the constraints of other countries, and the suggestion to revise their draft is met with stiff opposition. It is well established that economic growth requires energy, which is derived from fossil fuel, and consumption leads to the emission of GHG to atmosphere. These gases have long residence time. The GHG emitted in early last century is causing current problem. Each nation has equal right to economic growth

and ensures social welfare to their citizen. The consequence is more GHGs will be emitted. Hence a principal of equity is equity is essential in atmosphere. There are various estimates for addressing cost of climate change and the estimate of resource transfer varies from $125-150 billion to 1 trillion US$. From where this fund will come, as due to economic meltdown the stimulus package is consuming those funds. Thus in the international negotiation polluter pays principal needs to be revised with conditionality, such per capita emission, equity in atmosphere. There have been suggestions on Adaptation fund and any suggestion from developing country results in breakdown in discussion. There are various prescriptions forthcoming such as from Stern, European Union. The prescription does not consider poor's right to development and FCC's recognition of the PPP principle at national level? At the national level we should have inclusive growth, we are aware of high petroleum taxes, subsidy for kerosene/LPG etc.

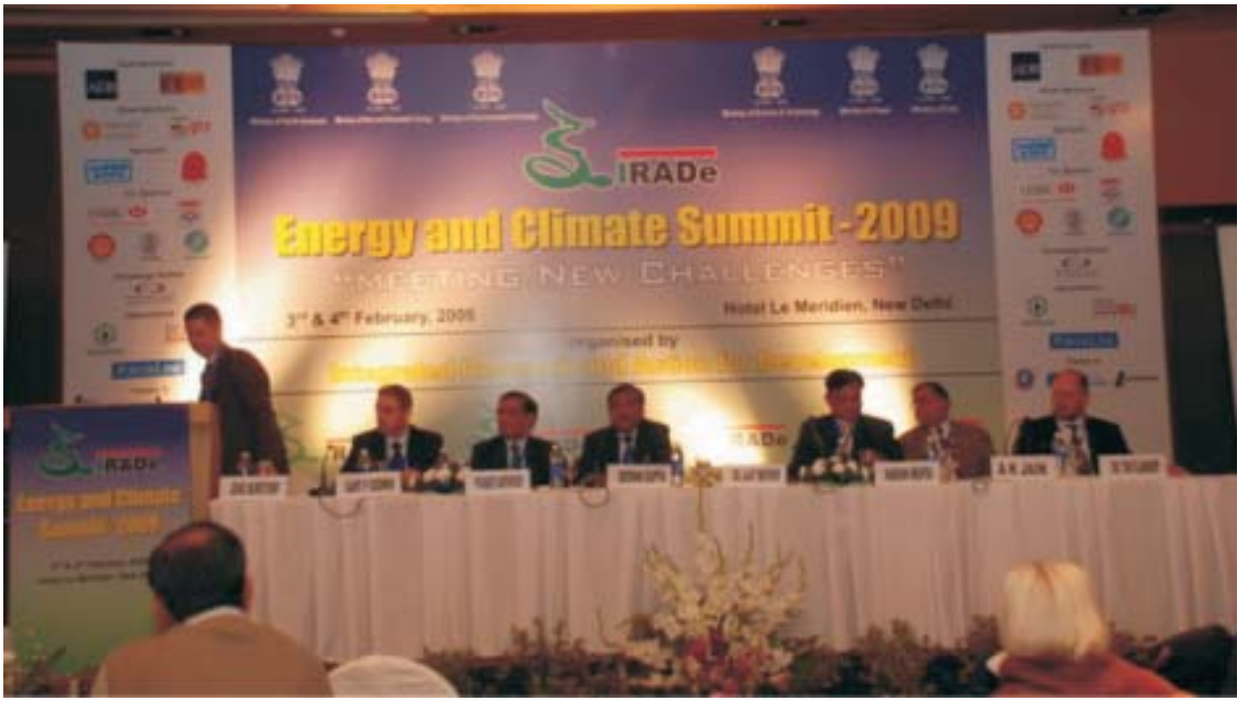
Mr. Shyam Saran (Chair and Special Envoy to Prime Minister) said that Developing countries have the responsibility to engage in sustainable development but their emission reductions will be the result of sustainable development, not the other way around. This is an important distinction. To enable enhancement of sustainable development in developing countries, there has to be support in terms of technology transfer and financial resources. India must do what it can for sustainable development. Sustainable development issues include climate change, energy security, development, poverty and environment. Climate change is global issue. Hence, collective action is needed. We would like to adopt world's standards but we are poor and we need not be able to pay for the technology without help. We need a collaborative approach based on a common and shared vision. India has announced its own National Action Plan on Climate Change on June 30, 2008. It is, in essence, our own strategy for sustainable development. It is based on the recognition that both in terms of energy security and tackling climate change, India must achieve a graduated shift from reliance on carbon-based fossil fuels to non-fossil fuels and from non-renewable to renewable sources of energy.

Highlights in the **financing and strategic initiatives** session are as follows:

- There is a need for capacity building in the SME sector, particularly as they account for 60 per cent of the industry. Capacity building also needs to be undertaken with respect to CDM projects, validation of projects, independent agencies etc.
- On the financing side, banks are increasingly taking into account the effect of climate change in the form of draught, floods, change in rainfall, reduction in GDP, reduced standard of living etc while funding energy projects.
- Companies that take environment into consideration generally tend to have better stock returns in the long term and attract equity and other investors.
- Venture Capital and private equity funding is needed to evolve for the sector, particularly the venture capital side as such funding is limited in nature. The early stage financing by such investors is critical to bring in new technologies and awareness about the long-term impact of climate change.
- Carbon credits principles needs to be looked at from a domestic perspective particularly as they have been set on a western footprint.

RENEWABLE OPTIONS AND ENERGY EFFICIENCY

4th February, Session - 2



The session "Renewable options and Energy Efficiency" was chaired by Mr. Deepak Gupta and co-chaired by Dr. Ajay Mathur.

Mr. Deepak Gupta (Secretary, Ministry of New and Renewable Energy) summarized the Key issues of the sessions that emerged from the discussion

- Challenges for penetration of Renewable Energy technologies
  - Cost of technology
  - Reluctance among potential users
  - Penetration in rural areas and evacuation of power issues
- Ministry of New and Renewable Energy (MNRE) and Bureau of Energy Efficiency (BEE) are working together and looking at sector specific interventions. MNRE is working on re-estimating the projections and goals set by the Integrated Energy Policy document and are hoping to double the targets.
- Key issue for the development of green fuels is technology neutrality in legislation to allow the technologies to grow and develop and not to mandate any particular technology.
- Biochar can provide a good potential for carbon sequestration and help in dealing with climate change, food, water, and energy crisis.

- MNRE is looking at the necessary changes required in the Electricity Act to support higher application of renewable energy and energy efficiency.

- Energy efficiency: key challenges

    - Overcome the barriers in promoting energy efficient appliances: through labeling program and increasing awareness among users.

    - Energy efficiency improvements in Commercial buildings: Training programs for architects being organized to increase awareness about energy conservation building codes

    - Increasing awareness about energy efficiency in small and large industries: training being provided to local consultants

He mentioned about the importance of increasing energy efficiency in 2 sectors; municipalities and agriculture. Further he also mentioned about promoting energy service companies (ESCo), who are making the initial investment, and recovering the costs from the energy savings achieved.

Dr. Ajay Mathur (Dir. General, Bureau of Energy Efficiency (BEE)**)** said that the energy efficiency in industry is economically viable, but the barriers are capital cost, lack of Information, and concern for whether technology will work or not. That is the reason for the slow adoption of new technologies. Reference to lack of information BEE has started energy-labeling program. They are preparing verified case studies for equipments in big industry. Energy efficiency in buildings sector in the country is a key thrust area of Bureau of Energy Efficiency (BEE). Under the Energy Conservation Act, 2001, Central Government has prescribed ECBC for commercial buildings (at present having a connected load of 500 kW) or building complex for efficient use of energy and its conservation.

According to ECBC, the building plans are expected to include all pertinent data and features of the building, equipment, and systems in sufficient detail of the following:

- **Building Envelope:** insulation materials, fenestration, solar heat gain coefficients (SHGC), visible light transmittance, and air leakage; overhangs and sidefins, building envelope sealing details.

- **Heating, Ventilation, and Air Conditioning:** system and equipment types, sizes, efficiencies, and controls; economizers; variable speed drives; piping insulation; duct sealing, insulation and location; requirement for balance report;

- **Service Hot Water and Pumping:** solar water heating system

- **Lighting:** lighting schedule showing type, number, and wattage of lamps and ballasts; automatic lighting shutoff, occupancy sensors, and other lighting controls; lamp efficacy for exterior lamps;

- **Electrical Power**: electric schedule showing transformer losses, motor efficiencies, and power factor correction devices; electric check metering and monitoring system.

Lastly he explained the energy efficiency key interventions:

- Overcome the barriers in promoting energy efficient appliances: through labeling program and increasing awareness among users.

- Energy efficiency improvements in Commercial buildings: Training programs for architects being organized to increase awareness about energy conservation building codes

- Increasing awareness about energy efficiency in small and large industries: Large industries are acting on energy efficiency to improve their bottom line. The challenge is with small and medium enterprises. They have limited capacity to develop on their own. BEE is encouraging the local consultants. Training is being provided to local consultants on DPR preparations, preparing reports and applications to be submitted to banks for financing.

- Increasing energy efficiency in 2 sectors- municipalities and agriculture: promoting energy service companies (ESCo) that are making the initial investment and recovering the costs from the energy savings achieved. The BEE makes investment grade audits and call for enquiries through public advertisements. They are rated by CRISIL and ICRA. There are fifty ESCo actively associated in the program.

- He mentioned about innovative pilot program in association with ESCo for serving farmers using pumps for irrigation in the Sholapur district, Maharastra. The financing of electricity subsidy to farmers operates by transfer of subsidy amount from state treasury to electricity utility company. The infrastructure improvement done was to connect the pumps to HVDS feeders. The ESCo will change the pump-set with BEE rated pump, and ensure power savings with better maintenance services. The savings achieved will be remuneration of the ESCOs.

- The delivery mechanism and institutional structure is being formulated for the Demand side management.

Mr. Jens Burgtorf (Director, GTZ) gave us an insight into GTZ operations and its activities in India mainly about energy efficiency and power plant optimization. He further explained the Fields of Competence of GTZ:

- Economic and employment promotion

- State and democracy

- Agriculture, fisheries and food

- Environment and infrastructure

- Health, education, social security

GTZ and KfW Entwicklungsbank jointly implement Indo-German energy programme (IGEN). The broad focus if IGEN is to support the implementation of the Energy Conservation Act 2001. This Act positively intervenes at all levels of society, such as energy intensive large industries, manufacturers of household appliances and industrial equipments, residential households as well as engineering consultancy firms. The components of IGEN as identified by him are as follows:

- Energy Efficiency
- Power Plant Optimisation
- Clean Development Mechanism
- Indo-German Energy Forum

He suggested three major tools for sustaining energy demand in future; practicing energy modesty, improving energy efficiency and developing renewable energy

Mr. A. K. Jain (Exe. Dir., PFC) gave an overview of PFC that it is a profit-making and dividend-paying Company, with net worth of Rs. 9,587 Crores & Loan Assets of Rs.60, 441 crores.(as on Dec 31, 2008) and declared as a Navratna PSE by the Govt of India in Jun, 2007. PFC sanctioned 2,220 Crore Rs. for 61 renewable energy projects of 7055 MW capacity.

PFC provides funds for different Power and energy projects but its main emphasis is on Renewable energy projects.

He also gave an overview about the background of PFC in brief. He told that Ministry of Power has nominated PFC for assistance to state utilities in preparation of CDM projects for R&M of generating units both thermal and hydro. PFC has been nominated as nodal agency for R-APDRP by MoP, GoI and it has also been desired that a CDM cell for facilitating the CDM benefits to State Power Utilities for reduction of T&D losses in the APDRP shall be created in PFC. ADB has sanctioned grant of US$ 1 million under the Technical Assistance (TA 4992-IND) through PFC to facilitate availing of carbon credits under CDM by state sector power utilities for RM&U of old generation projects.

Lastly, he mentioned the key strengths of PFC that it is a Leading Financial Institution with 20% market share with in depth understanding of the issues of power sector, offers a bouquet of products and services and customizes the products to suit borrowers' requirements. It has close relationships with all State Power Utilities and State Governments.

Mr. Gary P. Godwin (MD, UOP India Pvt. Ltd.) gave an interesting and illuminating talk on second generation feed stock to green fuels. He mentioned about the challenges and regulatory framework required for standardization of biofuels. He addressed importance of huge capacity of Biomass convert into liquid fuels for transportation.

He explained the advantages of biofuels over fossil based fuels that it is biodegradable. Biofuels are relatively harmless to the environment. In addition, biofuels stabilize stored fuels and are non-toxic.

Global energy demand is expected to grow at CAGR 2.1%. Primary Energy diversity will become increasingly important over this period with coal, natural gas & renewables playing bigger roles.

Fossil fuels are expected to supply 83% of energy and 95% of liquid transportation needs.

First generation biofuels, though raw materials are limited, are an important step for creating a biofuels infrastructure. Second generation feedstocks, cellulosic waste and algal oils, have the potential to make significant contributions. UOP is developing technology pathways to green fuels via the PyOil route that integrate well with petroleum refineries. Algal oils successfully converted to specification green fuels in UOP Labs

Dr. Tim Flannery (Environmental Scientist, Australia) gave an overview of pyrolysis techniques and benefits of using biochar in agriculture, like increasing yields, water retention.

- Biomass: The best science we have tells us it is going to be very difficult to apply new technologies for alternative energy options.
- Expect better performance to come down with expected emission reductions.
- Use Biomass as a mechanism for CCS; what we need is a storage element for that mechanism. Impact on agricultural productivity and carbon capture.
- Solar pyrolysis technology. Microwave technologies. In India such technologies are critically important.

He finally asks to consider these technologies.

Biomass is also a potential fuel for energy conversion plants with carbon capture. In concert with carbon capture and storage use of biomass as input fuel creates a process with negative GHG emissions – operating like a carbon vacuum cleaner that sucks CO2 out of the sky in producing biomass.

He explained the process of pyrolysis:

- **Fast pyrolysis:** fast pyrolysis yields 60% bio-oil and takes seconds for complete pyrolysis. In addition, it gives 20% biochar and 20% syngas. There are no waste streams other than flue gas and ash.
- **Slow pyrolysis:** Slow pyrolysis takes several hours to complete and results in biochar as the main product.

Afterwards he explained the benefits of Biochar, The growing concerns about climate change have brought biochar into limelight. Combustion and decomposition of woody biomass and agricultural residues subsequently results in the emissions of a large amount of carbon dioxide and methane. Bio-char can store this CO2 in the soil leading to reduction in GHGs emission and enhancement of soil fertility. In addition to its potential for carbon sequestration, biochar has several other advantages.

- Biochar can increase the available nutrients for plant growth, water retention and reduce the amount of fertilizer by preventing the leaching of nutrients out of the soil.
- Biochar reduces methane and nitrous oxide emissions from soil, thus further reducing GHGs emissions.
- Biochar can be stored for almost1000 years.

Mr. Pradeep Chaturvedi (Chairman Centre for advancement of science) rightly mentioned about renewables for climate change. He talked about the present policies, energy securities, sustainability of growth and cost of renewables. He mentioned that energy efficiency and renewable energy have to develop together.

Quoting Integrated Energy Policy (2008) he said that we are energy secure when we can supply life line energy to all our citizens irrespective of their ability to pay for it as well as to meet their effective demand for safe and convenient energy to satisfy their various needs at competitive prices, at all times and within prescribed confidence level considering shocks and disruptions that can be reasonably expected. He explained the broad vision behind the energy policy is to reliably meet the demand for energy services of all sectors including the lifeline energy needs of vulnerable households, in all parts of the country, with safe and convenient energy at the least cost, in a technically efficient, economically viable and sustainable manner. He also gave an overview on Integrated Energy Policy and National Action Plan on Climate Change (NAPCC).

He concluded his presentation by saying that the issues of sustainable energy supply for socio-economic growth is too big to rely only on the free market and the reputation risk of businesses. Government intervention is needed to drive this shift towards energy security in low carbon economy.

India will need comprehensive policy proposals to deliver real change for sustainable energy solutions. The slowing of economy should not be used as an "excuse not to act". Decisive action on climate change would stimulate the path for low carbon economy at a time when it is "certainly needed".

Mr. Harish Mehta (Director, Suzlon) stressed on 4 E's: energy, ecology, economy, and equality. He talked about factors affecting renewable energy technology, mitigation and adaptation techniques.

He explained that an increased need of energy has led to various significant issues like:

- Uneven Distribution of Supplies among countries
- Limited supplies of primary energy sources like Oil, Gas & Coal
- Environmental issues related to such forms of primary sources- Climate Change

The world is already running short of fossil fuels. Demand is more than the generation capacity. India needs to increase its power generation capacity but conventional sources of energy lead

us to climate change, acid precipitation, degradation, and loss of bio-diversity so renewables has to be part of the solution, as they do not emit harmful Greenhouse Gases.

He brought to notice that India has installed more than 13,500 MW of grid connected renewable energy (Dec, 2008) and approx. 9,500 MW power is being generated through wind energy alone.

He described the factors affecting Renewable energy development:

- Cost of Technology
- Reluctance among the prospective users including decision makers
- Most of the RE sources are located in rural areas where required intensity of energy is low. Thus there is need to device suitable measures for transport of energy to these areas of utilization.
- Lack of consistency in Policy Frame Work

Lastly he mentioned energy efficiency is more than energy savings and some common goals for Renewable Energy (RE) Technologies and Energy Efficiency are:

- Both aim at providing energy security
- Both aim for reducing GHGs emission
- Both make us self-reliant
- Last but not the least they help us to be responsible for future generation.

He suggested that current bottom line for each corporate is Profit. He emphasized addition of People and Planet. He went on to suggest that priority wise it should be Planet, people and profit.

Mr. Saurav Yadav (World Bank): The brief presentation of Mr. Saurav Yadav highlighted the service rendered by World Bank with multilateral partners like Asian Development Bank to the initiatives of BEE, MNRE and Ministry of Power. They are working on distributed power generation from small hydro, biomass and feasibility of linking to the grid. They are active on Village energy security program

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He mentioned about the importance of increasing energy efficiency in 2 sectors; municipalities and agriculture. Further he also mentioned about promoting energy service companies (ESCo), who are making the initial investment, and recovering the costs from the energy savings achieved.

CLIMATE CHANGE AND HYDROCARBON SECTOR

4th February, Session - 3

The session "Climate Change and Hydrocarbon Sector" was chaired by Mr. P. K. Sinha, Additional secretary & Financial Advisor, MoPNG

Mr. P. K. Sinha (Additional secretary & Financial Advisor, MoPNG) said that energy and climate have a fairly intimate relation. We cannot think of life or development without enhancing the availability of energy and perhaps we cannot enhance the availability of energy without impacting or affecting environment and climate in one way or the other. It is this human endeavor which has made the relation between energy and environment so much talked about these days. When we look at the India's energy mix, the oil and gas contributes about 45% and 50% comes from coal and lignite, balance 5% from hydropower and nuclear power. That gives us an idea of importance of oil and gas in the energy mix. 40% of the total pollution is caused by fossil fuels, which mean coal, lignite and oil and natural gas. Hydrocarbon is one sector, which affects the environment in the entire operational chain from (a) production that is extraction of mineral oil and gas, (b) the refining or the manufacturing and (c) the consumption by user such as transport. The suggestion of mitigation of CO2 are (a) use of natural gas, coal bed methane, underground coal gasification (b) use of eco viable bio-fuel (c) Improved quality of fuel conforming to euro III and above norms, branded fuel, use of CNG. But the question is what can be done to mitigate the worse impact of hydrocarbon sector on environment and climate. Therefore we have to look at all the three processes in detail, production, refining or manufacturing and consumption.

Mr. N. R. Raje (Director, CAER) said the issues relating to climate change have assumed centre stage in the last few years since 2005 after the ratification of Kyoto Protocol. India is a developing country also known as the non-Annex country as per the UNFCC. India's per capita

CO_2 generation is very low as compared to OECD countries but it is expected to rise almost by 60% by 2015. With regard to CDM projects India is given the host country approvals for around 900 projects of which 347 were registered by the UNFCC executive board. The major emphasis of oil companies as a response to climate change is the research efforts on energy efficiency and decarbonization of the fuels apart from their entry into the renewable sector. India has not only global but national as well as corporate social responsibility towards mitigation of climate change. There could be enormous opportunities and possibilities for the oil industry to take up projects having CDM potential.

Mr. Pramode Seth (Executive Director, Chief Corporate Planning, ONGC) gave the presentation on "Climate Change and Hydrocarbon sector" and said that there is global consensus that something has to be done immediately. He mentioned about the freak weather condition observed in the recent times. Currently fossil fuel accounts for 88% of the energy needs. The total hydrocarbon system in India has created an irreplaceable infrastructure. These have to make operationally viable during uncertain weather. Climate change mitigation efforts are (a) to induct environmentally friendly (green option) technology. This effort may lead to enhancing cost by another 20% (b) follow the best practices to enhance the energy efficiency of the process, such that the saving in energy per unit of product will result in reduced stress on environment (c) improve the quality of co-product and use of co-product. As an example he mentioned about CCS technology. ONGC is maintaining a green belt around its installation and actively protecting the mangroves near their installations. ONGC is working in the field of Coal bed methane, Underground coal gasification. ONGC has carbon management group, and this group is managing CDM projects. They have "ONGC energy trust" for promoting new and renewable energy. He also talked about their commitment to achieve of carbon neutrality status in near future.

Dr. Cleo Pascal (Royal Institute of International Affairs, London) gave presentation on Climate change and energy infrastructures. He told about three challenges and three opportunities in a time of climate change.

1. Vulnerable energy infrastructure in coastal areas
2. Vulnerable energy infrastructure in cold climates
3. Legal infrastructure poorly designed for changing geophysical circumstances

While emphasizing on vulnerable energy infrastructure in coastal areas, she gave an example of Katrina, which had hit the U.S. She said that Katrina was an expected phenomenon in an expected location. Yet it caused massive disruptions to the US, and it affected global hydrocarbon market severely. She also mentioned the Damages caused by Katrina and Rita in the year 2005 which are as follows:

- 457 damaged pipelines (Minerals Management Service)
- 113 Platforms destroyed (Minerals Management Service)

- US Gulf Coast refines around 30% of US oil supply. Katrina alone shut down 9 of 17 refineries in hurricane zone
- Oil production in Gulf Coast dropped to 57.37 of normal output, natural gas dropped to 40.35% (DoE)
- Spikes in global prices.

She also explained that effect of climate change on energy infrastructure in cold climates by mentioning following points:

- Pipelines, storage tanks, roads, railways, etc., built on permafrost potentially become substantially more unstable and expensive.
- Ice roads have shorter windows, requiring more flying-in of supplies, increasing expense.
- Increased erosion, landslides and slope instability add to disruptions and expense

She concluded by saying that we are heading into an era in which limiting loss will be just as important as promoting growth. It is no longer enough just to think about our impact on the environment.

Dr. K.K. Jajodia (Group Chairman, Assam Company Limited) delivered a very inspiring and motivating speech as group chairman of a 170-years-old heritage company. The company has a distinction of being second company in the world to explore crude oil. He reviewed the effect of climate change in India. He stressed that India is growing rapidly and should meet its required energy demand through better strategy and planning followed with implementation. In every activity- household, transport, etc. energy is required. He lauded the efforts of Reliance Industries, ONGC, GSPL in striking new gas reservoir. These are efforts that lead to solving national issue. But we have to study energy option for next generation. He emphasized on use of solar energy. The entire country is fortunate in terms of its accessibility to solar energy. Today only 15-20 % of energy is arrested but if we can go to 40-50 % all over the country much of our energy requirement can be met very easily. He said that country is blessed with large human resources with enormous potential. Today India has become a knowledge-based society. We have to see how we can channelise our resources energy and potential for renewable energy. India is second in population after China. The energy security has to be provided to every citizen. India has multiple options of renewable energy (solar, wind, micro-hydel etc), and development in each option has to be pursued. The option is to strategies and setting priorities of focus of action. The task ahead is to implement National action plan for climate change successfully. He felt confident that young human dynamos will be able to meet national requirement effectively.

Mr. Sanjay Das Gupta (DGM, Indian Oil Corporation) gave the presentation on "Climate Change and Hydrocarbon Sector". He spoke about global warming, global surface temperature trend. He said that focus been the climate change some of the manifestations of global warming are -extreme weather, heavy precipitation, heat waves, rising sea level, immersion of suburbs

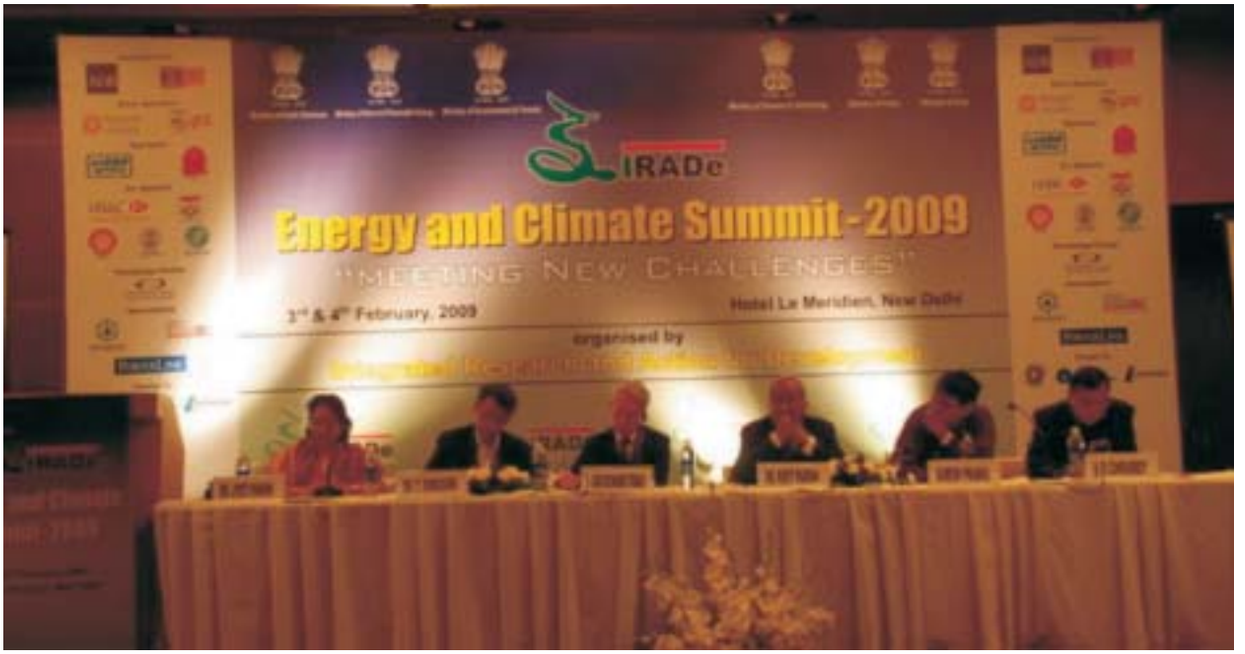
into the sea in countries like Maldives and new diseases such as bird flu becoming prevalent these days.

He also talked about the 1992 Earth Summit held in Rio De Janeiro and also about the Kyoto Protocol as per which, developed countries are supposed to cut their GHG emissions by 5.2% below their 1990 baseline over the 2008 to 2012 period. Despite being highly populous country India's emissions are quite low as compared to the developed countries. After post 2012 the pressure is on developing countries, majorly on countries like India, Brazil and China as they don't have any caps on their emissions but in future the developed countries want that these developing countries also must caps on their emissions.

The energy efficiency of IOC in terms NRGF factor (Specific energy consumption per barrel of crude) has come down by 15% (77 to 66) over 5 years and they plan to reduce the parameter by further 10- 20%. The Carbon Dioxide Emission, MT/MT of Crude processed, reduced from 0.333 to 0.223. IOC has undertaken Renewable Energy Projects (Setting up a Wind Power Project of 21 MW installed capacity in the state of Gujarat at a cost of Rs.131.66 crore, Use of Natural Gas, Use of hydrogen as fuel cell, Use of bio fuel (Bio-diesel)

VALEDICTORY SESSION

4th February 2009



Dr. Kirit Parikh, Member, Planning Commission chaired the valedictory session. He appraised the distinguished panelists on the deliberation, issues raised, during the summit over two days by presenting summary of each session.

Dr. T Ramasami, Secretary, DST:

In the current economic scenario, the path of development should be taken with consideration of climate change. The phenomena of climate can be considered as a prism occupying apex position, with energy, Technology, society/social choice at the base causing climate change. The right combinations of base elements are needed to control the climate. This will lead to optimum energy flow and utilization. There is a mismatch on the energy- mass balance at the national level. This creates difficulties for planning the economic growth. Current and future policies have to do with anthropogenic causes, and the scientific approvals to adaptation have to be irrespective of the cause. In all these social and life-style policies are most important and their choice is critical. The understanding of climate – technology and energy are truly complex. We need to analyze what is the bandwidth of energy & technology spectrum because the energy policy must change with technology, demand and supply.

The Energy technology bandwidth will specify how much energy is required for the commercial solar system. What is the life cycle technology input/output relationship? These questions are scientific issues, inclusive of thermodynamics. These are separate from economic choice or political decision. As they decide burden on climate. It is the experience that the availability of technology does not give best return without technology management. The feedback is a thermodynamic issue. The renewable energy is the answer but it requires a different management

system. The context in which energy is harnessed in our system, we have to develop our own system and solution. Science and technology must solve this problem within our existing means.

Similarly we have to develop a system for a decentralized solar power and use. There are no readymade solutions; we need to do science differently. Considering the current gap in indigenous science and technology; global partnership is a fundamental requirement.

Road Map: We can travel along the paved path. But that will not be a lasting solution. We can travel along the unpaved path, taking the path we have not taken before. But there are uncertainties. Performing science with nature is not against it, and progress is ascertained.

Sir Richard Stagg, HE British High commissioner:

The economic meltdown has caused the Global Financial crisis. This may retard the progress of many projects. But the projects related to climate change cannot be put on hold and indeterminate state. He mentioned about ICRISAT, Patancheru project, which has come up with an analysis of climate change on agriculture. Such projects are very relevant for understanding the path of economic progress. This is the unique opportunity for good projects of large-scale public sector investments, which address current concerns for climate change. The public investments have a significant role to bring the global economy on a sustainable growth. The current quantum of the government issuance of stimulus package for reviving economy has not been witnessed in the living memory. This amount may not be available in future. There are a large number of areas where these packages can be beneficially utilized. Scope of Energy efficiency in economic sector has great possibilities of innovation. India cannot be mute observer to the global concern of climate change even if it did not create the problem at the first place. The country will be affected by the climate change as it has long seacoast and an arid land area. The pool of Indian scientists and technologists can take up the challenge of climate change through research and development, and ensure their work fructify objectively. India can be a supplier of technology rather than being a buyer. The time to act on projected concern of climate change is now, and it cannot be left for future. India can take up large renewable programmes. The government of India is aware of their responsibilities. **The NAPCC was developed in-house without external assistance. All the effective projects on climate change done in India will create confidence and provide inputs for the International negotiations. Indian government can take up "per capita emission" concept in the international negotiation from a moral prerogative perspective and evolve a realistic framework leading to a practical outcome.**

Mr. Suresh Prabhu, Member of Parliament:

The energy issue is the biggest challenge for the civil society. The challenge can be best understood when we consider ensuring availability, supply provisions and the cost of the energy. In the process of consumption of fossil fuel, the unabated anthropogenic activity, mankind has created a problem, which we perceive as global warming or climate change. Climate change is a reality and is now accepted as a problem, which has to be addressed expeditiously. This is the form of challenge we are facing. In the quest for search for climate solution, we try to find the source of the problem, and the problem created by the developed countries. The global focus of responsibility for mitigation of climate change is on India and China, who are basically the affected parties. There are many other countries, which are going to be affected by global warming.

Observing the burden of the responsibility, India appears to have gone on defensive. The reality is that India has to address this challenge and come up with viable solutions. The nation should have a transparent well-articulated policy. India has to pursue the solar mission like the developed country (Due to our geographical position India has benefit of sunlight and Germany is deprived of this facility for half the year. Germany has aggressive program and our effort is lack-luster). We must energize our existing solar mission. There are various negative psyches in our planning, while being compared with China we feel good. This does not mean we should copy policies of China. As stated in IEP, we must diversify energy portfolio with more emphasis on renewable source of energy. In the era of globalization access to international level of technology has to be developed through co – operation with the developed countries. The cooperation should lead to indigenous technology. Currently there is very little investment in R&D technology. This has to be augmented. The proposed enhanced energy efficiency is beneficial for short term. In the long term there is a need for innovative and green technology. Coal as an energy source is a medium term solution. The CCS technology can be considered but others must pay for it such as developed countries. India has adequate hydro-power potential whose impact of climate change must be evaluated including positive and negative impact. There are concerns about adaptation to climate change. Prior to that impact of life style on carbon accumulation should be evaluated. There are bigger concerns due to great inequality in life style. There are social issues on whether we should go for urbanization or decentralized villages. These issues should be effectively analyzed; there should be clear position on path of development while engaging with others for inclusive growth. In the time of global economic meltdown, market cannot be panacea for all solutions. An innovative market economy should be deliberated. The forests are not just sinks of carbon; it is also economic resource for major population. The climate change and forest cover are interlinked. The summit has been organized at the right time, and the message of the summit should be provided to the politicians as they talk right thing before the elections.

Dr. U. D. Choubey, CMD, GAIL:

The most important topic today is climate change, which is in turn linked to all human activities whether to industrial, commercial or any other sort. As far as the industrial part is concerned with certainty 90% comes from the industrial side. Looking at the growth of the country only 8% sustained growth would require 3-4 times of the primary energy by 2030 and 5-7 times the additional electricity generation by that time. It means that if you go for such a vast industrial activity in infrastructure side it will be very important to have a clean environment with maximum emphasis on the climate Hydrocarbon sector which is the maximum contributor to these hazards. Almost 66% of the GHG emissions come from energy side whether it is industry, transport, building etc and only 33 % from agriculture. One very important aspect related to climate change is human related issue. The areas, which require emphasis is- providing, access to modern energy, clean energy, increasing the productivity and efficiency and reducing the GHG emissions. The role of industry (large or SME), corporate sector, PSU, private sector is very important to combat these hazards. The energy industry require 22 trillion dollar on infrastructure out of that one-fifth will be invested in India and China and if such a massive industrial activity to come and if we do not see at the hazards then the outcome might be very devastative. Therefore industry has to think for other sources of energy like renewable energy whether it is solar, wind or nuclear energy. Climate change issue should be included in corporate social activity and it should be given the highest priority.

INAUGURAL SESSION

Shri Sushilkumar Sambhajirao Shinde has been a distinguished politician of India. He is currently the Honourable Union Minister of Power. He started his career as an advocate, but his penchant for the agriculture sector was near to his heart. His intense desire to serve the social sector and downtrodden masses induced him to take up political career as a social worker. His illustrious political career started when he entered Maharashtra legislative assembly as MLA in 1974. He served government of Maharashtra with distinction as minister in the Ministry of Finance, Planning, Environment, Family Welfare, Rural and Urban development, Law and Judiciary. He moved to Center as member of Rajya Sabha and later won twelfth lok sabha election. His services were solicited in the Maharashtra assembly, and in the year 2003 he became Chief Minister of Maharashtra Government. It is needless to state that it is due to efforts of persons like Mr. Shinde, state of Maharashtra is one of the leading economic powers of India. In the year November 2004, he became Governor of Maharashtra. The Central Government of India sought his services for national development when he accepted challenging assignment of Union Minister of Power in April 2006. Shri Shinde is a man of knowledge and erudition. He has authored three books. For his social service he is recipient of National Citizen's Award 1993 and 1994.

Shri Montek Singh Ahluwalia, Deputy Chairman, Planning Commission, Government of India.Shri Ahluwalia is a B.A. (Hons.) Economics, from Delhi University. He has done his M.A and M.Phil from Oxford University. He has served as Director, Independent Evaluation Office, International Monetary Fund, Washington, D.C., Member: Economic Advisory Council to the Prime Minister, Finance Secretary: Ministry of Finance, New Delhi, Secretary, Department of Economic Affairs, Ministry of Finance, New Delhi:, Commerce Secretary, Government of India, New Delhi, Special Secretary to Prime Minister, Additional Secretary to Prime Minister, Economic Advisor, Department of Economic Affairs, Ministry of Finance, New Delhi, Chief, Income Distribution Division, Development Research Center The World Bank, Washington, D.C., Deputy Division Chief, Public Finance Division, The World Bank, Washington, D.C. Economist, The World Bank, Washington, D.C.

Shri Ahluwalia has many of his publications in a number of acclaimed national and international journals of economics. He has written a lot on various issues concerning the Indian economy. His primary area of research has been agricultural economics, poverty and inequality. He also has many publications on trade related issues in India and has been in the forefront of the debate regarding India's economic reforms program.

Shri Vilas Baburao Muttemwar, Hon'ble Union Minister of State of the MNRE. He is graduate from Nagpur University, Nagpur (Maharashtra). He held various positions such as- Elected to 7th Lok Sabha(1980), Secretary, Indian Youth Congress(1980-81), President, Maharashtra Pradesh Youth Congress(1981-84), Re-elected to 8th Lok Sabha (2nd term in 1985), Joint Secretary, Indian National Congress (1985-88), Re-elected to 10th Lok Sabha (3rd term in 1991), Secretary, Congress Parliamentary Party(1991-95), Chairman, Committee on Public Undertakings (1993-95) , Minister of State in the Ministries of Rural Areas and Employment (Department of Rural Employment and Poverty Alleviation) and Parliamentary Affairs (1995-96), Re-elected to 12th Lok Sabha (4th term) (1998), Member, Committee on Energy and its Sub-Committees on Power; and on Action Taken Reports; also Convenor, Sub-Committee-II on Coal(1998-99), Member, Committee on Public Undertakings , Member, Committee on Private Members' Bills and Resolutions, Member, Consultative Committee, Ministry of Urban Affairs and Employment, Re-elected to 13th Lok Sabha (5th term) (1999), Member, Committee on Transport and Tourism (1999-2000) , Member, Committee on Public Undertakings (2000-2001), Member, Consultative Committee, Ministry of Finance (2000-2004) , Secretary Congress Parliamentary Party(2003-05), Re-elected to 14th Lok Sabha (6th term)(2004), Union Minister of State (Independent Charge), Non-Conventional Energy Sources(23 May 2004 - onwards). He is also a Secretary of Nehru Mandal (a Sports Organisation), Nagpur.

Dr. Kirit Parikh is Member, Planning Commission and was Founder Director & Vice Chancellor of Indira Gandhi Institute of Development Research, Mumbai for 15 years. Dr. Kirit S. Parikh has a Doctor Degree of Science in Civil Engineering and a Master's Degree in Economics from MIT, USA. He has been a Professor of Economics since 1967.

He was the Member of the Energy Coordination Committee, Committee on Rural Infrastructure and the Committee on Infrastructure constituted by the Prime Minister.

He was the Chairman of the Integrated Energy Policy Committee, Planning Commission, which has recently approved by Cabinet Committee.

He was the Member of the Economic Advisory Council (EAC) of the Prime Ministers of India, Atal Behari Vajpayee, P.V. Narasimha Rao, Chandra Shekhar, V.P.Singh and Rajiv Gandhi. In the past he had also been a member of the National Committee for Environmental Planning & Co-ordination, the National Committee on Science and Technology and the Fuel Policy Committee.

He is a Fellow of the National Academy of Sciences, India and Fellow of the World Economic Forum, Davos. Dr. Parikh had been in the past on the Board of Directors of Petro-Chemicals Limited, Life Insurance Corporation, Industrial Development Bank of India and State Bank of India.

Dr. Parikh has been awarded "Padma Bhushan". He has received many awards e.g. "Vikram Sarabhai Award", "Visveswaraya Award", "Nayudamma Award". He was honoured as the most distinguished and illustrious alumni of the decade from India by the Massachusetts Institute of Technology (MIT) and the Distinguished Alumnus Award by Indian Institute of Technology (IIT), Kharagpur in September 2007.

He served as Special Economic Adviser to the Administrator, United Nations Development Programme (UNDP), Program Leader of the Food and Agricultural Program of the International Institute for Applied Systems Analysis (IIASA), Austria. He was Professor of Economics, Indian Statistical Institute (ISI), New Delhi from 1969-71.

He has published number of books, Journals, articles and founded "India Development Report".

CLIMATE CHANGE AND POWER SECTOR

Dr. Pramod Deo, Chairman of Central Electricity Regulatory Commission

He received his postgraduate degree in Physics, Ph.D in Infrastructure Economics and post-doctoral research in Energy Policy and Economics, Dr. Deo has to his credit three books co-authored, on energy Planning, Energy Management and Regulatory Practice. He has 30 years of experience in the Indian Administrative Service (IAS) of which more than 20 years of experience has been at both policy and project Management levels in the energy sector. He has been associated with several international institutions like UNEP, World Bank, Asian Institute of Technology, Bangkok

Shri Rakesh Nath, Chairperson, CEA and Member Ex-Officio, CERC

Shri Rakesh Nath is the Chairperson, Central Electricity Authority. He has over 35 years of experience in power sector in various capacities in different organizations viz. Central Electricity Authority, Bhakra Beas Management Board, Power Trading Corporation, Northern Regional Electricity Board, Western Regional Electricity Board, National Thermal Power Corporation and Rajasthan State Electricity Board. He has varied experience in Operation & Maintenance of Thermal and Hydro Power Stations and Transmission System, Maintenance of Canal System, Regulation of Water Supply, Operation of large Interconnected Regional Power Grids.

Shri Rakesh Nath was appointed as Chairperson, CEA in October, 2005. He was appointed on the Board of NPCIL on November 3, 2005.

Shri S.K. Chaturvedi, Chairman & Managing Director, Power Grid Corporation of India Ltd.

He holds his post graduate degree from Lucknow University. In a career spanning over 32 years, he has served in leading Public Sector Undertakings such as National Mineral Development Corporation, National Thermal Power Corporation, Power Grid Corporation of India and National Hydroelectric Power Corporation. Shri Chaturvedi has the rare distinction of having experience in Thermal, Hydro & Power Transmission Projects. Shri Chaturvedi has been conferred with many Awards, notably National HRD Network Award for Best HR Practices, PR Excellence Award by Public Relations Society of India and Fellowship of AIMA for professional contribution in the field of management. He is associated with bodies like Power HR Forum as its President, Coordinator, Media Coordination Committee, Ministry of Power & Member, Board of Studies & Curriculum, Indian School of Mines, Dhanbad and SCOPE Governing Council. He has published a number of papers and is today admired as a visionary Manager par excellence.

Mr. Tantra Narayan Thakur, Chairman & Managing Director of PTC India Limited. He is an engineering graduate and joined the Indian Audit & Accounts Service in 1973. PTC was set up as a Government of India initiated Public Private Partnership. Mr. Thakur provided sustained leadership to PTC's operations, and devised optimal capital structure and organizational processes. His managerial and financial skills were also amply demonstrated in his past assignment (since June 1995) as Director (Finance & Financial Operations), Power Finance Corporation Ltd. (PFC), New Delhi when he was the Chief Financial Officer at the Board level responsible for managing the entire financial systems and operations of the company.. He has worked as Dy. Secretary in Government of India, Asstt. Comptroller & Auditor General, Secretary to Chief Minister-Bihar and Member-Audit Board.

Mr. Pravin K. Laheri, Director, Torrent Power

He is an IAS (Retd.), Gujarat cadre & studied at St. Xavier's College & Government Law College, Mumbai. P.K. Laheri joined Indian Railways in 1967 & Indian Administrative Service in 1969. He served in Government of Gujarat in various capacities – District Development Officer ,Collector , Director-Cottage Industries, Joint Secretary (Education Department), Industries Commissioner, Principal Secretary to five Chief Ministers of Gujarat, Principal Secretary (Rural Development, Information etc.) and Chief Secretary. He also worked as Executive Director of National Institute of Fashion Technology (NIFT). He was Chairman & Managing Director of Sardar Sarovar Narmada Nigam and played a significant role in commissioning the project planned to generate 1450 MW of hydropower and irrigate 18 lakh hectare of agricultural land.

SECTORAL ANALYSIS- GREENHOUSE EMISSION CONTROL

Dr. Jyoti Parikh, Executive Director, IRADe

Brief background and qualifications: Professor Jyoti K Parikh is Executive Director of Integrated Research and Action for Development (IRADe), New Delhi. As an acting Director of Indira Gandhi Institute of Development Research (IGIDR) Mumbai. She worked at the International Institute for Applied Systems Analysis (IIASA), Austria for 8 years and worked at the Planning Commission, as senior energy consultant at New Delhi (1978-80). She has an experience for nearly thirty years of working on energy and environment problems of the developing countries. She has worked in the area of power systems and published a number of publications in IEEE transaction and guided PhD thesis in the field of Integrated Regional Grids, power pricing, Demand side management and environment.

She has served as energy consultant to the World Bank, the U.S. Department of Energy, EEC, Brussels and UN agencies such as UNIDO, FAO, UNU, and UNESCO, Environment Consultant to UNDP, World Bank and so on. She has guided 14 Ph.D. thesis on energy and environment. She obtained her M.Sc. from University of California, Berkeley, in 1964 and Ph.D. in Theoretical Physics from University of Maryland, College Park in 1967.

Her publications include nearly 200 project research papers and 25 books and monographs in the area of energy economics and modeling, energy technology assessment, rural energy, power sector, environment economics and physics. She has served on editorial boards and as reviewer for many scientific journals and has given lectures at reputed Universities and Institutions and important fora in India and abroad.

Research management experience:
International Appointments:

- Scientific and Technical Advisory Panel (STAP) to Global Environment Facility (GEF) – 1995-1998.
- Convening lead Author for 2nd Assessment IPCC and reviewing editor for 3rd and 4th IPCC
- Convening Lead Author Millennium Assessment and IPCC.
- Advisory Board of Tyndall Center for Climate Change, University of East Anglia, Norwich, UK, 2001-2004.
- START (A Global Change System for Analysis, Research and Training) Scientific Steering Committee (SSC), USA - from May 1997.

She worked as an advisor to various energy ministries for Gov. of India and Senior Consultant to the World Bank.

Mr. Brian Dean, Manager, ICF International, New Delhi, India**.**

Mr. Dean has a MS in Building Technology from Massachusetts Institute of Technology, Cambridge, Massachusetts, and a B.S. in Civil Engineering. He has over 11 years of experience in building-related design, research, energy efficiency and climate change projects. His experience includes commercial design and construction, energy modeling, sustainable technology consulting, and designing commercial buildings to LEED standards. His professional skills include: policy development. He was in the team of ICF, which developed emissions standardization and pooling procedures to create a uniform product for sale in the U.S. and international emissions trading markets.

Mr. C R Dutta Biswas is working as Advisor at Integrated Research and Action for Development. He has obtained his Masters degree in Metallurgical Engineering from IIT, Kanpur. He served Steel Authority of India Limited for thirty years. At IRADe he has worked on projects concerning fertilizer sector, natural gas, and rural electrification. Currently he is working on Carbon capture and Storage technology and sectoral analysis of Climate change.

Mr. Rajat Gupta is a **Director at McKinsey & Company's** Mumbai office**.** Since having joined McKinsey in 1992, he has served clients in the US, India, China and in Africa.

In recent years, Rajat has worked with several large industrial companies on transformation programmes spanning operational improvement, organizational effectiveness and growth. This has been in many industrial sectors including power, real estate, chemicals, metals, minerals, telecom and pharmaceuticals. For example, he has helped the top management at one of India's leading metal companies over six years in setting their agenda, driving operational improvement (e.g., programmes on building marketing capabilities, cost reduction, throughout enhancement), building a performance based culture and growth.

Mr. Rajat leads McKinsey's Industrial & Operations practice in India. He is driving McKinsey's Climate Change Special Initiative in Asia.

Prior to joining McKinsey, Rajat graduated from the Indian Institute of Management, Calcutta in 1992 with the Director's gold medal for securing the first position. Rajat holds an engineering degree (in computer science) from the Birla Institute of Technology and Science (BITS), Pilani, India. He was awarded the Director's gold medal at BITS for securing the first position in the institute.

CLIMATE CHANGE & COAL SECTOR

Shri Manohar Sinha has joined coal wing of **Geological Survey of India** in February 2008. Under his guidance many innovative work were pursued in the emerging field of Coal exploration; like Coal Bed Methane, underground coal gasification and carbon sequestration. The in-house efforts have established the dataset required for identifying the potential sites for CBM as well as underground coal gasification. Shri Sinha joined GSI in the year 1973, after obtaining post-graduate degree from Ranchi. He has served in different wings of GSI, and has publication in the domain of Environment Geology, Quaternary Geology, and Geo-archeology. As director of GSI he had conducted geo-scientific study of Ajanta-Ellora cave (world heritage) site. UNESCO has acclaimed the work, and at national level, Ministry of mines awarded him for noteworthy work. The suggested recommendations have improved old environment significantly.

Dr. Anoop Singh, Asst. Prof., Dept. of Industrial and Management Engineering, IIT Kanpur.

He worked as Dy. Director (Economics), Haryana Electricity Regulatory Commission, Panchkula, Fellow, Indian Council for Research on International Economic Relations, New Delhi. He has been awarded a number of fellowships / scholarships including a Visiting Researcher Fellowship from Asian Development Bank Institute (ADBI), Tokyo, a Ph.D. fellowship by United Nations University/Institute for Advanced Studies (UNU/IAS), Tokyo and a research scholarship from German Academic Exchange Council), Germany. He has undertaken a number of consultancy/ research projects related to electricity / energy sector for a number of institutions including the World Bank, the UNCTAD, UNU/IAS, AIT, the University of Cambridge, and the Planning Commission. He is a member of IEEE, International Association for Energy Economics (IAEE) and Indian Economic Association (IEA). He has been a Member of the Working Group on Power for the 11th Five-Year Plan, Planning Commission, Government of India.

Dr. Ambuj Sagar awarded his Ph.D from the Massachusetts **Institute of Technology (MIT), Cambridge.** He has been awarded for his thesis in Polymer Science and Technology, thesis concerned environmental friendly biodegradable thermoplastics. He has been associated with Harward University senior faculty where he was an Assistant Dean for Strategic Planning. Currently he is Professor in IIT Delhi in the Department of Humanities and Social Sciences & Vipula and Mahesh Chaturvedi Professor of Policy Studies. He was awarded BCSIA Post-doctoral Fellowship (John F. Kennedy School of Government, Harvard), Program in Polymer Science and Technology (MIT) Fellowship, 1988 Indian National Talent Scholarship, 1978-1985

Dr. (Mrs.) Malti Goel, Senior Scientist & Advisor heading the Science & Technology Advisory Committee Division in **Department of Science & Technology, Ministry of Science & Technology, Government of India.** Dr. Goel received Bachelor and Master's degrees in Physics from Birla Institute of Technology & Science (BITS), Pilani. She completed two degrees in Solid State Physics including a Doctoral degree from IIT, Delhi. She is a recipient of gold medal in M.Sc. Physics from BITS, Pilani and has been a topper in D.I.I.T. She studied Solid State Physics from IIT, Delhi. She has made significant contribution in Energy policy research & Carbon Sequestration particular in Clean Coal Technology Initiative and National Programme on CO2 Sequestration research jointly with other ministries. She has published over one hundred and forty scientific papers in Journals of international repute and presented keynote address/papers in conferences. She is recipient of Er. Abinash Chandra Chaturvedi award 2006 for excellence in Environmental Science & Technology and has been nominated to represent India as Vice-chair to Technical Group of International Carbon Sequestration Leadership Forum (CSLF).

She is also a member of important scientific committees and professional bodies in the country.

FINANCING AND STRATEGIC INITIATIVES FOR CLIMATE CHANGE

Mr. Shyam Saran, Special Envoy of the Prime Minister on Nuclear Issues. He was also appointed as Special Envoy of the Prime Minister for Climate Change Issues in April 2008. He belongs to the 1970 batch of the Indian Foreign Service. Mr. Saran holds a Post Graduate degree in Economics. He served in Commission of India, Hong Kong as Third Secretary, Embassy of India, Beijing, from 1974 to 1977, where he served as Second Secretary and later as First Secretary. Mr. Saran served at the Headquarters of the Ministry of External Affairs, New Delhi, as Under Secretary and Deputy Secretary, Mr. Saran was appointed as High Commissioner of India to Mauritiushe. He served as Ambassador of India to Myanmar, Ambassador of India to Indonesia and Nepal. Mr. Saran served as Foreign Secretary from August 2004 to September 2006.

Ms. Naina Lal Kidwai, Group General Manager & Country Head of the HSBC group of companies in India, which employs 34,000 people comprising Banking Services, Insurance, Asset Management, HSBC Securities and Capital Markets, HSBC Software Development (India) Private Limited and the Global service centers (BPOs servicing HSBC's operations in the UK, EU and USA). Under her stewardship, HSBC has emerged as one of the fastest growing banks in the country, recording a 41% rise in net profits in 2007-08. She did MBA from Harvard; she has been recognized in India and abroad with several awards and listings. Among others, she was ranked 34th in the Fortune list of Top Women in Business

(where she has been listed since its inception in 2000) in 2007, and 12th in the Wall Street Journal 2006 Global Listing of Women to Watch. In 2007, she was awarded the Padma Shri by the Government of India for her contribution to Trade and Industry.

Mr. Naoki Sakai, Energy specialist, Climate Change Focal Point in South Asia Regional Department, Asian Development Bank (ADB). Before that, he was Sr. Project Manager of Tokyo Electric Power, Ltd. (TEPCO). He did B.A. from University of Tokyo, MBA from University of Chicago.

Dr. Shailaja D Sharma holds a Ph.D. in Mathematics from IIT Bombay. She has 18 years of working experience, of which the first 7 were in statistical analysis in the development sector, 3 in the IT sector and 8 in the energy sector. She started her career at the World Bank and has been with Shell since 2001. In Shell, she handled different responsibilities covering corporate affairs and sustainable development and launched some of Shell's significant initiatives in this area. During 2002-04 she also oversaw the activities of the Shell Foundation in India. Currently, she leads Shell's business development and advocacy activities in the area of alternative fuels and CO2 in India and has recently been assigned responsibility for Shell's hydrogen stations in Asia-Pac region.

Dr. Shailaja is also a member of the Institute of Chemical Engineers and represents Shell on various industry associations such as the CII Committee on Biofuels and sits on the advisory committee of several non-profit organisations.

Mr. Manjeev Singh Puri is an **Indian Foreign Service officer**, who joined the service in 1982, after completing his Masters in Management Sciences and BA (Honours) in Economics. In the course of his Foreign Service career he has served twice in Germany (in Bonn and at Berlin, where he set up the Indian Cultural Centre), Bangkok, Caracas, Cape Town (as Head of the High Commission's Office) and Muscat (as Minister in the Embassy of India). He has served in the Ministry of External Affairs from 1994-1998 as Deputy Chief of Protocol in-charge of high level visits. Mr. Puri took over his present assignment as Joint Secretary (United Nations – Economic & Social) in the Ministry of External Affairs in March 2005.

RENEWABLE OPTIONS AND ENERGY EFFICIENCY

Mr. Deepak Gupta, Secretary, Ministry of New & Renewable Energy, Government of India. Shri Gupta is a 1974 batch of the Indian Administrative Service. A Post-Graduate in History from St Stephan's College and M. Phil in International Relations from Jawaharlal Nehru University; he did a Masters in Public Administration from the Kennedy School, Harvard University in 1991 as a Mason Fellow. He served as Deputy Jute Commissioner, Ministry of Textiles from where he went on deputation to India Trade Centre, Brussels, as Adviser (Jute & Coir) during 1983-85.During subsequent years; he had various assignments in Departments of Industrial Development, Export Promotion,

Human Resource Development etc in the Centre and State. He was Secretary, Water Resources, in Bihar from 1995-98. He has worked as Joint Secretary, Ministry of Health & Family Welfare, Additional Secretary, Ministry of Health & Family Welfare & Special Secretary in January, 2008 in the same

Dr. Ajay Mathur, Director General of the Bureau of Energy Efficiency and a member of the Prime Minister's Council on Climate Change. As Director General of BEE, Dr. Mathur coordinates the national energy efficiency programme, including the standards and labeling programme for equipment and appliances; the energy conservation building code; the industrial energy efficiency programme, and the DSM programmes in the buildings, lighting, and municipal sectors. He has headed the World Bank's Climate Change Team in Washington, DC; and the Energy Engineering Division of TERI in New Delhi; and he served as President of Suzlon Energy Limited, one of the largest wind energy equipment manufacturers.

Dr. Mathur received his Bachelor's degree in Chemical Engineering from the University of Roorkee, and PhD from the University of Illinois. He received the Outstanding Alumni Award of the University of Illinois in 2002. Dr. Mathur is the coauthor of three books, and lead author of several reports of the IPCC, which was the joint winner of the Nobel Peace Prize last year.

Mr. Jens Burgtorf, Director, GTZ-IGEN

Since March 2008, Jens Burgtorf is the Director of the Indo-German Energy Programme (IGEN) of German Technical Coorporation – Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) GmbH based in New Delhi. IGEN is embedded in the Bureau of Energy Efficiency of the Indian Ministry of Power, Government of India. The programme is funded by the German Ministry of Economic Cooperation and Development.

Before joining IGEN, Jens Burgtorf worked as a freelance energy consultant and has vast experience in the field of strategy, project and organizational development and management.

Prior to that, he held the post o Head of Department Asset Management Energy Production and Waste-to-Energy at Stadtwerke München – SWM Services GmbH, a public utility provider in Munich (2004 to 2007). From 2005 to 2008, he served as member of the extended Presidency of Geothermische Vereinigung – Bundesverband Geothermie e.V. in Berlin. Jens Burgtorf holds a diploma (MSc) in Energy and Process Engineering from the Technical University of Berlin.

Mr. A. K. Jain, Executive Director, Power Finance Corporation

Shri A.K. Jain is in-charge of RE&CDM Unit. He is BE (Electrical) from University of Roorkee of 1971 batch. He has the experience of working in Generation, Planning, Construction & O&M of Sub-Transmission and Distribution Network of Delhi Electricity Board (more than 14 years experience of DESU) and around 22 years with Developmental Financial Institution under Ministry of Power (Five years experience with Rural Electrification Corporation Ltd. and 18 years experience with Power Finance Corporation Ltd.) providing him a rich experience which covers both dimensions of power sector i.e. Technical experience of an integrated state power utility as well as techno-economic experience of two major FIs of Govt. of India dedicated to power sector ie. PFC and REC.

Mr. Gary P. Godwin, Managing Director-UOP India Private Limited. He is a graduate chemical engineer. Mr. Godwin was Global Business Director of UOP Sinco Srl UOP'S PET Technology business based in Milan, Italy & worked in UOP'S Guildford UK office, UOP'S Naphtha Technology Business Group for light Fuels & Hydro processing, 10 years he worked with Mobil Oil in various functions of refinery process engineering, operations, scheduling etc.

Dr. Tim Flannery is one of **Australia's leading thinkers and writers**. An internationally acclaimed scientist, explorer and conservationist, Tim's books include his best-selling examination of climate change: The Weather Makers: How Man Is Changing the Climate and What It Means for Life on Earth, and ecological histories of Australia (The Future Eaters) and North America (The Eternal Frontier), He was awarded the Edgeworth David Medal for Outstanding Research. Sir David Attenborough has described him as one of the world's greatest explorers. Formerly director of the South Australian Museum, Tim is now the chairman of the South Australian Premier's Science Council and Sustainability Roundtable; the director of the Australian Wildlife Conservancy; and the National Geographic Society's representative in Australasia. In April 2005 he was honoured as Australian Humanist of the Year. He took up a position at Sydney's Macquarie University mid 2007. Tim Flannery was named Australian of the Year the day before Australia Day on 25th January 2007.

Dr. Pradeep Chaturvedi, Chairman, World Environment Foundation. Dr. Pradeep Chaturvedi, a Mechanical Engineer, is International Consultant to United Nations Food and Agriculture Organisation's Bio Fuels Project in Cambodia; and Chairman to the Indian Association for the Advancement of

Science. He is involved with WEC and he was a member of the Expert Group India's Integrated Energy Policy in 2006.

He is a Fellow of the Institution of Engineers (I); Institution of Plant Engineers, Institute of Directors; International Council of Consultants and All India Management Association. He is the President, Bio Energy Society of India; and Vice Chairman, World Environment Foundation.

Dr. Chaturvedi has authored eight and in addition to that has edited 30 books on Energy and Environment Management. He has received many awards for his work.

Mr. Harish Mehta Director Suzlon Group of Companies

Mr. Harish Mehta, age 55 years, FCA (Chartered Accountant) is presently working as Director with various Suzlon Group of Companies. In addition, he is also a member of Executive Committee/ Managing Committee of various Associations like Assocham, IWTMA etc. He has an overall experience of more than 30 years. Having done his CA, he has been involved in Financial Services, Audits, Liasioning and Corporate Consultancy on strategic planning since 1979. He has been associated as Board Member in SUZLON Group, responsible for developing and implementing various business strategies and financial planning. Mr. Mehta has acted as Advisor to Issue, in cases of many reputed Public Limited Companies and has prepared Pre-investment Feasibility Studies for various kinds of industries, like: Wind Power, Steel, Textiles, Power, etc. Presently working with Suzlon group of companies in the capacity of Director responsible for corporate activities his main responsibilities include-

- Corporate Taxation matters
- Working with MNES
- Interaction with Associations.
- Various Corporate Presentations in Workshops Seminars etc.
- CDM projects and working on clean climate initiatives

CLIMATE CHANGE & HYDROCARBON SECTOR

Mr. P. K. Sinha, Additional secretary & Financial Advisor, MoPNG

He did graduation and postgraduation in Economics. He completed Master Diploma in Public Administration from Indian Institute of Public Administration, New Delhi and M. Phil with Social Sciences from Punjab University. He was awarded the first prize and a Gold Medal as a student in 1974 in an all India Open Essay Competition on the subject "Public Sector and The Fifth Five Year Plan".

He was nominated as the Chairperson of the international jury of experts for the selection of the prestigious 1999 ESCAP HRD Award. The theme of which was "Youth Empowerment". He joined Indian Administrative Service (IAS) in 1977 as a career bureaucrat.

Mr. N. R. Raje, Director, CAER

Mr. N.R.Raje is former Director (R&D) of Indian Oil Corporation. He Graduated in Mechanical Engineering from University of Bombay and did his Post Graduation from Leeds University U.K. He Worked with British Petroleum U.K. for three years before joining Indian Oil in 1972.He superannuated in 2005 since then he is heading the Center for Alternate Energy Research at UPES. He is a Member of Environmental Pollution (prevention & control) Authority (EPCA) and has done extensive research in Fuels, Lubricants, Automotive emissions and alternate fuels such as Bio fuels and Hydrogen.

Mr. Pramode Seth, Executive Director, Chief Corporate Planning, ONGC

He has done his B. Tech (Hons) in naval architecture from IIT, KGP and graduated in 1971. He did Diploma in Intl Ship Inspection, from DnV, Norway and Senior Mgmt. Course, from ASCI, Hyderabad in 1989 and Advance Mgmt. Course from IMD, Gurgaon in 1997.

He has been worked with **Garden Reach**, Kolkata; DnV, **Hovik** Norway; **Balmer Lawrie**, Kochi and now associated with **ONGC** Ltd. In ONGC for the first ten years he worked as head of Offshore Marine Logistics, in Mumbai. Next two years as head of Logistics at Baroda. Next four years as head of Offshore Logistics in Mumbai. Next two years as Admin Head in Assam (Nazira/ Shibsagar) and next two years as ED: CIO of ONGC in Delhi.

Since Feb 2005 he worked as ED (Chief of Performance Mgmt & Benchmarking Group at Dehra Doon/Delhi) and since Oct 2007 he worked additionally as ED: Corporate Planning, New Delhi.

Prof. Cleo Paskal, Associate Fellow, Royal Institute of International Affairs, Chatham House, London. Her ground-breaking research on the geopolitical, economic and security implications of environmental change has led to her being consulted by private industry, governments, and think tanks from around the world, including the UK Ministry of Defence, the EU Experts Committee on Climate Change and Security, the German Foreign Office, the U.S. Department of Energy and NATO. She has lectured at the London School of Economics and Cambridge University, and is Adjunct Faculty in the Department of Geopolitics, Manipal University and Adjunct Professor of Global Change, SCMS, Kochi. Prof. Paskal is also an award-winning writer who has contributed to, among many others, The Economist, The Times of India, The Times (UK), BBC and the Australian Financial Review. Her book, Global Warring: Environmental Change and the Economic, Political and Security Crises will be published during summer 2009.

Dr. K. K. Jajodia is the **Group Chairman, Duncan Macneill Group and Chairman Assam Co. Limited.** The Duncan Macneill Group is engaged in the tea business, Exploration and Production of oil and natural gas, and e-commerce business. He is an eminent philanthropist with active interest in social and cultural activities. He is an active member of WWF, 1001 Club. The K. K. Jajodia Foundation manages schools in Delhi and charitable organizations.

VALEDICTORY SESSION

Dr T Ramasami, Secretary to the Government of India, Department of Science and Technology, holds a Master's degree in Leather Technology from the University of Madras, India and PhD in Chemistry from the University of Leeds, UK. He has also worked on energy research in Ames Laboratory Iowa, USA and on electron transport phenomena in the Wayne State University, USA prior to returning to India for undertaking his scientific career. He joined the Central Leather Research Institute, Chennai as a scientist in 1984 and served as its Director for more than 10 years during the period up to May 2006. He is known among the scientific establishments in the country for his leadership to the Central Leather Research Institute. The institution earned a global leadership status during his tenure as its Director as evidenced by the 30% global share of publications, >7% share of global patents, positions in fashion forecasting and the level of public-private partnership built in leather research.

He was awarded Shanti Swarup Bhatnagar Prize for Chemical Sciences in 1993 and elected to all major science academies in India as a fellow as well the Third World Academy of Sciences and the National civilian award Padma Sri in 2001.

Sir (Charles) Richard (Vernon) Stagg KCMG, HE, British, High Commissioner. He served as Director General of Corporate Affairs: Responsible for the UK's global visa and consular operations, Director Public Services/Information, Sofia: HM Ambassador: During the NATO air campaign over Kosovo, FCO: Head of EU (External) Department: UK Presidency 1998: launch of Enlargement negotiations,FCO: Private Secretary to Foreign Secretary, Brussels: Press Spokesman: During the negotiation of the Maastricht Treaty which created EMU,FCO: Soviet Department: The final years of the Cold War and the collapse of the Soviet Empire, Brussels: Council Secretariat, FCO,The Hague, Sofia: Third later Second Secretary, CO [Foreign and Commonwealth Office]

Shri Suresh Prabhu, Member of Parliament (Lok Sabha) .Shri Prabhu is a leading Chartered Accountant and a practitioner owning a CA firm. He was the Chairman of the largest Urban Cooperative Bank in India and had been connected with over 150 NGOs, which operate in various fields. Shri Prabhu entered public life with his election to the 11th Lok Sabha (Rajapur constituency of Maharashtra) in 1996 and was re-elected to the 12th Lok Sabha in 1998 and to the 13th Lok Sabha in 1999 and to the 14th Lok Sabha in 2004 . He has been a Union Minister for several ministries including environment and power.

Dr. U. D. Choubey, Chairman and Managing Director, GAIL (India) Limited is a Post Graduate in Chemistry, MBA in Marketing and holds a Law degree. He holds a Ph.D. in "Hydrocarbon Derived from Coal and Petroleum" from ISM Dhanbad. Dr. Choubey has over 30 years of experience in Energy Sector particularly in Natural Gas and also in Fertilizers & Chemicals. He has authored a book titled "A Text Book on Natural Gas". He has presented papers at several International Gas Conferences and chaired sessions in the international prestigious conferences/seminars.

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