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Time to tap solar thermal energy

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A discussion on solar energy would naturally veer towards solar photovoltaics (SPV). Chances are few would have heard of solar thermal energy (STE), and rightly so, as PV panels dot the Indian landscape. Generating electricity from STE is similar to a conventional thermal power plant, the only difference being that instead of coal or gas, sunlight is concentrated by mirrors to generate steam, much like our childhood experience of burning paper with a magnifying glass.

The possibility of a 24×7 operation is the biggest USP of solar thermal plants. Moreover, unlike solar PV, which can only generate electricity, STE can be used to produce electricity, high temperature heat for process industries, refrigeration, and even fuels such as hydrogen. Clearly, STE is a dormant energy giant waiting to explode.

Despite its inherent advantages, STE is still in a state of infancy in India. Godavari Green Energy's 50 MW parabolic trough plant, India's first commercial solar thermal plant, went on stream in 2013, while the world's first commercial solar thermal plant started operation in California in 1984.

At Rs 14 crore/MW, a solar thermal plant is about 80% more expensive to build than a solar PV plant. STE currently is in the same state that solar PV was 15-20 years ago. Then too, solar PV was being castigated as being too expensive, a far cry from today when it is on the path to grid parity.

What stands in good stead for STE is that India has the expertise in many generic technologies that are used in the production of solar thermal energy. Companies like Bhel have the expertise to design and manufacture components for the power block that converts steam into electricity.

The solar block for converting sunlight into steam makes up 50-60% cost of a solar thermal plant, and is the biggest impediment in the path for cost-effective, indigenous development of STE. For example, expertise for making low-cost iron glass mirrors is not available in India. What should be our development strategy to make India a prominent technology provi-der in the global STE map? Let me outline a four-pronged strategy, which would go a long way in meeting the nation's energy needs, while increasing the indigenous engineering expertise and components manufacturing base.

* First, it is essential to set up a domestic manufacturing base for the solar block to drive down the costs. Making component would require significant infusion of technology and funding, which, alas, would depend on order volumes. So a viable solution is to hybridize a solar thermal plant with an existing coal/gas-fired plant. This should reduce the financial risk by 40% since the turbine will be shared.

Another advantage is fuel compensation. When the sun is strong during the day, a larger proportion of the power can be generated through STE, thus saving on coal/gas. To incentivize hybridization, the National Solar Mission should extend the incentives of stand-alone solar plants to hybridized plants. This also fits in neatly with the renewal purchase obligations of thermal plants and also for carbon dioxide emitting manufacturing plants that have captive thermal power plants.

* Second, efforts should be made to develop expertise for designing and manufacturing critical components of the mature STEs, namely, parabolic trough and solar tower, as they are most likely to be installed for supplying bulk power to the grid. This would require expertise for developing new materials like alloys, low iron glass, specialised coatings, vacuum tubes, etc. Of greater importance is the engineering expertise for large-scale production of critical components–an Indian weakness– which last 15-20 years.

* Third, value added applications of STE should be looked at. Production of hydrogen gas and multi-utility chemicals such methanol using STE holds great promise. STE-based sea water desalination demonstration plants have been set-up; the main challenge is to drive down the costs. Cold storages are generally located in semi-urban and rural areas where power supply is irregular. Here one possible solution is to set-up a self- compensating, hybrid solar-conventional (electricity-based) air-conditioning system. When the sun is high, STE provides cooling, and as the day progresses, the proportion of conventional cooling increases. In the absence of sunlight, biomass boilers power solar cooling.

* Four, R&D should begin right now on disruptive innovation related to development of both STE and value-added applications, two examples of which are: (i) adaptation of current STE for generating electricity using supercritical carbon dioxide or simply from pressurised air, and (ii) use of STE for "green" production of metals from its ores, thereby cutting coal dependency.

Work is also progressing on integrating STE and solar PV where the former extracts process heat and the latter generates electricity simultaneously. One major deficiency is the absence of small-scale STE units for deployment in distributed electricity generation and in commercial and housing complexes, one example of which is the MIT solar thermal system that can be used to create electricity without turbines.

How do we move forward? The main challenge is to synergise the expertise in generic STE technologies spread across several industries and move forward in a consortium mode. Materials and processes developed in laboratories have to be engineered and scaled-up by industry partners. Academic and R&D institutions have to work with industry to jointly design and develop manufacturing facilities for critical solar block components.

One noted scientist remarked “STE is not rocket science, but getting Indians to work together is the real rocket science.” So, who will fire this rocket? In essence, we have to take a call whether the PM’s “Make in India” campaign for STE will be about Chinese companies manufacturing components in India, or Indian companies manufacturing indigenously designed components?

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