The SOLAR QUARTERLY

The Complete Solar Magazine

Volume 3 • Issue 2 • January 2011

Rs 200

EXPECTING THE LIFE OF A SOLAR PANEL BEYOND THE KNOWN FRONTIERS

SOLARIFICATION OF THE LADAKH REGION

MAPPING SOLAR FOR TECHNO-ECONOMIC FEASIBILITY

TerraGreen

EARTH MATTERS

TERI's flagship monthly magazine – *TerraGreen* – is dedicated to disseminating information on issues of environment, energy, and sustainable development. Launched in 2004, *TerraGreen* has made an indelible impression on the minds of readers both in India and across the world. Today, it enjoys a readership of over 25000 and a subscriber base of close to 7000. Not only does *TerraGreen* focus on issues of crucial importance, it presents in-depth analysis of major environmental developments from around the world in crisp and simple language. Aimed at the common man the magazine stays away from all jargon and provides necessary knowledge and information. The rather vast coverage of issues makes the magazine one of its kind in the market—a gap it has filled with great panache.

Subscription rates for TerraGreen

Term (Yrs)	No. of Issues	Cover Price		You Pay		You Save		% Saving
		Rs	USD	Rs	USD	Rs	USD	
1	12	480	120	400	102	80	18	17%
2	24	960	240	750	192	210	48	22%
3	36	1440	360	1000	252	440	108	30%

Free online access for those subscribing for three years
Overseas subscriptions are accepted only in US Dollars

For further information, please contact:

TERI Press
Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003, India
Tel.: +91 11 2468 2100, +91 11 4150 4900 • Fax: +91 11 2468 2144, +91 11 2468 2145
E-mail: teripress@teri.res.in

To advertise, contact:

Ravi Shukla, e-mail Ravi.Shukla@teri.res.in
Kakali Ghosh, e-mail kakalig@teri.res.in

Buy online at http://bookstore.terriin.org

Head Office
TERI
Darbari Seth Block, IHC Complex
Lodhi Road, New Delhi – 110 003
Tel. +91 (11) 2468 2100 or 2468 2111
Fax +91 (11) 2468 2144 or 2468 2145w
Regional Centres
Southern Regional Centre
TERI, CA Site No. 2
4th Main, 2nd Stage Domlur
Bengaluru – 560 071
E-mail terisrc@teri.res.in
North-Eastern Regional Centre
TERI, Chachal Hengrabari
Express Highway, VIP Road
Guwahati – 781 036
Western Regional Centre
TERI, F-9, La Marvel Colony
Dona Paula, Panaji – 403 004 (Goa)
E-mail teriwrc@goatelecom.com
Affiliate Institutes
TERI North America
1101 Pennsylvania Avenue NW, 6th Floor
Washington DC, 20004
E-mail terisna@teri.res.in
TERI Europe
27 Albert Grove, London SW20 8PZ, UK
E-mail ritukumar@aol.com
Overseas Representation
TERI Japan
C/o IGES
Nippon Press Centre Building (8th Floor)
2-2-1, Uchisaiwai-cho, Chiyodi-ku
Tokyo, Japan - 100-0011
E-mail teris@iges.or.jp
TERI South-East Asia
Unit 503, 5th Floor
Menara Mutiara Majestic
15 Jalan Othman, Seksyen 3, 4600 Petaling Jaya,
Selagor Darul Ehsan, Malaysia
E-mail nimtech@tm.net.my
TERI Gulf Centre
Flat No. 105, Dalal Building, Al Qusais,
Dubai, UAE
E-mail meejana@gmail.com

Cover image: Bahrain World Trade Centre – an energy-efficient building

Printed on recycled paper

From the editor's desk...

A number of events at the recently concluded COP16 at Cancun, Mexico, focused on energy access. In fact, the year 2012 is proposed to be the beginning of the decade on energy, focussing on clear targets to provide clean energy for a billion people across the globe. Three UN organizations—UNDP, UNEP, and UNIDO—launched a collaborative programme called the United Nations Energy Access Facility aiming to provide universal access to modern energy services by 2030. The underlying theme is to reduce poverty and achieve the MDGs.

Efforts are being made at all levels for using appropriate technologies to provide energy to the rural and urban poor for a variety of applications. There are a number of conducive examples of policies as well as institutional and financing mechanisms to ensure that the poor are able to use and benefit from such technologies. However, the question is, has the outcome of all such efforts been measured in terms of increased access to energy? What do we understand from energy access?

There are several simple and comprehensive definitions available for energy access, but the challenge is to make these definitions penetrate into the government systems, industry, community groups, and so on, to ensure that we answer the four simple questions—is energy accessible to the poor; if yes, is it available; if yes, is it affordable; and if yes, are the poor using it?

Energy access is not about lighting alone, but when 1.4 billion people do not have access to electricity for lighting it is very much about lighting. Can we have 'beyond the grid' solutions for these people? If solar PV is one such solution, we should be happy that India is taking the lead in using off-grid PV for enhancing energy access to the rural poor.

Akanksha Chaurey
Director, TERI

Published by Dr R K Pachauri for the The Energy and Resources Institute, Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003, Tel. +91 (11) 2468 2100 or 2468 2111, E-mail teripress@teri.res.in, Fax +91 (11) 2468 2144 or 2468 2145, Web www.teriin.org/pub, and printed at Excel Printers Pvt. Ltd., C-205, Naraina Industrial Area, Phase-I, New Delhi – 110028.

I am a regular reader of *The Solar Quarterly* magazine and find it extremely informative and enriching. In the October 2010 issue, I particularly liked the article on 'Solar panel theft on the rise'. I liked the presentation of the article and the way it was written. This topic is not much discussed or written about. I thank the editorial team for picking up an issue that is of utmost importance and needs to be tackled soon.

Hope to read more such interesting articles in future.

Rekha Singh
New Delhi

Last month, I received a copy of *The Solar Quarterly* magazine. This magazine is highly research oriented and very informative. I am really impressed by the enormous amount of useful information in it. Each and every article in the magazine is great in itself. Even the collation of news items is great! In the October 2010 issue of the magazine, I was highly impressed by the article on sustainable community planning. It was a well-researched and informative article. I congratulate the editorial team for selecting such important and relevant topics and presenting them in the best way possible.

R Kumar
Maharashtra

I would like to congratulate the team of *The Solar Quarterly* magazine for the brilliant work that it comes out with. I have been reading the magazine for quite some time now and every time, there is something new, and better, in the collection of the articles. I would specially like to mention about the article based on the survey of solar lanterns. I have also read the article on the first solar lanterns survey. Both these article are extremely informative, well-researched, and well presented. I would like to congratulate all those involved in this survey. Such survey-based articles, with so much data, are very useful for readers, especially all those who are involved in research activities.

It will be great if the editorial team plans to have more such survey-based articles in the forthcoming issues of the magazine.

Manju Singh
Uttar Pradesh

I came across a copy of *The Solar Quarterly* magazine and it is a really interesting source of information on Indian and International solar energy market. We take great interest in the developments in the field of solar energy, especially in India. I congratulate you on your efforts.

Rahul Seth
New Delhi

I was very happy to go through an issue of *The Solar Quarterly* magazine. The information provided in this magazine is very useful to all those who are working in the field of solar energy, including R&D personnel, and entrepreneurs.

The quality of photographs is excellent, the matter is informative. I would request the editorial team to increase the news section in the magazine.

I congratulate *The Solar Quarterly* team for its efforts.

Radhika Kapoor
Madhay Pradesh

Thank you very much for your encouragement. The editorial team of The Solar Quarterly will make every effort to make this magazine highly informative and useful to all our readers. We welcome your suggestions and valuable comments to make further improvement in terms of content and presentation.

Editor
The Solar Quarterly

CONTENTS

Soladigm raises $30 million more for smart windows

Windows that change tint may not be that far away anymore. Soladigm, which makes electrochromic (EC) windows, has raised $30 million in a third round of financing. Investors in the company include Khosla Ventures and General Electric. Thus far, private investors have put $57 million into the company. The state of Mississippi has also given a loan of $40 million to the company as well as a $4 million grant. The funding combined with the announcement of an $80-million investment in Sage Electrochromics by French glassmaker Saint-Gobain last month, is a strong evidence that the market for these windows may finally be emerging. With EC windows, building owners can turn down heaters and/or air conditioners by tinting the windows, to block (or permit) solar heat. Alternatively, office lights can be dimmed in the morning by keeping the windows clear. "You can think of it as a building with sunglasses," said CEO Rao Mulpuri. EC windows will not block or disturb views, like window shades or permanently tinted windows, he points out. The European Union and some other bodies have already passed regulations requiring window shading for efficiency, opening the market for these kinds of windows. Companies like Sage have been trying to sell electrochromic windows since 1989. The major obstacles include cost, complexity, and performance concerns. Passive coatings and thermal windows can also accomplish much of what these windows do without networking headaches. Mulpuri (and executives at Sage) say that many of these problems have been conquered. Soladigm's active ingredient is coated onto the inside surface of the outer pane of the glass, in the double-paned windows. The company exploits techniques developed in the semiconductor market to apply the chemical. Wiring the windows is fairly easy with prefab construction techniques. The windows will function properly for about 30–50 years. Unlike the photo grey glasses in 1970s, the windows will not devolve into a permanent shade of gray.

Source *Greentech Media*

ACME inks supply pact with First Solar for Gujarat plant

Delhi-based ACME Tele Power Ltd (ATPL) and First Solar Inc. have inked a module supply agreement, which covers the supply of First Solar's advanced thin-film modules for a 15-MW DC solar power plant in the state of Gujarat. A statement issued by them says that the agreement entails building a 15 MW power generation project in the state of Gujarat. The delivery of thin-film modules is expected to take place by March 2011 so as to fulfil the Gujarat government's expectations, the statement said. Manoj Kumar Upadhyay, chairman and managing director, ATPL commented, "This agreement is in line with our endeavour of pioneering turnkey solar technologies in India. We are enthusiastic about working with First Solar to make this ambitious project a success and, thus, deliver larger benefits to the country."

Source *Business Standard*

Consumer markets will lead the way to a solar-powered future

Before the dawn of the PC era, electronics companies were dependent on do-it-yourself enthusiasts and high-end consumers looking for kicks. The bottom of the "s" curve is littered with false starts, with ideas that look crazy in retrospect, but which excite a few and lead to better things. Today, that means solar chargers. Prices keep coming down, and capabilities keep going up. The best news is that while solar chargers today only support low levels of power, increasing number of electronic components need small amounts of power. So, the utility of such devices is increasing exponentially. Most American consumers just plug in when our iPhones need a charge. Right now, most solar charger buyers are people who are vacationing off the grid, but who want to bring their gadgets with them. Given these limits, the preferred output is USB. Smart phones often **s**upport USB for charging. They are trickle-chargers, as a press release from one such maker, SunTactics, makes clear. Many

older units include an internal battery that charges from the solar panel. In 2010, 2 Watts was the norm for output. Newer units are now being introduced at 5 Watts. Apart from campers, who want to keep their iPhones and GPS devices charged when out in the woods, there is also a market in the developing world, where the grid does not exist. Things like the Solar Ear, a specialized device for recharging hearing aids, are starting to gain a market. What comes next? As was true 40 years ago, military necessity is leading the way. The US Army is evaluating things like the PowerShade, a collection of thin-film cells sewn into a command tent. The most powerful of these solutions, dubbed the TEMPER-Fly, is rated at 750 Watts of output. The company which makes it, the Tactical Solar unit of Energy Technologies Inc., Mansfield, Ohio, is a great place to bookmark for the future developments. Their most powerful unit weighs **£**450 and currently tops out at 2 KW. There will be more, which will weigh less, cost less, and deliver more power, by this time next year.

Source *Renewable Energy Network*

Government selects 37 companies to build solar power plants

India aims to produce 20 GW solar power by 2022. Foreign firms are trying to cash in on the burgeoning Indian solar market. The government has selected 37 companies to build solar power projects, as the country moves forward with an ambitious plan that seeks to significantly scale up production from near zero to 20 GW by 2022. Lanco Infratech, KVK Energy Ventures Pvt. Ltd and Rajasthan Sun Technique Energy Pvt. Ltd won bids for a maximum project capacity of 100 MW each, according to documents posted on the website of National Thermal Power Corporation (NTPC) Vidyut Vyapar Nigam Ltd. (NVVN). Under its Solar Mission plan unveiled last year, India is set to produce 1300 MW of power by 2013, an additional supply of up to 10 GW by 2017, and the rest by 2022 at an overall investment of about $70 billion. India's top power producer, NTPC Ltd, through its unit NVVN, will lead the solar plan's initial phase via long-term contracts to buy the first 1 GW of energy from developers at ₹15.31 per kilowatt-hour (kWh) for solar thermal and ₹17.91/kWh for solar module. Incidentally, it turns out to be about eight times the cost of coal power. One GW is enough to power close to 1 million homes. Once implemented, the plan would see output equivalent to one-eighth of India's current installed power base, helping the world's third-worst polluter limit its reliance on coal. Thus, it would ease out a power deficit that has crimped economic growth. Godawari Power and Ispat, Corporate Ispat Alloys Ltd, and Megha Engineering and Infrastructure Ltd were also selected to build power plants with a capacity of 50 MW each. Other selected bidders included Maharashtra Seamless Indian Oil Corporation; Welspun Solar AP, a unit of Welspun Corporation that has shown interest in steel and textile; and Punj Lloyd Infrastructure, a unit of engineering and construction firm, Punj Lloyd. India's Solar Mission plan is to make the use of solar-powered equipment and applications mandatory for hospitals, hotels, and government buildings and, thus, encourage the use of solar lighting systems in villages and small towns with micro-financing. This drive to ramp up solar capacity may trigger a stampede of firms from Asia, Europe, and North America, chasing a share of the business up for grabs and trampling over smaller domestic players. First Solar, China's Suntech Power Holdings along with Taiwan's Motech Industries are some of the companies expected to grab a piece of the pie, as the country is highly dependent on imports of critical raw materials, including silicon wafer used for solar cells and panels. India's top solar players, including Tata BP Solar, a joint venture of Tata Power and BP, and Moser Baer have announced expansion plans.

Source *Live Mint*

India's clean power sector may attract $169 billion by 2020

India could attract as much as $169 billion in clean power project investments in the next decade, says a report. According to a report released by The Pew Charitable Trusts, the annual clean energy investment in India is forecast to grow by as much as 763% over the next 10 years. Within the G20, India is on track to climb from tenth to third place in terms of clean power project investments worldwide, it said. Enhanced clean energy policies would increase private investments in India by 48%, tied with the United Kingdom for the highest rate of increase in the G20, the Pew report said. It said that under all policy scenarios, India, China, Japan, and South Korea will account for as much as 40% of clean power project investments over the next 10 years. Over the next decade, India is projected to increase its renewable energy generating capacity to 91 GW, five times than what is currently installed, it said. "The message of this report is clear: countries that want to maximize private investments, spur job creation, invigorate manufacturing, and seize export opportunities should strengthen their clean energy policies," said Phyllis Cuttino, Director of the Pew's Climate and Energy programme.

Source *PTI*

New York creates solar thermal incentive programme

The state government of New York City has created a five-year, $25-million solar thermal incentive programme–the first of its kind in the state. Under the newly released Programme Opportunity Notice (PON) 2149, the state will provide incentives of up to $4000 for residential systems. It will be as much as $25 000 for non-residential applications so as to encourage replacing hot water systems with solar thermal systems. The New York State Public Service Commission allocated the funding to the New York State Energy Research and Development Authority through the state's renewable portfolio standard (RPS) programme. The New York Solar Energy Industries Association, which has advocated for the inclusion of solar thermal in the RPS for the past two years, applauded the state's decision. " PON 2149 includes incentives needed to jump-start the solar thermal market," says Gail Markels, Executive Director of New York Solar Energy Industries Association (NYSEIA). PON 2149 also addresses NYSEIA's push for a streamlined application process to encourage usage and, thus, bring certainty to the industry. The programme will use the same streamlined processing that has been recognized as effective and workable for the recently revised PV incentive programme, NYSEIA says.

Source *Solar Feeds*

Talent shortage hits solar companies

India's solar sector is gearing up for huge capacity addition plants that will eventually generate about 20 000 MW of solar power, a whopping ₹43 370 million in allocations, and creation of over 0.1 million jobs. But, a dearth of good manpower may just play spoiler. While a few academic institutions are now offering courses on solar energy and its related technologies, however, shortage of electrical engineers is making the nascent industry flounder.

The solar industry is likely to face a crunch in the areas of research and development and manufacturing, amongst other things. "There may be a shortage for the next 2–3 years, but a lot of effort is being made to introduce related courses, which would subsequently address the recruitment issues in the sector," an official from the Ministry of New and Renewable Energy (MNRE), which is spearheading the Jawaharlal Nehru Solar Mission 2020, said.

In November, just two months before the launch of the mission, the MNRE had indicated that about 0.1 million trained and skilled personnel would be required by 2020, the last year of the Solar Mission. However, experts are not sure where the personnel will come from. (About 30 000 people are currently engaged in the industry). "From manufacturing to system installation; research and development and technicians to look into operations and maintenance, to consultants and project finance experts, all kinds of expertise will be needed," says Sanjay Chakrabarti, Partner and national clean tech leader at Ernst & Young. Ajay Gupta, head of the solar thermal business at ACME Tele

Power, a company operating in this sector, adds that people with specialization in electrical, electronic, and mechanical engineering would be highly in demand, alongside experts in software, control, instrumentation, and supervisors who can oversee the installation and testing of systems.

Currently, 25 institutes offer courses on energy studies, with renewable energy as one of the subjects. Anna University in Tamil Nadu, Amity University in Uttar Pradesh, and Indraprastha University in Delhi head the list. To bridge the gap between demand and supply, the government has sought the help of the Ministry of Human Resources Development, the All India Council of Technical Education, and the University Grants Commission to decide on the course content. The idea is to eventually offer one-year diploma courses, two-year MTech programmes, and specialized technical training in both the areas of solar thermal and photovoltaic.

"The government will soon meet with institutes, which had expressed an interest in the field, including some Indian Institutes of Technology and National Institutes of Technology. Which institutions will eventually partner with the MNRE to start these courses, is likely to emerge then," says an official. Funds are not a problem. About 2% of the Solar Mission's current annual allocation of ₹10 000 million, will be channelled towards education, with 8%–9% within that being set aside for research and development.

The government will also conduct vocational training and help institutes organize short-term courses on the subject. It may do some of this in partnership with global institutions like the Plataforma Solar de Almería in Spain, Fraunhofer Institutes for Solar Energy Systems in Germany, and the National Energy Renewable Laboratory in the US. "These international institutions have been identified to have proven expertise in solar technologies. They are keen to know more about our off-grid technologies and rural electrification, while we can learn grid-connected technologies and system design from them," the MNRE official added. The curriculum should address the architectural and design elements of solar technology, besides product design, says Deepak Puri, founder and managing director of Moser Baer, which is building a talent pool to focus on innovative technologies and efficient solar solutions in the country.

Efficient solutions would ensure that panels of roughly the same size will generate more energy in the future, thereby ushering in standardization, efficiency, and marketability. "Training is crucial in bringing Indian manpower at par with global standards," adds Puri. "We send our research and development teams to institutions and business partners in and outside India on exchange programmes, to obtain knowledge that they can then pass on to colleagues."

The company plans to invite academic institutions to send their students to work in its facilities, and gain hands-on knowledge. Institutions like The Energy and Resources Institute (TERI), in 2009 started a two-year MTech programme and a PG Diploma (through distance education) on renewable energy. While some companies are partnering with institutes like TERI, others are creating a talent pool by hiring specialists from abroad to train Indian project managers. Sujana Energy, for example, partners with foreign institutions to offer courses on design, installation, and commissioning of solar projects.

They aim to train project managers to address any on-site challenges. Companies like these are seeking government subsidies to bring foreign technicians to India to train the workforce here. Though appreciative of the government's efforts, they feel more needs to be done to keep up with the rising demand for personnel in the sector. Solar (power) is essentially a technology. Once local experts become comfortable with it, the transition (of expertise) will occur.

Source *Economic Times*

Tata taps MIT to light up low-income houses

The Tata group is investing millions of dollars in Sun Catalytix, an energy storage and renewable fuels company, founded by a Massachusetts Institute of Technology (MIT) professor, Daniel Nocera. The aim is to introduce a low-cost solar contraption to power homes for the poor, primarily in developing countries like India. The Tata group is well known for its bias towards

low-cost innovations like the Nano car and Swach water filter.

Sun Catalytix's prototype can split hydrogen from any source of water, be it river water, sea water or even human waste. Once the water molecules are split into hydrogen and oxygen, the hydrogen can be used to power fuel cells. Built at a cost of about $20, it is expected to hit the market in 18 months.

"We have the capability to power a household with just two bottles of water from any source," claims Nocera, who is also the director of MIT's Solar Revolutions Project and the ENI Solar Frontiers Centre. The reasoning is simple. Solar power, up until now, has been a daytime-only energy source. But, storing extra solar energy for use after sunset is expensive.

Sun Catalytix also believes batteries have a limitation when it comes to storing electrical energy. The company's prototype, hence, has taken a cue from nature—the process of photosynthesis, whereby plants and bacteria use energy from sunlight to produce sugar, which cellular respiration converts into adenosine tri-phosphate, or ATP, the 'fuel' used by all living things. It was about two years ago that Nocera and Matthew Kanan, a post-doctoral fellow in Nocera's laboratory, had announced the details of the experiment. They have since refined it further. "By eliminating expensive precious metals and substantially reducing costs, our technology promises to enable the conversion of electrical, solar or wind energy into storable energy at low cost," says Nocera. The contraption, according to Prof Nocera, has advantages over current electrolysers, which split water with electricity and are often used for industrial purposes. However they are not suited for artificial photosynthesis because they are expensive (about $12 000 per kW) "and require a highly basic (non-benign) environment that has little to do with the conditions under which the photosynthesis operates".

Currently, though, solar power is much more expensive than power generated by other sources of energy like wind, coal, and water. The government, therefore, has to subsidize solar power. Other companies like Amyris of the US are also developing genetic-engineering technologies that change the way microbes process sugar, turning them into "biorefineries". This could provide alternatives to products derived from petroleum.

Source *Business Standard*

World's biggest solar power plant planned

Giant mirrors and solar panels in the Northern Cape Province of South Africa would reduce carbon emissions and generate one-tenth of the country's energy needs. South Africa is to unveil plans for what it claims will be the world's biggest solar power plant, a radical step in a coal-dependent country where one in six people still lack electricity. The project, expected to cost up to 200 billion rand (GBP18.42 billion), would aim by the end of its first decade to achieve an annual output of 5 GW of electricity, currently one-tenth of South Africa's energy needs. Giant mirrors and solar panels would be spread across the Northern Cape Province, which the government says is among the 3% of the regions in the world with minimal cloud or rain and maximum sunshine. The government hopes the solar park will help reduce carbon emissions from Africa's biggest economy, which is still more than 90% dependent on coal-fired power stations. Energy is already a high priority in South Africa where, at the end of racial apartheid, less than 40% of the households had electricity. Over a period of 16 years, the governing African National Congress has undertaken a huge national expansion, with a recent survey showing that 83% are now connected to electricity. However, power outages are still very common in both townships and middle-class suburbs. An estimated 200 foreign and domestic investors are expected to discuss plans to fund the hugely ambitious solar project. A master plan will be set out by the US engineering and construction group Fluor. This follows a viability study by the Clinton Climate Initiative, which described South Africa's "solar resource" as being amongst the best in the world. De Vries, a special adviser to the energy minister, said the Northern Cape had been chosen for insolation readings (a measure of solar energy) that rank among the highest in the world. South Africa currently consumes 45–48 GW of power per year. It is estimated that this will double over the next 25 years. "In South Africa, over 90% of our power comes from burning of coal, and we need to reduce this because of our international obligations on climate change," de Vries said.

Source *Guardian Newspaper*

NTPC plans 100 MW solar projects in Gujarat

Powering its way ahead in tapping renewable energy sources for power generation, public sector power utility National Thermal Power Corporation (NTPC) has set the ball rolling for its two solar thermal units of 50 MW each in Gujarat. The company has firmed up its plans to initially install a solar power generation capacity of 100 MW in the state, which may go up to 300 MW at a later stage.The Gujarat government has already approved NTPC's 50 MW solar thermal power unit. "The public sector unit (PSU) plans to set up two solar power units, each having installed capacity of 50 MW. Soon, NTPC will sign a memorandum of understanding (MoU) with the state government," said Bharat Singh Solanki, Minister of State for Power, Government of India. Kutch and Banaskantha districts in Gujarat have been identified for the proposed 100 MW solar thermal power capacity, with an investment of about ₹20 000 million from NTPC.

Source *Worldofsolarthermal.com*

GEMCO announces first triple state thermal solar cooling/ heating project

The system is designed to address the cooling, heating, and domestic hot water needs of the hospital using energy from the sun. Glenbarra Energy Management Corp (GEMCO) has announced that it has entered into a contract with Shouldice Hospital to provide the turnkey design of Canada's first ever "Triple-State" absorption thermal cooling/heating system to be used in Canada. The system is designed to address the cooling, heating, and domestic hot water needs of the hospital using energy from the sun. The Shouldice project, located at 7750 Bayview Avenue in Toronto, US, will provide a live test centre to showcase the viability of using this renewable technology and energy storage capability as an offset to energy currently provided from traditional fossil fuels such as natural gas and electricity. The core components of the system include 10 solar cooling machines and 141 solar thermal collectors. Based on preliminary energy modelling, the cooling/ heating system is targeted to offset the following loads for the hospital.

- 36% cooling
- 44% heating
- 91% domestic hot water

It will, thus, reduce CO_2 emissions annually by an estimated 150 tonnes, which is equivalent to removing 28 cars from the road, per year. Darren Cooper, President and CEO of GEMCO, explains that the ultimate goal for GEMCO will be to utilize the experience, knowledge, and data arising from this cooling/heating project to roll out the technology across North America. According to Cooper, "Solar cooling offers substantial environmental, financial, and social benefits. These benefits include limiting the use of traditional energy-guzzling cooling systems that use ozone damaging refrigerants as well as offsetting electricity use during peak billing periods, where there may be electrical grid overloads and black outs".

Source *Worldofsolarthermal.com*

Mandatory use of local cells for solar projects may be deferred

The government may postpone mandatory use of locally made photovoltaic (PV) cells in solar power projects being set up under the national solar mission to speed up projects and allow access to the best-available technology, although the move would be a blow to local suppliers. Under the Jawaharlal Nehru National Solar Mission that aims to add 20 000 MW of grid-connected solar power by 2020, the use of domestic content has been made mandatory in the case of modules in its first phase of bidding and this clause is proposed to be made mandatory for PV cells from next financial year. "We will consider mandatory clause for PV cells only after evaluating progress on projects that have been bid in the first round. "If need arises, we may postpone its implementation to allow for more global technologies to come into the Indian market," Deepak Gupta, Secretary, Ministry of New and Renewable Energy told *Economic Times*. PV generation produces power by directly converting solar radiation into electricity through solar cells made of semiconductors. Solar panels or modules comprise of a number of cells containing PV material. The development will come as a jolt to domestic companies who have urged the government to encourage foreign investment in manufacturing while curbing imports.

Source *Economic Times*

Foreign firms look to increase solar power presence in India

The Elephanta Caves, a UNESCO World Heritage Site off the coast of India's financial capital Mumbai, draw hundreds of thousands of tourists every year.

But, when the last of the wooden ferry boats leaves at nightfall for the mainland, the villagers who live permanently on the island are plunged into darkness.

A new scheme, recently launched by an Australian firm, aims to change that, providing three villages with round-the-clock electricity for the first time by harnessing power from sunlight.

This initiative by the Sydney-based Solar-Gem to run LED lamps from panels that soak up the sun's rays and store them as electricity in battery units comes as domestic and foreign firms look to India as a growth market for renewable energy.

Prime Minister Manmohan Singh has said he wants the country to become a world leader in the sector, not just to cut a crippling energy deficit that could hinder development but for security of supply and to tackle climate change.

The government figures from the end of November showed that highly-polluting coal accounted for nearly 55% of India's total energy production.

Renewable energy, most of it from wind power, provides 10%. The use of solar energy use is negligible.

Now India's National Solar Mission aims to source 20 000 MW of electricity from solar power by 2022, about 4000 MW more than the current capacity provided by all forms of renewable energy.

The head of Solar-Gem, Khimji Vaghjiani, said solar power had "enormous scope" in India, as 80 000 villages have no electricity and plans for conventional power plants are often delayed over land or environmental concerns.

"Trying to distribute power is going to be very difficult (in India)," he told AFP. "What do we do in the meantime where villagers are using kerosene and candles? We can put the solar panels in every household, moving them away from harmful kerosene and costly diesel."

Indian companies, which are likely to benefit from the focus on solar energy include Tata BP Solar and Reliance Solar. Foreign players are also sensing opportunities, as the price of solar power technology falls and overseas governments look to support India as it tries to switch from a reliance on fossil fuels to "clean" energy sources.

Solar-Gem, whose initiative is a jointly funded Australian-Indian project, said India could become a manufacturing hub for its technology.

Source http://www.solardaily.com/reports/Foreign_firms_look_to_increase_solar_power_presence_in_India_999.html

Delhi gets 1 MW solar energy generator

North Delhi Power Ltd (NDPL), a joint venture of TATA Power with the Delhi government, recently commissioned a solar power plant installed by the TATA BP Solar. It consists of more than 5500 solar photovoltaic panels made of crystalline silicon. These would absorb sunlight and convert it into electricity, to be directly fed into NDPL's main grid line.

The panels are designed to work for 25 years. This 1-MW unit is designed to produce 1.58 million units of electricity annually, sufficient to light more than 1000 homes.

NDPL has planned a three-fold initiative to promote solar power generation over the next three to four years. This includes setting up grid interactive solar PV systems on the roofs of 56 of its grid substations in its distribution network of North and North-West Delhi, with a cumulative capacity of 2.5–3 MW. It is also pursuing the prospect of setting up a 100 MW grid interactive solar power plant in Rajasthan.

It will also facilitate grid interactive solar PV systems on the rooftops of individual households and commercial buildings.

Source http://www.steelguru.com/indian_news/Delhi_gets_1_MW_solar_energy_generator/182393.html

An EFYGROUP EVENT

If It's Electronics It Will Be Here

Being organised by the Electronics For You team, the Electronics For You Expo (EFY Expo) is an attempt to go beyond the usual 'components' or 'SMT equipment' shows. EFY Expo is an attempt to get the entire Indian electronics industry under a single roof. Spanning across 5 halls with an area of 14,000 square meters, it's destined to be the BIGGEST electronics event in North India, and might just end up being the *numero uno* show of India!

Electronics ForYou expo 2011

Innovate. Design. Manufacture. Source.

17 to 19 February, 2011
Pragati Maidan, New Delhi

17 to 19 February, 2011, Hall No. 2, 3, 4, 5, 6
Pragati Maidan, New Delhi

Manufacturing Zone

Planning to buy new production equipment, accessories or consumables for a plant?
Meet the manufacturing solution providers viz. electronics production equipment & assemblies (SMT), electronics manufacturing services (EMS), and contract manufacturers. Also those who make consumables for electronics manufacturing; provide soldering technology, packaging, and PCB assembly... **and more**

B2B Buyers' Zone

Handling purchase? Or looking for trading opportunities?
Meet vendors of components, plugs, sockets and connectors, LED lighting and display products, security systems, power conditioning and back-up systems, industrial automation products, telecom products, identification and tracking products, solar power products, cabinets, enclosures and accessories, wires & cables ... **and more**

Engineers' Zone

On the lookout for the latest solutions that can help 'engineer' new products?
Get a first hand view of design solutions and the latest technology for engineers in the fields of passive components, active components, micro controllers and micro processors, EDA technology, FPGA and VLSI solutions, embedded systems: hardware and software design tools, test & measurement, communication technology ...**and more**

Innovation Zone

Interested in the latest innovations from India?
Visit innovation zone to see the latest innovations, technologies and intellectual properties from innovators (individuals), start-ups, R&D organisations, leading academic institutions, venture capitalists and incubators, tech-transfer facilitators ...**and more**

Spotlight

SPECIAL FOCUS ON

- Solar Products • Security Devices • Wireless Devices • LEDs & LED Products
- Test & Measurement Equipment • Electronic Components
- Tech Products for Education • Power Electronics (UPS, Inverter, Batteries, etc)

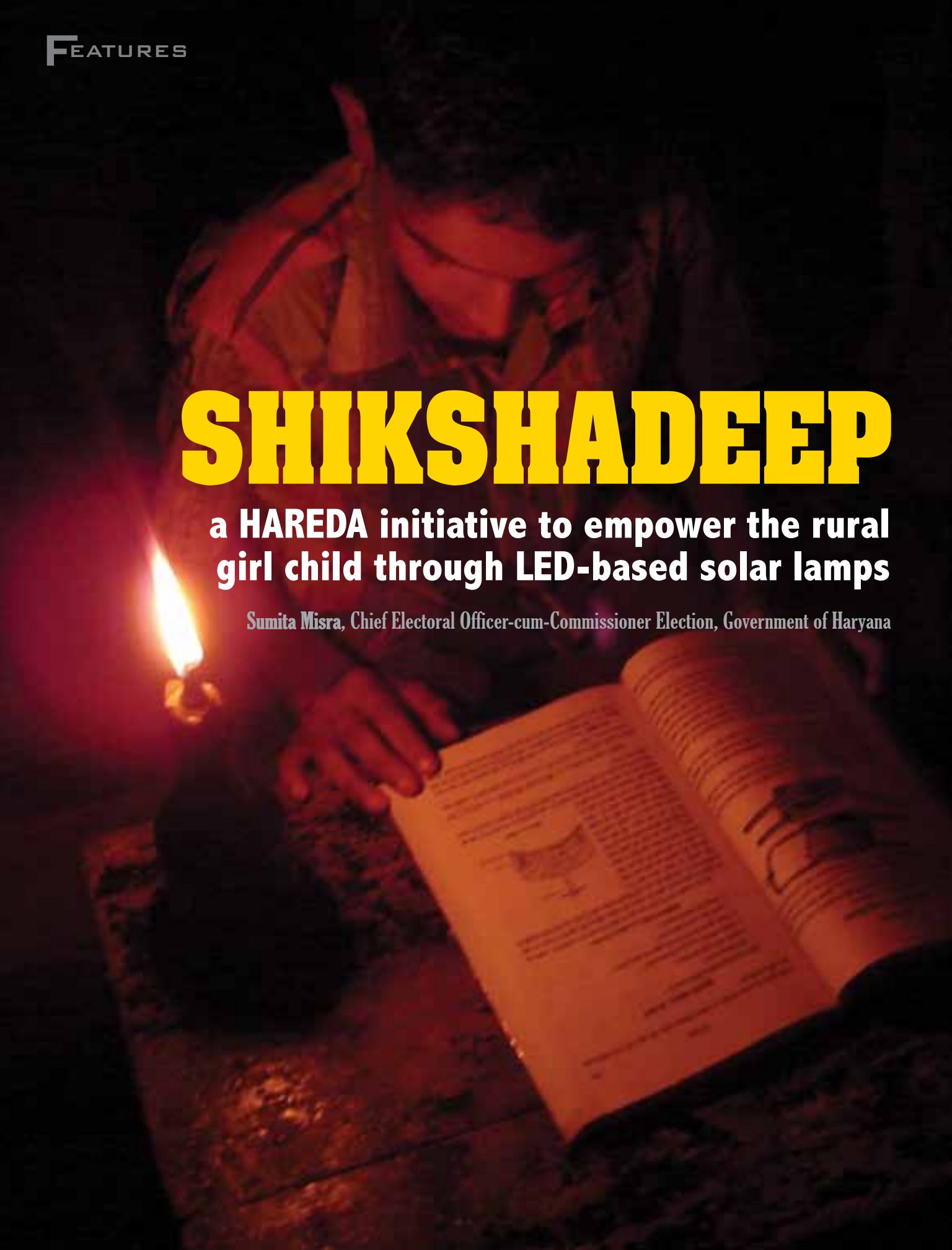
Presented by: ElectronicsForYou
Knowledge & Exhibition Partner: ELCINA
Supporting Associations: CEMA, MAIT
Knowledge Partner
Media Partners

FOR EXHIBITORS **SPECIAL OFFER:** FOR BOOKING BOOTHS ₹ 10500 per square meter Offer Valid Till 15th January, 2011

Call: Sonali (011-26810601), Tanmay (09313843924), Subhasish (09873131699) or 011-40596600

EFY Enterprises Pvt Ltd, D-87/1, Okhla Industrial Area, Phase 1, New Delhi 110 020
Phone: 011-26810601/02/03 | Fax: 26817563 | Email: efyenq@efyindia.com

www.efyexpo.com



SHIKSHADEEP

a HAREDA initiative to empower the rural girl child through LED-based solar lamps

Sumita Misra, Chief Electoral Officer-cum-Commissioner Election, Government of Haryana

Background

"Lead me from darkness to light"… is the goal of every person seeking enlightenment. Even in our day-to-day life, light (electricity) happens to be one of the basic needs of human beings. During day time, the sun provides us with light, but after sunset, we require electricity for various activities.

As per the available estimates, about 30% of electricity consumption in the domestic sector is for lighting alone. In India, roughly 57% of rural households still do not have access to electricity. In such a scenario, providing basic lighting is a huge challenge for the development machinery. Even in the electrified areas, power quality and frequent power cuts require standby systems. Normally, rural households use kerosene lamps for primary lighting needs or for backup lighting. A typical kerosene lamp used daily burns about 80 litres of kerosene per year. This leads to about 0.2 tonnes of CO_2 emission, annually. Also, kerosene lamps create pollution and toxic gases when used for indoor lighting. According to various studies and data, 1.6 million people every year die from the use of kerosene lamps every year.

Sun offers the solace

Solar energy provides an excellent option for standby lighting applications. In areas without electricity, it can surely be termed as a boon, whereas in areas with electricity, it acts as a reliable backup. As of now, both portable and fixed-type solar lighting are available in the marketplace. Solar-to-electricity conversion technologies have shown a remarkable improvement over the last decade or so. The new generation material technologies, especially those based on cadmium telluride, can stimulate a huge market demand for the portable units, more commonly known as the lanterns.

Counting on the new lighting choices

The indoor lighting sector has witnessed great technological innovations right from incandescent lamps to fluorescent tube lights to CFLs, and lately to LED lamps. LED lamps are not only cost effective but also last much longer than CFLs. Besides, these lamps are energy efficient, easy to use, and easy to handle. Table 1 gives a comparison of compact fluorescent, incandescent, liner fluorescent, halogen, and white LED.

Quite clearly, LED edge past the rest of the lighting technologies, as far as operational benefits are concerned. Further, in these days of high environmental concerns, LED scores a new high over the traditional CFL, FTL, and HID lamps. LED lanterns do not contain mercury—a known neurotoxin. As compared to other lanterns, LED lanterns have a number of advantages. They do not shatter like bulbs and fluorescent lights. This results in lower risk of laceration injuries. LED-based solar lanterns are also more robust and portable, and their module is more compact due to higher light efficiency of LED. The number of solar panels required for equivalent light output is reduced to about one-third in case of a LED-based solar lantern as compared to a CFL-based solar lantern.

HAREDA showing the beacon

The Haryana Renewable Energy Development Agency (HAREDA) has always been in the forefront of promoting and demonstrating the latest technologies, which can benefit the common person. It is promoting off-grid applications of solar photovoltaic (SPV) technology, under which solar lanterns and SPV home lighting systems (CFL/LED based) of different models are being provided to the individual beneficiaries. Haryana is the only state in India where

Table 1 Comparing various lamp technologies

Technology	CRI	Efficacy (lumen/W)	Lifetime (hrs)	Colour temperature
Compact fluorescent	80–90	60–70	6000–10 000	2700–6500
Incandescent	100	12–18	750–1500	2400–2900
Liner fluorescent	70–90	80–100+	20 000	2700–6500
Halogen	100	16–29	2000–4000	2850–3200
White LED	65–90	90–110	Up to 100 000	2700–6500

a LED-based solar lighting system was designed, developed, and introduced before the Ministry of New and Renewable Energy (MNRE), Government of India undertook the activity.

This has been solely possible due to a concentrated product development exercise encouraged by HAREDA through continuous research and development of innovative technologies. It has been followed up by field trials of the new technologies for a smaller section of target groups. On the basis of the end-user feedback, the specifications are modified and standardized. Also, HAREDA initiated the development of a prototype model of a LED-based solar lantern suitable for reading and general use in league with a group of manufacturers. It was subsequently tested in various government-sponsored laboratories for its technical parameters and lumen efficiency. Recognizing the need for lighting amongst the students, especially belonging to the rural areas, a LED-based solar lantern was developed after interaction with technology providers, that is, manufacturers and end-users.

Small is beautiful

A LED-based solar lantern consists of a 3 Watt solar panel and 6 Volt 4.5 Ah battery. It offers an illuminance of 50 lux, when measured from a distance of 1 foot from the centre point of the bottom of the lamp in the same plane of the horizontal. It is basically a portable lighting device, which works for five hours daily. To begin with, the LED lanterns were supplied to about 800 students on a pilot basis. Thereafter, on the basis of the feedback received from the students, the specifications of the product were upgraded so that the lanterns could provide illumination of 60 lux. To address the concerns regarding maintenance of these lanterns, the lamp and battery have a warranty period of five years, whereas the solar panels have a warranty period of 10 years.

Sun empowering the girl child

The Haryana government had declared the year 2008 as the "Year of the Girl Child", which prompted HAREDA to develop a scheme for the benefit of the girl child. It not only helped in their empowerment, but wanted to bring about gender equity by creating better environment for the education of the rural girl child. The name of the programme was also decided after long discussions on various options like Gyandeep, Vidyadeep, Kanyadeep, and Shikshadeep.

After witnessing the acceptance and utility of the lantern, finally, an innovative scheme on LED-based solar lamps called Shikshadeep was launched on 20 August 2008 by Bhupinder Singh Hooda, Chief Minister of Haryana, in the presence of the then Union Renewable Energy Minister. This coincided with the celebrations marking the name of Rajiv Gandhi Akshay Urja Divas at Panchkula. Under this scheme, Shikshadeep lamps are being provided free of cost to girl students from rural government schools, who have stood first in their 5th, 8th, 10th, and 12th class examination. The larger objective is to help them to pursue their studies during the power cuts. The scheme not only aims at encouraging the meritorious girl child in the rural areas, but also serves the twin objective of gender and women empowerment in the long run.

The impressive outreach

The project involves distribution of Shikshadeep lamps to 1861 girl students every year, which costs a total of ₹31.171 million. These lamps are procured on the basis of the rates finalized by the state-level high powered purchase committee headed by the state finance minister, through a competitive bidding mechanism. Till now about 19 000 Shikshadeeps have been distributed and about 35 000 Shikshadeeps are

being distributed. The cost of one lamp is ₹1675. This is a fully state-sponsored project as the MNRE has no separate programme to fund this project. The Shikshadeeps are distributed to students in functions organized at school/district level, either by the senior officers or public representatives.

Performing as per the expectations

The project has an in-built mechanism for performance evaluation. Necessary feedback is collected from the eligible students with the help of a format specially developed for the purpose. The feedback received is analysed on a regular basis, from the viewpoint of any product modification and up-gradation. Feedbacks received from 776 students suggest that these lamps have about 99.48% functionality and are very useful while studying.

The environmental impact of this programme is significant and positive. Assuming three hours of daily use, the 19 000 Shikshadeeps distributed so far have contributed towards saving of about 760 kilolitres of kerosene, annually. This has saved us from emitting about 1900 tonnes of CO_2 every year, which is likely to increase exponentially year after year.

Creating a brand identity

The design of the Shikshadeep lantern is also different from the lanterns usually distributed by HAREDA under its other programmes. The underlying rationale is to create a unique and recognizable brand identity for this lamp. This was done so that the homes with Shikshadeep lamps are identifiable as homes with an academically brilliant, school going girl child, where the girl's academic brilliance has earned a multi-utility lighting device for the whole family.

Shikshadeep is a first of-its-kind initiative in the country. By virtue of this initiative, HAREDA has attracted appreciation from several quarters, both from the government and the non-government sectors. We, at HAREDA, strongly feel that an educated girl child will not only empower herself, but shall also have a significant role to play in the nation-building process. Shikshadeep is now in its third year, and the postcards from girl students from all over the state, expressing their happiness and pride with their solar lanterns, is perhaps the greatest validation of this unique initiatve.

EXPECTING THE LIFE OF A SOLAR BEYOND THE KNOWN FRONTIERS

Dr Suneel Deambi
Consultant, TERI
<sdeambi@airtelmail.in>

Background

Sun, as a form of energy, has been constant for ages. It is the means of solar energy conversion that have changed for the better, in recent times. Quite clearly, the life span of the solar-electric devices, more commonly known as solar cells, is not infinite, even under the maximum possible theoretical limits of efficiency. Does it mean that solar cells, which effectively perform the simple but highly sophisticated taste of such a conversion, are as vulnerable as similar other products. The answer is not a difficult one, given the present day age limit of 25–30 years set up by solar energy producers, around the world. Perhaps the estimate does not seem to be an ill-founded one, when it comes to comparing the lifespans extended by the manufacturers across different geographical territories. Take, for example, the case of the developing countries, where there are still no fixed limits of lifetime warranties from the locally available solar products. In India, the guarantees for solar modules are now set up routinely for 10 years and not more in many cases. This is certainly a worrisome situation, more so in the backdrop of the just initiated megawatt-scale solar power generation plants. These are normally expected to produce some useful power from the free flowing solar energy for about 25–30 years. When this happens, the predicted economics of a solar power system will not be difficult to realize.

Envisaging the larger gain

The moot question at this stage is not just whether the solar modules are still active after crossing the often maximum envisaged age of 25 years or so. It may be possible that a number of solar modules have crossed this age limit, making visible the additional economic gains. Thus, it is an interesting issue to ascertain, whether any such case- specific examples are present to support this type of hope. As one begins to document such field experiences here, optimism seems to writ large about an extended gain from within the same system. Simply put, the economic viability of a PV system under consideration becomes more attractive in more ways than one.

Experiences galore

The development of solar energy, through a time prism, is replete with various examples. Perhaps one of the better known examples of solar PV working beyond its known age limit is that of a family in Colorado, USA. It purchased a 20-WP module to operate a few lights and a radio at a remote cabin.

PANEL

Incidentally, the module is still actively generating about 90% of its original rated power capacity at the end of the 28th year. Does it not sound interesting for a technology, which is still perceived to be out of bounds in terms of direct affordability for the rural poor? In terms of the price, it had cost the owner about $ 900 at the time of the installation. Today, a module, which delivers 10 times that power, is available for even lesser cost. Thus, this points towards two major issues; first is the issue of capability of the modern day panels to pack much more power within them and being available at a lower cost too, and second, whether the solar panels really enjoys the lifespan of 25–30 years or less or more by a fine margin.

What actually determines the life of a solar panel?

Majority of the solar panels have a life expectancy of 20–25 years. To go back to the early days of selenium cells may help to understand the life cycle better. It is claimed that selenium cells have been salvaged from the cameras and light meters dating back to 1950s. Incidentally, these still produce almost the same amount of energy that they did in the very beginning. Is this not a classic case of a technology withstanding the test of time? Solar panels are expected to withstand heat, cold, rain, and hail. Quite a few crystalline silicon manufacturers offer warranties that guarantee electrical production for 10 years at 90% of the rated power output and 25 years at 80% of the rated output.

Problems with the old designs

The old designs were confronted with several problems such as browning. It is often a vexing question as to why some solar PV modules have proved very reliable under the actual field operating conditions, while others have simply failed for one reason or the other. Solar industry experts around the globe, have been trying to answer this question, for quite some time now. Solar modules should continue to produce some useful power throughout their active life. This alone is essential for a potential customer to recover the expenses and ultimately realize some savings too. The General Electric Company produced a few variants of solar cells in the mid-to-late 1950s with selective few possible uses. The modern day module designs have undergone several changes, beginning with the use of better laminating materials. The physical problems have come to the fore mainly due to the hostile environment across different geographical regions.

Case specific concrete examples of extended lifespan

Sacromento Municipal Utility District (SMUD) is a community-owned electric utility. It serves about 0.6 million customers and a total population of 1.1 million. The utility set up large-scale solar PV installations in 1984, which are still working fine. The component assembly that focuses the available sunlight on the PV materials also continues to work well. So, this stands

testimony to the long-term endurance of a solar PV module under actual field operating conditions. The simple trick of realizing lower costs and an extended lifespan has really worked well.

Carissa plain was a thinly populated grassland in 1983. The infamous oil crisis of the 1970s affected the entire world and the need for putting up solar panels was at an all time high then. It was in 1983, that ARCO Solar deployed about 100 000 panels (a whopping number by the early inception records) in the Carissa Plains. Such panels made use of concentrating mirrors with an obvious purpose, of both material savings as well as achieving optimum conversion efficiency levels. However, the field performance led to some quick degradation, both in the power output as well as the physical appearance. The underlying reason being a material substance, better known as ethylene vinyl acetate (EVA), which was mainly used for encapsulating silicon solar cells. It so happened that the concentrated light, giving rise to severe heat formation, had a negative effect on the EVA. The browning effect occurred, thus, making way for the dismantling of the Carissa arrays around 1990s. This showcased the field-related problems of solar panels early on. This case clearly brings out the need to routinely attend to the problems coming to the fore as a result of various reasons.

The new hope

There is growing optimism amongst the solar community that solar modules may last much longer than the usual lifespan of 20–25 years. Several PV companies, which meet the requirements across the domestic and commercial sectors, are now offering long-term leases or power purchase agreements. These are similar to a better known term—lease. They may ensure specific levels of production and, importantly enough, involve themselves in the routine operation and maintenance works. As per the available information, several module designs have been active in the field for more than 25 years or so. It is of an absorbing interest for the PV companies to extend the life of solar modules beyond the customary boundaries. Simply put, life expectancy studies of solar modules are still gaining a foothold, both across the academic and industry environments, thus, springing new hope.

The renewed impetus

The concern for the above mentioned field related problems are not totally unfounded. One of the strong reasons is that modules of different types and capacity are finding their way into the market across the world. Thus, expectations of an extended lifespan for the whole spectrum of the field-deployed modules are hard to come by. It is important to mention here that the National Renewable Energy Laboratory (NREL), a premier laboratory of the USDOE, has been investigating the browning crisis, since the early 1990s or even before. The early presumption of browning, bearing some definite and direct relation with loss of power in a solar module, came under cloud. NREL has carried out an in-depth analysis of the weathering effects on solar equipment, both in the real time as well as by accelerating its exposure to changing magnitudes and types of heat, light, moisture, and so on. These concerns were subsequently pursued by various PV manufacturers in terms of colouring change and power reliability issues. The light-induced power degradation was attributed to the thin-film amorphous

silicon modules in a more pronounced manner, than crystalline silicon modules.

Elaborated case specifics of an individual's long-lasting experience

There is an interesting case of Martin Holladay, as documented on GreenbuildingAdvisor.com, who has a thirty-year-old solar PV module as one of his prized possessions. He purchased this panel in 1980, and installed it on the rooftop of his house in Vermont, USA. The rated capacity of this module was 33 Watt and priced at about $275 then. Martin recently celebrated the 30th anniversary of the solar module by quick testing it via a Fluke multimetre. According to him, the module was designed to charge a 12-Volt battery at a maximum voltage of about 16 Volts. It produced 2 Amps current under full sunlight. So, an obvious curiosity was to test its existing performance, which he did by connecting the module directly to the following two different 12-Volts loads.

a. 35-Watt incandescent light bulb
b. Blower rated at close to 54 Watts

The module, when tested got exposed to an outdoor temperature of about 50 ºF. It easily operated a light bulb and displayed an impressive voltage of 14.93 Volts under a full load of 2.015 Amps. That was not all; the 54-Watt blower was connected directly to the solar panel. Incidentally, the blower began to spin as reported by its owner and drew about 2.5 Amps. Such a realization, vis-à-vis both these load operations, was thought to offer more power than would normally be expected from the factory specifications.

Further analysing the results

Martin, the proud owner of this module, discussed the test results with Raju Yenamandra, a top company official of Solar World. Solar World is an existing owner of the old ARCO Solar factory in California. It is important to mention here that the outdoor temperature was rather cool with an unusually clear sky on the day of the module testing. Thus, the cool temperature conditions helped to obtain a 10% gain in the performance of module. The power output worked out to 36.3 Watts (that is, 33 times 1.1) and the current value obtained was 2.48 Watts (36.3/14.6 Volts). Thus, the panel bearing the serial number, 256 387, still functioned in a satisfactory manner. The manufacturing year was traced back to 1979, during the formative years of ARCO's solar production history.

What has changed between then and now?

There have been quite a few qualitative changes in the module fabrication techniques and accompanying material used in recent times. Like for example, in the early days, ARCO panel used to have simple electric lugs at the backside for wiring. The new generation modules have sturdier junction boxes, marked up by a definite improvement in the use of encapsulate and the lamination material. The earlier designs of modules incorporated polyvinyl butryl or simply PVB, lately replaced by ethylene vinyl estate or EVA. More importantly, there are still no visible signs of browning, electrical corrosion or water seepage in Martin's solar module. Thus, it seems all set to embark on a long journey of active performance yet again.

The issue of regular cleaning of panels

As per the available information, the power loss has totalled about 20% after a lapse of 20 years. Now, after 25 years, the panels produce about 70% of their rated peak electrical capacity in case of the SMUD solar system. It is often a matter of debate, whether regular cleaning of the panels can enhance the power output, more so during long dry spells? The fact of the matter is, that each and every installation shows a definite variation in terms of exposure to sun, rain, snow, dust, hail, and similar other weathering elements. Perhaps, the SMUD field data may not be completely relevant to look at now. After all, the solar equipment

is already 25-years-old and many generations older than what is being installed now. These experiences are not unique to the SMUD location alone, but many first-generation panels, which have had long life spans, owe its origin to Japan.

Recycling results for real

Shrihama Energy Land is a theme park in Japan, showcasing to the theme, "Human and natural energies". It opened up a new solar town and removed about 1700 solar panels. These panels had been installed at this park for about 20 years from December 1989 to February 2009. Prior to this, these panels had been used for research and development/demonstration purposes in Hamamatsu City in the eastern part of Japan. Thus, the panels were already 25-years old and, thus, no longer needed under the new dispensation. Incidentally, a Japanese company, Next Energy and Resources, procured these used panels. This company supports the use of natural energy and runs the PV units recycling centre. It is worth mentioning here that these panels had been in use since the 1980s. The sale of these panels, which were rated to deliver 20–40 Wp, was kick started in April 2009.

The buyer company tested the field performance of nearly 330 panels. Out of these, at least 90% can still generate 80% or more of their rated output. It is quite interesting to note here that such panels would simply have found their way as a waste metal, but for the intervention of the Next Energy and Resources Company. Also, this very company found about 6500 panels with a lifespan of 20 years. These had a total power generation potential of about 300 kilowatts, which may be regarded equivalent to the amount of energy used by about 100 houses or so. The Japanese company does not regard it as a final revelation, but hopes to look for more such invaluable panels, otherwise regarded as sheer waste.

Understanding specific needs

The purpose of this article has been to present case-specific examples of PV systems with extended lifespans

and those with relatively shorter lifespans. The underlying rationale is to understand several core realities, such as the following.

- Variations in the warranties offered in case of solar modules across the geographical regions
- Manufacturing capabilities being at some variance here and there
- Subdued documentation of modules with poor performance being a part of various systems
- Near-absent recognition for a need to test modules beyond their expected lifespan
- Analysing the possible economic gains under the extended lifespan

India-specific outlook

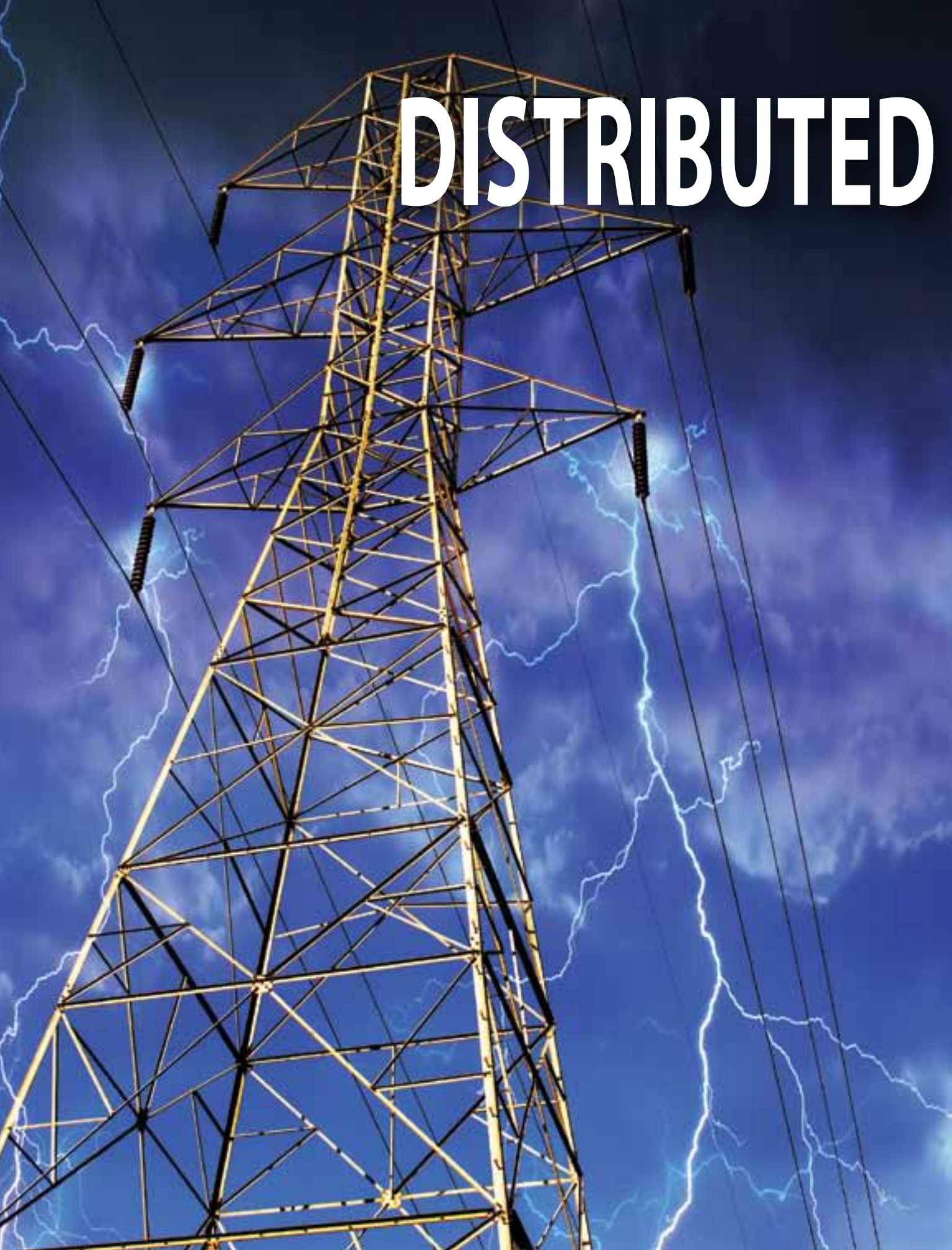
As is widely regarded, the Indian PV programme took off quite early. Under the ambit of which, large-scale demonstration of a wide range of products and systems materialized. The quantitative achievements were taken note of by various interested groups across the world. On the qualitative front, several modified design configurations were adopted for better individual/community gain. However, we are still curious to know whether, the PV modules of yesteryears in the country are performance worthy even today. A few field evaluation studies, concerning the solar lanterns, water pumping systems, street lighting systems, and village power packs, have been commissioned by the concerned Ministry of New and Renewable Energy (MNRE), from time to time. But, the following considerations still merit some attention in the backdrop of our current discussion on extended lifespan of the solar modules.

a. What percentage of modules existing in the field today has survived since the very inception of the PV programme?
b. What course of action has been followed up, with respect to the modules having crossed their expected lifespan?

The definitive purpose of ascertaining this is to know whether PV modules, deployed under the actual field operating conditions locally, are performing as good as those put up in identical/near-identical geographical locations. There is also an added reason to link up economic gains with an increased tenure of field-related modules. It may be beneficial to conduct a nation-wide study to consolidate vital field data on the outdoor module performance, vis-à-vis the lifespan of 20–25 years. The field team may have members drawn up from the academic, research, industry, and development sectors, so as to evolve a common methodology of evaluation and, thereby, practical assessment.

The lasting impression

Technically speaking, a typical solar module may last anywhere between 30–40 years. However, the fact of the matter is that, today, the majority of PV manufacturers include warranties for only about 25 years. In some cases, it covers even less than 20 years, for example, as it is now in India. Also, most of these modules achieve about 80% of their true potential maximum power during their lifetime. Various studies have pointed out that the power output of a solar panel decreases as time advances. There are several field-related reasons too, not just those attributed to the production setup. For example, the environmental factors can also bring down the efficiency of solar panels. Perhaps, the future solar modules may produce much more energy than the old ones. As and when that happens, it may be economically viable to upgrade from older modules to the newer ones. In the case of large-scale PV power generation facilities, this may be a more feasible practice to adopt.


DISTRIBUTED

GENERATION AND SMART MINI-GRIDS

Debajit Palit, Fellow, TERI <debajitp@teri.res.in>

Distribution Generation (DG) started to get prominence after the launch of the Decentralized Distributed Generation (DOG) scheme under the RGGVY (Rajiv Gandhi Grameen Vidyutikaran Yojana) of the Ministry of Power in January 2009. The DOG scheme aims to electrify remote villages in the country where extension of grid electricity is economically daunting.

With these terms gaining significance in the electricity sector, this article attempts to discuss these expressions, their interrelation, significance and relevance, and suggests the way forward to derive benefits through synergy of all the three concepts.

What is Distributed Generation

Since the last decade, technological innovations and a changing economic and regulatory environment have resulted in considerable revival of interest in connecting generation to the distribution network and this has come to be known as DG. However, the expression is used very widely in the relevant technical literatures. Some of the definitions of DG follow herein.

- The European Commission considers DG as a source of electric power connected to the distribution network or the customer site.
- Arthur D Little has defined DG as integrated or stand-alone use of small, modular electric generation close to the point of consumption.
- International Council on Large Electric Systems (CIGRE) refers DG as all-generation units with a maximum capacity of 50 MW to 100 MW, that are usually connected to the distribution network and that are neither centrally planned nor dispatched.
- The Institute of Electrical and Electronics Engineers (IEEE) defines DG as the generation of electricity by facilities that are sufficiently smaller than the central generating plants so as to allow interconnection at nearly any point in a power system.

The reviews of various prevalent definitions of DG, led to its broad definition proposed by Thomas Ackermann and Lennart Soder from the Royal Institute of Technology, Stockholm and Goran Andersson from Swiss Federal Institute of Technology, Zurich. They defined DG as the installation and operation of electric power generation units connected directly to the distribution network or connected to the network on the consumer site. In India, the first attempt to define DG was made by the Gokak Committee in 2002, which referred distributed power to a variety of small, modular power generating technologies that can be combined with energy management and storage systems and used to improve the operations of the electricity delivery systems, whether or not these technologies are connected to an electric grid.

All definitions, however, are in consensus to say that DG can employ a range of technological options (such as engines, turbines, fuel cells, and so on) and can either be connected to the distribution network or be in off-grid mode.

Micro- and mini-grid

A micro or mini-grid is an electricity distribution network operating typically below 11 kV, providing electricity to a localized community, and deriving electricity from a diverse range of small local generators using renewable energy technologies (solar PV, wind, small hydro, biomass, and so on) and/or fossil fuels (diesel, gas), with or without its own storage (batteries), depending on the technology. Conceptually, micro or mini-grid's may be viewed as a framework accompanying growing deployment of DG, especially renewables-based, for meeting demand for power access, availability, quality, and reliability.

The concept of mini-grids was pioneered in India in the Sunderban Islands in the late nineties with the establishment of solar power plants-based mini-grids by the West Bengal Renewable Energy Development Agency (WBREDA). Later on, the concept was replicated in various other states under various programmes of Ministry of New and RenewableEnergy (MNRE) such as RVE, Village Energy Security Programme Renewables (VESP)-based off-grid technologies such as solar PV, mini/

micro hydro, biomass gasifiers, biofuel-powered generator, and small wind aero generators in hybrid mode have been disseminated in areas, which are either inaccessible for extending macro grids, such as remote, hilly, and forested villages or hamlets, which are not recognized as villages as per the 2001 Census of India. Even in non-remote locations, autonomous micro-grids sometimes are found to be the preferred option for augmenting electricity supply in such areas or extend the reach of electricity to populations, which do not opt for utility connections. Privately owned diesel generators or biomass gasifiers, set up by Husk Power and DESI Power, supply electricity (usually referred to as *choti bijli* in local parlance) to the rural markets, small enterprises, and economically better-off households on a light point basis in many villages, especially in the states of Bihar and Uttar Pradesh.

Though, off-grid DG projects has been quite successful as a pre-electrification option for limited electricity services such as lighting and entertainment, various studies indicate community's aspiration for longer hours of electricity supply and preference for grid power. The key reason seems to be the ability of the grid to act as a balancing sink or source and also supplementing power in the local area during periods of DG plant shutdown. Further, off-grid projects usually have small capacity generators, typically in the range of 2 kW to 100 kW, and are not suitable to powering productive loads and irrigation pump sets. However, it is also observed that many of the off-grid electrification projects could not be sustainably run because of low load density in the remote villages. On the other hand, in case of grid-connected projects, the productive load, irrigation pumps, and agri-processing can be served on demand. It is interesting to mention here that whereas the off grid community perceive, grid-connected projects can enhance the reliability and quality of power supply, the *choti bijli* concept proves beyond doubt the efficacy of grid power in the rural areas of the country.

Another key reason for the limited success of the off-grid electrification projects is that most of the projects are not financially viable. The remoteness of the projects increases the capital cost, operation, and maintenance costs, and in turn the cost of generation and supply. Added to this is the low paying capacity of the consumers in the absence of any disposable income in such areas. The financial non-viability results in closure of these projects after few months of operation. This not only makes the villages de-electrified, but also renders these projects, set up with capital subsidy from the government, as dead infrastructure. A World Bank study on 'Welfare Impact of Rural Electrification' also indicates that off-grid investments usually have a lower rate of return than grid extension, because the costs are more and the benefits are less.

Though the issue of high cost of supply and low paying capacity is also prevalent in remote villages having utility's grid network, the issue gets addressed through regulatory measures such as cross subsidization of the consumer tariff. However, such measures are not extended to the off-grid DG projects, as the Rural Electrification Policy provisions permitting stand alone systems for rural areas allows people, exempted under the eighth proviso to Section 14 of Electricity Act 2003, to be free from licensing obligation and purview of the Appropriate Commissions in matters pertaining to the determination of tariffs. The policy further allows fixation of retail tariff through mutual consultations between the energy service provided and the consumers.

With off-grid projects not covered under the usual tariff setting by SERCs, the benefits of cross subsidization is not extended to rural consumers of such projects, which otherwise could have helped in achieving financial viability of these projects. It seems that the perception of non-viability of off-grid projects is one of the key reasons restricting the progress and success of the DDC scheme. The scheme envisaged involvement of project developers, such as corporates, suppliers, equipment manufacturers, NGOs, SHGs, cooperatives panchayats, and individuals, to set up projects in remote areas. Under the scheme, 90% of the total project cost (capital cost and soft cost) is provided to the project developers through the

state implementing agency as subsidy. The balance 10% can be arranged by the implementing agency or the project developers at their own or taken as loan from any financial institution or Rural Electrification Agency. In addition, the scheme also speaks of providing operational subsidy (up to a certain limit) to meet the gap of revenue collection and cost of operation of such DG projects.

Viability of DG mini-grids: alternative options

Two alternative options are suggested to bring in the much needed viability of DG-based mini-grid projects, whether in the off-grid or grid-connected mode. These are as follows.

- Extending the tariff fixation by regulators in case of off-grid power projects and providing cross subsidy to the project developers from a universal service fund. The universal service fund can be worked out through a suitable mechanism from the cross subsidization amount and or deploying savings out of the reduction in kerosene subsidy, which otherwise is used for lighting in such un-electrified villages. However, for such cases, monitoring mechanism has to be developed to see that only the functional plants are beneficiaries of the subsidy amount. The above option can be attempted for off-grid villages where grid extension is economically daunting.
- In case of partially electrified villages or power starved villages, DG projects interconnected to the utility distribution grid could be attempted. These DG projects could utilize the locally available renewable energy resources to generate and ensure availability of quality power in such villages and also provide tail-end voltage support to the utility grid. While DG with mini-grid is an appropriate concept and will work with the exercise of matching the load profile with generation mix, the grid connectivity can take care of uneven load profile in the rural areas. Thus, the DG with local mini-grid, which could work off-the-grid, but, when needed, also have the compatibility of being connected with the macro-grid, can be an appropriate option for the above mentioned villages. However, grid connection at the distribution level may be a challenge in India due to various technical reasons and limited experience of connection at the distribution voltage level. There are only few such examples of interconnection of small generators at the distribution network in India such as the Ramgarh mini-hydel plant in Uttarakhand, Biomass Energy for Rural India (BERI) gasifier project in Karnataka, and rooftop PV systems in Kolkata.

Issues of grid interconnection

Interconnection of DG systems with the electric power network has recently started to be seen as a technology that can change the traditional method of electricity delivery and provide multiple advantages to the electricity suppliers and end-customers.

Distribution network traditionally have been designed to take power from high voltage grids and distribute to end consumers at lower voltages. The interconnection of DG to the distribution networks will not require any major changes to the system where the DG unit does not actually send power into the network. However, power export to the distribution network from large number of DG units, with varying capacity and fuel mix, may alter the flow of electricity and affect the stability of the network. The survey of various international literatures indicates that the integration of generators in the distribution networks may result in technical problems such as excessive voltages, increase in fault levels, voltage unbalance, overloading, and so on, especially when penetration of distributed generators becomes high.

The cardinal principle of grid interconnection of DG units is that the distribution network should not be unacceptably affected by the DG unit ,that is, the quality of supply to the consumers should be maintained at all times. Conversely, the distribution systems should not damage the DG unit's equipment, and the generator should be able to operate and evacuate power to the grid as intended. Depending on the application and operation of the DG unit, the interface can represent a complex parallel interconnection, or can be non-existent when the DG unit is operated in isolation. The complexity of the interface increases with the level of interaction required between the DG project and the distribution electrical grid. Complexity also varies by whether single or multiple generators are interconnected.

Introducing smart grid

Making the grid smarter will not only address the issues of physical interfaces and interconnection, such as safety, protocols, system impacts, reliability, standards, metering, and real time monitoring, the market interfaces encompassing dispatch tariffs, business, and operational transactions will also get addressed substantially. In case of DG-based mini-grid projects in off-grid mode, smartness can be introduced through remote monitoring of the actual generation and consumption.

But, what is smart grid and how relevant is the concept is for India. The 'USAID White Paper on Smart Grid'

defines the smart grid as the integration of information and communications technology into electric transmission and distribution networks. The smart grid delivers electricity to consumers using two-way digital technology to enable more efficient management of consumers' end uses of electricity as well as the more efficient use of the grid to identify and correct supply demand-imbalances instantaneously, and detect faults in a "self-healing" process that improves service quality, enhances reliability, and reduces costs. Thus, the smart grid concept is not confined to utilities only; it involves every stage of the electricity cycle, from the utility through electricity markets to customers' applications. The evolution of smart grid can be mapped broadly in the following sequences—Manual Meter Reading to Automatic Meter Reading to Advanced Metering Infrastructure to Smart Meters to Smart Grid.

Adoption of smart grid in India

The factors that are expected to drive the adoption of DG and smart grid in India could be one or more of the following.

- *Peak load management*: India's supply shortfalls are expected to persist for many years. While the DG can meet the local area demand, thereby reducing the peak load demand, their smart interconnection to the macro-grid with appropriate feed-in tariffs for the off-grid generator will not only ensure supply of excess electricity to the macro-grid, the off- grid consumers can get shielded from adverse pricing by blending the cost of off-grid generation with the average weighted price of electricity used in the tariff.
- *Loss reduction*: India's aggregate technical and commercial losses are thought to be about 25%–30%, but could be even higher given that a substantial fraction of the population is not metered. Smart distributed power generation systems and automated meter reading (which can assist to collect meter data rapidly and accurately) of off-grid and on-grid consumers can greatly reduce these losses and improve the reliability of the grid network. The remote disconnection and reconnection of customers, not paying their bills, can also be done through automated meter reading.
- *Access to remote and inaccessible areas*: In many parts of the country, extension of the grid may not be economically feasible. In such cases, DG can play a major role. The performance of such DG projects can be remotely monitored through smart command and control mechanism and the cross subsidy implemented for sustainability of such projects.
- *Optimal use of the existing grid:* Inadequacies in distribution network have been one of the major reasons for poor supply of power. For the Indian rural grid system, where voltage drop at the tail-end of the feeder is a recurrent problem, a smarter distribution network with tail end voltage support by DG units can facilitate optimal use of the grid, thereby improving the reliability of the grid network, especially in the rural areas.
- *Interconnection of distributed generation to distribution network*: Installation of smart control devices will assist in easy connection of renewable energy sources to the macro-grid, and exchange information and commands with the energy dispatch centre to integrate wind generation, small hydro, micro hydro, solar, and similar supply side technologies into the power system network. Smart devices on the distribution system, equipped with remote reading capability, could make the collection of field data from such projects automatic and accurate. This will help the utility improve its planning process and optimize the resources deployed in power restoration.

Conclusion

The "smart" factor in a smart mini or macro-grid is the information and communication technology—an area of unique capability in India. Quite obviously, considerable further work is required for the development of understandings and mechanism, by which a large number of DG projects with local grids can be smartly interconnected to regional macro-grids not only for improving the power availability and reliability of the grid network, but also improving the viability of the DG-based local mini-grid projects in providing improved access to electricity. The convergence software and hardware will provide the much-needed smartness to the mini-grid systems and their interconnection to the macro-grid to ensure better availability and higher reliability of power not only in town and cities, but also in the remote villages to ensure technology based 'inclusive development' in the country.

This article first appeared in *Electrical India*, October 2010, Volume 50, Number 10

Solar appliances

INSTALLATION AND MAINTENANCE ISSUES IN RURAL AND URBAN AREAS

Dr Suneel Deambi
Consultant, TERI
<sdeambi@airtelmail.in>

Background

Each one of us wants to bask in the sun during the winter months. However, today, many people, especially in the countryside, bask in sunlight almost throughout the year. Here, I am referring to the use of solar energy products and systems for meeting various end-use applications, such as the lighting, water pumping, battery charging, and so on. So far so good, then what is the pressing issue at hand? Obvious enough is the fact that solar installations need to be need to be reliable and safe, and tamper proof, performing well. Today, there are a large number of solar systems, deployed across the country, with varying levels of field performance reliability. This article tries to analyse issues that are important from the point of view of physical and technical performance standards.

The rural sun

Solar systems and applications are delivered to remote villages by the manufacturers, with active cooperation from the local offices of the state nodal agencies for renewable energy. The users, by themselves, are incapable of judging the field worthiness of the systems being put up under the ambit

of various central and state government programmes and schemes. By and large, the beneficiaries of the solar systems keep a regular vigil on their solar belongings, as this lights up both their houses and immediate surroundings every evening. However, there is a need to keep a closer watch on the solar systems and have reserve spare parts within easy reach of the operator, specially trained for the purpose.

The adamant user

Using a solar battery for a non-designated purpose, for example, to run electrical appliances during festivals in the village is not a rare phenomenon. The charge controller, serving as a vital link between a solar module and the battery, is bypassed on such occasions. This leads to battery failure, at times, and renders the solar facility ineffective. Thus, the solar manufacturers must design such a safeguard, which will stop the battery from being used for other purposes. This seems to be easier said than done, as most of us feel that it is easy to connect the two terminals of a battery to the load under consideration.

Right positioning of a solar module

The solar module, to be used for an indoor lighting system, needs to be properly aligned to the path of the sun to reap the maximum possible benefit. The system suppliers provide the necessary support structure to place the module in accordance with the already worked out tilt angle. However, there have been several cases where hired goons try to rob the poor users of the solar module, which is the most expensive part of the system. Sometimes, they succeed in taking away both the module and the support structure or one of the two. The user then tries to orient the module all by himself/herself in the direction

that he/she feels is best. The module is secured by using modern day methods, failing which, loss of power output may take place due to wrong positioning of the module. In some cases, the hapless villagers lock the module every evening, within the safe confines of their houses. This may, at times, lead to mishandling of the solar module as the glass surface is prone to breakage.

Regular maintenance, an absolute necessity

It is great to see the advertizing signboards, which are now using solar powered, eco-friendly green power rather than the roaring diesel generators of the past, dotting the urban landscape. However, when I look at one of these advertising boards from a metro window, I fail to recognize the power element, that is, the solar module resting on a firm support structure, mainly because of the heaps of accumulated dust on the glass surface of the panel. This, and many such examples, proves that solar systems and appliances require regular maintenance. However, if high surface solar installations are not maintained, the battery charge will definitely decimate earlier than anticipated.

Larger the solar installation, greater the challenge to meet the cost of replacing the battery after every 3–4 years. Now, if, the battery fails to get properly charged during the day, it may

have to be replaced earlier than the time period already mentioned. Various studies have proved that regular cleaning of the panels can reduce about 8%–10% of the wastage.

Possible tie-up in urban areas

Arguably, solar power installations are being set up in cities, not only for showcasing the green energy technology. They are also intended to save some amount of conventional power that would otherwise have to be used for the purpose. The municipal corporations often use mechanized ladders to attend to pole mounted street lights. It may not be possible for a solar company to house such a facility, after it installs a solar system. However, a formal tie-up between a solar installer and the municipal corporation to make use of such a facility for periodic cleaning could perhaps be the solution to the problem. Here, I would like mention the state of Maharashtra, which specially encourages the use of solar power for billboard applications. Similar initiatives should be taken by other city corporations as well. The solar city master plan project of the Ministry of New and Renewable Energy (MNRE) is a sound rejoinder to the evolving role of the municipalities.

Solar needs the recognition

Sunlight brightens up the landscape during the day, but solar applications mainly come alive at night. Nowadays, in many cities of our country, solar energy is applied to illuminate the signboards. However, unfortunately, very few people know about solar installations of this nature. I am reminded here of an effective visual display board put up by the Indian Meteorological Department (IMD) at its office in Lodhi Road, New Delhi. It seems that, today, solar needs a display akin to this one, which clearly highlights its benefits.

Are faulty installations an issue?

Quite a while back, a reputed solar company had put up solar-powered traffic booths at a few busy traffic intersections in Delhi. Apart from exemplifying the use of green power, these were designed to enable the traffic police to control traffic from within a portable cabin. However, after some time these lights were vandalized by some rowdy elements. Since then, I have hardly noticed any such useful installation in the metropolis. Thus, here is something to ponder over—should these installations be customized in a tamper-proof manner? One is reminded of the early solar street lighting installations in a few states, set up under the ministry-sponsored subsidy scheme. The batteries, placed at knee height or even below, often got stolen and either sold of or used for other purposes. Now that is no longer the case in the existing designs of the solar street lighting systems. This means that the altered installation regime has worked well. Table 1 shows the number of PV lighting systems installed during 2007/2008.

The procurement route

All solar systems supplied by the government, whether off-grid or on-grid, have to be procured through normal tendering process? It essentially means that a single solar company, which is successful in the tendering process, will be chosen to make the supplies. This would further mean that solar systems of different companies will be used in different regions of the country, leading to a regular flow of solar products, with the following differences.

a. Physical specifications (as per the tender)
b. Technical specifications (as per the tender)
c. Testing certifications
d. Make of the equipment
e. Volume of supplies delivered
f. Price at which delivered
g. Installation and commissioning guidelines
h. Warranty periods
i. Annual maintenance contracts

This process can help us to identify which solar panel performs relatively better. It can also provide a first hand feel of the physical and technical problems across varying climatic conditions, in different regions of the country. Also, operation and maintenance issues handled in real time can be visualized quite clearly. However, more often than not, such type of information, gathered by various agencies, commissioned for the purpose, is not available in the public domain. Actually, such valuable data should be made available to all stakeholders so that they could gain the desired insights, pending which, the market would continue to be flooded with all types of good and bad solar equipment.

Case specific example

The Ministry of New and Renewable Energy (MNRE) has just released an expression of interest for monitoring and evaluating solar photovoltaic (PV) systems installed in the field during the period 2007–2010. Table 1 gives an idea about the quantitative achievements of three widely used systems—solar home lights, street lights, and lanterns.

Table 1 shows that major concentration of the systems compared in the table is centred in the northern, western, and eastern regions of the country. This also implies field level variability in terms of the end-use, end-user awareness and, more importantly, the operation and maintenance infrastructure, within these specified regions. It is expected that the key outcome of this important field performance evaluation activity will be disseminated through all possible mediums, including the ministry's website. Also one gets to know more easily about the outcome of the systems deployed in other geographical regions of the world, more easily. Perhaps, there should be an enhanced degree of appreciation for such system suppliers, whose field performance record has been exemplary. The existing mode of deciding on the PV procurements through the customary lowest bidding route should be reevaluated. With increasing competition in the Indian market, quality supplies/checks may be made even more stringent.

Table 1 Number of PV lighting systems installed during 2007/08

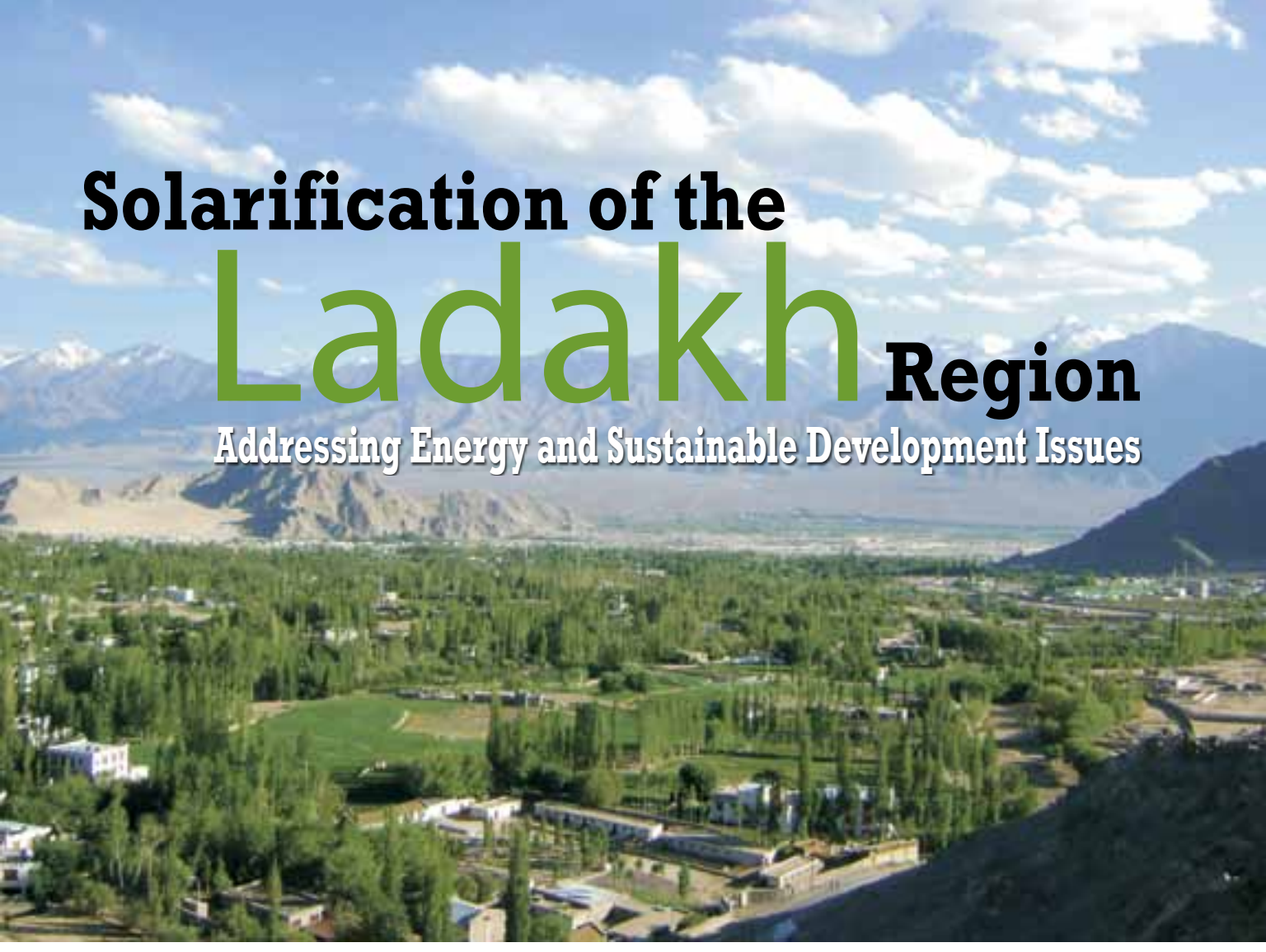
Type of system	Total number delivered (during 2007–2010)	State with highest penetration (during this period)
Solar lantern	132 881	Maharashtra (with a record number of 60 000 during 2007/08
Solar home light	163 394	West Bengal (with about 34 783 numbers delivered)
Solar street light	32 887	Haryana and Uttar Pradesh (with near identical number of 6000 +)

Summing up the perspective

Solar PV systems will always have to confront the intermittent nature of the available sunshine. If, that is set aside for a moment, it should pass through similar end-user expectations as witnessed in the case of conventional electrical appliances. Quality-cum-performance standards are enunciated even for the use of solar products. However, there still are noticeable variations along these key considerations, while shifting from one accredited source of supply to the other. Perhaps, the answer lies in extending the scope of independent observations of PV system use at many nodal points across the country.

Solarification of the Ladakh Region

Addressing Energy and Sustainable Development Issues



Dr Ishan Purohit, Lahmeyer International India Pvt. Ltd, Gurgaon (India) <drishanpurohit@gmail.com>

This article is dedicated to the people of the Ladakh region who lost their lives in the cloudburst in 2010.

Background

Energy is one of the prime movers of both economic and sustainable development. It is closely linked to the key contemporary global challenges that the present day world faces, such as social development, poverty alleviation, environmental degradation, climate change, besides issues of food security. As such, it is a defining issue. Simultaneously though, there has to be an appropriate balance between the ever-growing demand for energy and an urgent need to protect the environment and the climate. The case in point is the Ladakh region, the land of high passes, located in the northernmost part of India.

Ladakh is a land-based economy and follows a typical socio-cultural pattern of living. Being a mountainous desert, this region is confronted with several vexing issues.

- Difficult topography
- Extreme climate
- Variation in weather conditions
- Isolated location of villages
- Low income level of households

The biggest challenge is to provide energy solutions to the rural people of the Ladakh region. Leh has been effectively destroyed by the cloudburst this year and the challenge is to build a new township in the region. Using solar energy technologies in the buildings

could effectively solve energy-related issues of the region.

The existing power line

The existing demand for power is about 90 MW. As of now, more than half of this demand is being met with the help of expensive diesel generators. Conservative estimates suggest that the power development department, together with defence establishments and other appendages of the government are consuming kerosene worth ₹12 000 million a year for lighting purposes alone. This is bound to have a huge impact on the region's fragile ecology.

The energy deficient Ladakh region receives massive government investment in the power sector. The underlying rationale is to lessen the dependence of this ecologically fragile region on polluting diesel-generated power. Undoubtedly, there is great shortage of power in the region, thus, constraining the development of all other sectors. The region lacks the presence of any internal energy resources, which is why, fossil fuel is brought from external sources.

Making a strong case for the use of renewable energy

The way forward for Ladakh with respect to its power and energy requirements clearly lies in the field of renewable energy sources. The potential for solar and micro-hydro-generated energy exists in abundance in Ladakh, and even geothermal and wind energy possibilities are present in certain pockets.

The Ministry of New and Renewable Energy (MNRE) has recently prepared a plan of action for the large-scale utilization of renewable energy technologies with a total financial requirement of ₹4730 million. It envisages implementation of large-scale use of solar energy technology in the region. The hydro projects in the region have their own limitations mainly because of the sub-zero temperatures in the harsh winter months when the water freezes.

However, solar intensity over the region is usually high throughout the year, because of geographical conditions and very little rainfall. Also, the energy use pattern of the region is ideal for the development of solar energy technologies. The present article is an attempt to present a preliminary analysis of the sustainable energy supply in the Ladakh region, which can also fulfil the demand of decentralized energy in the region. The region is currently under the process of resettlement, following the recent cloudburst. Expectedly, the incorporation of solar technologies, under the ambit of various schemes, can lead to secure and sustainable energy supply.

The Ladakh region

Geography

The Ladakh province of the state of Jammu and Kashmir is surrounded by two of the world's mightiest mountain ranges, namely the Karakoram in the north and the Himalayas in the south. This region is separated from the rest of the state by high mountains, dissected by passes at various points, ranging from about 9000 feet at Kargil to 25 170 feet at Saser Kangri in the Karakoram Range. Ladakh is the highest plateau of the Indian state of Jammu and Kashmir with much of it being over 3000 m. It lies between 32 ° to 36 °N latitude and 75 ° to 80 °E longitude. Contemporary Ladakh borders Tibet to the east, Lahaul and Spiti to the south, and the Valley of Kashmir, Jammu, and Baltiyul regions to the west. The Suru and Zanskar valleys form a great trough enclosed by the Himalayas and the Zanskar range. Rangdum is the highest inhabited region in the Suru valley, after which the valley rises to 4400 m at Pensi-la, the gateway to Zanskar. Kargil, the only town in the Suru valley, is the second most important town in Ladakh. The Indus river is the backbone of Ladakh and most of the major historical and current towns namely Shey, Leh, Basgo, and Tingmosgang, are situated close to the Indus river. Ladakh is one of the highest and coldest inhabited regions in the world. With an area of about 97 000 km^2, the Ladakh region covers about 70% of Jammu and Kashmir's land area and is split into two districts namely Leh and

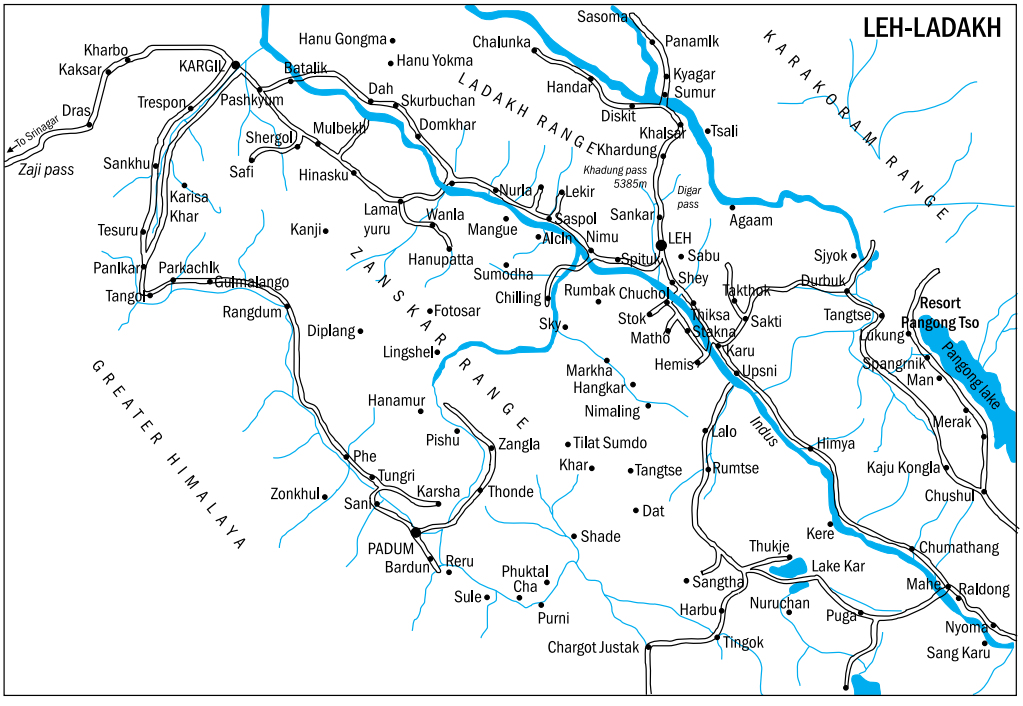


Figure 1 Map of Leh-Ladakh