

Energy security to energy independence*

Since the beginning of this century, energy is taking a central place for economic development and social progress of nations around the world. Today, more than 80% of the global energy needs are met by fossil fuels such as oil, gas and coal. Unfortunately, the global reserves of these scarce and non-renewable sources are very limited. The global proven oil reserve was estimated to be 1188 billion barrels (one barrel is equivalent to ~160 litres) by the end of 2004. In the same year, the proven gas reserve was found to be approximately 6400 trillion cubic feet (one trillion cubic feet is equivalent to ~100 million barrels of liquid fuel) with the Russian Federation having the largest share. According to several estimates, it is forecasted that the time to depletion is approximately 40 to 60 years for oil, while gas is likely to last a little over 100 years. Therefore, many nations in the world are worried about their security of future energy supplies, especially those which depend heavily on the imports for their oil and gas needs. This gloomy scenario associated with the current oil prices around US\$ 66/bbl has made energy a highly topical subject. In tune with this, the President of India, Dr A. P. J. Abdul Kalam, while visiting the Indian Institute of Petroleum (IIP), Dehradun on the eve of Indian Independence Day dealt with a new energy vision at the institute and delivered a talk.

Addressing a huge gathering, the President called upon the institute to initiate research and development activity in the domain of alternative energy technologies to make the country energy-independent by the year 2030. The basic aim of energy security for a nation is to ensure uninterrupted supply of energy to support its commercial and economical activities for sustained economic growth and also to reduce its dependency on imported energy sources. On the other hand, zero import of energy sources leads to energy independence.

Having been concerned with the problem, Kalam began by asking – can we allow a few oil rich nations to control our economy? He informed that the country's

present annual requirement of oil is 114 million tonnes, while we produce only 25% of it. This requirement is expected to grow further by 50% over the next two decades and a significant part of this shall be consumed by the transportation sector. Moreover, the reserves world over are fast depleting and future exploration of oil and gas may give mixed results. He also mentioned that the oil prices are escalating and the cost of a barrel has doubled within a year. Today's import cost of oil and natural gas has exceeded Rs 120,000 crores. Within this framework, Kalam suggested that IIP provide thrust to research in the areas of alternate sustainable energy sources such as bio-fuel, photovoltaics and hydrogen fuel.

Talking on biofuels, Kalam explained how the nation could use available wasteland for growing petro-crops and hence bring large-scale employment and prosperity to the people. He pointed out that it is possible to use the wasteland (63 million hectares available at present) to grow multi-purpose biofuel plants such as *Jatropha* with minimum input. Once grown, the crop has 50 years of life and fruiting can take place in two years. It yields up to five tonnes per hectare oil seeds and produces two tonnes of biodiesel. This diesel can be used by the transportation sector, which will result in saving of foreign exchange outflow paid for importing crude oil. Presently, the cost of biodiesel through this plant varies from Rs 17 to 19 per litre, which can substantially be reduced through choice of right size and high yield variety, of the plant. Biodiesel plants grown in 11 million hectare of land can yield a revenue of approximately Rs 20,000 crores, a year and provide employment to over 12 million people both for plantation and running the extraction plant, he added. Kalam also informed that use of biodiesel is carbon-neutral and can also be used by soap and candle industry. Based on the results of performance analysis, the safe and possible use of biodiesel in a power plant of large capacity (500 MW gas turbine in combined cycle mode) was also discussed by him. In this context, Kalam called upon IIP to work jointly with industry and agricultural universities to design, develop and commission a biofuel plant of one million tonne capacity per annum. According to him, research should be directed to increase the blend-

ing of biofuel with diesel from the current 5%, so that we can aim at a power plant run exclusively on biofuel. He also felt the need to improve the oil content of *Jatropha* seed from the present 33% to at least 50%. Another area requiring further research is to develop seeds which can produce fruits throughout the year, he added.

The President also discussed recent progress in the science and technology of the photovoltaic system and mentioned that the current high capital costs of solar power stations can be reduced by grid-locked 100 MW sized, very large-scale solar photovoltaic or solar thermal power stations. He predicted that future breakthroughs in nanotechnology promise significant increase in solar cell efficiencies from current 15% to over 50% levels, thus reducing the cost of solar energy production. Based on a big potential in photovoltaics, he suggested to initiate collaborative research for developing high efficiency carbon nanotube-based photovoltaic cells.

Forecasting a possible transformation of economy from the currently fossil fuel-driven one to the future hydrogen fuel-driven one, Kalam mentioned the enormous potential of hydrogen in providing a clean, efficient and reliable supply of energy for meeting the growing energy needs, while protecting the environment and ensuring energy security. It offers a sustainable energy carrier to replace fossil fuels, but tapping into this potential still remains a complex challenge. Creating an economically viable infrastructure for production, storage and distribution of hydrogen energy is an important task. In this direction, Kalam identified three sustainable routes for production of hydrogen, namely microbial degradation of biomass, electrolysis of water using polymer electrolyte membrane and steam reforming of methanol.

Concluding the talk, Kalam expressed hope that in the near future IIP will realign its research activities from petroleum to alternative futuristic fuels and shall succeed in assisting the nation to become energy-independent by 2030.

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