Technologies and New Paradigms in Renewable Energy Sphere

Dr. Ramakrishna R Sonde

An Eassay on Imperatives on faster translation of "near-viable and still-in -R&D technologies" into commercially viable ones using the triple mantra of technology, manufacturing and appropriate policy and financial instruments.

Introduction

India's energy demands will grow exponentially. Energy here refers to all forms viz. electricity, transport, industrial heating and cooling and kitchen / cooking needs. The energy demands when converted to million tons of oil equivalent (MTOE), the current consumption of 480 million tons of oil equivalent per annum is predicted to reach 1700 MTOE by 2032. Including coal reserves, India's fossil resource at this consumption level will not last even for two decades and hence it is imperative that India plan its strategy so as to secure its long-term energy needs using multiple strategies. If we fail to do so, we will become highly vulnerable to externalities and the geo-political pressures. Our developmental goals will get throttled and hence this one factor will become a major deterrent in our growth trajectory. Yet another dimension on climate change both at micro i.e. local level and global level will start putting pressure on the global community and India's commitments will add further pressure on our energy security. The six degrees rise in temperature - tipping point – is staring at humanity and it will demand a concerted action on the minimisation and the ultimate removal of fossil fuels in energy sector for millennia.

The way the country should move forward will require a very different approach and this approach should get integrated with different aspects of value chain. Merely adding some electricity production numbers to clean and renewable energy generation will not do even if it means in gigawatts scale. This addition should touch all the segments of the society and this means we should build very strong technological and manufacturing capabilities while ramping up energy generation using renewable energy. The option in front of us is to continue with the "business as usual" (BAU model) where we continue to build new power plants as per the past approach. This is clearly not a sustainable option and would lead to inefficiency and operation-related problems. Import of new technologies is the second

option, but this needs to be examined from the point of view of the REAL value addition that happens in the country, and hence, would require careful consideration. Otherwise the situation that is shaping up currently in the field of PV will evolve and eventually create a minimum value chain in the country. Today, in the field of PV, a limited value chain is established in the country and its impact is not felt across the society and the various segments of industry such as mineral processing, manufacturing, human skill developments, etc. This will become a serious issue when imported technologies will start proliferating recklessly and no appropriate indigenous technology and manufacturing will take place within the country. The third option of developing appropriate new energy technologies would be the option that India should seriously pursue. This option will be sustainable and bring in a long-term immense value chain in the country. This is what every developed nation in the world is trying to do by pumping enormous resources and money into developing world-class technologies to lure the global community to adopt to their technologies. This, they consider as a huge opportunity. Undoubtedly, India should not lag in this area. The country possesses the necessary repository of knowledge and intellect through academic research institutions and industrial communities and today is in a position to invest sufficiently in building mission mode technology developments. Coupled to this, the vibrant Micro, Small and Medium Enterprises sector, if properly directed, can develop an expertise to manufacture various components and sub-systems necessary in these new technologies. By this way the country would gain enormously as the industry value chain will get realized within the country's landscape.

Why this is more important now than in any point in time in the history of the country since independence:

We, as a nation, are at a very crucial stage in our developmental trajectory and hence a new approach is necessary in meeting India's energy demand. Clearly, the transition from fossil to renewable will throw up radically new challenges. Identification of the appropriate new technologies and a move to actualisation of the same will be the need of the hour. The new technologies may be in "near-viable" stage or "still- in -R&D" stage and all the efforts will be about how fast to push them into a viable zone by using a triple platform of technology, manufacturing and appropriate policy/financial instruments. If India has to build 175 GW of renewable energy in the next five years resulting in nearly Rs 600,000 crores of investment, then, we need to have clear plan to push the indigenously developed near-viable technologies into the commercial space and give a thrust to the still-in-R&D technologies to make them viable. Only then will the investment of Rs 600,000 crore create the necessary "domino" effect and result in all round growth. The global community is watching India and are thirsty to push their technologies with a promise of some loose tie-ups and licensing, but this will hardly bring in a complete value chain.

The first step is to identify the new technologies. The nature of the new technologies will be essentially in the following categories:

1. Distributed scale-power-cum-energy plants which use multiple energy sources mainly solar, biomass and wind and are grid-connected to the rear end of the grid and meet the requirements of the local communities. These energy plants will be having a capacity ranging from 0.5 MW to 5 MW scale and will also support the energy needs required in the kitchen and transport applications. Poly-generation plants of this nature using multiple renewable energy resources are critical. Given India's demography and rural landscape, this is the most appropriate technology to be taken up. The necessary elements of the poly-generation technologies are available and it calls for an intelligent way to integrate them and offer them as total energy solution at the distributed scale.

2. Waste to energy technologies both using waste heat and waste mass. There are set of new technologies, which need to be deployed for industrial waste heat and also wastes generated from other sources such as municipal solid waste (MSW), industrial waste, sewage, agro residue and kitchen waste. Again these waste energy plants can be pure electricity-generating plants or pure compressed biogas (CBG) plants with hybrid generations in a combined heat and power mode. Even plastic to oil is an important piece of development in this space, which the country should rigorously pursue.

3. Set of technologies in solar, biomass, wind and even geothermal, which can be integrated in the existing fleet of power plants/energy plants. Coal/natural gas-driven power plants and refineries and fertilizers using large scale industrial heat can be integrated with waste biomass, solar thermal, geothermal and blended biofuels, which will result in making these plants more efficient and less carbon emitting ones.

4. Energy storage and micro grid will also start assuming importance as renewable plants start building their capacity and the issues of meeting the demand will pose a challenge in grid stability due to the very nature of renewable energy plants.

On a concluding note, it is important to once again reiterate that India is poised to set up renewable energy plants equivalent to 175 GW with an investment of Rs. 600,000 Crores and would also need to find a substitute for its over-dependence on import of oil and gas. India imports 80 per cent of its oil and gas which stands today at 3.7 million barrels per day. The current fall in crude prices should not lull us into inaction. We have to build new technologies for finding alternate fuels like bio fuels, drop fuels, methanol and CBG and also deeply explore. This calls for large investments and technology will be the main underpinning of this development. If technology development and a quick traction of technology for the market is created, it would give a huge fillip and create a very effective virtuous cycle and have a multiplier effect on the growth of the country. On

the contrary, if we do not develop the technologies at the grassroots scale, and depend majorly on imported technologies, it will have an exactly reverse effect and hence a bold strategy is needed to identify appropriate technologies and classify them in "near-viable to still-in-R&D stage" technologies and apply different strategies to push them into the market place. If we get our act right this will be India's moment at the world stage.

What are the "near-viable technologies"?

There are many near viable technologies which need to be pushed into the commercial zone very quickly. Concentrated solar thermal as a substitute for using coal, oil, diesel for industrial heating, solar PV technologies (this has already become viable now), biomass gasification, MSW to compressed biogas and power generation, solar direct cooling and cold storage, organic rankine Cycle (ORC) for converting the low grade industrial heat into power are some examples of technologies which have been developed in India but are waiting to enter into the market space provided appropriate viability gap funding (VGF) is available to push them into the market. This would require a stage-wise approach in terms of the VGF model to be built: identifying critical mass of projects to be deployed, connecting the manufacturing sector to these projects, and of course working with academic institutions to develop human skills to manage the new technologies. Such a graded approach will have multiplier effect and will then result in continuous reduction in the cost and hence dependency on VGF. Appropriate policies and financial instruments for sustaining the phase of VGF are important. Quick action is invariably needed or else the developed nations will dump their new technologies with minimum impact within our ecosystem and we will then go back in time.

Still-in-R&D technologies

There are a large number of new technologies which are in the still-in-R&D scale even at global level and these technologies should be taken to the next stage from the R&D stage by mission mode approach. There is a level playing field here and if some of these technologies are successful, then the impact will not only be within India but on a global scale. Hence, creating a network with various stakeholders is extremely critical for their success. The golden triangle involving the collaboration of industry, academia and research institutions based on the support coming from the government would be essential for these technologies.

Fuel Cell technologies, energy storage technologies, hydrogen-based technologies, technologies which can use the ocean energy and geothermal technologies are the real cutting-edge developments which make disruptive developments. The list is also enhanced by a lot of new generation bio technologies including artificial photosynthesis. Some of these technologies are in the advanced stage of R&D, ready to be pushed into a real viability stage while there are few which are at the fundamental scale.

Conclusion

India must relentlessly push its competence in building new technologies and the current announcement of 175 GW of renewable energy really offers a great opportunity for this push. Building an appropriate VGF mechanism and a mission mode technology development should be the mantras that we should pursue. The Indian manufacturing sector is also ripe and ready for acceptance of this and it would truly be a renaissance for the country and enable us to secure ourselves with energy which will then enable all-round development in a seamless manner. Industry, both private and public sector, must be involved in this process of technology development as key stakeholders and identify academic and research institutions (at a global level) who will work with them in developing the new technologies. The funding should happen liberally once new technologies are identified and then relentless follow-up will be needed to realise these technologies on ground. Human skills in all segments of value chain must be an integral part of this development.

About the author

Dr. Ramakrishna R Sonde is currently working with Thermax Limited as Chief Technology Officer and Executive Vice President – Research, Technology & Innovation. He is also a Fellow of Indian National Academy of Engineering and a Member of its Governing Council. He was awarded Dr. Homi Bhabha Gold Medal by the Prime Minister in 2006, for his outstanding contributions in the field of nuclear energy. He is also the recipient of Dr. Doraswami IIChE Medal and Gold Medal from the Indian Nuclear Society.

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