

## **Challenges for R&D in the Indian Energy Sector**

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### **Introduction:**

India, with over 15 percent of the world's population and high rates of economic growth, is likely to become a significant consumer of global energy resources. While nearly 50% of India's population does not have access to clean, modern energy forms at least 20% of its population can be classified as middle class and this percentage will increase in the coming years. This fast growing new middle class with increased disposable incomes and more easy access to appliances will demand more energy for a more comfortable life style while at the same time millions of poor people in rural areas are still waiting for electricity access. The shortage of energy in India (2007/2008: approximately 10 %; at peak times about 15 %) is one of the biggest challenges for the country's development. Model calculations done by The Energy and Resources Institute (TERI) indicate, that until 2031 electricity supply in India has to increase six fold (from 150 to 900 GW) to meet the demand. This would mean a five to six fold increase in consumption of fossil energy sources compared to today if the growth pattern does not change significantly.

India lacks sufficient domestic energy resources and must import about 30 % of its growing energy requirements. It is not only experiencing an electricity shortage but is also increasingly dependent on oil imports to meet demand. In addition to pursuing domestic oil and gas exploration and production projects, India is also stepping up its natural gas imports (liquefied natural gas). Coal accounts for more than half of India's total energy consumption (53 %, EIA International Energy Annual 2006) followed by oil, which comprises 31 percent of total energy consumption. Natural gas and hydroelectric power account for 8 and 6 percent of consumption, respectively. Although nuclear power comprises a very small percentage of total energy consumption at this time (1%), it is expected to increase following recent international civil nuclear energy cooperation deals. The efforts of the Indian government in the field of energy research and technology, although great, are not nearly sufficient. R&D expenditure in the field of energy currently only makes up about 8 % of India's overall spending on research and technology with a large share on nuclear energy.

Within the Government of India the following ministries and departments are in charge of energy research, policy, development, production and dissemination of energy technologies in India:

- Ministry of Power (MoP),
- Ministry of New and Renewable Energy Resources (MNRE)
- Department of Atomic Energy (DAE),
  
- Ministry of Coal,
- Ministry of Petroleum and Natural Gas
- Ministry of Science and Technology/ Department of Science and Technology (DST) and others.

Especially the Department of Atomic Energy (DAE) and the Department of Science and Technology (DST) fund energy research in India.

### **Thermal Power:**

With coal still as the most abundant conventional energy form and the cheapest, India would need to build a large number of new thermal (coal) power plants and also upgrade old thermal power plants by technology transfer to enhance energy efficiency and extend lifetime. This sector needs large investments both from the public and private sector, including international investments.

### **Renewable Energies:**

In June 2007, renewable energy (capacity: >10 GW) accounted for approximately 7 % of India's total energy production. This share is to be increased to 10 % of energy production by 2010 and 20 % by 2020. The greatest progress so far has been made in the use of wind power, which now amounts to approximately 70% of India's renewable energy. India has become the world's third-largest producer of wind power and the fourth-largest exporter of wind turbines. The Indian company SUZLON Energy bought a majority stake (86.5 %) in the former Germany-based wind power company Repower Systems, Hamburg on 1 June 2007. At the time, this was the third-largest cross-border takeover by an Indian company of all time. Small hydroelectric power plants (up to 25 MW) contribute a further 20 %, and combined heat and power generation and biomass (mainly wood firing) are responsible for another 20 % (2007) of India's renewable energy production. The Indian government supports this development through financial incentives as well as training and information programmes.

In addition, there is a (small) solar energy programme. With only 2 MW, the contribution of solar energy to India's renewable energy production is very small. MNRE provides financial support for several pilot projects in the area of photovoltaic. However, there is room for improvement when it comes to transferring the findings from these pilot projects to practical application. Indian companies are second only to the U.S. in the production of solar cells. Moreover, MNRE has launched a pilot programme to support energy generation from biomass.

### **Nuclear energy:**

India is also working on developing its civil nuclear energy programme so as to become independent from other countries. In fact, India's research and development activities in the area of nuclear energy use have the ultimate aim of making the entire fuel cycle – from uranium mining to nuclear waste management – independent from other countries. There are two major atomic research centres in India: BARC and IGCAR.

### **Fusion energy:**

Nuclear fusion has a potential to solve the world's energy problems in the long run, but a lot of research and development has to be done to be able to manage this high-technology energy source. Fusion energy will not be broadly available within the next 20 to 30 years. However India contributes to the large fusion experiment ITER in France: Together with the European Union (incl. Switzerland), Japan, Russia, PR China, South Korea and USA India is a full partner country contributing to build and operate ITER, the future very large pan-European experimental facility to be build on the generation of electricity by nuclear fusion. For Germany BMBF is involved as well.

### **Indo-German Collaboration:**

The governments of Germany and India have agreed to engage in a dialogue on energy as part of their strategic partnership. The Indo-German Energy Forum (IGEF) was created in 2006 by German Chancellor Angela Merkel and Indian Prime Minister Manmohan Singh. It

**2<sup>nd</sup> German-Indian Conference on Research for Sustainability**  
*United Nations University, Bonn, 27-28 April, 2009*

aims at promoting cooperation in energy security, energy efficiency, renewable energy, investment in energy projects and collaborative research and development. Participating actors include the Indian and German governments, public institutions and the private sector. The Indian Government is represented by the Ministry of Power (MoP) and Ministry for New and Renewable Energies (MNRE) and the German Government by Federal Ministries of Economics and Technology (BMWi), Economic Cooperation and Development (BMZ), Environment, Nature Conservation and Nuclear Safety (BMU) and Education and Research (BMBF). The Department of Science and Technology (DST) is associated. The private sector is invited to participate in and should clearly benefit out of the IGEF. Clear objective is to develop joint cooperation projects between German and Indian institutions or – even more desired – between the private sectors of both countries. The Indo-German Symposium on Energy Efficiency held in New Delhi in May 2008 generated an additional momentum for the bilateral political dialogue on energy; a second Symposium is scheduled for November 2009.

Efficiency enhancement in fossil fuels based power plants: Under the Indo-German Financial Cooperation (funded by BMZ), KfW Bank has launched the “Energy Efficiency Programme”, which aims at demonstrating the benefits of energy efficient Rehabilitation and Modernisation / Lifetime Extension in selected power stations.

Together with Anna University in Chennai, the Helmholtz Association of German Research Centres carried out a workshop on the subject of “Major Aspects of Energy Research in India and Germany: The challenges for the future” on 20 and 21 June 2007. A recent workshop focused on R&D cooperation in fuel cell technology between both countries.

The recently established Cluster Network Germany-India ([www.CNGI.de](http://www.CNGI.de)) is a research initiation project funded by the German Ministry for Research and Education (BMBF). It aims at strengthening the Indo-German ties in the research areas of “Renewable Energy” and “Energy Efficiency”. In a recent joint call for proposals under the Indo-German Science and Technology Centre (IGSTC) several Indo-German R&D project proposals in energy research were submitted. Following the recommendation of the G8+O5 summit in Heiligendamm (2007) BMBF initiated the “Dialogue for Sustainability (D4S)” with Brazil, Russia, India, China and South Africa (BRICS) to strengthen the contribution of R&D for finding sustainable solutions to challenges in priority areas. Under the umbrella of the Indo-German Science and Technology Committee (BMBF and DST), the establishment of an Indo-German Joint Working Group on “Science for Sustainability” was established in May 2008. A first conference on the topic organized in New Delhi, September 2008 identified “energy” as one out of four priority areas for joint Research and Development (R&D) initiatives for enhanced cooperation.

Some areas in which further cooperation/collaboration can effectively take place between our two countries include:

- Demonstration projects and sharing of experiences on solar rooftop installations
- Design and impact evaluation of economic/financial instruments for promoting energy efficiency
- Simulation tool for concentrating solar power technologies
- CDM project on concentrating solar PV technology
- Cost-Optimised Energy Management for Stand-Alone Photovoltaic Hybrid Systems
- Applied optics in the context of solar devices and seasonal shading
- Mini grids: socio-technical integration

**Conclusion:**

Meeting the fast growing energy demand in India in a sustainable way, i.e. contributing to economic development, being ecologically acceptable and socially just is a major challenge. Germany and India should continue exchanging experiences and step up cooperation in R&D to find sustainable solutions.