54th Convocation of IIT Bombay

1st Convocation of Department of Energy Science and Engineering

Chief Guest: Dr. Gireesh Pradhan
Chairman, CERC

Chief Guest – Speech

Challenges for India in Energy Security

Energy has become one of the biggest of modern day challenges for the world. Economic advancement for a country is both premised and predicated on the amount of per capital energy consumption. There is a direct correlation between the use of energy and the economic development of a country. Taking this further inside a country also the larger the use of energy the more economically advanced is the individual or family. The criticality of energy has come to the forefront over the last century and more so during the last four decades. Primary sources of energy like coal, oil and natural gas are surely yielding ground to non-conventional or renewable source of energy like wind, solar, bio-mass, hydro and so on. With the focus squarely on energy, technical advancement and research has quadrupled in the last 50 years. At present it may be no exaggeration to state that all over the world research into energy technologies has reached a feverish pace.

2. Energy forms the cornerstone for almost all the goods and services provided in the world. Improved standard of living if marked by a single benchmark would be the uninterrupted and economical supply of energy available per capita. The developed countries have already reached a per capita level of energy consumption which ensures an advanced and comfortable level of standard to their citizens. Developing countries are struggling to provide the barest minimum of assured energy consumption to their citizens. The gap between the advanced developed countries and the developing countries is presently very vast. However, it is not just a question of catching up with the advanced countries in terms of energy that developing countries face. The issue over the last 40 years has become more complicated given the reality of global warming and climate change – for which the latest contributor has been the profligate use of fossil fuels amongst developed countries. Thus for the large number of the developing world the challenge is just not limited to providing energy through whatever sources but to provide energy in a sustainable and benign manner. In today's world the twin issues of energy security and energy access are of crucial importance. In terms of energy security, the direct impact on national security is just being realized. For India I believe that energy security has an important dimension of national security itself. The question

of energy access impinges on both energy security as well as national security. There can be no real growth for a country like India unless the engine of growth which is energy is given the importance and priority it deserves.

3. In the light of the above, let us look at and critically examine the coal sector in our country. Although the last 40 years have shown a marked improvement in coal production from a level of 70 million tonnes to a record 613 million tonnes for the year 2014-15[1], we are still short of approximate requirement of 800 million tonnes per annum that the country requires. The power sector alone consumes at present approximately 530.4 million tonnes[2] out of the 613 million tonnes being produced. Unfortunately, for us the average quality of India coal is quite poor and this necessitates import of high quality coal to meet the requirements of certain other industries as well as the steel sector. Even for the power sector in the recent past we have resorted to importing coal. Between the years 2005-06 and 2013-14 the net import of coal increased from 36.6 million tonnes to 166.29 million tonnes[3].

4. Coal based thermal generation capacity in India which is today at approximately 186.21 GW[4] and constitutes 61.43% of the total generation, is likely to increase between 330-441 GW[5] by the year 2040. This translates into a requirement of coal has fuel to the tune of 1.1-1.4 billion tonnes[6]. Our estimated resources of coal in the year 2014 stood at 301[7] billion tonnes. The present known resources are likely to support an annual freak produce of 1.2-1.3 billion tones[3] by 2037[3]. However, this would be a reality only if sustained production of domestic coal keeps taking place. The implication of higher levels of coal production of energy security of India is obvious.

5. As in the case of natural monopolies, some inefficiencies are bound to creep in. Quality of coal has been a critical issue of contention. For a buyer especially from power sector, i.e. the sector which is one of the largest consumers of coal in the country, any positive change in quality of coal would greatly improve upon the generation. Quality of coal has improved over the period but it still remains far from the desired level. Grade slippages are a common phenomenon, which adversely affects the power sector. The cost of such inefficiencies is finally borne by the consumers at large. This is an area which needs attention in terms of policy push, governance improvement and technological intervention. As young professionals, the country looks towards you to deliberate over the issues and find innovative solutions in the interest of consumers.

[1] Para 1 under "Coal Production", http://coal.nic.in/content/production-supplies
[2] Table 15, Page 11, Executive Summary for June, 2016, Central Electricity Authority
[3] Table 4.1, Energy Statistics 2015, Central Statistics Office, MoSPI, GoI
[4] Page 3, Executive Summary for June, 2016, Central Electricity Authority
[5] Para 5.1, NITI Aayog Discussion Paper on the National Energy Policy
[6] Para 5.3.5, NITI Aayog Discussion Paper on the National Energy Policy
[7] Para 1.1, Energy Statistics 2015, Central Statistics Office, MoSPI, GoI

6. Petroleum and natural gas sector is also afflicted with a number of problems. The estimated reserves of crude oil in India as on 31.03.2014 stood at 762.74 million tons. There was increase of 0.57% in the estimated reserve of crude oil for the country as a whole by 31st March, 2014 as compared to the position a year ago. But, we have a huge shortage of petroleum and natural gas in the country. Net imports of crude oil have increased from 99.41MTs during 2005-06 to 189.24 MTs during 2013-14. Although more than 70% of its crude oil requirements and part of the petroleum products is met from imports, India has developed sufficient processing capacity over the years to produce different petroleum products so as to become a net exporter of petroleum products. The export of petroleum product has increased from 23.46 MT during 2005-06 to 67.86 MTs during 2013-14. However, we also import certain petroleum products, and the import of petroleum products has increased from 13.44 MT in 2005-06 to 16.72 MT during 2013-14.

7. The estimated reserves of natural gas in India as on 31.03.2014 stood at 1427.15 billion cubic meters (BCM). The production of natural gas has steadily increased from a mere 31.33 BCMs during 2005-06 to 34.64 BCMs during 2013-14, registering a CAGR of 1.12%. Most of this increase in the indigenous production is due to discovery of new reserves. The flexibility offered by gas based electricity generation has a significant effect on the power sector. This flexibility in generation can effectively absorb spikes owing tothe variation in load as well as the variation caused by renewable energy sources. However, price of gas based generation is one of the biggest concerns.

8. In terms of generation capacity through renewable energy sources we have already reached a figure of 43 GW. As you are all aware, the Government has a path breaking target of creating a renewable energy capacity of 175 GW. This includes 100 GW from solar, 60 GW from wind, 10 GW from bio-mass and 5 GW from small hydro. Such an ambitious plan finds no match in the global context. To my mind this is also indicative of the Government's resolve to sincerely and substantially reduce the carbon footprint in India. Going forward beyond 2022 we need to create by 2030 an RE capacity that would be at least 40% of our country's total generation capacity. It is in this context that we need to tap and accommodate all …… of renewable energy using different technologies ranging from solar PV, solar thermal, wind, bio-mass, bio-fuel, bagasse, geo-thermal, tidal, etch. The greatest challenge before us as we go forward is the variability that renewable energy imposes on the system challenging the safety and security of grid operations in terms of commercial impact and apart from the cost of generation and transmission there are costs associated owing to the enhancement intermittency or variability of renewable power. Therefore, I believe while we must be aggressive in terms of the high targets set up for RE generation, we must be equally concerned with the issues of integrating RE power into the grid.

9. The recent development of Hybrid solutions, which provide for an optimal combination of different RE technologies and the development of newer storage technology solutions are considered to have potential for partially addressing the issue of variability in generation. This area calls for further research to reduce cost of generation, storage and supply.

10. There is another area of great significance which we need to consider while pursuing the renewable energy capacity addition of 175 GW by 2022. Assessing the manufacturing capability in the country especially in terms of solar panels would be essential. Solar power is now recognized in India as being a source of strategic importance. If the strategic importance of solar power has been accepted then the corollary that manufacture in the solar sector would necessarily have to be encouraged indigenously. Dependence on imports will not only have a commercial impact but would compromise strategic planning. Manufacturing equipment locally is not merely a commercial viable option but would also provide long term sustainability to the growth of this industry. There is of course a need for enhancement of domestic skill sets for the production of solar PV and solar thermal generation equipment which is viable for our future. Our country is in a much higher position vis-à-vis wind generation equipment. Here we are considered amongst the leaders in the world and our local manufacturers have contributed to a significant reduction on the dependence on imports of turbines and other equipment for wind generation. I would like to reiterate that large scale manufacturing on the solar side is presently bedeviled by ……. hitches as well as extreme external and environment factors. This would definitely be an area for further research and innovations.

11. All these lead to the question of energy security of the country. Considering our increasing dependence on import of coal, gas and oil, we are taking regulatory initiatives to use our existing coal and gas based generators more efficiently. But, these are the areas for future intervention where we need the young minds to think over and bring innovative solutions. As I have already mentioned, renewable energy has already got the desired attention and the country is geared upto realize the vision of large scale integration of renewable energy.

12. I would now like to turn to the second major challenge that I referred to at the beginning of my talk. This is the challenge of energy access. It is well known that almost 35% to 40% of the population still do not have access to basic energy. A large number of the households are located in remote areas which pose both technical and commercial challenges to facilitate grid connectivity. Last-mile connectivity is a problem where decentralized generation can play an important role in extending access to much of the rural population of India. Decentralized generation through solar PV,

bio-mass and other such technologies, which would be close to the point of consumption would form a small network in terms of a grid. However, this "Off Grid Activity" would need integration with the main grid once connectivity is established.

13. I would like to go into further details with regards to the distributed energy resources "or DER". "Distributed Energy Resources" are changing the paradigm of electricity supply. The DER is causing the traditional process of electricity flow from a generator through transmission and distribution network to a consumer, undergo a change. The consumers themselves now are becoming generators of electricity, for instance through roof top solar. Going forward, the consumer demand in the areas not connected to the grid, is likely to be met through micro-grid and off-grid solutions. Therefore, in future the role of the utilities is likely to undergo major change. In other parts of the world people are debating all these issues seeking to find innovative strategy to handle such challenges of the future. We need similar thinking and research in India to make sure that our utilities also got geared up to meet these challenges.

14. Here I wish to emphasize that the country has depended on energy technologies imported from other countries especially related to hydrocarbons such as shale gas, gas liquefaction, as well as energy storage and renewables such as solar photo voltaics, wind turbines, etc. Unless we carry out basic research and development we will always be dependent on imported technologies and in the process weaken our energy security. Domestic research and technology development is also key to cost reduction and effective deployment in the country. Moreover, experience in India and worldwide has shown that domestic technological capability is necessary to maximize the benefits of technology that is imported as well.

15. We have a huge qualified human resource and yet we remain heavily dependent on import of technologies which in any case need substantial adaptation efforts. A dramatic revamping of the energy innovation ecosystem will yield high payoffs both in terms of national security as well as economic and social welfare. Technology development deserves much stronger effort than hitherto both in terms of hardware (e.g. solar devices, wind equipment) as well as software for digital transformation of the energy producing (e.g. renewables), transmission (e.g. smart grids) and using sectors (e.g. buildings, urban transport).

16. These are some of areas that I thought I would highlight and give you as a food for thought. As you venture into the energy sector there are a number of challenges which you can take up yourselves to come out with innovation strategies and solutions in the interest of a common man in the country.