Appendix A
Stakeholder Consultation

Meeting Date: January 18, 2010
Meeting Site/Venue: Reliance Infrastructure Limited (RIL), Mumbai
Meeting Participants: Mr. Kamal Kant, Vice President, RIL, and Mr. Satya Narayana Palai, Technical Services, RIL; and Mr. S. Karthikeyan, Counsellor, Confederation of Indian Industries (CII)

Summary: Mr. Kant gave an overview of RIL, a fully integrated company utility, which is India's foremost private sector utility with annual revenues of US$2.1 billion. RIL distributes more than 28 billion units of electricity to over 25 million consumers across different parts of the country, including Mumbai and Delhi, in an area spanning over 124,300 sq. km. They generate 941 MW of electricity from five power stations located in the states of Maharashtra, Andhra Pradesh, Kerala, Karnataka, and Goa. RIL has several gas, coal, wind, and hydro projects with aggregate capacity of over 12,500 MW at various stages of development in four Indian states - Maharashtra, Uttar Pradesh, Arunachal Pradesh, and Uttaranchal. Three 4,000-MW ultra supercritical coal-based plants are also under construction at Sasan, Krishnapattinam, and Tilaya.
Like many other private Indian power producers, RIL is adding new capacity. As a result, there is fierce competition for the limited power plant-related technical resources available in India. As a result, Mr. Kant supports the idea of creating a service providers network in India and pledged RIL support and participation. For example, he suggested that some of the Indian service providers currently being used by RIL could join the network through cooperative agreements with participating U.S. firms and RIL could provide plants to be used as sites for launching new services and technologies. RIL expressed interest in two areas: 1) feed water heating in power plants with solar thermal systems; and 2) low-value heat recovery systems from the exhaust flue gas. He proposed using the Dahanu plant as a technology demonstration site provided that it would not affect the plant load factor (PLF). The same plant could also be made available for new technology demonstration projects if desired.

Meeting Date: January 18, 2010
Meeting Site/Venue: TATA Power's Trombay Power Plant, Chembur, Mumbai
Meeting Participants: Mr. Ashok Sethi, Vice President, Operations; Mr. S. Karthikeyan, CII; Ms. Monali Hazra, USAID; and Dr. R.P. Krishnan, Technical Advisor, LTI

Summary: TATA Power (TATA) has an installed capacity of 2,174 MW (334 MW of hydro, 1630 MW of coal, and 210 MW of gas-fired combined cycle). The first 500-MW coal-fired power plant in India (Trombay), which was commissioned in 1985, is owned by TATA. Trombay has been a model plant for high performance, safety, and induction of new technologies. It is also the first and until recently, the only utility power plant in India to have a flue gas desulfurization (FGD) system, which uses sea water. Because of its proximity to Mumbai, the environmental standards adopted at Trombay are more stringent than other plants in the country. TATA engineers provide consultancy services to other plants in the country and have recently formed

a ”Users Group” with Reliance Energy and Maharashtra State Power Generation Co. Ltd. (MAHAGENCO), a state utility. They hold monthly meetings to resolve common problems and to generate new ideas for improving plant performance. Mr. V.P. Raja, Managing Director, Maharashtra Electricity Regulatory Commission (MERC), who is very supportive of new technology deployment and adoption of best practices for efficiency improvement, attends some of these meetings.

Mr. Sethi suggested that the current alliance between TATA Power, Reliance Energy, and MAHAGENCO could serve as a platform for launching new technologies and plants owned by the three companies could be used for new technology induction. In his opinion, one plant in India could be selected and benchmarked against the best performing plants in different parts of the world. TATA power is currently engaged in an international benchmarking project for a hydro plant in India and he thinks the same concept could be extended to coal plants. TATA Power would welcome the opportunity to be a partner in setting up such a model plant.

Mr. Sethi would like to have a copy of the Model Plant concept paper to present to TATA senior management. After seeking senior management approval, he would make a presentation to the members of the “Users Group” to garner their support for the project.

Meeting Date: January 20, 2010
Meeting Site/Venue: Center for Power Efficiency and Environmental Protection (CenPEEP), NTPC Limited (NTPC), Noida
Meeting Participants: Mr. D.K. Agrawal, General Manager, CenPEEP and his team; Dr. Rekha Pillai, Oak Ridge National Laboratory (ORNL); and Ms. Kathleen Nawaz, National Renewable Energy Laboratory (NREL); Ms. Monali Hazra, USAID; and Dr. R.P. Krishnan, Technical Advisor, LTI

Summary: Mr. A.K. Mittal, Additional General Manager, CenPEEP, made a presentation highlighting the technical support received by CenPEEP under GEP through NETL. CenPEEP provides technical consultancy services to all NTPC plants and it serves as the national outreach center for efficiency and environment. Two regional CenPEEPs have been set up at Lucknow and Patna to cater to the power plants in the region with USAID support. These three centers also provide technical support to state and private utilities. The demand for CenPEEP’s services is on the rise owing to the lack of service providers in the country. Technical expertise and skills required to address specific plant problems are not easily available in India. India plants rely solely on the original equipment manufacturer (OEM) – most often BHEL – for technical support. The dearth of service organizations in India is hurting the power sector. The model adopted in the GEP Project – technology acquisition, adaptation (for Indian conditions), and dissemination – has worked well and should continue to support the needs of the expanding Indian power sector. CenPEEP promises to continue to provide the services that it has provided for years under CERDI if given the opportunity. Other new areas of interest to CenPEEP include 1) knowledge-based intelligent systems for plant performance monitoring and diagnostics; 2) fleet-wide performance monitoring and CO_2 emissions reduction documentation; 3) best

practices in operation and maintenance of supercritical plants; and 4) establishment of a dedicated center for modeling and simulation of power plants.

Meeting Date: January 20, 2010
Meeting Site/Venue: Council of Power Utilities, New Delhi
Meeting Participants: Mr. C.V.J. Verma, President, CPU; Mr. D.K. Mehta, Director, CPU; Ms. Monali Hazra, USAID; and Dr. R.P. Krishnan, Technical Advisor, LTI

Summary: The Council of Power Utilities (CPU, www.indiapower.org) was formed to evolve solutions to the problems faced by Indian power supply industry in the areas of eco-friendly power generation, transmission, distribution, and utilization. In the course of its evolution, CPU's interaction has been extended to cover major manufacturers and suppliers of power plant equipment, fuel (coal, oil, and gas) suppliers, engineering consultants, academicians, environmentalists, financial organizations, etc. CPU regularly has discussion/interaction and exchange of information between its members by way of workshops, seminars, and conferences, both national and international, at regular intervals focusing on technological advancements for conventional and non-conventional environment-friendly power development with improved efficiency. CPU has developed close-working relationships between experts from manufacturers/suppliers of plant and equipment, utilities, and others through personal interaction. Expert groups are constituted from time to time by the Council to examine different problems/issues and to suggest solutions through meetings and discussions. Findings of such meetings are also communicated to other members. The feedback on implementing the suggestions is discussed, if necessary, for further investigation and solution. Suggestions are also offered to the Ministry of Power, Ministry of Coal, Planning Commission, Power Finance Corporation, and other concerned authorities for solutions of common problems besetting the Indian power sector. CPU works to standardize procurement procedures for important plant equipment. It disseminates information from other national and international utilities in the form of pamphlets/ publications for benefit of the members and publishes the quarterly journal 'INDIA POWER' in which contributions is made by senior-level executives of the council and power supply industry for the benefit of the readers.

Mr. Verma is a member of CenPEEP's Advisory Board and serves on GoI's IGCC Task Force. Efficiency improvement in state-owned utilities is high priority for GoI because the potential to reduce coal consumption and CO_2 emissions is enormous in state-owned utilities. Under the National Renovation and Modernization (R&M) program, many plants have been restored to acceptable level of performance. There is resource constraint and knowledge on how to implement a broad-based efficiency program is lacking. CenPEEP, the only center with the relevant knowledge and expertise, does not have the capacity to reach out to all Indian utilities.

Mr. Verma was briefed on the USDOE –USAID APP efficiency improvement projects completed at the Punjab State Electricity Board's (PSEB) Ropar power plant, the West Bengal Power Development Corporation Limited's (WBPDCL) Kolaghat Power Plant and ongoing work at the Tamil Nadu Electricity Board (TNEB) Tuticorin Thermal Power Station (TTPS). He was not aware of these activities and was encouraged to learn that USAID and DOE have extended such

support to state utilities, which is sorely needed. Mr. Verma acknowledged that while many state utility power plants are not at par with NTPC's plants, some, such as Andhra Pradesh Power Generation Corporation (APGENCO) and MAHAGENCO, have good track records. He would like to see them participate and take advantage of new initiatives under CERDI. CPU will assist in coordinating CERDI activities with the state utilities.

Meeting Date: January 21, 2010
Meeting Site/Venue: Calcutta Electric Supply Company
Meeting Participants: Mr. D.K. Basu, Technical Advisor, CESC; Mr. Ashok Roy, Climate Change Specialist, CESC; Ms. Monali Hazra, USAID; and Dr. R.P. Krishnan, Technical Advisor, LTI

Summary: The meeting scheduled for January 21, 2010, in Kolkata, with the Calcutta Electric Supply Company (CESC) did not take place because of a flight cancellation due to heavy fog in New Delhi. A telephone meeting was conducted CESC has three coal-based power generating units with a total capacity of 627.5 MW. Up to 1,200 MW of additional capacity is planned to come on line in 2012. CESC is also working on a 660-MW supercritical unit under a joint venture with Reliance Energy in Talcher, Orissa. CESC's first priority is improving PLF and heat rate of its plants. In 2008-2009, the average availability of their plants was 96% and their average heat rate was 2400 kcal/kWh. Two United Nations Framework Convention on Climate Change (UNFCCC) projects involving municipal solid waste (MSW) co-firing with coal were completed at Bhuj Bhuj; several other potential project sites have been identified in Kolkata. CESC likes to focus on technology deployment and capacity building. He expressed interest in technologies that would help sustain performance of existing units. The concept of a model plant for technology deployment makes sense to CESC, but Mr. Basu suggested that it might be better to start small with well-defined technology induction projects in two or three private utilities before embracing a single model plant. Mr. Basu desires technical assistance in three areas: 1) guidelines and practices for sustaining performance, 2) creation of a "CenPEEP" within CESC, and 3) support in renewable energy projects, such as wind, solar, and MSW.

Meeting Date: January 22, 2010
Meeting Site/Venue: Fuel Management Department, NTPC, Noida
Meeting Participants: Mr. T.K. Chatterjee, Executive Director, where and Mr. Ramesh Kher, Deputy General Manager (Gas Sourcing), Fuel Management; Ms. Monali Hazra, USAID; and Dr. R.P. Krishnan, Technical Advisor, LTI

Summary: NTPC plants consumed 94 million tonnes (Mt) of coal in 2008-2009 and 145 Mt is projected for 2009-2010. This number is expected to further increase to 181Mt in 2012 when NTPC's installed capacity is expected to reach 38, 000 MW. The shortage of domestic coal is forcing NTPC and other utilities to import coal. NTPC imported 4 Mt in 2008-2009 and would have imported more, but the number and size of existing sea ports and handling facilities is constrained. The coal blending done at NTPC plants is not engineering based as it should,

leading to coal wastage in the form of unburnt coal. Another coal-related area of interest to NTPC is preparation of a technical specifications manual for coals from different sources for blending. NTPC imported coals from Indonesia, South Africa, and more recently, China. They would welcome any assistance by way of exposure, training, and workshops on coal blending. A visit by NTPC representatives to U.S. coal companies and utilities to learn from their experience is highly desired by NTPC.

Meeting Date: January 25, 2010
Meeting Site/Venue: Bharat Heavy Electricals Limited (BHEL), Technical Services Group, Noida
Meeting Participants: Mr. N.K. Bansal, General Manager; Mr. V.K. Sharma, Additional General Manager, Performance Testing; Mr. A. K. Sinha, Turbine and Condition Assessment; Mr. Anil Verma, Boiler and New Technologies; Mr. H. Simadhani, Boiler Chemistry and Safety, of BHEL; Ms. Monali Hazra, USAID; and Dr. R.P. Krishnan, Technical Advisor, LTI

Summary: BHEL's Technical Services Group provides consulting and onsite services to its customers on as-needed basis. It is the corporate department responsible for customer relations and technical support. Presently, their focus is on new capacity addition. Mr. Bansal said that his company's activities are closely monitored by the Prime Minister's Office and the Cabinet Secretaries to ensure that planned additions come on line as planned. Currently, the company has a backlog of up to 15,000 MW of new capacity. As a result, the routine services that they used to provide to existing customers are now provided by BHEL's four regional field offices. It was felt that the Service Providers Workshop funded by USAID/India and convened in New Delhi in 2008 by CII was a good start. BHEL is focused on its own capacity additions and is interested in strategic alliances with U.S. companies with expertise in supercritical, ultra-supercritical, CFBC, and IGCC technologies. USAID and NETL have a long history of collaboration with BHEL that could be leveraged in bringing the right U.S. partners. BHEL generally does have resource constraint. What they need most is help from an organization such as NETL to identify and facilitate one-on-one meetings with U.S. companies who have the appropriate technologies.

Meeting Date: January 25, 2010
Meeting Site/Venue: BHEL Corporate Office, Siri Fort, New Delhi
Meeting Participants: Mr. O.P. Bhutani, Director (Engineering and R&D), BHEL; Mr. N.K. Bansal, BHEL; Mr. V.K. Sharma, BHEL; Mr. Scott Smouse, DOE/NETL; Dr. R.P. Krishnan, LTI; and Ms. Monali Hazra, USAID/India

Summary: Mr. Bhutani led the meeting for BHEL, stating that it plans to add 15,000 MW each year for the next 2 years and that beginning in 2012, India's 12^{th} 5-Year Plan calls for annual addition of 20,000 MW. Fifty percent of the new capacity additions in the 12^{th} Plan will be supercritical units (nearly 84,000 MW). BHEL has a collaborative agreement with Alstom on supercritical boilers. Their next move will be for ultra-supercritical boilers, for which they have identified potential partners and started exploring collaboration options. Mr. Scott Smouse talked about NETL's current research activities. The topic of BHEL-NETL collaboration in clean coal technology R&D came up. Mr. Smouse suggested that if this proposed cooperation is to

move forward, a technical team from BHEL's R&D organizations in both Trichy and Hyderabad should visit NETL to meet with its technology managers and lead researchers. During the meeting, the need to identify potential areas for collaboration with well-defined objectives, scope, schedule, and resources from both sides was highlighted. Any proposed projects should be mutually beneficial and would need to add value to DOE's R&D programs. Three potential areas of interest to BHEL are advanced materials, IGCC/CCS, and simulation/modeling.

Meeting Date: January 25, 2010
Meeting Site/Venue: Central Electricity Authority (CEA), Ministry of Power (MoP)
Meeting Participants: Mr. Amarjeet Singh, Chief Engineer, CEA: Mr. Chandra Sekhar, Director, CEA; Mr. U. Sharma, Chief Engineer (R&M), CEA; Mr. Scott Smouse, DOE/NETL; Dr. R.P. Krishnan, LTI; and Ms. Monali Hazra, USAID/India

Summary: The two combustion optimization projects recently completed at PSEB's Ropar and WBPDCL Kolaghat power plants by NETL under the APP program with CEA collaboration was discussed. Mr. Singh confirmed that both plants have started implementing the recommendations made in the final report although they have not been formally communicating relevant data desired by NETL. He said there is not much CEA could do to enforce their compliance but he promised to continue to communicate NETL's request to the two power plants and their senior corporate staff. He expects all units at both plants will be tested because the plant has begun to see improvements in the performance of the unit that tested under the APP program. Regarding Tuticorin, the next plant to benefit under the program, Mr. Singh expressed some disappointment with the plant management because they have not kept him in the loop. Dr. Krishnan gave him an update on the project.
Mr. Sharma discussed the National Efficiency Enhanced Renovation and Modernization Program (EE R&M). GoI has an ambitious plan on Life Extension and R&M of existing coal-fired units. Presently, 60% of the total generation is from 200/210/250/500MW coal-fired units. A large number of the 200/210MW units have or are reaching the end of their useful design life and are in need of modernization and life extension. The potential to increase the rated capacity of the old 200/210-MW LMZ design by 4 to 8% and efficiency by 8 to 10% was acknowledged by everyone. Six units, three with funding support from the World Bank and three with funding support from KFW, Germany as pilot projects have started under EE R&M. This project has a replication potential in over 60 units representing a total of 13,700 MW. CEA desires technical support from USAID and DOE/NETL in the following areas; 1) life assessment of critical components; 2) efficiency upgradation; and 3) capacity enhancement and environmental pollution control. Technical expertise in these areas resides mainly in the OEMs, which could constitute potential conflicts of interest because they are not excluded from bidding on any of the major R&M projects.

In the United States, life assessment projects are conducted by companies specializing in these services. CEA wishes to adopt the U.S. model in their EE R&M program.

Meeting Date: January 25, 2010
Meeting Site/Venue: NTPC Corporate Office, New Delhi

Meeting Participants: Mr. B.P. Singh, Director (Projects), NTPC; Mr. Scott Smouse, DOE/NETL; Dr. R.P. Krishnan, LTI; and Ms. Monali Hazra, USAID/India

Summary: Mr. Singh, an experienced mining engineer, was formerly in charge of NTPC's Fuel Management. NTPC has leased three mines from the government, which are capable of supplying up to 50 Mt/year of coal. These mines are located in North Karanpura in Bihar State, Ib Valley in Orissa, and the Northern Coal fields of Coal India Limited (CIL). NTPC plans to develop and operate these mines under a long-term contract with interested global partners and tenders have already been released. The specifications for the coal to be supplied will be 35% ash, 10% moisture, 4200-kcal/kg heating value, and 50-mm top size. Any stone band more than 50 cm will have to be mined and separated from the coal seam. Deviations from the specifications would be subject to penalties, a measure NTPC expects to help them in maintaining good coal quality.
Capacity building in coal mine planning, coal blending and in-situ gasification is some of the areas where there is little or no expertise in India. This lack of expertise could be augmented with outside help and should be done as soon as possible.

Meeting Date: January 26, 2010
Meeting Site/Venue: Shangri-La Hotel, New Delhi
Meeting Participants: Mr. S. Karthikeyan and Mr. S. Venkatagiri, Senior Counsellor, CII; Mr. Scott Smouse, DOE/NETL; and Dr. R.P. Krishnan, LTI

Summary: Messrs. Karthikeyan and Venkatagiri gave a brief feedback on the October 2009 Combustion Optimization Workshop, which was sponsored by USAID/India. The feedback received from 35 participants from cement, steel, utility, and other captive power plant operators that attended the workshop was very good. They all commented that the workshop gave them good information on the need for combustion optimization and acknowledged that guidelines and recommendations to optimize combustion will be very useful to improve power plant operations and maintenance. CII plans to hold a workshop on turbine performance assessment and they requested USAID/NETL assistance in getting at least one U.S. expert to participate. CII supports the idea of expanding the service providers network and would be willing to coordinate future activities that would benefit India's private power sector.

Meeting Date: January 27, 2010
Meeting Site/Venue: Energy Infratech, New Delhi
Meeting Participants: Mr. R. V. Shahi, CEO, Energy Infratech; Mr. Scott Smouse, DOE/NETL; Dr. R.P. Krishnan, LTI; and Ms. Monali Hazra, USAID/India

Summary: USAID/India and DOE/NETL has a long association with Mr. Shahi, when he worked for NTPC, BSES (now Reliance), and as India's Secretary of Power. He was instrumental in creating CenPEEP. He currently employs about 500 consultants working on coal, hydro, and infrastructure projects. He suggested that to be effective and sustainable, private companies should be responsible for efficiency improvement work in the state and private utilities. He suggested that USAID help set up several joint ventures between U.S. and Indian companies to

test the idea. Eventually, the same services that provided by the U.S. service providers would be provided at lower cost by Indian companies trained by their U.S. partners. With time, the companies will become self sustaining with opportunities to expand. He offered that Energy Infratech could be used as a platform to launch this effort. To support the goal, he would set up a "Power Plant Performance Improvement Company' as a subsidiary of Energy Infratech to facilitate the process and act as conduit to the state and private utilities. Initial support for test equipment, training, and capacity building could be provided by USAID through a grant.

Meeting Date: January 27, 2010
Meeting Site/Venue: Ministry of Coal, New Delhi
Meeting Participants: Mr. Alok Perti, Additional Secretary and Mr. T. Mandal, Advisor, Ministry of Coal; Dr. R.P. Krishnan, LTI; and Ms. Monali Hazra, USAID/India

Summary: The Indo–U.S. cooperation and activities under the APP Clean Coal Task Force were briefly discussed. Specifically, the visit of a technical team, sponsored by DOE/NETL under APP to the Central Mine Planning Institute (CMPI) in Ranchi on waste coal utilization project in September 2009 and the information/data requested by the team to complete their report were discussed. Mr. Mandal promised to help secure the information requested from CMPDI. The Ministry of Coal now leases mine blocks to private companies. The Ministry is concerned though that these new companies may not be familiar with the environmental regulations under which they are required to operate. A set of guidelines for mine planning and environmental control and remediation need to be developed and provided to private mine operators. A comprehensive environmental assessment of a major coal belt, using for example, the Ib Valley and the Talcher coal mine could be used for a joint study with technical assistance from USAID was also proposed.

Coal washeries are few and far between and are mostly available in the private sector. Dry coal beneficiation is an area where technical assistance could be provided under CERDI and shortage of water for power plant operation in India supports dry beneficiation.

Mr. Scott Smouse requested help in getting representation from Neyveli Lignite Corporation (NLC) in the forthcoming Lignite Conference in Australia. Sponsors of the conference have not succeeded in securing commitment to attend from a senior Neyveli executive. Mr. Preti offered to speak with the Chairman and Managing Director of NLC to see if he can get someone to attend the conference.

Meeting Date: January 27, 2010
Meeting Site/Venue: Shangri-La Hotel, New Delhi
Meeting Participants: Mr. Prabir Neogi, Managing Director, Integrated Mine Company Limited (IMCL), Kolkata; Mr. Scott Smouse, DOE/NETL; and Dr. R.P. Krishnan, LTI

Summary: IMCL, a subsidiary of CESC, supplies coal to CESC power plants and operates a CESC-owned coal mine in Asansol, West Bengal. The run-of-mine (ROM) produced is washed to reduce the ash content from 42% to 34% and the rejects are sent to a fluidized bed combustion

(FBC) plant for power generation and heat recovery. The FBC plant is a 40-MW plant with a throughput of 300 tons/hour.

Some of the technical challenges faced in the FBC plant involve operation and high unburnt carbon due to incomplete combustion. They would like to visit similar plants operating in the United States to learn how they deal with these issues. Another area where IMCL desires assistance is coal blending. A pilot facility to investigate coal blending issues will be very useful to end users.

CESC has a collaborative agreement for excellence in distribution with Singapore Power. The Asia Institute of Power Management in Kolkata, which offers training programs in generation and distribution, was suggested by Mr. Neogi as a center that could be used for outreach activities and implementation of pilot projects.

Meeting Date: January 27, 2010
Meeting Site/Venue: Ministry of Power (MoP)
Meeting Participants:—Mr. Girish Pradhan, Additional Secretary, MoP, Mr. Scott Smouse, DOE/NETL; Dr. R.P. Krishnan, LTI; and Ms. Monali Hazra, USAID/India

Summary: Mr. Pradhan strongly supports including efficiency improvement in existing coal plants as a GoI top priority under CERDI. Mr. Pradhan acknowledged that the plant-to-plant approach adopted under the USAID and APP Programs is difficult to sustain, and a model of working with private Indian entities is need for quick adoption of best practices. He is also convinced that CenPEEP's ever-increasing commitments to their own plants will prevent them from contributing at the level that is needed. He also endorsed Mr. Shahi's idea of forming an Indian private company to provide these services to power plants operated by state and private utilities and promised to have further discussions with him on the subject.

Meeting Date: January 29, 2010
Meeting Site/Venue: Foreign Commercial Service, American Center, New Delhi
Meeting Participants: Mr. Carmine D'Aloisio, Minister-Counselor for Commercial Affairs, Foreign Commercial Service (FCS); Ms. Preetha Nair, Senior Commercial Specialist, FCS; Mr. Scott Smouse, DOE/NETL; Dr. R.P. Krishnan, LTI; and Ms. Monali Hazra, USAID/India

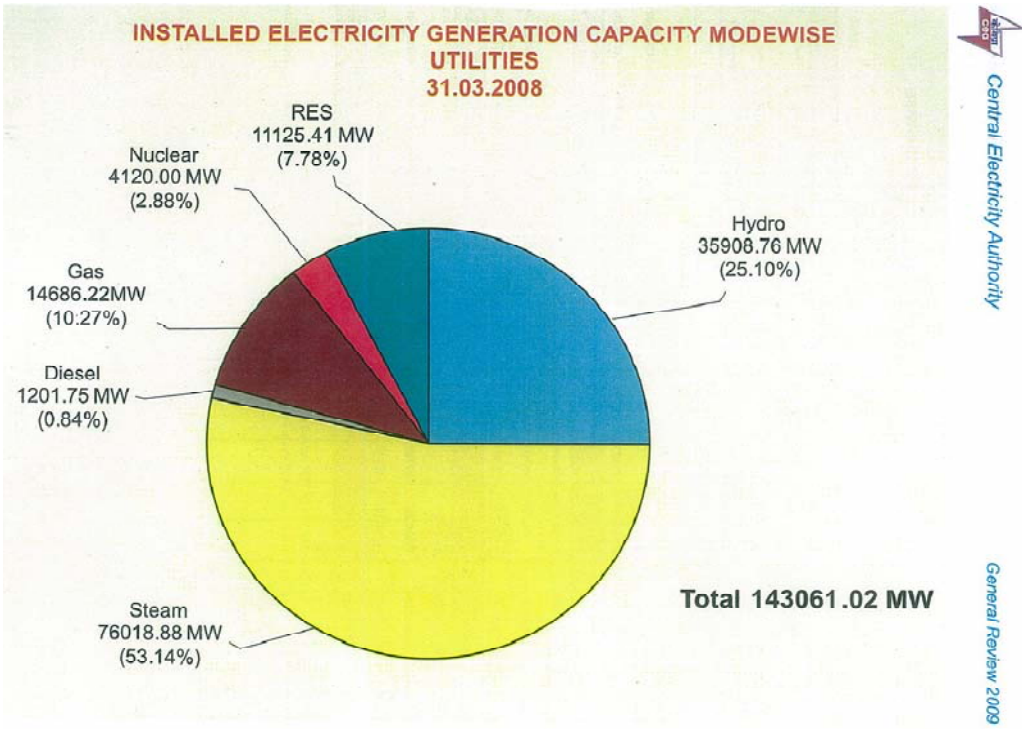
Summary: This meeting was held to discuss potential opportunities for U.S. companies specializing in technical services and technologies in the Indian power sector and to seek guidance on how to create a commercial service providers network in India. Mr. D'Aloisio requested a listing of the U.S. companies that would be interested in commercial joint ventures with Indian companies and the technologies/services that they would provide to help him identify the Indian companies that would be interested in these products/technologies/services. Mr. D'Aloisio made it clear that U.S. companies will have to pay for the services rendered by his office. He can be contacted for details. The Gold Key

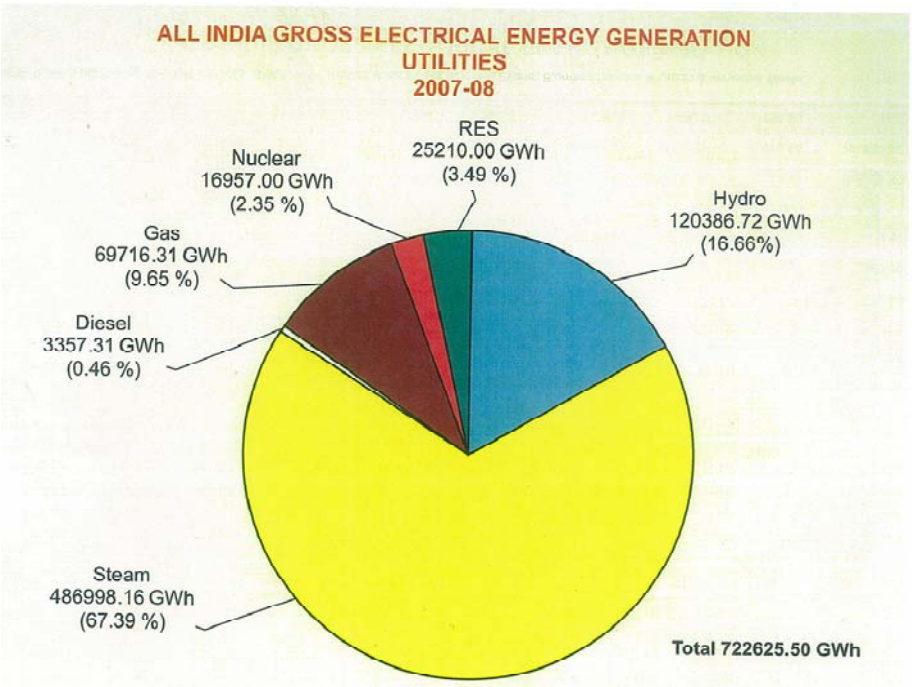
program run by the Department of Commerce is an established program, which several U.S. companies have successfully utilized to pursue business opportunities in India. His office coordinates business-to-business meetings with potential business partners, which could be one way to have additional Indian partners meet with U.S. companies interested in business in India. He gave an example of a manufacturing facility in Chennai that was set up through a joint venture that was facilitated by their office. FCS can help companies in many ways but persevere is needed to succeed in India.

Meeting Date: January 29, 2010
Meeting Site/Venue: NTPC Corporate Office
Meeting Participants: Mr. Sharad Anand, Executive Director, NETRA and Mr. Geetha Dave, General Manager, NETRA; Mr. Scott Smouse, DOE/NETL; and Dr. R.P. Krishnan, LTI

Summary: The meeting was held to discuss the proposed NTPC-NETL cooperation in clean coal R&D, which was raised under the U.S.-India Energy Dialogue in 2007. Mr. Smouse commented that the process is stalled because of DOE directives that prohibit NETL from executing MOUs with foreign partners that include R&D that might generate intellectual property. He explained that cooperation with NTPC could be implemented under an existing science and technology agreement, but this requires a GoI Ministry to designate NPTC as an implementer. Mr. Dave produced an MOU sent by DOE, in late November 2009, to the Ministry of Power, which provided it to NTPC, related to new U.S.-India cooperation agreement. Mr. Smouse said he could not comment on it because he had not seen it. Mr. Anand agreed to bring up the issue again at the next U.S.-India Energy Dialogue meeting. Mr. Smouse agreed to follow up on the MOU when he returns to the United States.

Appendix B
Additional India Power Sector Background




ALL INDIA GROSS ELECTRICAL ENERGY GENERATION
UTILITIES
2007-08
RES
25210.00 GWh
(3.49 %)
Nuclear
16957.00 GWh
(2.35 %)
Hydro
120386.72 GWh
(16.66%)
Gas
69716.31 GWh
(9.65 %)
Diesel
3357.31 GWh
(0.46 %)
Steam
486998.16 GWh
(67.39 %)
Total 722625.50 GWh
Central Electricity Authority
General Review 2009

ALL INDIA INSTALLED ELECTRICITY GENERATION CAPACITY OWNERSHIP-WISE AND MODE-WISE UTILITIES
31.03.2008

(MW)

Sl.No	State/U.Ts.	Installed Generating Capacity							
		Hydro	Thermal				Nuclear	RES	Total
			Steam	Diesel	Gas	Total (Thermal) (4+5+6)			(2+6+7+8)
	1	2	3	4	5	6	7	8	9
1.	**Public Sector**								
1.1	State Electricity Board	6969.88	8510.00	236.78	331.00	**9077.78**	0.00	584.37	**16632.03**
1.2	Elect. Deptt./Govt./ Corpns./ Joint Ventures	19260.88	36107.50	367.83	3623.22	**40098.55**	0.00	1531.90	**60891.33**
1.3	Central Sector	8448.00	25910.00	0.00	6549.00	**32459.00**	4120.00	0.00	**45027.00**
	Sub-total Public Sector	**34678.76**	**70527.50**	**604.61**	**10503.22**	**81635.33**	**4120.00**	**2116.27**	**122550.36**
2	Private Sector								
2.1	Private Companies	1230.00	5491.38	597.14	4183.00	**10271.52**	0.00	9009.14	**20510.66**
	Sub-total Private Sector	1230.00	5491.38	597.14	4183.00	10271.52	0.00	9009.14	20510.66
	Total All India	**35908.76**	**76018.88**	**1201.75**	**14686.22**	**91906.85**	**4120.00**	**11125.41**	**143061.02**

Note : R E S Includes 1168 MW Of SHP capacity transferred from conventional Hydro capacity.

RES: Renewable Energy Sourses includes Small Hydro Project, Wind Power, Biomass Power, Biomass Gasifier & Urban & Industrial Waste

(GWh)

Sl. No	State/U.Ts.	Gross Electrical Energy Generation (GWh)							
		Hydro	Thermal				Nuclear	RES	Total (3+7+8+9)
			Steam	Diesel	Gas	Total (Thermal) (4+5+6)			
1	2	3	4	5	6	7	8	9	10
1.	**Public Sector**								
1.1	State Electricity Board	26096.68	48717.43	374.14	1418.85	50510.42	0.00	2028.69	78635.79
1.2	Elect. Deptt./Govt. / Corpns,/ Joint Ventures	58864.33	210397.16	345.46	15305.28	226047.90	0.00	5339.02	290251.25
1.3	Central Sector	30446.26	194272.43	0.00	31128.74	225401.17	16957.00	0.00	272806.43
	Sub-total Public Sector	**115409.27**	**453387.02**	**719.60**	**47852.87**	**501959.49**	**16957.00**	**7367.71**	**641693.47**
2.	**Private Sector**								
2.1	Private Companies	4977.45	33611.14	2637.71	21863.44	58112.29	0.00	17842.29	80932.03
	Sub-total Private Sector	**4977.45**	**33611.14**	**2637.71**	**21863.44**	**58112.29**	**0.00**	**17842.29**	**80932.03**
	Total All India	**120386.72**	**486998.16**	**3357.31**	**69716.31**	**560071.78**	**16957.00**	**25210.00**	**722625.50**

RES: Renewable Energy Sourses includes Small Hydro Project,Wind Power,Biomass Power,Biomass Gasifier & Urban & Industrial Waste.

State/U.Ts.	CONSUMPTION						Gross Generation
	COAL	FURNACEOIL	LIGHT DIESEL OIL/HSD	LSHS/ HHS	GAS	LIGNITE	
	thou. MT	(KL)	(KL)	(KL)		thou. MT	(GWh)
NORTHERN REGION							
Haryana	7819	0	38534	0	0	0	10690.22
Himachal Pradesh	0	0	0	0	0	0	0.00
Jammu & Kashmir	0	0	0	0	0	0	0.00
Punjab	10994	16303	0	0	0	0	16456.69
Rajasthan	12163	9715	535	0	0	176	18810.76
Uttar Pradesh	16985	3806	59276	0	0	0	21040.70
Uttarakhand	0	0	0	0	0	0	0.00
Delhi	1718	0	10308	1593	0	0	1925.27
Central Sector(NR)	39143	11929	0	0	0	0	58007.44
Sub Total (NR)	**88822**	**41753**	**108653**	**1593**	**0**	**176**	**126931.08**
WESTERN REGION							
Gujarat	18170	3958	3186	415441	0	4104	32209.22
Madhya Pradesh	11999	25968	6306	0	0	0	14500.40
Chhattisgarh	7994	13822	10314	0	0	0	10620.22
Maharashtra	39385	1124510	568	0	(A) 219193		57032.43
Goa	0	0	0	0	0	0	0.00
D. & N. Haveli	0	0	0	0	0	0	0.00
Daman & Diu	0	0	0	0	0	0	0.00
Central Sector (WR)	29614	6634	0				43616.94
Sub Total (WR)	**107162**	**1174892**	**20374**	**415441**	**219193**	**4104**	**158031.21**
SOUTHERN REGION							
Andhra Pradesh	17587	22615	4089	0			23685.95
Karnataka	7875	609	7738	0	(B) 474849	0	13106.53
Kerala	0	0	0	0	0	0	0.00
Tamil Nadu	15663	38595	4269	1203	0	1813	23190.98
Lakshadweep	0	0	0	0	0	0	0.00
Puducherry	0	0	0	0	0	0	0.00
Central Sector (SR)	18903	17457	13805	0	0	20012	45823.23
Sub Total (SR)	**60028**	**79276**	**29901**	**1203**	**474849**	**21825**	**105806.69**
EASTERN REGION							
Bihar	134	4	0	0	0	0	143.96
Jharkhand	3795	0	5795	0	0	0	4903.80
Orissa	2650	0	1889	0	0	0	3047.19
West Bengal	18184	7468	28800	0	0	0	26508.68
DVC	10062	8687	46067	0	0	0	14802.73
A.& N. Islands	0	0	0	0	0	0	0.00
Sikkim	0	0	0	0	0	0	0.00
Central Sector (ER)	36335	18885	0	0	0	0	46822.82
Sub Total (ER)	**71161**	**35044**	**82551**	**0**	**0**	**0**	**96229.18**
NORTH EASTERN REGION							
Assam	0	0	0	0	0	0	0.00
Manipur	0	0	0	0	0	0	0.00
Meghalaya	0	0	0	0	0	0	0.00
Nagaland	0	0	0	0	0	0	0.00
Tripura	0	0	0	0	0	0	0.00
Arunachal Pradesh	0	0	0	0	0	0	0.00
Mizoram	0	0	0	0	0	0	0.00
Central Sector (NER)	0	0	0	0	0	0	0.00
Sub Total (NER)	**0**	**0**	**0**	**0**	**0**	**0**	**0.00**
Total (All India)	**327173**	**1330965**	**241479**	**418237**	**(A) 219193**	**26105**	**486998.16**
					(B) 474849		

Note: (A): Unit in MMSCM. (B): Unit in knm3-Corex Gas.

CLASSIFICATION OF STEAM TYPE ELECTRICITY GENERATION STATIONS EFFICIENCY-WISE 2007-08

Thermal Efficiency	No. of Generating Stations	Installed Capacity (MW)	Energy Generated (GWh)
Up to 20%	9	1696.38	1503.25
Above 20% & up to 25%	10	4417.50	15453.38
Above 25% & up to 30%	25	14055.00	69071.18
Above 30%	53	55850.00	400970.35
Total	**97**	**76018.88**	**486998.16**

ALL INDIA THERMAL EFFICIENCY (COAL & LIGNITE BASED PLANTS)

Year	(%)
2004-05	32.16
2005-06	32.73
2006-07	32.44
2007-08	32.69

India / Inde

Figure 1. CO_2 emissions by fuel

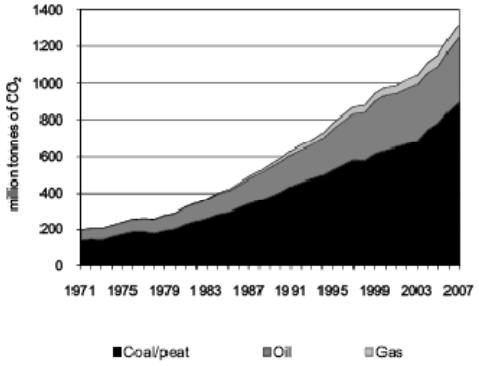


Figure 2. CO_2 emissions by sector

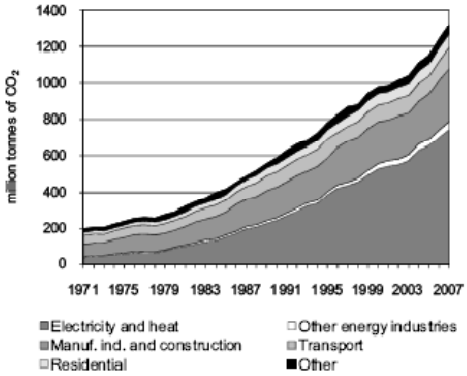


Figure 3. CO_2 emissions by sector

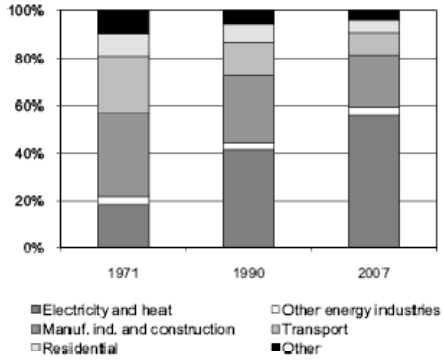


Figure 4. Reference vs Sectoral Approach

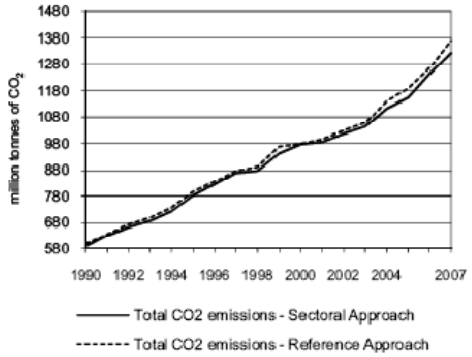


Figure 5. Electricity generation by fuel

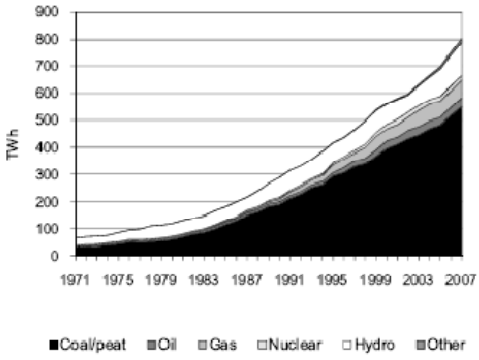
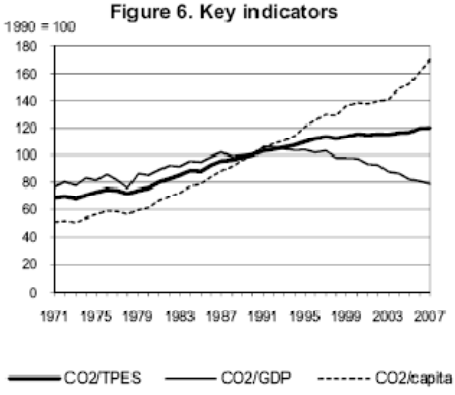


Figure 6. Key indicators



India / Inde

Key indicators

	1990	1995	2000	2004	2005	2006	2007	% change 90-07
CO_2 Sectoral Approach (Mt of CO_2)	589.27	782.53	976.43	1 112.25	1 153.57	1 244.04	1 324.05	124.7%
CO_2 Reference Approach (Mt of CO_2)	597.39	797.22	978.11	1 139.86	1 188.44	1 265.36	1 369.93	129.1%
TPES (PJ)	13 321	16 132	19 150	21 627	22 362	23 436	24 908	87.0%
TPES (Mtoe)	318.16	385.30	457.38	516.56	534.10	560.97	594.91	87.0%
GDP (billion 2000 US$)	270.50	346.59	460.18	589.56	644.70	707.03	771.09	185.1%
GDP PPP (billion 2000 US$)	1 411.90	1 809.11	2 402.02	3 077.33	3 365.13	3 690.51	4 024.89	185.1%
Population (millions)	849.52	932.18	1 015.92	1 079.72	1 094.58	1 109.31	1 123.32	32.2%
CO_2 / TPES (t CO_2 per TJ)	44.2	48.5	51.0	51.4	51.6	53.0	53.2	20.2%
CO_2 / GDP (kg CO_2 per 2000 US$)	2.18	2.26	2.12	1.89	1.79	1.76	1.72	-21.2%
CO_2 / GDP PPP (kg CO_2 per 2000 US$)	0.42	0.43	0.41	0.36	0.34	0.34	0.33	-21.2%
CO_2 / population (t CO_2 per capita)	0.69	0.84	0.96	1.03	1.05	1.12	1.18	69.9%

Ratios are based on the Sectoral Approach.

2007 CO_2 emissions by sector

million tonnes of CO_2	Coal/peat	Oil	Gas	Other *	Total	% change 90-07
Sectoral Approach	**894.97**	**357.84**	**71.24**	**-**	**1 324.05**	**124.7%**
Main activity producer elec. and heat	622.69	17.04	23.29	-	663.02	203.0%
Unallocated autoproducers	65.08	9.53	7.54	-	82.15	209.8%
Other energy industries	2.90	36.41	5.43	-	44.75	182.0%
Manufacturing industries and construction	164.39	94.74	30.08	-	289.21	71.0%
Transport	-	115.80	2.92	-	118.72	45.2%
of which: road	-	*107.21*	*2.92*	-	*110.12*	*67.4%*
Other sectors	39.91	84.32	1.97	-	126.20	63.5%
of which: residential	*10.93*	*62.14*	*1.96*	-	*74.73*	*71.0%*
Reference Approach	**939.99**	**358.69**	**71.24**	**-**	**1 369.93**	**129.1%**
Diff. due to losses and/or transformation	28.67	- 1.24	-	-	27.43	
Statistical differences	16.36	2.09	0.00	-	18.45	
Memo: international marine bunkers	-	*0.15*	-	-	*0.15*	*-67.5%*
Memo: international aviation bunkers	-	*14.38*	-	-	*14.38*	*171.7%*

* Other includes industrial waste and non-renewable municipal waste.

Key sources for CO_2 emissions from fuel combustion in 2007

IPCC source category	CO_2 emissions (Mt of CO_2)	% change 90-07	Level assessment (%) **	Cumulative total (%)
Main activity prod. elec. and heat - coal/peat	622.69	206.3%	27.3	27.3
Manufacturing industries - coal/peat	164.39	32.7%	7.2	34.6
Road - oil	107.21	63.0%	4.7	39.3
Manufacturing industries - oil	94.74	160.1%	4.2	43.4
Unallocated autoproducers - coal/peat	65.08	187.6%	2.9	46.3
Residential - oil	62.14	95.2%	2.7	49.0
Other energy industries - oil	36.41	333.6%	1.6	50.6
Manufacturing industries - gas	30.08	240.9%	1.3	51.9
Non-specified other sectors - coal/peat	28.98	-2.6%	1.3	53.2
Main activity prod. elec. and heat - gas	23.29	231.2%	1.0	54.2
Non-specified other sectors - oil	22.18	490.1%	1.0	55.2
Memo: total CO_2 from fuel combustion	*1324.05*	*124.7%*	*58.1*	*58.1*

** Percent calculated using the total GHG estimate for CO_2, CH_4, N_2O, HFCs, PFCs and SF_6 excluding CO_2 emissions/removals from land use change and forestry.

Appendix C
Background Information on Other Bilateral and Multilateral Clean Coal Programs

This section presents a high-level review of other bilateral and multilateral organizations' clean energy programs/projects in India. The goals and objectives of most of these programs/projects align with CERDI's thereby making the organizations potential funding sources for proposed clean coal technologies under CERDI. The review is a source of information that could be utilized to assess the successes and shortcomings of the programs identified and could offer recommendations as to what may be replicable under CERDI.

Major Economies Forum on Energy and Climate

The Major Economies Forum on Energy and Climate (MEF) was launched on March 28, 2009. The MEF is intended to facilitate a candid dialogue among major developed and developing economies, help generate the political leadership necessary to achieve a successful outcome at the December UN climate change conference in Copenhagen, and advance the exploration of concrete initiatives and joint ventures that increase the supply of clean energy while cutting greenhouse gas emissions.

The 17 major economies participating in the MEF are Australia, Brazil, Canada, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, Korea, Mexico, Russia, South Africa, the United Kingdom, and the United States. Denmark, in its capacity as the President of the December 2009 Conference of the Parties to the UN Framework Convention on Climate Change, and the United Nations have also been invited to participate in this dialogue.

In July 2009, the MEF established a Global Partnership to drive transformational low-carbon, climate-friendly technologies. The Global Partnership will dramatically increase and coordinate public sector investments in research, development, and demonstration of these technologies, with a view to doubling such investments by 2015, while recognizing the importance of private investment, public-private partnerships and international cooperation, including regional innovation centers. Drawing on global best practice policies, the Partnership will undertake to remove barriers, establish incentives, enhance capacity-building, and implement appropriate measures to aggressively accelerate deployment and transfer of key existing and new low-carbon technologies, in accordance with national circumstances. The Global Partnership will advance actions on advanced vehicles; bioenergy; carbon capture, use and storage; cross-cutting R&D; energy efficiency in buildings; energy efficiency in industry; high-efficiency and low-emissions coal technologies; marine energy; smart grids; solar energy; and wind energy.

As an initial step, they requested a suite of plans, which now span ten climate-related technologies that together address more than 80% of the energy sector carbon dioxide (CO_2) emissions reduction potential identified by the IEA. The Executive Summary summarizes the resulting menu of potential actions for all countries to consider in pursuit of the common goal of a global low-carbon economy.

MEF High-Efficiency, Low-Emissions (HELE) Coal Technologies Action Plan

High-efficiency, low-emissions (HELE) coal technologies can help reduce the carbon emissions produced by coal-fired power generation while enabling the energy source to continue to meet growing power demand. Highlights of the HELE coal technologies action plan include:

- GHG Emissions and Mitigation Potential – coal-fired power will remain in high demand. HELE coal technologies can meet power demands and mitigate emissions
- Development and Deployment – barriers and best practice policies include varying qualities of coal; the high upfront cost of advanced HELE coal technologies; lack of appropriate price, financial, legal, and regulatory frameworks; inadequate operations and maintenance skills; and insufficient research, development, and demonstration. Best practice policies encouraging the development and deployment of HELE coal technologies include identifying research and development priorities, establishing regulatory incentives and benchmarking, and multilateral and bilateral cooperation
- Opportunities to Accelerate Development and Deployment – supporting innovation, accelerating deployment through development of an effective technology transfer mechanism to promote international dissemination of clean and efficient technologies (including HELE coal technologies) and an effective mechanism to match technology needs with technology owners and financial sources.
- Facilitating information sharing – on best available technology options and related best practices and developing an international initiative for creating "international technology hubs" in key sectors (e.g., power sector) using the expertise of existing international forums (e.g., IEA).

MEF Carbon Capture, Use and Storage Action Plan

Carbon capture and storage (CCS) reduces emissions by separating CO_2 from industrial and energy-related sources, transporting it to a storage location, and then isolating it from the atmosphere for the long term. CCS has the potential to reduce CO_2 emissions from fossil fuels by up to 90% and thus, is a critical mitigation option for a broad range of industries and an essential part of the portfolio of technologies and mitigation policies needed to address climate change. This plan has outlined the potential for greatly reducing GHG emissions through the use of integrated carbon capture, transport, and storage technologies. Highlights of the action plan include:

1. GHG Emissions and Mitigation Potential
    - Fossil fuels are a major energy and emissions source. Energy derived from the use of fossil fuels accounts for approximately 81.4% of the world's energy output and 60.5% of total greenhouse gas emissions.
    - Rapid CCS deployment is required to cost-effectively meet abatement goals. Per IEA scenarios analysis, to cost-effectively halve annual CO_2 emissions by 2050, CCS will need to contribute 19% of the emissions reductions. This will require deployment of 100 CCS projects by 2020 (with approximately half in developing countries), and 3,400 by 2050.
2. Development and Deployment: Barriers and Best Practice Policies

- Barriers to deployment include project time frames, failure rates, and component interdependence; identifying suitable storage sites; transport and pipeline issues; high costs and low investor support for CCS projects; insufficient policy and regulatory frameworks to reduce risk; and limited experience with CCS scale-up.
- Best practice policies to encourage CCS development and deployment include government funding commitments, legislation and guideline development, capacity-building efforts, demonstration and research efforts, and country-specific initiatives.

3. Opportunities to Accelerate Development and Deployment
    - Supporting innovation:
        - Accelerate RD&D to reduce capture cost and improve overall system efficiencies.
        - Take steps to ensure the fulfillment of the G8 commitment to support the launch of 20 commercial-scale CCS projects by 2010 and recognize that by 2020, many more could be required in both developed and developing countries, which may need assistance from developed countries.
    - Accelerating deployment:
        - Encourage the use of captured CO2 to generate revenue that can partially offset the cost of CO2 capture, as a transitional measure.
        - Develop comprehensive legislative and regulatory frameworks that address, among other things, long-term storage and financial liability.
        - Provide government investment through public-private partnerships in integrated CCS projects, for both power and industrial plants, to drive down technology costs and share or reduce risk.
        - Provide government investment to accelerate understanding of storage sites.
    - Facilitating information sharing:
        - Actively participate in international forums that collaborate on CCS, particularly the Carbon Sequestration Leadership Forum, the Global CCS Institute, and the IEA.
        - Develop principles to facilitate knowledge sharing from publicly funded projects.

Asia Pacific Partnership on Clean Development and Climate
Power Generation & Transmission Task Force

The Asia-Pacific Partnership on Clean Development and Climate (APP) is an innovative new effort to accelerate the development and deployment of clean energy technologies. The purposes of the Partnership are to:

- Create a voluntary, non-legally binding framework for international cooperation to facilitate the development, diffusion, deployment, and transfer of existing, emerging and longer term cost- effective, cleaner, more efficient technologies and practices among the Partners through concrete and substantial cooperation so as to achieve practical results
- Promote and create enabling environments to assist in such efforts.

- Facilitate attainment of our respective national pollution reduction, energy security and climate change objectives; and
- Provide a forum for exploring the Partners' respective policy approaches relevant to addressing interlinked development, energy, environment, and climate change issues within the context of clean development goals, and for sharing experiences in developing and implementing respective national development and energy strategies.

Power Generation and Transmission Task Force (PG&T TF) is one of eight public-private sector Task Forces established by the APP. Potential areas for cooperation in the power sector would include the improvement of thermal efficiency of power plants, fuel switching and/or multi-firing, reform of electricity markets, loss reduction in transmission, and demand side management. The objectives of PGTTF are to:

- Assess opportunities for practical actions to develop and deploy power generation, transmission and demand side management technologies that can aid development and climate concerns.
- Facilitate demonstration and deployment of practices, technologies and processes to improve efficiency of power production and transmission within Partnership countries.
- Enhance collaboration between Partners on research and development of such technologies and processes.
- Enhance synergy with relevant objectives of other Task Forces (i.e. Cleaner Fossil Energy, Renewable Energy and Distributed Generation, Buildings and Appliances).
- Identify potential projects that would enable Partner countries to assess the applicability of energy feedstocks to their specific requirements.
- Identify opportunities to enhance investment in efficient power supply by improving energy markets and investment climate.

Asia Development Bank

The ADB is the leading promoter of energy privatization in Asia and the Pacific. Through energy sector reform programs, the ADB requires countries to privatize state-owned electricity utilities and promote foreign investment in energy generation, transmission and distribution. The ADB believes that private sector participation in the energy sector will relieve governments' debt burdens and allow scarce resources to be allocated to social sectors such as health and education. In October 2000, the ADB approved a loan of US$250 million for the establishment of a national grid for interstate power transmission and extended a partial credit guarantee for raising another US$120 million from commercial banks. The ADB's support of Powergrid, the state company overseeing the unification of the national grid, is part of a move to encourage private sector involvement in the power sector. In December 2000, the ADB approved two loans totaling US$350 million to implement sweeping reforms of the power sector in the western Indian state of Gujarat.

Reforming Power Sector in India's Madhya Pradesh State

ADB has approved loans totaling US$350 million to help restructure the power sector in the central Indian state of Madhya Pradesh. The loans will help to create a more efficient, competitive, commercially run, and financially viable power sector to support the economic and social

development of one of India's larger states. Evidence shows that economic growth is the most effective path to poverty reduction in India. The program will:

- improve the policy environment and governance in the sector
- help establish a competitive business environment to increase efficiency and reduce system losses
- enhance the viability of the Madhya Pradesh State Electricity Board through financial restructuring
- introduce a computerized information and revenue management system
- corporatize and commercialize the generation, transmission and distribution functions of the Madhya Pradesh State Electricity Board through the establishment of new companies in the power sector.

The project is part of ADB's strategy to help Indian states reform their power sectors as part of changes in macroeconomic management. Madhya Pradesh is the second state to receive such assistance, following Gujarat.

Energy Efficiency Enhancement in the Power Generation Sector – This ADB technical assistance (TA) will contribute to mainstream energy efficiency projects in the thermal and hydro power generation sector, through enhancing efficiency rates and reducing greenhouse gas emission of the existing power plants and its replacement. In addition, technology transfer scheme will be considered.

Energy Efficiency Enhancement Project in Assam
ADB provided a sector development program loan in 2003 to support restructuring of the power sector in Assam to create an efficient, self-sustaining, and competitive power sector to ensure that electricity is supplied in adequate quantities, in an efficient manner, and at reasonable cost to all consumers. The sector assistance program evaluation for the India energy sector concluded that the program loan and associated technical assistance (TA) were successful and that the project loan is showing early indications of a successful outcome.

Energy Smart-Facilitating the Operations of Energy Conservation Fund (ECF) in Madhya Pradesh
This initative will promote the culture of energy efficiency in Madhya Pradesh and suppliers and consumers of energy will work in tandem to conserve energy. This initiative will encourage commercial banks and financial institutions in shedding their hesitation for financing energy conservation projects in MP. Through its promotional activities like information dissemination and outreach and spreading awareness amongst the consumers and financiers, the TA will produce a model which will facilitate implementation of energy conservation measures and promote the culture of energy efficiency in MP.

The World Bank
The World Bank supports developing countries' efforts to provide cleaner, stable electricity services to households and businesses through its financing instruments, policy advice, partnerships, and knowledge transfer. India’s power shortage is a formidable obstacle to the country’s development.

More than 400 million Indians - equal to the combined populations of the US, UK and France - do not have access to electricity. Sixty percent of Indian industries are forced to make their own arrangements for securing a reliable power supply. In 2008, the country faced a 16.6 percent shortfall during hours of peak consumption and a 9.9 percent gap for energy generation. It has not improved much. Over the next decade, some old and polluting plants will be renovated. While some of the older generation units will need to be closed, others can be rehabilitated using modern techniques that will help boost power production while using less coal and with lower carbon emissions. To alleviate power shortages, therefore, the Government of India plans to rehabilitate a range of old coal-fired plants even as the country moves to more climate-friendly options for energy generation in the longer term. It has therefore initiated a National Renovation and Modernization Program which, over the next decade, aims to rehabilitate old and inefficient power plants with a cumulative capacity of 27,000 MW - almost one-fifth of India's installed power capacity of 145,000 MW.

The World Bank energy program in India supports GoI's energy sector development strategy articulated in the Electricity Act 2003. World Bank – Global Environment Fund (GEF) project will help pilot the renovation of 4 power units. To help launch the first phase of the national program, the Government of India has sought the World Bank's assistance to pilot the renovation and modernization of four coal-fired units with a combined capacity of 640 MW. The US$225.5 million World Bank-Global Environment Facility assisted Coal-fired Generation Rehabilitation Project will thus rehabilitate and modernize around 200-220 MW of capacity at each of the three coal-fired power plants at Bandel in West Bengal, Koradi in Maharashtra and Panipat in Haryana. (The assistance comprises an IBRD Loan of US$180 million and a GEF Grant of $45.4 million). The pilot project's success could help the Government of India and the various state utilities scale up the rehabilitation of a significant portion of the 27,000 MW capacity so far identified for renovation and modernization. The project will help:

- Reduce India's emissions by almost half a million tons of CO_2 equivalent each year by making the renovated plants more energy efficient and environmentally sustainable. This means they will use less fuel (coal) and emit fewer greenhouse gases for every unit of electricity they produce
- Modernizing coal-fired plants will allow India to adopt a lower-carbon path to energy generation by supporting efforts to control particulate emissions, and improve water treatment and ash disposal at these plants, leading to better environment conditions for people living in the vicinity. A parallel focus on better operations and maintenance practices in these plants will help sustain the improvements made through the renovation and modernization effort. This combined emphasis will allow India to adopt a lower-carbon path to energy generation by modernizing its coal-fired plants and enabling the country to add cheaper and cleaner electricity to its grid.

Other World Bank projects in India that focus on infrastructure and institutional development include:

- Clean Power Generation – hydro power projects with two public sector companies in Himachal Pradesh and Uttarakhand
- Energy Efficiency – transmission and distribution to reduce transmission and distribution losses and demand side management for chiller efficiency and support for the Bureau of Energy Efficiency (BEE)
- Efficient energy markets and inter-regional power transfer with PowerGrid, Haryana Transco, and Maharashtra Transco
- Utility governance and quality of electricity distribution services in West Bengal, Maharashtra Distribution Company, and Haryana Distribution Company
- Distributed generation (1-3 MW) for improved rural access and services and support for rural electrification scale up to 10% of generation by 2012

Deutsche Gessellschaft fur Technische Zusammenarbeit (GTZ)

Support for India's electricity sector by GTZ is intended to help improve the supply of electricity to industry, trade, the service sector and agricultural enterprises. In concrete terms, this means helping to accelerate the implementation of reforms already under way in the electricity sector, improving energy efficiency and making greater use of renewable energies.

Due to the high levels of investment required, German Development Cooperation activities in the energy sector are addressing the following areas:

- provision of additional energy, generated efficiently and in an environmentally sound manner, and its productive use in order to generate economic growth and more employment
- promotion of projects to consistently exploit efficiency-enhancing and energy-saving potential in order to clearly reduce emissions
- promotion of technologies for the use of renewable energies in hydropower, wind power, solar energy and biomass
- support reform-minded union states in implementing sector reform programmes (in cooperation with multilateral donors) by expanding and modernizing generating capacities (coal-powered plants), taking into account environmental aspects
- support for implementing the Clean Development Mechanism (Kyoto Protocol) in the field of energy efficiency and renewable energies.

The Indo-German Energy Programme (IGEN) is managed by Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ) in India. The lead India executing agency is the Bureau of Energy Efficiency (BEE) and the Central Electricity Authority (CEA), Ministry of Power, Government of India. The term of the program is October 2003 - September 2011. The program objective is to help electricity producers and energy consumers improve energy efficiency and contribute to climate protection leading to a decoupling of energy demand from economic growth. The broad focus of IGEN is to support the implementation of the Energy Conservation Act, which positively intervenes at all levels of society, such as energy-intensive large industries, manufacturers of household appliances and industrial equipment, residential households as well as engineering

consultancy firms. The bilateral cooperation involves local and international professionals and supports:

- labeling of energy efficiency of household appliances and energy intensive industrial equipment
- certification of energy managers and energy auditors
- setting norms and standards for energy intensive industries
- transfer and promotion of cutting edge technology to reduce energy consumption
- promotion of Clean Development Mechanism and
- operation of one of the largest web portals on this subject

So far, support by GTZ has yielded the following results:

- 1.4 Bill EUR have been invested on energy efficiency and climate protection measures
- 4,500 energy managers and 3,500 energy auditors have been certified.
- Indian Certified Emission Reduction (CER) worth 160 Mill. EUR have been sold abroad.
- Rules and regulations under the EC Act have been vetted.
- Energy efficiency measures result in 150 Mill. EUR annual reduction of energy costs.
- Energy consumption labels have been introduced and accepted by the market for four major electric end-user devices.

Japanese International Cooperation Agency

Over 40 years ago, the Japanese International Cooperation Agency (JICA), formerly known as Overseas Technical Cooperation Agency (OTCA), established and initiated its operations in India. The following are some of the projects supported with JICA loans:

- Bakreswar Thermal Power Station Units Extension Project 2003
- North Karanpura Super Thermal Power Project (2005)
- Rural Electrification Project (2006)
- Transmission system Modernization and Strengthening Project in Hyderabad Metropolitan Area (2007)
- Maharashtra Transmission System Project (2007)
- Development Studies
- Improvement of Power Distribution System of Andhra Pradesh (2004)
- Enhancing Efficiency of Operating in Thermal Power Plants in India (2008)

(Source: https://libportal.jica.go.jp/fmi/xsl/library/Data/PlanInOperation-e/EastAsiaSouthwesternAsian/India-e.pdf)

JICA Training Programme

The Training Programme of JICA is a government-to-government relationship under which government employees like engineers, technicians and administrative officials or NGO staff from developing countries are invited to Japan and provided with the training in the skills and technology that is needed in their respective countries. JICA has provided the following group/individual courses on energy supply and energy conservation:

- Thermal Power Engineering for Gas Turbine and Coal Fired Steam (2005)
- The Improvement for Electric Power Distribution Grid (2005)
- Economical Planning and Operation for Electric Power (2005)
- Small-Scale Hydro Power and Clean Energy Power Engineering (2005)
- Energy Efficiency and Conservation (2005)
- Energy Efficiency and Conservation (2006)
- Hydro-Electric Power Engineering for Stable and Sustainable Supply (2008)
- Thermal Power Engineering for Gas Turbine and Coal Fired Steam Turbine for India (2008)
- Small-scale Hydropower and Clean Energy Power Engineering (2008)
- Energy Efficiency and Conservation (2008)
- Audit Technology for Energy Conservation for Asia (2008)
- Fuel-reduced Operation by Economical Load Distribution of Multiple Diesel Generators (2009)
- Energy Efficiency and Conservation (2009)

Appendix D
Background Information on GoI Energy Policy

This section presents a high-level review of key Government of India policy documents related to clean energy supply.

Integrated Energy Policy

India's integrated energy policy document, put together by the Expert Committee on Integrated Energy Policy, Planning Commission, Government of India, acknowledged the formidable challenges faced by India in meeting its energy needs and providing adequate energy of desired quality in various forms to users in a sustainable manner and at reasonable costs. India needs to sustain an 8% to 10% economic growth to eradicate poverty and meet its economic and human development goals. Such economic growth would call for increased demand for energy and ensuring access to clean, convenient and reliable energy for all to address human development. To deliver a sustained growth of 8% through 2031, India would, in the very least, need to grow its primary energy supply by 3 to 4 times and electricity supply by 5 to 7 times of today's consumption. By 2031-32 power generation capacity would have to increase to 778,095 MW and annual coal requirement would be 2040 MT, if we measures aren't taken to reduce consumption.

Along with quantity, the quality of energy supply also has to improve. The energy challenge is of fundamental importance to India's economic growth imperatives. The broad vision behind the energy policy is to reliably meet the demand for energy in all sectors in a safe, convenient efficient, economically viable and environmentally sustainable manner. Meeting this vision would require that India pursues all available fuel options and forms of energy, both conventional and non-conventional, as well as new and emerging technologies and energy sources. Coal shall remain India's most important energy source till 2031-32 and possibly beyond. India will need to take a lead in seeking clean coal technologies and, given its growing demand, new coal extraction technologies such as in-situ gasification to tap its vast coal reserves that are difficult to extract economically using conventional technologies. The approach of the Committee is directed to realize cost-effective energy system. For this, the following are needed:

- Markets that promote competition
- Pricing and resource allocation to take place under market forces under an effective and credible regulatory oversight, as far as possible
- Subsidies to be transparent and targeted
- Improved efficiencies across the energy chain
- Policies that reflect externalities of energy consumption
- Policies that rely on incentives and which are implementable

A key proposal of the policy is tax neutrality across energy sources.

2009 Electricity Act

In June 2009, the Ministry of Power decided to amend the Electricity Act, 2003, to grant long-term open access to about 14,000 MW of generation capacity to independent power producers to sell power to consumers of their choice through the open access system doing away with states' intervention. On the long-term open access front, Power Grid Corporation received 178 applications from various customers seeking open access amounting to about 1,42,000 MW in the next 3-4 years. State governments, state electricity regulatory commissions and state load despatch centres had to play an active role to facilitate implementation of open access in intra-state transmission and distribution.

11th Five Year Plan

The prime document which articulates GoI's seriousness to respond to climate change and its desire to develop and deploy clean technologies is the "National Action Plan on Climate Change" (NAPCC). This is driven by the Prime Ministers' office, mainly in response to growing pressure on India to take decisive steps to reduce the trend of rapidly growing GHG emissions. The multi-faceted tasks of dealing with climate change issues and reducing GHG emissions across India's various sectors will be carried out through Eight National Missions (PM Action Plan: refer pages 2 thru 5). These missions will be implemented through related ministries with the help of industry, academia and civil society. Supercritical technologies for power generation from coal will be adopted wherever they are found to be most cost effective. Ultra-supercritical technology will be adopted after its commercial viability is proven for low-grade Indian coal. Both of these technologies have efficiency levels of 40% and above as compared to the 35% efficiency levels of sub-critical technology that is predominant in the Indian power sector. Similarly, demonstration of IGCC for coal-based power generation is being pursued (PM Action Plan: refer pages 38, 39). The NAPCC calls for multilateral funding support for development, deployment and diffusion (i.e. absorption) of technologies (PM Action Plan page 47).

The National Mission for Enhanced Energy Efficiency (NMEEE) launched by Power Minister Shinde on December 14, 2009 is an effort to create a market for energy efficiency in India, estimated to be INR 740 billion (US$16.5 billion). The flagship of NMEEE is its "Perform, Achieve and Trade (PAT)" initiative, which is a market-based mechanism to incentivize energy efficiency in nine energy-intensive industrial sectors. This includes power generation plants. This initiative provides a mechanism by which to work with existing power plants to reduce their specific energy consumption and improve overall efficiency through improvement in heat rate (Source: NMEEE second attachment pages 12-14).

Specifically, GoI is making an effort to accelerate clean technologies through the Clean Development Mechanism (CDM) route and capitalize on the following in the power generation – renovation and modernization (R&M) of old plants; supercritical technology; IGCC based on local coal; combined cycle projects using high efficiency gas turbines (second attachment: refer pages 23,24). When the USAID GEP Project was launched in 1995, India ranked 6th globally in terms of overall GHG emissions. As reported in 2009, India has moved up to ranking 4th, following China, the United States, and Russia, with a share of 5.3% of global emissions. (Source: Sandeep Tandon, SAIC-India)