## Sector News Updates

### Government of India plans INR 2 lakh crore (USD 33 billion*) solar and wind power projects in deserts *Business Standard, July 4, 2014*

The Government of India plans to set up renewable energy generation capacity, including both solar and wind, along with associated evacuation infrastructure, on a mega scale in the four Indian deserts - Thar in Rajasthan, Rann of Kutch in Gujarat, Lahaul-Spiti in Himachal Pradesh and Ladakh in Jammu & Kashmir.

- Estimated budget for implementing the scheme requires an investment of INR 208,350 crore (USD 34.4 billion) including INR 108,000 crore (USD 17.8 billion) for setting up 11,100 MW capacity generation projects (10,400 MW of solar and 700 MW of wind), INR 19,800 crore (USD 3.3 billion) for laying transmission lines and INR 80,000 crore (USD 13.2 billion) for balancing infrastructure (pumped and battery storage projects)
- The overall fund requirement would go up to INR 16 lakh crore (USD 263.8 billion) for extending the plan to 2032 and further INR 43 lakh crore (USD 708.9 billion) by 2050
- According to the implementation strategy, a National Desert Mission will have to be formulated with provision for single window clearance on the lines of conventional ultra mega power projects.

### India is building a massive floating solar power plant, *Science alert, July 8, 2014*

India's National Hydroelectric Power Corporation (NHPC) is in the process of building a massive solar power plant with a capacity of 50 MW on a 1.27 million square metre floating platform on one of the large stretches of water in Kerala.

- The approximate cost of the project would be about INR 387-435 crore (USD 63.8-71.7 million)
- Under the contract with NHPC, Renewable Energy College will provide technical know-how and assist in the installation of the proposed floating solar power plant
- A pilot project is scheduled to be commissioned this year in October to be installed in a pond in Victoria memorial hall, Kolkata.

### INR 1,000 crore (USD 165 million) allocated for solar power in the Union Budget 2014, *FIRSTPOST, July 10, 2014*

Finance Minister Arun Jaitley has allocated INR 1,000 crore (USD 165 million) for the solar power sector, a move that will boost energy generation from renewable sources.

- INR 500 crore (USD 82.4 million) has been allocated to construct Ultra Mega Solar Power Projects or high capacity plants in the radiation rich states of Rajasthan, Gujarat, Tamil Nadu, and Ladakh in Jammu and Kashmir
- INR 400 crore (USD 66 million) has been allocated to launch a scheme for solar power driven agricultural pump sets and water pumping stations for energising one lakh pumps
- INR 100 crore (USD 16.5 million) will go towards developing solar canal projects
- The Union budget has extended the concessional basic customs duty of 5% for setting up solar power generation projects. Customs duties are waived for flat copper wire ribbons (used in modules), back sheets and EVA sheets
- The ten year income tax holiday (Section 80 IA) on solar projects has been extended till March 2017.

### Highest efficiency of about 36% for concentrator photovoltaic (PV) modules announced, *Fraunhofer ISE, July 14, 2014*

In July 2014, the Fraunhofer Institute for Solar Energy Systems announced world record module efficiency of 36.7% using concentrator PV technology.

- The module named "FLATCON" uses Fresnel lenses to concentrate the sunlight onto miniature (7 $mm^2$) highly efficient solar cells
- These modules could produce electricity at less than 8 eurocents per kWh, which is comparable to electricity generated from c-Si PV which ranges between 6-12 eurocents per kWh depending on irradiation (kWh/ $m^2$)
- Fraunhofer's industry partner Soitech plans to implement its highly efficient (44.7%) four junction solar cells in the "FLATCON" modules.

### A village called Dharnai in Bihar, India now runs entirely on its own solar power grid, *THE WEEK, July 22, 2014*

Dharnai is the first village in India powered entirely by solar electricity.

- The micro-grid is operated in association with BASIX, a livelihood promotion institution as well as Centre for Environment and Energy Development (CEED), which is a network of NGO's and Think Tanks to support renewable energy development in the state of Bihar
- A 100 kW system powers about 450 homes of 2,400 residents, 50 commercial enterprises, two

* Currency exchange rate as on 9/9/14, 1 USD= 60.66 INR

schools, a training centre and a health care facility.

**India announces bids for 1,500 MW under the National Solar Mission**, *Down To Earth, July 25, 2014*

The Ministry of New and Renewable Energy (MNRE) released a draft document outlining allocation process for another 1,500 MW of solar PV capacity under the Phase 2 of India's National Solar Mission (NSM). Key points include:

- Split the auction into two offerings of 750 MW each over 2014-15 and 2015-16 respectively
- Encourage prospective developers to submit bids on a discount to the base tariff (INR 6.99 per kWh for FY 15). 500 MW has been set aside towards domestic content requirement category
- NTPC Vidyut Vyapar Nigam Limited (NVVN) shall enter into suitable power purchase agreement with solar power developers and power sale agreement with distribution companies/ utilities/ other bulk consumers
- Similar to Phase I of NSM, Bundling Scheme will be reintroduced wherein solar power is bundled with coal-based power and sold to distribution agencies
- The average cost of bundled power is expected to be around INR 4-4.5 per kWh.

## SERIIUS Updates

### IEEE Photovoltaic Specialist's Conference (PVSC) at Denver, Colorado

The 40th IEEE PVSC conference was hosted in Denver, Colorado from June 7-13, 2014. There was a significant participation from SERIIUS members with presentations from more than 50 researchers. The conference helped in getting a wide recognition and engagement with researchers from outside the SERIIUS community. In addition, there was a separate meeting held for all SERIIUS members on June 11, 2014. Discussions and identification of new potential member partners were some of the highlights of the event.

### SERIIUS "Review, Planning and Integration" meeting at Breckenridge, Colorado

A 'Review, Planning and Integration' meeting involving primarily SERIIUS members was held at Breckenridge, Colorado from June 13-14, 2014. It included over 40 participants from PV and SEI thrusts; also there were representatives from buildings consortium and Department of Energy (DOE), USA. Discussions were held to make amends to the 10 point plan based on progress made over the year. Research projects under PV thrust were also discussed. In addition, members were consulted on integration of PV and SEI thrusts. A team was constituted to develop plans for joint research between the US-India Center for Building Energy Research and Development (CBERD) and SERIIUS. A poster session comprising different intermediate research outputs was a key highlight of the meeting.

### PV Module Reliability Short Course and Workshop at IIT Bombay

The PV module reliability workshop was conducted jointly by IIT Bombay and SERIIUS from April 3-4, 2014, covering extensive research on PV module degradation. A report on 'All India Survey on PV Module Degradation' by IIT Bombay was released at the workshop. There was extensive participation with more than 60 members from PV manufacturing industries, academic and research institutions from India and the US. In addition, many SERIIUS Principal Investigators (PIs) gave presentations at the event.

### US-India Strategic Dialogue Meeting

The US DOE deputy secretary Mr. Daniel P. Poneman visited India for the US-India Strategic dialogue on July 31, 2014 held in New Delhi. He also visited the Indian Institute of Science (IISc), Bangalore on July 29, 2014 to overview the research activities being conducted under SERIIUS.

### MAGEEP Highlight

SERIIUS researchers from MIT, Matt Orosz and Amy Mueller, both post-doctoral researchers, spent 10 weeks during the summer of 2014 in IISc, Bangalore working on the CSP-4 project - Small-Scale Positive-Displacement Organic Rankine Cycle Expander. They identified prospective research topics with researchers at IISc, CSTEP, Thermax and IIT-B. One of the important outcomes of the exchange included plans for the three SERIIUS India-US joint publications over the next year between collaborators from IISc, CSTEP and MIT.

*Researchers from MIT, IISc, IIT-B, CSTEP at Thermax CSP plant, in Shive near Pune (India)*

## CSTEP's Solar Techno-Economic Model (CSTEM)

CSTEP's Solar Techno-Economic Model (CSTEM) is a Graphical User Interface tool to evaluate the performance of Parabolic Trough technology considering the options of thermal storage and hybridization. The base version was developed with support from MNRE and additional features & improvements were made through SERIIUS funding. This is an hourly performance tool, which has been developed using Java platform for Windows, Mac and Linux versions. The latest version of this tool can be accessed at the following link: www.cstep.in/CSTEM_Windows.zip

The tool has been provided with hourly DNI database of various locations in India with flexibility for adding/modifying database. Default values for technical and financial inputs based on information from literature are also built into the system. It estimates the annual energy generation and Levelized Cost of Electricity for a chosen configuration.

*Interview with Dr. Harish Hande †, Managing Director & Co-founder, SELCO Solar Light Pvt. Ltd. Dr. Hande is a recipient of the Ramon Magsaysay Award and under his leadership, SELCO has been awarded several prestigious awards including the Ashden award (popularly known as Green Oscars) in 2005 and 2007.*

*Interviewed by Dr. Sharath Chandra Rao, Senior Research Scientist, Center for Study of Science, Technology and Policy (CSTEP)*

**How many states does SELCO serve? How many branches does your organization have and what is the typical branch size? Also, please highlight the revenues that were achieved last year and the number of home lighting systems that were installed?**

SELCO works in Karnataka, Tamil Nadu, Maharashtra, Kerala, Bihar and Gujarat and has 43 Energy Service Centers (ESC) in total. Each ESC has 5-15 employees with sales varying from 200-1500 solar home lighting systems (SHLS)/year catering an area of radius 25-75 kilometres. Total revenue was about Rs. 27 crore and we installed around 15,000 SHLS.

**What is the mix of target consumers who purchase the home lighting system? Could you also throw some light on their monthly per capita expenditure and the typical wattage installed?**

Seventy five percent of the consumers are small farmers, individual working households, informal/ home-based workers/daily labourers. Another 10–15 % come from lower middle income group with an annual income between Rs. 1,25,000 – Rs. 2,50,000. The rest, 10–15 % of the installations are institutional i.e. schools, hostels, health centers, banks, religious places, refugee camps etc. Average Equated Monthly Instalments (EMI) of customers is about Rs. 150-200 for 5 years based on the system cost. Typical wattage of systems are 12, 18, 25, 30 and 40 Wp.

**What is the most pressing concern affecting your industry?**

Shortage of skilled human resources at the local level like entrepreneurs, operators and technicians is a major concern. Currently, there is limited access to appropriate financing for relatively new applications viz. pumps, motors for sewing machine/sugar cane juice making; for instance, bankers are fairly confident to provide financing primarily for lighting applications. In addition, there is a dearth of favourable investment environment for social enterprises and low-cost debt financing for small entrepreneurs (without strong credit histories). More significantly, there is a need for an integrated rural electrification and energy planning program.

*Lack of favourable investment conditions for social enterprises and lack of access to low cost debt financing for small entrepreneurs are the most pressing concerns affecting the industry.*

**What are some of the major hurdles faced by your organization since its beginnings in 1995?**

One of the major hurdles was building capacity and awareness amongst bankers to initiate solar financing and the possibility of using it for energy access. After 2006, accessing 'Patient Capital‡' through like-minded investors was difficult. In addition, bringing in a variety of new products/applications for households and achieving productive utilization (energy efficiency, technology innovation, design) by working with local manufacturers was another hurdle and finally, engaging the policy makers and making them aware of the issues affecting decentralized energy sector, the probable solutions and bridging the energy access gap was a challenge.

**Currently ~60 million households (IEA, 2011) do not have electricity in India, of which, a large portion of the population has subsistence level of existence. What type of innovation in technology,**

† CSTEP is thankful to Dr. Harish Hande and his colleagues at SELCO Solar Light Pvt. Ltd and SELCO Foundation – a not for profit organization for providing the answers. The efforts were coordinated by Ms. Surabhi Rajagopal (Principal Analyst, SELCO Foundation).

‡ This refers to social internal rate of return. A capital which is employed and whose returns are either very low or will yield only after prolong time period.

**finance and service would be required to provide them with electricity? Please explain some of the innovative financial products launched by your company to address the plight of the unelectrified population?**

There has been an attempt to integrate energy with critical socio-economic needs such as education, health, livelihoods which should become a part of planning at the policy and implementation levels. Under the Small Scale Sustainable Infrastructure Development Fund ($S^3IDF$) a 'not for profit' section 25 company, we have established a 'revolving fund' for solar energy systems through an organization called Bhagini Nivedita Grameen Vigyan Niketan in Maharashtra. Specifically for slum communities and migrant or temporary settlement, an innovative model called the Integrated Energy Center (IEC) has been piloted (more than twelve across Karnataka) using a variety of financial models. So far, four main models have stood out: the entrepreneur, the operator, the partner and the community run model. These centers have been instrumental in providing a positive impact on the quality of life by addressing fundamental energy needs and services relying on energy.

*SELCO's Integrated Energy Centers have been instrumental in providing a positive impact on the quality of life by addressing fundamental energy needs and services relying on energy.*

**Karnataka is 100% electrified (under the definition of Electricity Act 2003), it is the lack of electricity supply or generation that has resulted in 18-20 hours of power cuts in the rural areas. A few experts recommend 'grid intensification' as a better approach. Could you provide your thoughts on what role decentralized systems could play in such an event? In general, what is your take on this perspective?**

As per our discussions with Karnataka Electricity Regulatory Commission, Karnataka Power Transmission Corporation Limited etc., the issue of load shedding in rural areas of Karnataka is more to do with how the distribution network has been designed than power supply itself. This is the reason the state has embarked on the Nirantar Jyothi (NJ) scheme (feeder segregation) to separate agricultural (pumps) and non-agricultural loads (residential, commercial). Villages where this has been implemented, have improved situation of power availability and quality in rural households in the interim. The houses get about 18 to 20 hours of power now as against 8 to 10 hours previously.

However, we opine that, with more villages coming under the NJ scheme, the demand on the grid is going to go up significantly. We may just get back to the previous scenario of power availability (8 to 10 hours) but this could be of better quality (this is our intuition and merits further study).

Decentralised Renewable Energy (DRE) will continue to play a major role in the future, since it has the potential to reduce electricity demand from the grid and consumption of fossil fuels; reduce transmission and distribution losses and power theft related issues. DRE also has other co-benefits like for instance; one can customize system designs; select the technology; business models as per the community needs and their domestic/economic growth projections. Once grid connected, they can potentially shave peak power demand with intelligent use of storage technology and also reduce requirement of short term power purchase.

*A typical Solar Home Lighting System installation by SELCO in a rural town near Kundapur, Udupi District*

**What has been your organizations experience with the National Solar Mission (NSM)? Has it benefited the industry and/or consumers? If yes or no, then in what manner? What has been the major plus point and the drawback of the initiative?**

The benefits that have yielded from NSM are that the mission document has explicit targets for decentralized systems. It has promoted financing for decentralized solar systems which includes lighting, basic energy requirements, water heating and water pumping. The flows of subsidies are routed through banks thus preventing leakages. Finally, guidelines to include cooperative banks and inclusion of increased system capacity eligible to avail subsidies have been the other plus points.

The drawbacks on the procedural front are: targets for decentralized systems (i.e energy access) are not

ambitious; monitoring and evaluation is weak and flow of subsidies to banks is very time consuming. Ecosystem building (especially on skills and financing) which is critical in any mission is completely missing (only adhoc, nothing sustainable and institutionalized). For example, there is a lack of sufficient skill training programmes and building financier capacity is a significant challenge that has not been sufficiently addressed. It has also not been integrated with any of existing rural electrification plan/scheme which highlights lack of efficient utilization of resources.

**What are the short and long term interventions sought by decentralized sector?**

Energy financing is one of the key interventions which will benefit the end-users and entrepreneurs. In addition, there is a need for greater support for technology innovation, for example, providing financial support to organizations involved in field trials and mandates for manufacturers to increase efficiency of equipments such as pumps, sewing machine motors, motors for sugarcane juice making, household appliances and tools for education - TVs, projectors etc. There is also a need for intervention in the area of skill development (technicians, operators, micro entrepreneurs) and policy modifications are sought for better integrated rural energy planning bringing together a variety of solutions and engaging them to complement grid planning.

*Promotion of energy financing, greater support for technology innovation, skill development, policy changes for better integrated rural energy planning are some of the interventions sought by decentralized sector.*

***Consortium Leads***

Indian Institute of Science, India & National Renewable Energy Laboratory, USA

***Research Thrust Leadership***

Indian Institute of Technology Bombay, Center for Study of Science, Technology and Policy, Sandia National Laboratories, RAND Corporation

***Consortium Partners***

***Institutes and National Laboratories***

International Advanced Research Centre for Powder Metallurgy and New Materials, National Institute of Solar Energy, Lawrence Berkeley National Laboratory

***University Partners***

Indian Institute of Technology Madras, Indian Association for the Cultivation of Science, Arizona State University Carnegie Mellon University, Colorado School of Mines, Massachusetts Institute of Technology, Purdue University, Stanford University, University of Central Florida, University of South Florida, Washington University in St. Louis

***Industry Partners***

Clique Developments Ltd., Hindustan Petroleum Corporation Ltd., Moser Baer India Ltd., Thermax Ltd., TurboTech Precision Engineering Ltd., Wipro Ltd., Corning Incorporated, BHEL, Alpha, Sun Edison LLC, Solarmer Energy, Inc.

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