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Akshay Urja

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Saurabh Motiwala, in this article, discusses the criticality of energy yield assessment for solar projects. The objective of this article is to present readers with an overall idea of the procedure and importance of energy yield assessments carried out for any solar project.

Professor Chetan S Solanki brings out how and why the solar PV technology route for cooking can now begin and overtake the solar thermal route for cooking. He also says that solar PV cooking solutions can fulfill all domestic cooking needs and can be customized ...

Dr Shashank Vyas from TERI put theory into practice and made reduced carbon footprint a way of life...

I liked reading the apt information on 'RE in Union Budget 2018/19' published with the editorial column in the latest issue of ***Akshay Urja***. It is heartening to note that the Indian government is giving good impetus to installation of renewable energy capacity in the country. In this regard, the MNRE Secretary's statement that "India would achieve its target of 15 GW of installed renewable energy capacity well before 2022" should be seen as a positive sign by all Indians. Obviously, over the years renewable energy has become cheaper and is set to replace conventional energy, which is a healthy development. I must thank MNRE and TERI team for such an informative publication.

Dr Divakar Mohite
Indore, Madhya Pradesh

The cover story article published in the December 2017–April 2018 issue is a well-compiled article on the Founding Conference of the International Solar Alliance that was held in New Delhi in March 2018. It was a proud moment for India as it was attended by Heads of State/ Heads of Government, dignitaries from the United Nations, Presidents of Multilateral Development Banks, and global funds/financial institutions, leaders from energy-related institutions, corporate sector, and civil society. The Joint Declarations of Financial Partnerships were also signed during the event to deepen the cooperation in support of renewable energy. I also liked the designing and the overall layout of the magazine.

Prabhashakar Trivedi
Pune, Maharashtra

I am a regular reader of ***Akshay Urja*** magazine since the last 10 years. The magazine has been improving in all the aspects over the last many years. In this issue, I liked the Special Feature on Saubhagya scheme. In line with the global target to achieve universal electrification, the Indian government launched a new scheme, Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya),in September 2017 to achieve universal electrification for urban and rural households in India by March 31, 2019. The author rightly points out that electricity delivered to the rural areas must be priced rationally and the tariff structure is simplified for the consumers so that they easily understand the bill and their willingness to pay increases and at the same time it is financially viable for the DISCOMs to serve.

Abhishek Sarkar
Ranchi, Jharkhand

In the feature article on Energy Sector Transitions published in the latest issue of the magazine the authors have discussed some of the key energy sector transitions in India as well as in the world and feel that despite the resilience of oil demand, much of the changes in the energy sector are being made with the long-term aim of decarbonization. I also liked reading the Technology Focus article on optimizing transmission from large RE farms. The article is an eye-opener as it informs that at current costs, energy storage may not provide sufficient benefits, but with time, as the costs fall, it will start to play a more important role for large renewable energy farms.

Aryan Rawat
Dehradun, Uttarakhand

I am a BSc (Hons.), Physics student in Patna University and I make it a point to read this quarterly magazine cum newsletter published by the Ministry of New and Renewable Energy, GoI. Although instant information is available 24x7 on the Internet but ***Akshay Urja*** is still very much relevant as it presents well-researched articles and case studies to its discerning readers. When the current issue of the magazine was published on a later date, I was fearing for the worst that it should not be discontinued. I was very happy to receive the latest and combined issue of the magazine.

Salim Ansari
Patna, Bihar

The feature article on maximizing solar power generation by making use of existing roofs is an excellent article as it outlines various aspects of solar photovoltaic (SPV) systems on rooftops, including evaluation of existing roofs where SPV systems can be safely installed. I agree with the author that although SPV systems are being installed on the roofs of newer constructions, a large potential is available for generating solar power using unutilized roof spaces. It is now attractive and economical to install SPV systems over existing roofs considering the on-grid system promoted by DISCOMS.

Aradhana Shukla
New Delhi

Dear Reader, Thank you very much for your suggestions and encouragement. The editorial team of *Akshay Urja* 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 improvements in the content and presentation.

Editor, *Akshay Urja*

सत्यमेव जयते

आनन्द कुमार
ANAND KUMAR

सचिव
भारत सरकार
नवीन और नवीकरणीय ऊर्जा मंत्रालय
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF NEW AND RENEWABLE ENERGY

Message

Transformation of the world's energy landscape is well-underway. India is a part of global renewable energy transition and stands today among the top five countries of the world in terms of renewable energy capacity. We have made remarkable strides during last four years. Significant cost reductions in renewables have finally made them a serious mainstream power supply option. With 70 GW capacity on ground, and 40 GW at different stages of fruition, we are well on the way to exceed the 175 GW target by the year 2022. We have worked systemically for putting in place facilitative policies and programmes for achieving the goal. Waiver of inter-state transmission charges for sale of solar and wind power; Renewable Purchase Obligation trajectory; competitive bidding guidelines for procurement of solar and wind power; flexibility in generation and scheduling of thermal power stations; solar-wind hybrid policy; solar PV manufacturing linked with assured take-off; standards for deployment of Solar PV systems are some of the major initiatives.

Key clean energy technologies have been growing faster than many experts predicted. Solar and wind power have already touched cost competitiveness. Innovations are shepherding the renewable revolution. A team of MIT researchers has demonstrated that theoretically predicted ceiling for converting sunlight into electricity of about 32 per cent, called the Shockley-Queisser Limit, can be far exceeded. All across, renewables are witnessing disruptive innovations. As such in the face of the global warming challenge, renewable energy holds massive potential for meeting humanity's energy needs over the long term while cutting greenhouse gas emissions.

India is the global host of the 2018 World Environment Day on 5 June , 2018. This day is celebrated to raise awareness about the importance of a sustainable environment and to rededicate ourselves for addressing the issues confronting sustainability of resources and environment. Renewable energy is central to sustainable energy transition and climate change mitigation. Our focused efforts are towards hastening renewable energy transition.

I am sure the present issue will be successful in providing you a panoramic view of last 4 years achievements in renewable energy. Over the period, Akshay Urja newsletter has been successful in disseminating information on dynamic and ever evolving renewable energy programmes and policies. Readers' feedback has always been of immense value in shaping up our initiatives. I invite you to write to me about your thoughts, suggestions and ideas for improving our effectiveness. I assure you of a response.

With best wishes

[Anand Kumar]

अक्षय ऊर्जा से देश विकास
गांव गांव बिजली, घर घर प्रकाश

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From the Editor's Desk

Dear readers,

In his message to this issue Secretary, MNRE, has observed that innovations are shepherding the renewable revolution. Indeed, we are witnessing innovation in every sphere—policy support, technology improvements, and cost reductions. These are transforming renewable energy sector, and the virtuous cycle is unlocking the economic, social, and environmental benefits of renewables in the country.

With his permission, we reproduced Shashank's blog "*From Lab to Room—How I Integrated Renewables in My Life*". Today when everybody is on the e-mobility bandwagon, Shashank purchased an electric two-wheeler five years back. His pursuit is amazing in all respects, particularly for the conviction, and sincerity of approach—which pours from and into the heart. I am sure you will enjoy reading his experiments with renewables.

Prof. Chetan S Solanki has examined innovations in solar PV cooking in detail. He has calculated that a 350–400 Watt PV module, with 1 kW induction cookstove and 1,300 Wh battery storage would be sufficient for 2-member family to cook three times a day. Standardization of design and mass scale deployment has potential to not only lead to significant cost reduction, but also providing an option for clean cooking.

Our consistent efforts are aimed towards increasing the visibility, impact, and the overall quality of *Akshay Urja*. We have planned the next issue to be from ground zero, which will capture the India renewable rainbow where people speak of renewables that is with them or in their neighbourhoods.

I hope that the readers find the issue interesting.

P C Maithani
pcmaithani@nic.in

Plastic Waste into Fuel Using Solar Power!

Scientists from Indian Institute of Technology (IIT) Madras have developed a solar powered system to convert non-recyclable plastic into fuel that can substitute diesel used in generators, furnaces, and engines. The technology—which consists of a mobile unit that can collect and process waste—currently yields around 0.7 litres of fuel oil per kg of plastic, researchers said. "India produces approximately 15,000 tonnes of plastic waste in a day. Centralized systems for plastic waste management cannot work to effectively deal with this much plastic waste on a daily basis, said Ramya Selvaraj, a research student at the IIT Madras in Tamil Nadu. "We thought that if the plastic can't come to the industry, let the industry come to the plastic," Selvaraj said. The team showcased its project on the occasion of the World Environment Day on June 5, 2018, hosted by the United Nations (UN) in New Delhi. The theme of this year's World Environment Day was 'Beat Plastic Pollution'.

The conversion of plastic to fuel involves a process called pyrolysis—a thermochemical treatment that exposes the material to high temperature in the absence of oxygen, leading it to go through physical and chemical changes. This creates a low density fuel oil by breaking down the polymer chain of plastic at the temperature of 350–500 °C. This oil can be used as a substitute for diesel to power generators, furnaces, and engines. "Our major proposition was instead of taking technology to waste, taking all the waste to a decentralized technology which is a very complex model in solid waste management," said Aravind E S, a research student at IIT Madras. "We found that the current plastic waste management systems were not working because of the logistics involved; there were cost and space requirements that could not be met," Selvaraj added. The IIT Team had won the Zero Carbon Challenge 2018, which included initial funding of ₹ 5 lakh for developing the prototype, and another ₹ 10 lakh for incubating the idea.

Source: http://www.dnaindia.com/

Low Viscosity Fuel Oil from Plastic Waste

Researchers from IIT Guwahati have successfully converted packaging plastic waste to plastic-derived oil (PDO), which has characteristics similar to diesel. Low- and high-density polyethylene (LDPE, HDPE) and polypropylene are commonly used as packaging materials and end up in the waste stream. The researchers collected the waste (biscuit wrappers, shopping bags, food containers, shampoo bottles) from houses, cleaned and segregated them according to the resin identification code. These codes on plastics indicate the type of plastic resin it is made of. Using a semi-batch reactor, the different wastes were heated for six to seven hours at 300–400 °C. "Heating at very high temperatures in inert conditions caused the plastic to convert into wax, so we chose this particular temperature range in which the plastic turned to plastic-derived oil and stayed in its oil state," explains Pallab Das, PhD scholar at the institute and first author of the paper published in Resources, Conservation and Recycling. But burning plastic waste generates pollution, particularly dioxins which are toxic to humans. "There is no oxygen in the three plastic wastes that is heated that we are also not supplying any oxygen. Pyrolysis is done under inert conditions. Only hydrocarbon gases such as methane, ethane and propane were produced and there was negligible amount of carbon dioxide and carbon monoxide produced," says Das.

Source: http://www.thehindu.com/

RENEWABLE ENERGY NEWS

DIU SMART CITY BECOMES THE FIRST TO RUN ON 100% RENEWABLE ENERGY DURING DAYTIME

Diu Smart City has become the first city in India, which runs on 100% renewable energy during daytime setting a new benchmark for other cities to become clean and green. Diu had been importing 73% of its power from Gujarat until last year. It has now adopted a two-pronged approach, whereby a 9 MW solar park spread over 50 ha of rocky barren land has been developed besides installing solar panels on the rooftops on 79 government buildings, thereby generating 1.3 MW annually. To further enhance its solar capacity, Diu offers its residents a subsidy of ₹10,000–₹50,000 for installing 1–5 kW rooftop solar panels. Diu is saving about 13,000 tonnes of carbon emissions every year. Due to low-cost solar energy, power tariffs have been cut in residential category by 10% last year and 15% this year.

To improve traffic management in Bengaluru Smart City, a prototype of an intelligent traffic management solution is currently being tested in collaboration with the Electronics City Township Authority (ELCITA). It will provide traffic information that is currently unavailable and will help improve management of commuter traffic. It involves capturing video streams from several cameras and processing them using artificial intelligence so that typical traffic management tasks, such as vehicle detection, traffic density estimation, and control of traffic lights can be automated for real-time performance.

Source: http://pib.nic.in/

EESL FLOATS SECOND TENDER FOR ACQUIRING 10,000 EVs

Energy Efficiency Services Ltd (EESL) has floated a second tender to procure an additional 10,000 electric vehicles as part of the government's national e-Mobility Programme launched earlier. In 2017, the company had come out with a similar tender for 10,000 electric vehicles (EVs) which was won by Tata Motors. The winning bid was also matched by Mahindra & Mahindra. So far, both companies have delivered around 500 such vehicles. These EVs will be leased to government departments and various ministries to replace their existing fleet of petrol- and diesel-run vehicles.

According to an official statement by the Ministry of Power, 20,000 electric cars will help save over 5 crore litres of fuel every year and a reduction of 5.6 lakh tonne of annual carbon dioxide emissions. "Electric vehicles makes sense from the point of view of both the environment and the economy. The future is electric. My message to the industry is to come and invest in manufacturing of e-vehicles and batteries," said Shri R K Singh, the Minister of State (IC) for Power and New & Renewable Energy while launching the National e-Mobility Programme. He added that the per kilometre cost for an electric vehicle is just ₹0.85 as compared to ₹6.5 for normal cars and the switch to electric will also help the country reduce expensive petroleum imports.

Source: www.fortuneindia.com

INDIA'S FIRST INDUSTRIAL SOLAR MICROGRID COMMISSIONED IN GUJARAT

Swedish-Swiss multinational giant ABB has commissioned India's first industrial solar microgrid at its Vadodara manufacturing facility in Gujarat. The Vadodara factory is ABB's largest facility in India with over 3,000 employees and is amongst its biggest manufacturing hubs in the world. "The microgrid is the first-of-its-kind to be installed at a manufacturing campus in India and will harness the area's abundant solar energy supply to help the expanding factory meet its growing electricity needs, while lowering its carbon footprint," the company said in a statement.

The microgrid's rooftop photovoltaic field and its battery-energy storage system will support the factory's productivity and enable green power supply. A sophisticated control and automation system serves as the brain of the microgrid which ensures maximizing renewable energy use. The facility's carbon footprint is expected to be reduced by around 1,400 tonnes of carbon dioxide per year. "Growth demands power and access to clean, reliable electricity sits at the heart of India's economic development," said Claudio Facchin, President of ABB's Power Grids Division. "The solar energy-driven ABB Ability microgrid at our Vadodara campus reinforces our commitment to clean energy as we lead by example to enable a stronger, smarter, and greener grid," he added.

Source: energy.economictimes.indiatimes.com

MAHARASHTRA'S TOY TRAIN STATIONS TURN GREEN

The four stations of Central Railway's Matheran Hill Railway in Maharashtra's Raigad district have turned 'green' with the installation of solar power and wind energy plants. Sunil Udasi, the Chief Public Relations Officer, Central Railway said in a statement that on the installation of Green Energy System, the generation capacity of each system at four stations—Jummapatti, Waterpipe, and Aman Lodge is 75–80 kWh, while at Matheran, it is 680–690 kWh per month. All these four stations are now provided with a solar power plant of capacity 500–1,000 Wp and windmill of capacity 6.1 KWp at Matheran including energy-efficient LED lights and fans. The electric supply from the renewable sources will bring down the hill railway station's power bill drastically resulting in savings of ₹2.07 lakh per year, besides reducing its carbon footprints.

The Matheran Hill Railway is a narrow-gauge heritage railway in Maharashtra. A delight to the tourists and the route to the summer destination for Mumbaikars, the line covers a distance of 21 km, cutting a swathe through dense forest in the Western Ghats from Neral to Matheran.

Source: The Economic Times

MNRE CALLS FOR 'EXPRESSION OF INTEREST' FOR FIRST OFFSHORE WIND ENERGY PROJECT OF 1,000 MW CAPACITY

The National Institute of Wind Energy (NIWE), an autonomous body under the Ministry of New and Renewable Energy (MNRE), has called for 'Expression of Interest' (EoI) for the first offshore wind energy project of India. The global EoI is intended to shortlist prospective offshore wind energy developers for a 1,000 MW offshore wind energy project in the Gulf of Khambat, off the coast of Gujarat. The proposed area is located 23–40 km seaward side from the Pipavav port. MNRE plans to install at least 5 GW of offshore wind capacity by 2022. As per the National Offshore Wind Energy Policy notified on October, 2015, NIWE, Chennai is the nodal agency to carry out the necessary studies/surveys before the final bidding and acts as a single window for facilitating the necessary clearances required for the development of offshore wind projects in India.

The first offshore LiDAR was installed in the Gulf of Khambhat in Gujarat for measurement of wind resource and NIWE is collecting wind speed data from November, 2017 onwards. Areas off the coasts of Gujarat and Tamil Nadu are the two identified areas for the development of offshore wind power. The second LiDAR would be installed off Tamil Nadu coast by September 2018. In addition, NIWE is planning to set up few more LiDARs for assessment of offshore wind resources. Besides, necessary geo-technical and geo-physical studies off the coast of Gujarat and Tamil Nadu are underway.

Source: http://pib.nic.in/

MNRE ISSUES NATIONAL WIND–SOLAR HYBRID POLICY

The Ministry of New and Renewable Energy, Government of India, issued the National Wind–Solar Hybrid Policy on May 14, 2018. The objective of the policy is to provide a framework for the promotion of large grid-connected wind–solar PV hybrid system for efficient utilization of transmission infrastructure and land. It also aims at reducing the variability in renewable power generation and achieving better grid stability.

On technology front, the Policy provides for an integration of both the energy sources, that is, wind and solar at AC as well as DC level. The Policy also provides for flexibility in the share of wind and solar components in the hybrid project, subject to the condition that, rated power capacity of one resource be at least 25% of the rated power capacity of other resource for it to be recognized hybrid project. The Policy seeks to promote new hybrid projects as well as hybridization of the existing wind/solar projects. The existing wind/solar projects can be hybridized with higher transmission capacity than the sanctioned one, subject to the availability of margin in the existing transmission capacity. The Policy provides for procurement of power from a hybrid project on tariff-based transparent bidding process for which the Government entities may invite bids. The Policy also permits use of battery storage in the hybrid project for optimizing the output and further reduce the variability. It mandates the regulatory authorities to formulate necessary standards and regulations for wind–solar hybrid systems. With significant capacity additions in renewables in the recent years and with Hybrid Policy aiming at better utilization of resources, it is envisaged that the Hybrid Policy will open-up a new area for the availability of renewable power at competitive prices along with reduced variability. A scheme for new hybrid projects under the policy is also expected shortly.

Source: http://pib.nic.in/

MNRE SETS UP THE BIGGEST SOLAR POWER PLANT IN UTTAR PRADESH

The Hon'ble Prime Minister of India, Shri Narendra Modi, and the French President Mr Emmanuel Macron inaugurated Uttar Pradesh's biggest solar power plant of 75 MW (101DC) capacity in Mirzapur on March 12, 2018. Built at a cost of around ₹528 crore, the 75 MW solar plant at Vijaypur village in Mirzapur, will generate 13 crore units of electricity per annum.

The power plant has been set up by the French firm ENGIE through a transparent bidding process under the Solar Park Scheme of the Ministry of New and Renewable Energy (MNRE), Government of India. The electricity generated by the project will be supplied by ENGIE at the rate of ₹4.43 per unit for a period of 25 years. Viability Gap Funding (VGF) for the project at the rate of ₹74.25 lakh per MW has been provided by the Government of India for the project. With the inauguration of 75 MW power plant in Mirzapur by the Prime Minister, the total capacity of solar power plants in Uttar Pradesh has gone up to 165 MW. Shri R K Singh, Union Minister of State (IC) for Power and New & Renewable Energy, said on this occasion that India is amongst the pioneering countries in promoting the use of solar power. India has set up an ambitious target of setting up of 1 lakh MW solar power plants in the country by 2022. He also said that in view of the progress made so far, nation will meet the target ahead of the schedule. The Power Minister said that solar energy is important for India's energy security and the Government is working in a fast track mode in this direction.

» The Prime Minister, Shri Narendra Modi and the President of the French Republic, Mr Emmanuel Macron at the inauguration of the Solar Power Plant, at Mirzapur, Uttar Pradesh on March 12, 2018. The Minister of State (I/C) for Power and New and Renewable Energy, Shri Raj Kumar Singh is also seen.

Source: http://pib.nic.in/

'SAUBHAGYA' PROGRAMME LAUNCHED IN MEGHALAYA

Meghalaya has become the latest state to become a participant of the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) programme, which aims to provide last-mile connectivity to all willing households in India by 2018. The programme was launched on April 20, 2018 by the state's Chief Minister Shri Conrad K Sangma and Shri R K Singh, Union Minister of State (IC) for Power and New & Renewable Energy, in the presence of Meghalaya Power Minister, Shri James P K Sangma.

Under the programme, there will be no upfront fee for availing electricity connection as well as no charges for poor households.

Meghalaya became the fifth state after Assam, Madhya Pradesh, Manipur, and Jammu and Kashmir to join the Saubhagya programme. In Meghalaya, there are 139,267 unelectrified households as of today. The Saubhagya rural electrification programme was launched by the Hon'ble Prime Minister of India, Shri Narendra Modi in 2017 with the goal of providing electricity connections to all households, including the most remote villages, by the end of 2018.

The national Saubhagya programme was launched at a total cost of ₹163.20 billion ($2.54 billion), including Gross Budgetary Support (GBS) of ₹123.20 billion ($1.92 billion) from the central government. To ensure the success of the programme, the Saubhagya web portal was launched late last year to monitor the progress of household electrification.

Source: http://www.renewableenergyworld.com

HERO FUTURE ENERGIES SETS UP COUNTRY'S FIRST HYBRID RENEWABLE POWER PLANT

Hero Future Energies has commissioned the country's first large-scale hybrid renewable energy project—a combination of sun and wind power—in Karnataka's Raichur district. The company has added a 28.8 MW solar project to an existing 50 MW wind project set up two years ago. Also, both wind and solar are 'infirm' sources of power in that their supply varies according to the speed of the wind or the intensity of solar radiation. By combining the two, the project can supply steady power for a longer period in a day than standalone wind or solar plants, and improve its overall plant load factor (PLF). Wind speeds are usually highest early in the morning and at night, while sunshine is available only during the day. The project is a group captive one, with a number of private companies buying power from it directly at mutually agreed tariffs .

Source:economictimes.indiatimes.com

SHAKTI STHALA SOLAR PARK LAUNCHED IN KARNATAKA

The Karnataka government inaugurated the first phase of a 2,000 MW solar park in the drought-prone Pavagada region of Tumkur district on March 1, 2018.

The first phase of the ₹16,500 crore park called 'Shakti Sthala' will generate 600 MW, while the balance 1,400 MW is expected to be commissioned by the end of this year, the government said in a statement.

The solar project, touted as the largest in the world, is spread over 13,000 acres and five villages. It is part of the 'Karnataka Solar Policy 2014–2021' which aims to decrease dependence on traditional power sources and move to environmentally friendly ones to meet the growing power needs of the state.

The park ties in with the centre's scheme to generate 100 GW of solar power by 2020. The land for the solar park has been taken on a 25-year lease by the government from around 2,300 farmers, and in return, they are paid an annual rental of ₹21,000 per acre, with scope for a 5% increase every two years. The move was intended to curb the mass migration of people from the region which has been declared drought-hit in 54 of the last 60 years.

The park's development was initiated with the creation of the Karnataka Solar Power Development Corp. Ltd (KSPDCL) in March 2015 as a joint venture between Karnataka Renewable Energy Development Ltd (KREDL) and Solar Energy Corp. of India (SECI).

Source: www.livemint.com

COSTA RICA TO BAN FOSSIL FUELS AND BECOME THE WORLD'S FIRST DECARBONIZED SOCIETY

Costa Rica's new president has announced a plan to ban fossil fuels and become the first fully decarbonized country in the world. Carlos Alvarado, a 38-year-old former journalist, made the announcement to a crowd of thousands during his inauguration. "Decarbonization is the great task of our generation and Costa Rica must be one of the first countries in the world to accomplish it, if not the first," Mr Alvarado said. Symbolically, the president arrived at the ceremony in San Jose aboard a hydrogen-fuelled bus. Costa Rica already generates more than 99% of its electricity using renewable energy sources, but achieving zero-carbon transport quickly—even in a country well-known for its environmental commitment—will be a significant challenge, experts say. Jose Daniel Lara, a Costa Rican energy researcher at the

University of California-Berkeley, said completely eliminating fossil fuels within just a few years is probably unrealistic—though the plan will lay the groundwork for faster action towards that goal.

Source: www.independent.co.uk

SEA OF SOLAR PANELS TURNS MEXICAN DESERT GREEN

With 2.3 million solar panels—covering the equivalent of 2,200 football fields in the arid northern state of Coahuila—the Villanueva power plant, built by the Italian energy company Enel, is part of Mexico's push to generate 43% of its electricity from clean sources by 2024. Arrayed across the sand in seemingly endless rows that stretch to the horizon, the solar panels are made to turn in tandem with the sun, like a giant field of shimmering metallic sunflowers. The $650-million project is due to produce 1,700 GW hours when fully operational—enough to power 1.3 million homes. The Villanueva plant is the largest solar project in the world outside China and India. Mexico won plaudits from environmentalists in 2015 when it became the first emerging country to announce its emissions reduction targets for the United Nations climate accord, ambitiously

vowing to halve them by 2050. To get there, it is tendering clean energy projects in which private companies produce, sell, and purchase electricity in an open market.

Source: https://energy.economictimes.indiatimes.com

ASIA LEADS THE CHARGE IN GROWTH OF RENEWABLE ENERGY

In 2017, Asia accounted for nearly two-thirds of the worldwide increase in renewable energy generating capacity, according to a report published in April 2018 by the International Renewable Energy Agency (IRENA). IRENA, an intergovernmental organization based in Abu Dhabi, reported that the global renewable energy capacity in 2017 was 2,179 GW—greater than the capacity of world's coal powered plants, and approximately eight times Japan's entire energy-generation capacity—an increase of 8% compared with the previous year. For Asia as a whole, including Central Asia, renewable energy capacity has nearly doubled over the past five years, reaching 918 GW in 2017. China and India were the biggest contributors to the increase. Asia's third-largest producer of renewable energy is Japan, with a total capacity of 82 GW, rising 7 GW last year. Hydropower is driving renewable energy growth in Vietnam, Asia's fourth-largest producer, with about 18 GW of capacity. The growth rate for renewable energy was rapid in Mongolia and Cambodia, albeit from a low base.

Source: asia.nikkei.com

SOLAR ENERGY CAN HELP SOLVE AUSTRALIA'S WATER CRISIS SAYS NEW REPORT

Australia can help solve its water crisis by optimizing use of water-friendly solar energy, a new report concludes. Because solar power generation consumes minimal to zero water, it beats water-hungry coal-fired power production in terms of conserving an increasingly precious natural resource.

That's the verdict of the World Resources Institute (WRI). Its new report points out that solar energy is therefore not only clean, but critically important in water conservation.

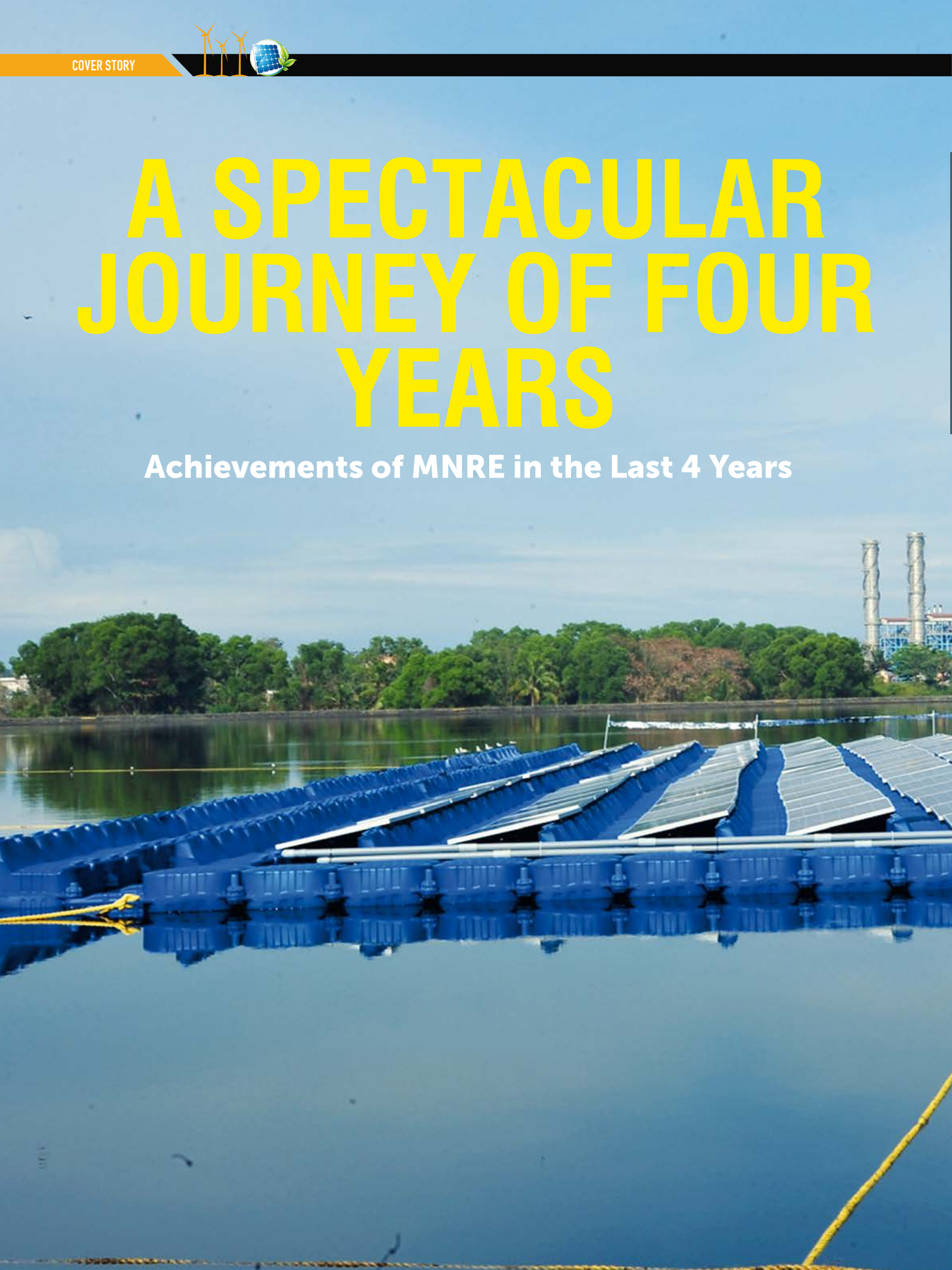
And because energy production accounts for around 10% of the world's water consumption, solar power can play a crucial role in tackling the world's growing water shortage.

Australia is ranked 17 in the world for solar energy potential according to the WRI report. In scientific terms, it reaches 232.5 in global horizontal irradiance wattage per metre squared. This is a measure of the strength and concentration of the solar power hitting a solar panel. Australia should be aiming for 100% renewable energy according to global clean energy pioneer Yosef Abramowitz. However, opposition from the fossil fuel industry is holding it back. With solar energy accounting for just over 5% of Australia's power, it is failing to meet its full potential.

Source: www.energymatters.com.au

A SPECTACULAR JOURNEY OF FOUR YEARS

Achievements of MNRE in the Last 4 Years



The Government of India has embarked upon an ambitious journey on the green energy front with scaling up of target of installing renewable energy capacity to 175 GW by the year 2022, which includes 100 GW from solar, 60 GW from wind, 10 GW from bio-power, and 5 GW from small hydro power. As on March 2018, a total of 70 GW of renewable power capacity has been installed which includes 34.04 GW from wind power and 21.65 GW from solar power, 9.5 GW from bio-power, and 4.48 GW from small hydro power. With 70 GW of installed renewable power capacity, the renewable power has a share of over 20% of the total installed capacity in the country. In this article, we present a compilation of the major achievements of the Ministry of New and Renewable Energy, Government of India, in the last four years.

The Ministry of New and Renewable Energy, Government of India, has taken major strides in the last four years. Significantly, the capacity addition of over 35 GW grid connected renewable power has been achieved during the last four years (2014/15 to 2017/18) which includes 19.5 GW from solar power, 13 GW from wind power, 0.68 GW from small hydro power, and 1.46 GW from bio-power. The cumulative renewable energy installed capacity has increased from 35.51 GW as on March 31, 2014 to 70 GW as on date (May 2018). This accelerated deployment has been achieved through the process of transparent bidding and industry facilitation which has resulted in historic low tariff rates, viz., ₹2.44 per unit in case of solar and ₹2.43 per unit in case of wind power. The Government has bid out over 20,000 MW of solar power and 12,500 MW of wind power capacity in the year 2017/18.

ACHIEVEMENTS IN SOLAR POWER

- During 2017/18, highest ever total of 9,362.64 MW capacity has been added till March 31, 2018, taking cumulative achievement to 21,651.46 MW.
- Solar tariff has declined to lowest level of ₹2.44/kWh at Bhadla Phase-III Solar Park in Rajasthan, which is approaching close to grid parity. The chronology of downward trend in solar tariff during recent times is as given below:
- New innovative approaches towards solar power, such as floating solar, wind solar hybrid, and solar power coupled with manufacturing being attempted.

Solar parks

- Capacity of the scheme for "Development of Solar Parks and Ultra Mega Solar Power Projects" has been enhanced from 20,000 MW to 40,000 MW.

S. No	Period	Capacity	Lowest Tariff (₹/kWh)	Scheme	State
1	February 2017	750 MW	3.30	State Scheme	Madhya Pradesh (REWA Solar Park)
2	May 2017	250 MW	2.62	VGF Scheme	Rajasthan (Bhadla IV Solar Park)
3	May 2017	500 MW	2.44	VGF Scheme	Rajasthan (Bhadla III Solar Park)
4	August 2017	500 MW	2.65	State Scheme	Gujarat (Non-Solar Park)
5	December 2017	250 MW	2.48	VGF Scheme	Rajasthan (Bhadla IV Solar Park)
6	December 2017	500 MW	2.47	VGF Scheme	Rajasthan (Bhadla III Solar Park)

- Under the Solar Park Scheme, 40 Solar Parks in 21 states with an aggregate capacity of over 21 GW have been sanctioned.
- Kurnool Solar Park in Andhra Pradesh with 1000 MW capacity and Bhadla Phase II Solar Park in Rajasthan with 680 MW capacity have already been commissioned and are operational. With the commissioning of 1,000 MW capacity at single location, Kurnool Solar Park has emerged as the World's Largest Solar Park.

Rooftop solar programme

- The Ministry is implementing Grid Connected Rooftop and Small Solar Power Plants Programme which provides for installation of 2,100 MW capacity through central financial assistance (CFA)/incentive in the residential, social, Government/PSU, and institutional sectors.
- So far, sanctions for over 2,009 MWp capacity solar rooftop projects have been issued as on March 31, 2018 and around 1,063.63 MWp capacity has been installed, including projects with and without subsidy.
- MNRE has allocated Ministry-wise expert PSUs for implementation of RTS projects in various Ministries/ Departments.
- All the 36 State/UT ERCs have notified net/gross metering regulations and/or tariff orders for rooftop solar projects.
- Concessional loans of around 1,375 million US dollars from The World Bank (WB), Asian Development Bank (ADB), and New Development Bank (NDB) have been made available to State Bank of India (SBI), Punjab National Bank (PNB), and Canara Bank for solar rooftop projects.
- A new online tool, Solar Photovoltaic Installation (SPIN), has been developed for tracking and implementation of Rooftop Programme (RTS).
- Launched mobile app ARUN (Atal Rooftop Solar User Navigator) for ease of access of beneficiaries for request submission and awareness.

Off-grid solar applications

- Apart from grid connected solar power, decentralized or distributed solar energy can provide an economical option for meeting electricity, lighting, motive, and heating needs through the deployment of SPV home lighting systems, solar street lights, solar pumps, power packs, and other solar applications.
- As on March 31, 2018, over 53.86 lakh Solar Lighting Systems, 1.71 lakh Solar Pumps, and power packs of 185.9 MWeq capacity have been installed in the country.
- The Ministry also Launched Atal Jyoti Yojana for Solar LED Street Lights in five States. Under the scheme, a total of 92,238 solar street lights have been installed as on March 27, 2018.

ACHIEVEMENTS IN WIND POWER

- The largest ever wind power annual capacity addition of 5,502.39 MW in 2016/17.
- During 2017/18, a total of 1,766.25 MW capacity has been added till March 31, 2018, taking cumulative achievement to 34,046 MW.
- Now, in terms of wind power installed capacity India is globally placed at fourth position after China, the USA, and Germany.
- The lowest tariff of ₹3.46 per kWh was determined through 1st round of e-reverse auction for 1,000 MW of wind power projects.
- Further, the wind tariff in India touched lowest ever level of ₹2.43 per kWh in the bid conducted by the Gujarat utility.
- Wind Bidding Guidelines were issued in December, 2017 to ensure transparency in bidding and low tariffs.

- India has a long coastline where there is a good possibility for developing offshore wind power projects. The National Offshore Wind Energy Policy was notified on October 6, 2015, to provide a facilitative framework for the development of off-shore wind power in the country.
- The first LiDAR has been installed and commissioned off the Gujarat coast for gathering off-shore wind resource data.

ACHIEVEMENTS IN SMALL HYDRO POWER

- A capacity addition of 682.06 MW has been reported under Grid Connected Small Hydro Power plants during the last four years, taking cumulative small hydropower projects capacity to 4,485.80 MW from 1,097 projects in the country.
- The Ministry is also giving special emphasis to promote use of new and efficient designs of water mills for mechanical as well as electricity generation and setting up of micro hydel projects up to 100 kW for remote village electrification.

ACHIEVEMENTS IN BIO-ENERGY

- A cumulative installed capacity of 8,700.80 MW has been achieved from biomass power/bagasse cogeneration and 662.81 MW from biomass captive power/non-bagasse cogeneration as on March 31, 2018.
- Family-type Biogas Plants mainly for rural and semi-urban households are being set up under the National Biogas and Manure Management Programme (NBMMP).
- During 2017/18, 0.46 lakh biogas plants installations have been achieved taking cumulative achievement to 50.05 lakh biogas plants as on March 31, 2018.

GREEN ENERGY CORRIDOR

- In order to facilitate the integration of large-scale renewable generation capacity, a new scheme of 'Green Energy Corridors' has been launched.
- This scheme involves the strengthening of Intra state (being implemented by the STUs) and interstate transmission system (being implemented by the POWERGRID). Further, it also envisages setting up of control infrastructure comprising of forecasting of renewable generation, dynamic compensation, establishment of Renewable Energy Management Centres (REMC) at State/Regional and National levels.
- The intra state transmission scheme (InSTS) is being implemented by eight renewable rich State's Transmission Utilities (of Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu) with total project cost of ₹1,0141 crore, with funding mechanism consisting of 20% State Equity, 40% Government of India Grant (total ₹4,056.67 crore), and 40% KfW loan (500 million EUR).
- The InSTS project includes about approx. 9,400 ckm transmission lines and Substations of total capacity of approx. 19,000 MVA to be completed by March 2020. The purpose is to evacuate approx. 20,000 MW of large-scale renewable power and improvement of the grid in the implementing States.
- Projects worth ₹7,120 crore have been awarded and approx. ₹1,440 crore have been disbursed to the States from the Government of India share for InSTS GEC.

OTHER INITIATIVES OF MNRE

In order to achieve 175 GW RE targets, various initiatives have been taken by the Government which inter-alia include:

- To ensure that quality of the solar equipment's are not compromised, the Government has notified a Quality Control Order of Solar Photovoltaic Systems, Devices and Components Goods on August 30, 2017 under BIS Act. This Order will ensure that low quality products do not enter the Indian market.
- Suryamitra program was launched for creation of a qualified technical workforce in 2015 and over 18 thousand Suryamitras have been trained under the programme up to March 31, 2018.
- Solar Bidding Guidelines have been issued to ensure transparency in bidding and low tariff through reverse auction.
- Framework has been notified on forecasting, scheduling, and imbalance handling for Renewable Energy at interstate level for large scale grid integration.
- Issued order for waiving the Inter State Transmission System charges and losses for interstate sale of solar and wind power for projects to be commissioned by March 2022.
- Suitable amendments were made to the Electricity Act and Tariff Policy for strong enforcement of Renewable Purchase Obligation (RPO) and for providing Renewable Generation Obligation (RGO).
- Declared Renewable Generation Obligation on new coal-/lignite-based thermal plants.
- Foreign Direct Investment (FDI) up to 100% is permitted under the automatic route for renewable energy generation and distribution projects subject to provisions of The Electricity Act, 2003.

INTERNATIONAL SOLAR ALLIANCE (ISA)

- International Solar Alliance (ISA) was launched by Shri Narendra Modi, Hon'ble Prime Minister of India, and Mr François Hollande, Former President of France on November 30, 2015 in Paris, France. The Paris Declaration on ISA declared ISA as a common platform for cooperation among solar resource rich countries lying fully or partially between the Tropics of Cancer and Capricorn, and intended to make joint efforts for mobilizing more than US$ 1000 billion of investments needed by 2030 for massive deployment of solar energy.
- In conformity with the Framework Agreement of the International Solar Alliance (ISA), 30 days after ratification by the 15th country, on December 6, 2017, ISA became the treaty-based international intergovernmental organization. Till date, 61 countries have signed and 33 countries have ratified the ISA Framework Agreement.
- The Founding Conference of the ISA was co-chaired by Shri Narendra Modi, Hon'ble Prime Minister, Government of India and Shri Emmanuel Macron, Hon'ble President of France, on March 11, 2018 held in New Delhi. At the event, Hon'ble Prime Minister highlighted India's target to achieve 175 GW of renewable energy, out of which 100 GW would be solar energy. He emphasized upon the need for developing the latest technology, reducing solar tariffs, ensuring proper storage technology, mass manufacturing, and innovation in the domain.
- At present, the ISA is implementing three programmes: 'Scaling Solar Applications for Agriculture Use', 'Affordable Finance at Scale', and 'Scaling Solar Mini-grids'. These programmes will help in achieving the overall goal of increased solar energy deployment in the ISA member countries for achieving universal energy access and speeding up economic development. ISA now plans to launch two more programmes one for Scaling Solar Roof Top and the second for Scaling Solar supported e- mobility. In addition, a large number of organizations, such as the World Bank, the UNDP, European Investment Bank, the European Bank for Reconstruction and Development, Climate Parliament, etc., have signed Joint Declarations for forging partnerships with ISA for development and deployment of solar energy globally.
- India has offered to meet ISA Secretariat expenses for initial five years. The Government of India has allotted 5 acres of land to the ISA in NISE Campus, Gurugram, and released a sum of ₹130 crore for creating a corpus fund, building infrastructure and meeting day-to-day recurring expenditure. Besides, the Ministry of External Affairs, Government of India, has set aside US$2 Billion for solar projects in Africa out of Government of India's US$10 Billion concessional Line of Credit (LOC) for Africa. The ISA Secretariat is located in the NISE campus, Gurugram, Haryana. AU

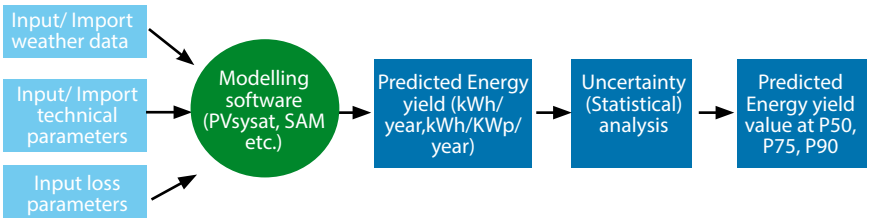
Courtesy: The Ministry of New and Renewable Energy (MNRE), Government of India.

CRITICALITY OF ENERGY YIELD ASSESSMENT

For Solar Projects

Saurabh Motiwala, in this article, discusses the criticality of energy yield assessment for solar projects. The objective of this article is to present readers with an overall idea of the procedure and importance of energy yield assessments carried out for any solar project. The article does not capture a detailed technical assessment of this exercise.

Long-term estimation (typically for project life of 25 years) of energy generation from solar projects is critical for techno-financial viability of the project. Energy Yield Assessment (EYA) of solar projects forms the basis for project developers and financial institutes for financial modelling of the project. Several modelling softwares are available in the market for the EYA of solar projects, including PVsyst, PV*SOL, RETScreen, HOMER, HelioScope, PlantPredict, Archelios, and SAM amongst others. Over the years, PVsyst has emerged as the most bankable modelling software for the EYA of utility scale solar PV projects while SAM has been used by few developers to predict energy yield from utility scale Concentrating Solar Power (CSP) projects. The objective of employing these modelling softwares is to predict actual energy generation with maximum possible accuracy. The solar PV industry in general follows established norms to carry out the EYA of projects worldwide. However, the CSP industry is yet to identify such common norms.



» **Figure 1:** Procedure for predicting energy yield from modelling softwares

COMMON PROCEDURE FOR PREDICTING ENERGY YIELD

Usually, simulation softwares for predicting energy yield from solar projects broadly involves the following steps:

I. *Importing weather data*: Solar irradiance, wind speed, ambient temperature, etc., form a part of weather data. The weather data for the project location can be satellite based, ground measured, or a combination of both. Prior to importing weather data, the most relevant data source is identified through the exercise of solar radiation resource assessment. Users can also import weather data from the software library.

II. *Input/import technical parameters*: The technical parameters to these softwares will mostly rely on the suppliers of major components. For instance, the technical parameters of PV modules and inverters would be captured in .pan and .ond files certified by respective suppliers. These files are imported directly to PVsyst for simulation. Users can also choose equipment of a different make for project design from the software database.

III. *Applying losses*: The application of loss parameters for simulation requires some level of technical expertise. Some losses are quantifiable while others have to be assumed with appropriate basis. The calculation or assumption of loss values will depend on the present status of the project (planning, execution, commissioned, etc.)

IV. *Statistical analysis of energy yield output:* The predicted yield value would have acquired uncertainties from the input values particularly solar resource and performance of major equipments. The inherent uncertainties with solar resource data has to be studied while estimating confidence interval of final energy predication.

CRITICALITY OF EYA

An underestimation or overestimation of energy yield may significantly impact risks imposed on project finance. For instance, the solar resource of any project reduces by a variable (unknown) factor every year for the project life. Consequently, the annual energy yield from the project would be less than the planned yield. Revenues from the project would be lower than expected, the expenses (e.g., O&M cost) would remain unchanged and hence the project would pay less dividends as planned.

Even so, the return on equity from the project would reduce. The project would eventually turn out to be less attractive financially and this may raise concerns to the lenders.

A few critical aspects of EYA of solar projects have been discussed below:

➢ Weather (solar resource) data: Unavailability of bankable solar resource data is one of the key barriers in the development of CSP projects in India. Godawari Green CSP Project in India with parabolic trough technology struggled to achieve the estimated output which led to re-engineering of the project; 80 loops of parabolic mirrors were increased to 120 loops.

➢ Consideration of losses: The consideration of loss values in simulation will significantly impact the performance ratio[1] of the project. In case of turnkey projects, the project developer will take over and accept the project from EPC contractor on the basis of a guaranteed PR% value. The input loss values will depend on the current development stage of the project and level of expertise of the designer. Some key loss values input to PVsyst software for simulation have been discussed in Table 1.

1 Performance ratio is a percentage to express performance of PV plant. This also provides a benchmark to compare plant performances over a given time period.

Table 1: Estimation of key losses for the EYA considered in PVsyst

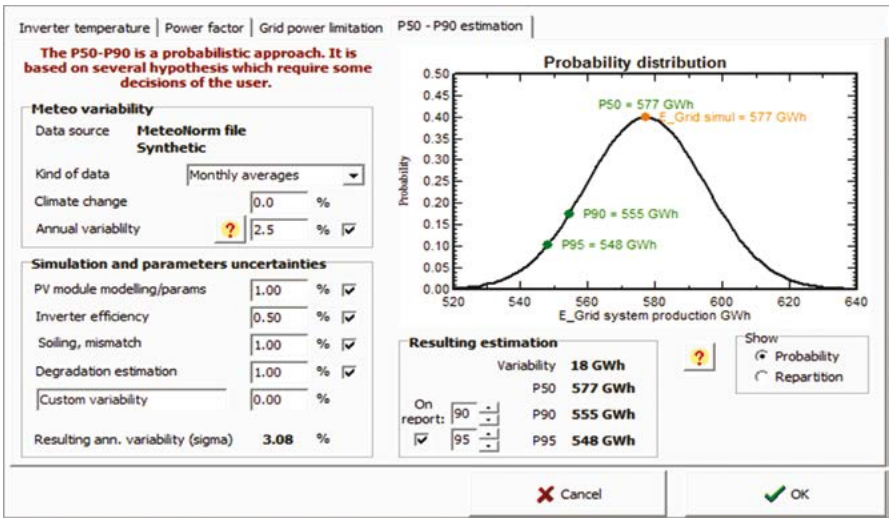
S. No.	Key technical losses	Remarks
1	Shading losses	These losses occur due to obstacles, mutual shading between different rows of PV modules. Can be estimated with an accurate 3D modelling of the plant.
2	IAM (Incidence Angle Modifier) factor	These losses occur when the radiation does not strike the front glass of PV modules in perpendicular. User-defined IAM factor is considered, when manufacturer certified .pan file is available.
3	Soiling losses	The soiling losses occur generally due to dust and bird droppings. It generally depends on the site location, module cleaning cycle, and tilt angle. Difficult to quantify/estimate and require expertise.
4	Module degradation losses	The performance of PV modules degrade over time. The manufacturer also warrants a particular degradation rate of its module over time based on third-party tests. These losses can be considered as per manufacturer's recommendation for a conservative analysis.
5	Irradiance level losses	The reduction in power output of modules under actual irradiance as compared to Standard Test Conditions (Irradiance of 1,000 W/m^2). These losses are quantified by PVsyst as per the site weather data and characteristics of the selected module make.
6	Loss due to module temperature	The characteristics of PV modules are defined at 25 °C. At higher temperature, the efficiency of modules reduces. These losses are quantified by PVsyst as per the site weather data.
7	Module quality losses	These losses occur due to deviation in nominal peak power of PV modules suggested by manufacturer and actual power. Usually, a positive quality value is taken as input for simulation.
8	Module array mismatch losses	These losses arise due to variation or 'mismatch' in current/voltage profiles of modules actually connected in a string produce. Difficult to estimate and require expertise.
9	DC ohmic wiring losses	The I^2R losses in the cables between modules to inverter input contribute to DC ohmic losses. These losses can be quantified during detailed engineering of the project.
10	Inverter losses during operation	DC to AC conversion efficiency of inverter varies with load. These losses are quantified by PVsyst as per the characteristics of the selected inverter make.
11	Inverter losses over inverter nominal power	These are generally clipping losses, occurring due to overloading of the inverters. These losses depend upon designed DC/AC ratio of the inverters and characteristics of the selected inverter make. If the DC power connected to an inverter is more than its rated DC input, the inverter adjusts/limits this excess input which leads to be output power being clipped.
12	Transformer losses	These are no-load and full-load losses of the transformer. These losses can be quantified from the GTP (general technical parameters) provided by transformer manufacturer.
13	AC ohmic losses	These are ohmic losses in AC cables from inverter output till metering point. These losses can be quantified during detailed engineering of the project.
14	Auxiliary consumption	Load consumption by security systems, main control room including HVAC, lighting and plant monitoring systems during day and night time contribute to these losses. These can be quantified during detailed engineering of the project.
16	System (Plant + Grid) unavailability	Plant unavailability: These losses are assumed in terms of hours/day, to account for breakdown maintenance grid unavailability: The ability of plant to evacuate power depends entirely on the availability of the grid/ transmission network. If the transmission network is down due to maintenance, the generation from the plant would be affected. These losses are assumed in terms of hours/day, if detailed information about the network is unavailable.

Predicted energy yield

The predicted yield values from EYA exercise are expressed at P50, P75, and P90 confidence level. These values indicate that the predicted energy yield value will exceed with 50%, 75%, and 90% probability, respectively. Lenders/financing institutions or other stakeholders rely on consultants to furnish bankable EYA reports to feed information into their financial models. A bankable report would generally provide P50, P75, or P90 values as minimum.

Quantification of uncertainty

The predicted annual yield values for the project would be associated with uncertainties, which would propagate throughout the predication period. Till date, there is no standard framework for calculation of uncertainty of predicted yield values. The associated uncertainty would propagate in predicted annual yield values for the project lifetime. Parameters, such as solar resource measurement, modelling software, module



» **Figure 2:** PVsyst interface depicting input uncertainty parameters and Gaussian distribution of energy yield

characteristics, performance of inverter, transformers, cables, module degradation, inter-annual variability, shading and soiling, etc., would tend to introduce uncertainty in the EYA. Research and developmental work are under progress to establish a better understanding of uncertainties which can assist in portfolio assessment, design and execution, O&M activities, etc.

CONCLUSION

The EYA plays a critical role in decision making of not only project developers but other stakeholders, such as suppliers, investors, lending institutions, and insurers. There is a common approach worldwide for the EYA of solar PV projects. However, for CSP projects, a generalized approach is essential to significantly reduce risks associated with project financing. AU

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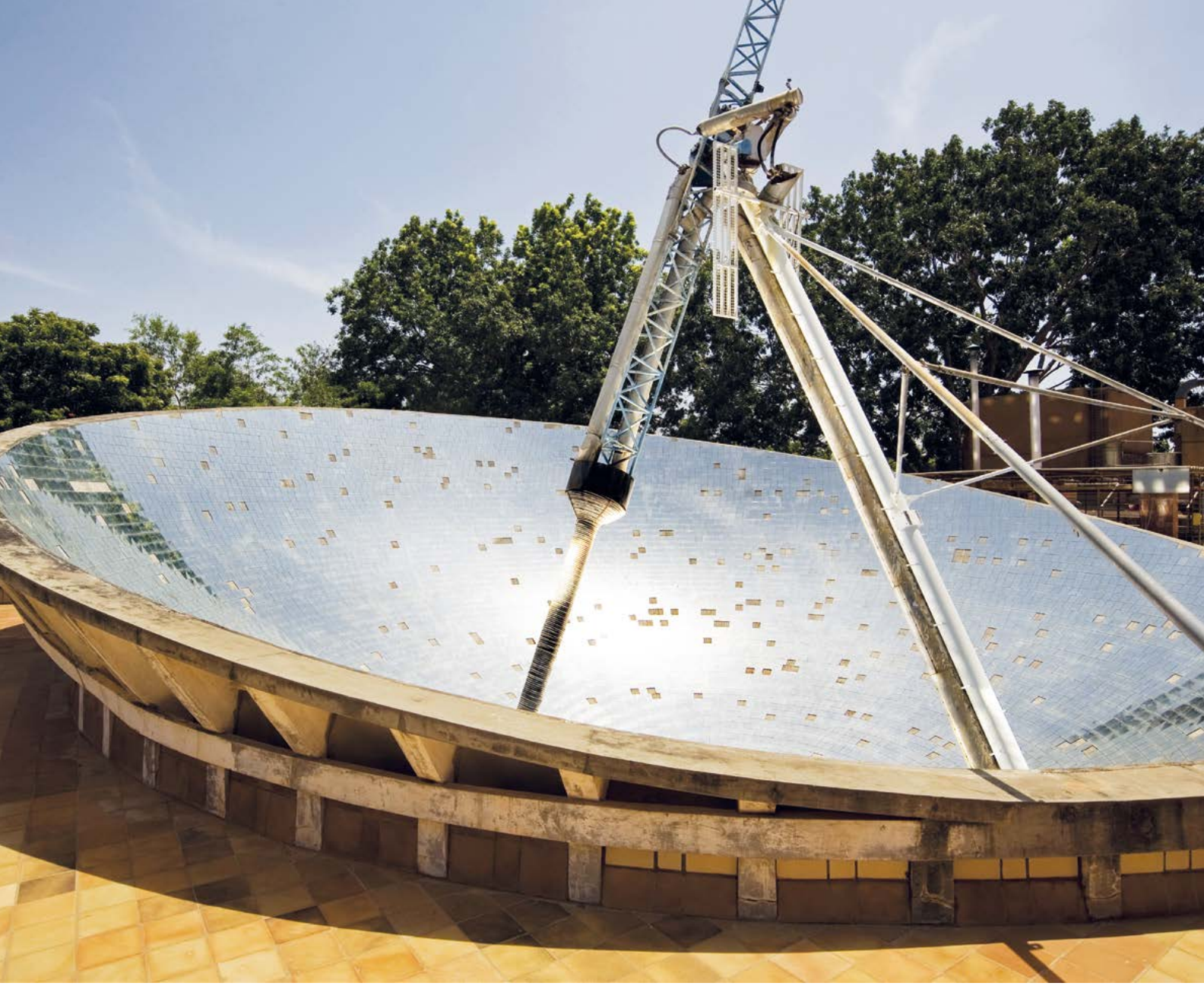


DAWN OF SOLAR PV COOKING

Solar thermal has primarily been explored for cooking and hence solar cooking has become synonymous with solar thermal cooking. Solar PV technology has always been considered expensive and unviable. In this article, **Professor Chetan S Solanki** brings out how and why the solar PV technology route for cooking can now begin and overtake the solar thermal route for cooking. He also says that solar PV cooking solutions can fulfill all domestic cooking needs and can be customized as per the user's choice and needs. Usage of induction cookstoves with PV modules and batteries can provide the required power to cook all types of Indian cuisines, matching the performance of LPG-based cooking. With further expected reduction in the cost of battery and PV module and increase in efficiency of cooking, the author believes that it can become one of the preferred cooking solutions.

Humans need food and water for survival. Cooking is ubiquitous in human life as a daily ritual. It is considered to be an important influence in human evolution for survival and sustenance. Charles Darwin considered 'the art of making fire' as probably 'the greatest discovery', except language, ever made by man. By cooking, we get to eat the food that gives us the energy and nutrients to grow and develop, be healthy and active, to move, work, play, think, and learn.

TRANSITION IN COOKING FUELS

Over the years, human civilization has evolved by leaps and bounds with the development of science and technology, and so are the types, techniques, and technologies of cooking. The options available as the sources of heat energy for the purpose of cooking are numerous today. When looked at closely, one could witness a significant transition in the form of heat energy source for household cooking; starting with use of solid fuel (traditional biomass) since stone age to liquid fuel (kerosene) to gaseous fuel (LPG) to now most modern electricity as cooking fuel (electric resistive and induction-based cookstoves).

The transition towards more modern and clean cooking solutions is desirable and is also taking place, however, the pace in terms of its reach to most of the rural households around the world remains slow. Moreover, there are households that use LPG along with biomass fuels. The 'energy ladder model' conceptualizes fuel switching in three distinct phases. The first phase is characterized by universal reliance on biomass. In the second phase of fuel switching households are hypothesized to move to 'transition' fuels, such as kerosene, coal, and charcoal in response to higher incomes, urbanization, and biomass scarcity. The third and final phase of fuel switching is characterized by households switching to modern energy, such as LPG, natural gas, or electricity for cooking. Yet, a large number of households simultaneously use a variety of cooking fuels sometimes spanning both upper and lower levels on the energy ladder.

CURRENT SCENARIO AND ACCESS TO CLEAN ENERGY FOR COOKING

Today, around 2.8 billion people in the world lack access to clean cooking (Source: www.iea.org). A large number of people die prematurely each year as a result of smoke caused by burning solid fuels or from combustion of kerosene or coal. Children below five years of age can develop risks of acute lower respiratory infections due to the exposure (Source: Asante et al. 2016). They have adverse environmental impacts too; they emit black carbon that has a global warming potential 4,000 times greater than that of carbon dioxide over a 20-year span. Access to clean energy cooking is essential for economic growth, human development, and environmental sustainability. Women, in particular, would gain by reducing the time spent in gathering fuel and cooking, and thus avoiding household air pollution. UN's sustainable energy goal (SDG 7) aims to ensure access to affordable, reliable, sustainable, and modern energy for all. Hence, it's crucial to enhance energy efficiency and invest in technologies that convert energy into electricity using renewable sources.

ANALYSING COOKING

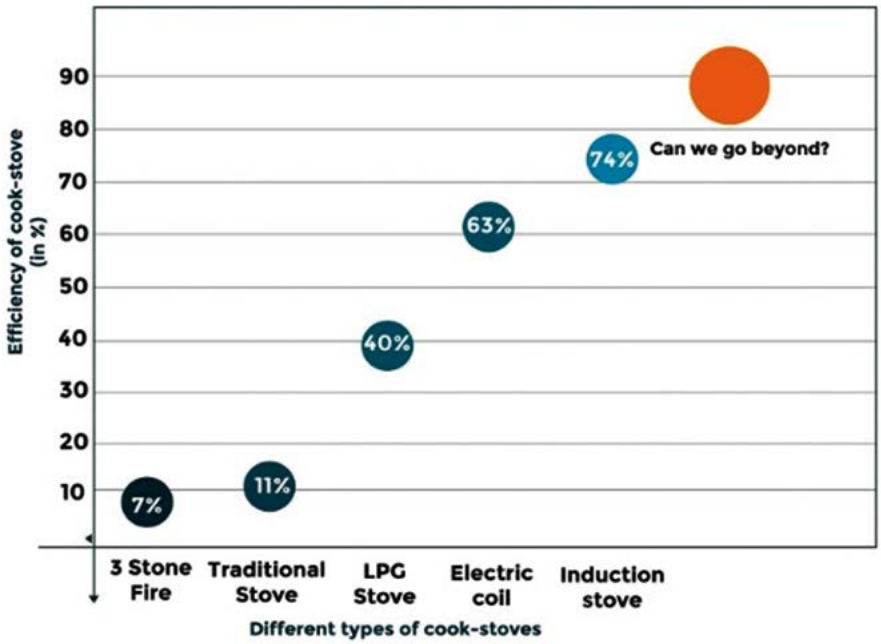
As the cookstoves have evolved over centuries, their efficiencies have also increased. The efficiency of three stone cookstove is only 7%. The LPG cookstove has an efficiency typically in the range of 30%–40% while the induction stoves have gone up to 74% (Figure 1). Before we start looking at solar energy options for cooking, let's ask ourselves the following questions: How much minimum energy is required for cooking, considering that we do very efficient cooking? Is it possible to increase efficiency further, leading to further reduction in cost?

The total energy required (Q) for cooking is given by the following expression:

Q= Energy required for cooking food + energy required for heating vessel + energy lost due to evaporation of water + other energy losses

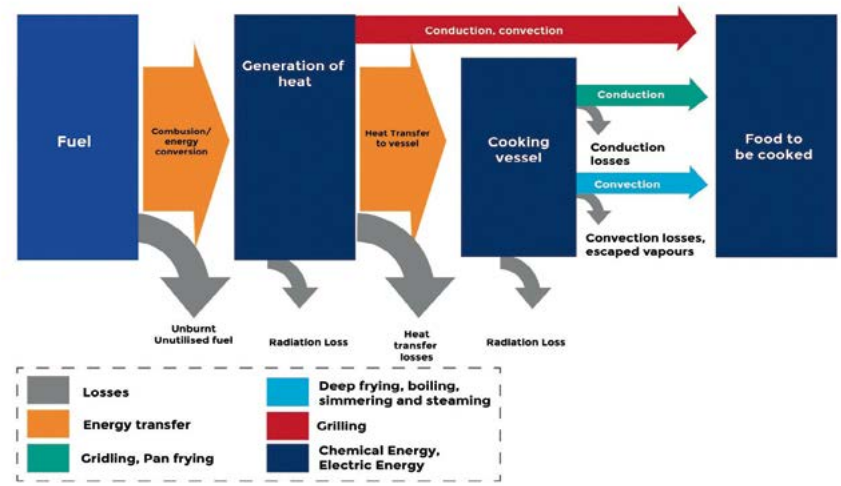
$$Q = \Sigma\, m_{\text{ingredient}} \Delta T + m_{vessel}\, C_{vessel}\, \Delta T + m_{vapourescaped}\, C_v + Q_{losses}$$

Here, m represents mass, C specific heat capacity, and dT temperature difference and Q energy.



» **Figure 1:** Graph depicting efficiency of cookstoves

From the above equation, theoretically, the estimated energy required for cooking 100 g rice comes to only about 30 Wh. Theoretical calculations do not take heat losses in account. In our experiments, energy required for cooking the same amount of rice in pressure cooker on induction cookstove was measured to 76.5 Wh but in well-insulated vessel measured to about 35 Wh. This indicates that there is significant scope of minimizing the heat losses. For designing an efficient cooking solution, the cooking process is to be understood in detail, as depicted in Figure 2. In the process of cooking, loss of heat during heat generation, heat transfer and during cooking needs to be avoided or minimized.

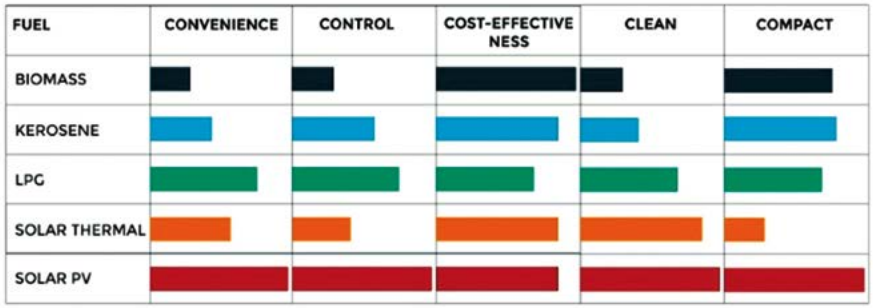


» **Figure 2**: Process of cooking in detail

SOLAR THERMAL COOKING: MORE LIMITATIONS THAN ADVANTAGES

When it comes to use of solar energy for cooking, there are two technology routes: converting sunlight directly into heat for cooking (solar thermal route) or converting sunlight into electricity, and then using it for generating heat for cooking (solar PV route). However, over the span of 250 years (in 1767, Horace de Saussure, a Swiss physicist, invented the first solar oven), solar thermal has primarily been explored for cooking and hence solar cooking has become synonymous with solar thermal cooking. Solar PV technology has always been considered expensive and unviable. Here we shall discuss how and why the solar PV technology route for cooking can begin now and overtake the solar thermal route for cooking.

Any modern cooking solution needs to fulfill the 5C criteria of: (i) convenience, (ii) control, (iii) cost-effectiveness, (iv) clean, and (v) compactness. The comparison between various fuels on these parameters is given in Figure 3. A cooking solution must provide convenience of indoor cooking, should provide good control over cooking temperature, must be cost-effective for users, must be clean from health and



» **Figure 3**: Comparison between various fuels on five important parameters (scale is based on perception of author)

sustainability perspective, and compact for installation and use. Most of the solar thermal cooking solutions available today do not satisfy one or more of these criteria. Although one of the advantages of solar thermal cooking is that it is simple to build and of low-cost.

Solar thermal cooking is practically cumbersome as the place for heat generation (in outdoors, under sunlight) and the place of cooking (indoors, inside kitchen) are different, and the transfer of heat is not easy. Also, concentration of sunlight requires optics to do the same and the structure to hold optics adds to the cost. The life of reflectors, cleaning of reflectors, and impact of wind on output remain significant challenges even today. Since one can only concentrate parallel rays, diffused sunlight which is nearly 15%–20% of total sunlight becomes useless. For achieving sunlight concentration, movement of sun needs to be followed with sun tracking devices and that adds to the overall cost. Moreover, storing heat in thermic fluids (generally requires 7–8 L per 5 member family) and recovering it again for cooking requires an elaborate set- up. Despite a long history of development, solar thermal cookstoves have not been adopted in a significant way. By the end of 2014, only 6.4 MW_{th} capacity was in operation in India with 9,200 m^2 of installed collector area. There has been a 15% reduction in the market growth of new installed capacity in the year 2013/14. Hence, given the limitations, solar thermal cooking solutions such as box-type solar cookers, parabolic dish cookers, Scheffler dish cookers are not very convenient for users. In the modern world, since time is precious, quick cooking solutions that would be able to provide quick

supply of energy to achieve the required temperatures in short time, that is, (80–100 °C for boiling and 180–240 °C for frying) are needed.

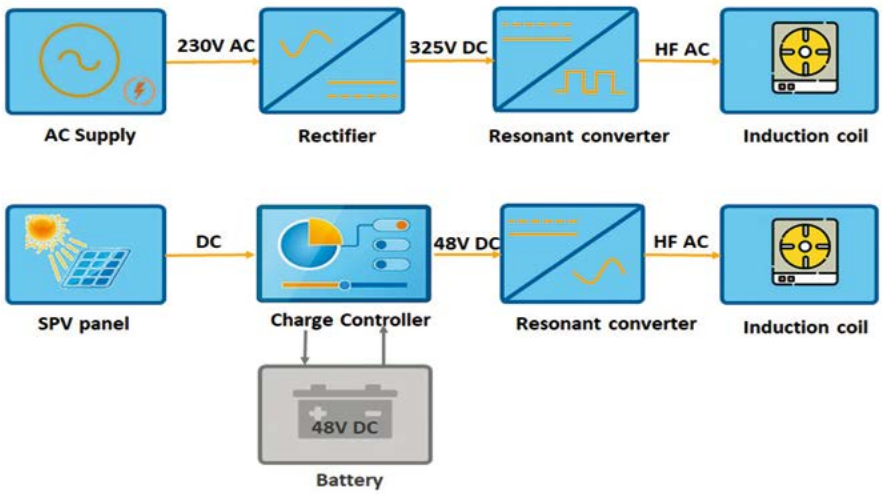
SOLAR PV COOKING: A NEW DAWN

Can solar PV cooking solution overcome the problem inherent to solar thermal cooking? Can solar PV cooking fulfill the 5C criteria? The answer is 'yes', to both. Solar PV technology converts sunlight into electricity, which not only can be used for cooking directly inside kitchen, but can also be stored easily in batteries. Therefore, it can provide the convenience of cooking indoors as well as during non-sunshine hours. Use of electricity coupled with inductive or resistive principle for cooking can give good control over the rate of heat energy supplied. One can cook in low, medium or higher power with just a push of button. Solar PV cooking solutions can fulfill all domestic cooking needs and can be customized as per the user's choice and needs. Usage of induction cookstoves with PV modules and batteries can provide the required power to cook all types of Indian cuisines, both vegetarian and non-vegetarian, on 24x7 basis, matching the performance of LPG-based cooking.

A basic solar PV rice cooker is a combination of a PV module, directly coupled with DC resistive coil designed to match the impedance of coil and panel for maximum power transfer. In this simple arrangement, the heating coil (generally made up of Nichrome or Constantan) is embedded with the vessel and PV module, directly supplying power to the coil during day time. A 40 Watt PV module coupled with 6.5 Ohm nichrome resistive coil can cook rice for 3–4 people, twice in a day. The cost of such cookstove would be about ₹2,000. This arrangement not only matches performance of a box-type solar thermal cooker and cost, but also provides the convenience of indoor cooking. A 350–400 Watt PV module, with 1 kW induction cookstove and 1,300 Wh battery storage would be sufficient for 2-member family to cook thrice a day. Design can be customized to fulfill

entire cooking needs for different family sizes. The exact choice of PV panel power depends on the location and number of sunshine hours at that place and the exact size of battery depends on how much back up time one requires.

ONGC launched a 'Solar Chulha Challenge' at national level to come up with a solar cookstove that can cook three meals a day for five-member family. The IIT Bombay team won the competition with its innovative prototype: SIX Cook-Stove (Solar Intelligent Cooking with Storage). The induction cookstoves available in market work on AC power. Internally, in the induction cookstove, the 230 V AC power gets converted into 325 V DC power, which is then converted into 20 kHz high frequency AC power (See Figure 4). High frequency AC power is required for induction of eddy currents in the vessel, which is responsible for generating heat. In solar PV cookstoves, power generation and storage occur in the form of DC; therefore, it makes sense to design the power control circuitry based on DC. Circuit configuration is more suitable for solar PV cookstoves and will be more efficient as well (Figure 4). A 48 V DC power system, which will also be safe to operate, is a good choice. Globally, PV module prices have come down significantly and PV modules are now available at less than $0.45 per Watt-peak (₹30) Similarly, the prices of batteries are going down. Currently, lead-acid batteries are available at nearly $70 per kWh (₹4,700) and Li-ion batteries with $125 per kWh (₹8,350). Induction circuits



» **Figure 4:** Comparison of AC induction stoves and DC induction stoves

and power electronics control circuits are not expensive and can be manufactured in $20–$25. With these costs, solar PV cooking solutions for domestic needs can be made in ₹30,000–₹60,000, depending on consumer needs, family size, and backup time.

Annualized Life Cycle Costing (ALCC) is a good tool to compare the cost of various alternatives available for the same purpose. For a 5-member household, 3 units of electricity per day, derived theoretically as well as measured experimentally, is sufficient in solar PV cooking. A solar PV cookstove with 800 W panel and a 4 kWh lead-acid battery storage can provide this much energy. Considering a slightly over-designed cookstove with 1,000 W solar panel (@₹28/W) and 5 kWh lead-acid battery storage (@₹4,700/kWh), the ALCC for solar PV cookstove comes to about ₹8,000. A life-cycle of 20 years with battery replacement every five years is assumed. Doing the ALCC analysis for the same effective energy consumption from LPG cookstove (equivalent of 15 cylinders per year), and considering cost of LPG cylinder as ₹750, the annualized cost comes to nearly same amount, ₹8,000. Thus, it appears that the solar PV cooking solution, even in today's economic terms is competitive with LPG solutions. With further expected reduction in the cost of battery and PV module and increase in efficiency of cooking, the author believes that it can become one of the preferred cooking solutions. An additional benefit of this solution can be to use the stored electrical energy to power the home-lighting systems and other appliances as well, thus, finding solution for electricity scarcity in underserved areas.

CONCLUSION

Cooking solutions are becoming convenient, quick, and efficient, but ensuring the availability of the same as clean, reliable, and affordable remains a humongous task for world leaders and policymakers. The thrust on clean energy scenario is at its peak at present and the need of the hour. The emergence of solar PV cooking can be most viable solution to address cooking needs as it fits well in 5C parameters of convenience, control, cost-effective, clean, and compact. Since the solar PV cooking solutions fits well to fulfill the cooking needs, both in urban as well as in rural areas, therefore, if promoted well, it can grow significantly and it will not be far when it becomes one of the most adopted cooking methods. It is the dawn of solar PV cooking. AU

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COMMUNITY-BASED SERVICE DELIVERY MODEL

Through Solar Irrigation Pump

GIZ in India is exploring different service delivery models mainly in the eastern parts of India. **Nilanjan Ghose** highlights one of the models being tested which is a community-based 'pay-as-you go model' in Bihar. The objective of this article is to share some insights on the community-based pay-as-you-go-water-as-a-service delivery model based on the operational data collected over last four years and also provide some learnings from the model.

Over the last two years, there has been a steady increase in the deployment of solar irrigation pumps in India. The Ministry of New and Renewable Energy (MNRE), Government of India, has already installed around 142,000 solar pumps by November 2017 and has a target of installing 1 million solar pumps by 2020/21. Apart from the MNRE's subsidy-based technology deployment model, there are also experiments to promote other means of deployment and testing of service delivery models. GIZ is exploring different service delivery models mainly in the eastern parts of India. One of the models being tested is a community-based 'pay-as-you go model' in Bihar. The article is broadly divided into three sections apart from the introduction. The second section explains the community based 'pay-as-you go–water-as-a-service model' as has been tested by GIZ in Bihar. The third section provides an insight into the usage pattern of the solar pump while the concluding section basically summarizes the key insights and also outlines the enabling condition for deployment of community-based service delivery model.

UNDERSTANDING THE COMMUNITY-BASED 'PAY-AS-YOU GO–WATER-AS-A-SERVICE DELIVERY MODEL

A community-based model involves sharing of the asset, that is, solar pump within an irrigation water-sharing group of farmers based on the individual member's irrigation requirements. One of the preconditions for formation of the group is that the farmers sharing the solar pump either need to have their land adjacent to the water pump or within the catchment area which the pump can cater to. Generally, an operator nominated within the group keeps track of the usage of solar pump by different members and a service charge is levied based on the quantum of water delivered to various members. In case of the GIZ pilot in the Vaishali district of Bihar with Vaishali Area Small Farmer's Association (VASFA), a solar pump was installed in two of the sites used by diesel pump, which were being used for irrigation. The objective was to set up a site for the community-based pay-as-you-go–water-as-a-service-delivery model, to reduce the usage of the diesel pump for irrigation and to use the same site for technology demonstration of farmers of the neighbouring districts. Apart from the operator, there is a group leader elected by the group members for collection of service charges. The service charge to be collected is also decided by the irrigation group and the collected money is partly used for salary of the operator and the rest is saved within VASFA for operation and maintenance of the asset. The group leader decides the sequence in which the members will receive water in a particular day. In this model, irrigation water is also shared with non-members after meeting the needs of the primary members. The service charges for non-members are slightly higher than that of the members. GIZ has provided financial support to set up the site for the pay-as-you-go model. In case of the GIZ project, the ownership of the asset lies with VASFA.

ANALYSIS OF THE SOLAR PUMP UTILIZATION DATA

This section provides an analysis of one of the community-based solar pump sites (referred as Tube Well No. 11) installed in Vaishali. The solar pump caters to a group of around 34 farmers with a catchment area of approximately 34 acres. The irrigation group had access to an 8.5 HP diesel pump. With the GIZ intervention, a 5 HP (4.8 kW) AC solar submersible pump was installed. The operational data on the usage of pump has been analysed for four years starting from April 2014 till November 2.017. Some details of the project are mentioned in Table 1.

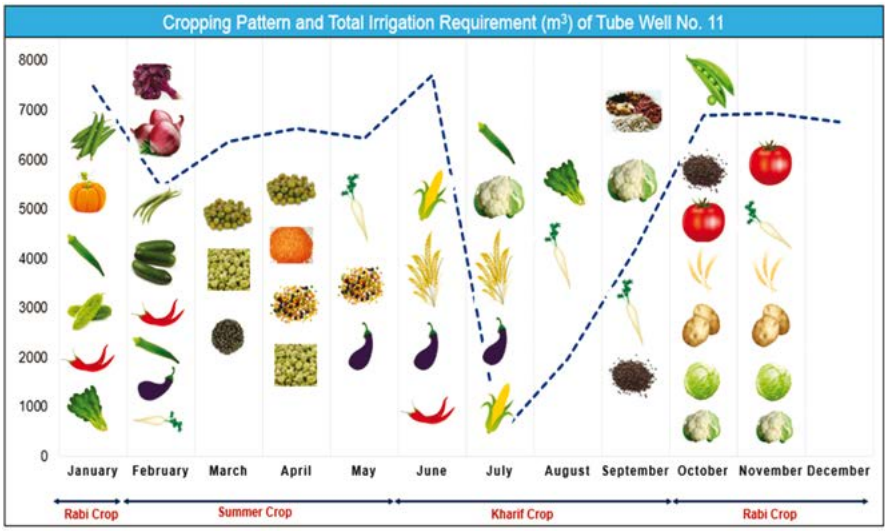
It is worthwhile to mention that the farmers in the site have less than 1 acre of land and cultivate for three seasons in a year. For most of them, agriculture is the primary occupation. Cultivation of vegetables is a common practice and is mostly undertaken during the Kharif and Rabi season. As seen in Figure 1, Tube Well No. 11 grows a variety of vegetables, wheat, paddy and pulses, and therefore, experiences a high water requirement throughout the year.

Table 1: Details about the project site

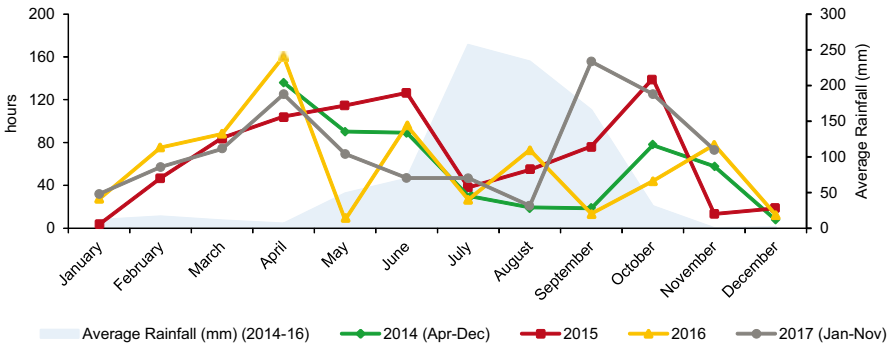
Parameter	Details
Geographic details	Village: Lalpura District: Vaishali
Year of installation	2014
Pump capacity	5 HP
Solar panel capacity	4.8 kW
Type	AC Submersible
Supplier	Claro Energy Private Limited
Catchment area	34 acres
No. of farmers served	34
Mode of finance	Financed by GIZ
Alternate pumping options available	Diesel pump
Capacity of the diesel pump	8.5 HP
Operating model	Water as a Service

Figures 2 and 3 highlight the usage of the solar pump set by the farmer group for the years 2014, 2015, 2016, and 2017. Figure 2 has been plotted against the average rainfall data over the mentioned year while Figure 3 provides the distribution of the usage hours of the solar pump between the members and non-members over the projected duration.

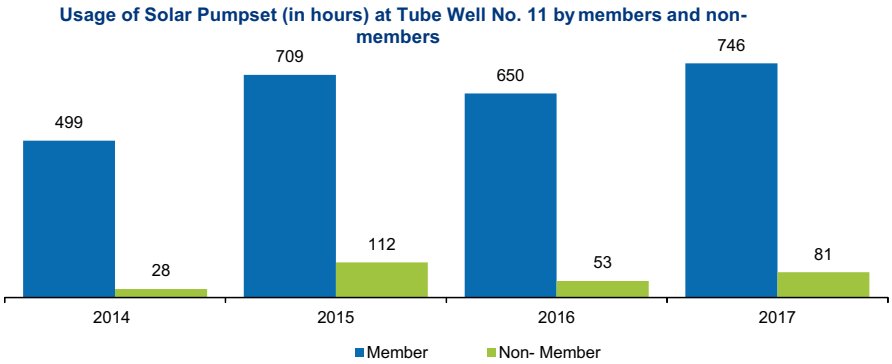
The total number of hours of usage of the solar pump set in Tube Well No. 11 was 527 hours, 821 hours, 703 hours, and 827 hours in 2014 (April–December), 2015, 2016 and 2017 (January–November), respectively. The monthly usage of diesel pump set available in Tube Well No. 11 and the total number of hours of usage is 262 hours, 578 hours, and 259 hours in 2014 (May –December), 2015, and 2016, respectively. It can be seen that the usage of both the pump has significantly reduced in 2016. This may be



» **Figure 1:** Cropping pattern and irrigation requirement of Tube Well No. 11



» **Figure 2:** Total usage at Tube Well No. 11



» **Figure 3:** Usage of solar pump set at Tube Well No. 11 by members and non-members

attributed to adequate rainfall during the monsoon season.

The water requirement is highest during October to May. During high demand seasons, the farmers have to wait for water delivery and therefore sometimes opt for other irrigation means, preferably diesel pump sets. During peak season, the solar pump set cannot fulfill the entire water requirements. The problem might have been addressed through a higher capacity of solar irrigation pump. However, the higher capacity solar irrigation pump might also have two other implications: a) it would have increased the project cost; b) the pump would have remained underutilized for a major duration of the year.

USAGE PATTERN OF THE SOLAR AND DIESEL PUMPS ACROSS THE DAY OVER MULTIPLE YEARS

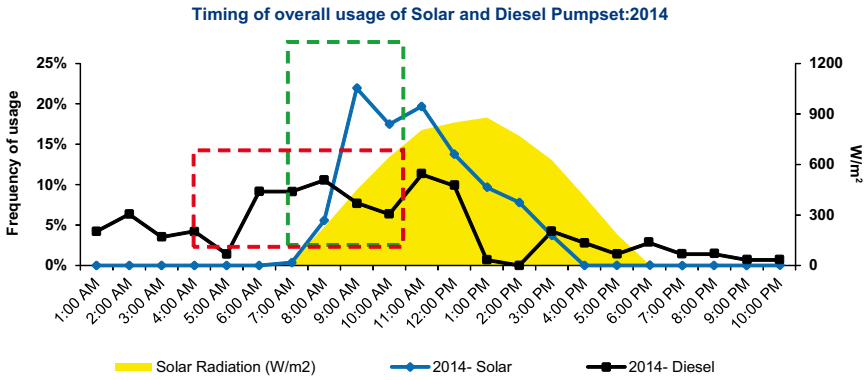
Solar pumps run on solar energy and their performance fluctuates based on the intensity of solar radiation. Therefore, the time of solar pump operation is of importance to get a consistent output. Figures 4 to 7 provide a year-wise break-up of the usage pattern in terms of the preference of the day for irrigation. The graphs show that the majority of the farmers prefer having irrigation water in the early morning. It seems that the farmers prefer to irrigate the most before 12:00 noon.

The time usage pattern for Tube Well No. 11 is shown below.

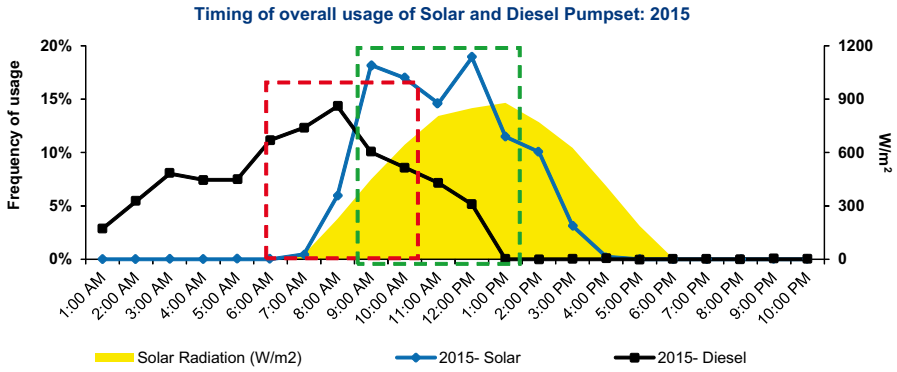
- Discussions with farmers have revealed that most farmers do not want to work in the field post noon due to the heat and hence tend to prefer completing their irrigation activities before noon. It was also revealed that most farmers tend to go to market in the late afternoon and hence they prefer to complete their irrigational activities before noon.
- The farmers highlighted that the group grows a lot of vegetables especially during February to June and the irrigation requirement for the vegetables is mostly during early morning and evening. Therefore, the specific water requirements, especially early morning and late evening, are better fulfilled by diesel pump set.
- Assurance of irrigation water at the appropriate time to prevent crop mortality is more important than economic incentive of lower price of irrigation water. Hence, if needed, the farmers prefer paying higher price to get assured supply of water especially during November to January when the solar irradiance in Vaishali is often much lower to run the solar pump for the desired duration.

CONCLUSION

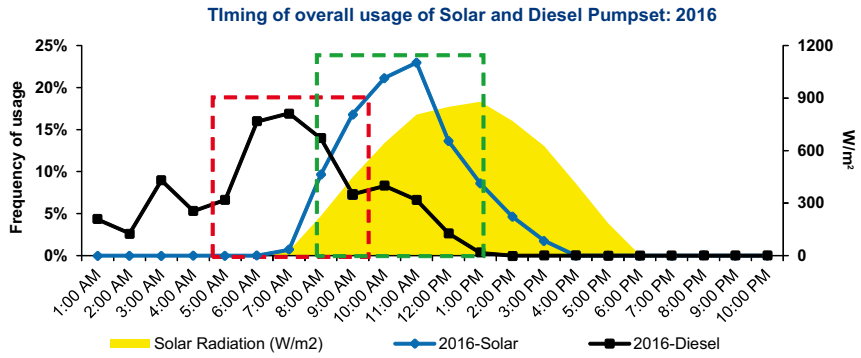
Having a dedicated community-based organization can create an enabling



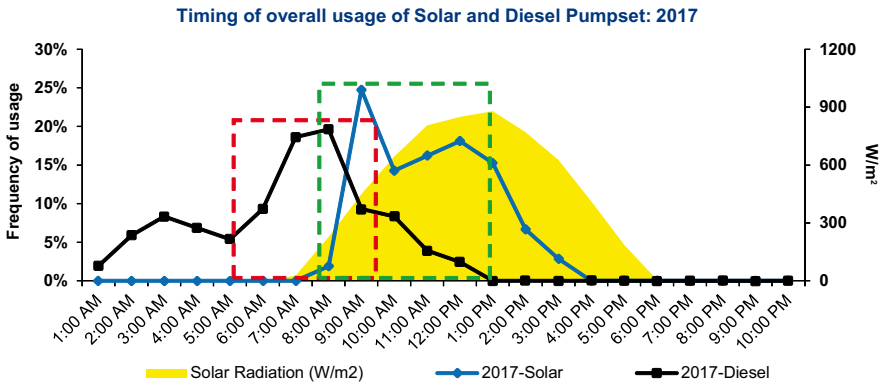
» **Figure 4:** Timing of overall usage of solar and diesel pump set: 2014



» **Figure 5:** Timing of overall usage of solar and diesel pump set: 2015



» **Figure 6:** Timing of overall usage of solar and diesel pump set: 2016



» **Figure 7:** Timing of overall usage of solar and diesel pump set: 2017

environment for developing a community-based asset sharing model. Presence of such an organization can facilitate in technology transfer and also technology adoption. Collaboration between private sector and farmer's collective or a community-based organization is essential for upscaling such a model. The project developer needs to carefully look at the sizing of the solar pump. While oversizing of the asset can lead to increased project cost and also under-utilization of the asset, undersizing may not be able to meet the irrigation demand of the catchment area.

In a community-based water sharing model, solar irrigation pump can supplement the use of diesel/electric pump. Analysis of the operational data (over the past four years) of the community-based solar irrigation pump in Vaishali, Bihar, reflects the fact that a considerable portion (about 50%) of the irrigation load is borne by solar pump. The need of water for irrigation for the winter crops often remains unmet through the solar pump, due to low or inadequate solar irradiance, during the months of November to January in Vaishali district of Bihar.

The usage pattern of the solar pumps in Bihar also shows that farmers have a preference of using the water pump only during a limited period of the day (especially between 8:00 a.m. till 12:00 noon). A change in the behavioural pattern of the farmers can also lead to increased and improved utilization of solar pumps. Having a water tank for storage can also reduce the dependency on diesel/electric pumps and can also ensure access to water for irrigation in periods with low or inadequate solar radiance. The experience also highlights the fact that assurance of supply of adequate water during a particular period is more important than economic incentive in the form of a lower service charge for irrigation water for farmers. Therefore, a community-based service delivery model most importantly needs to ensure assurance of irrigation water for farmers.AU

Mr Nilanjan Ghose, Senior Advisor IGEN-Access GIZ.

GASIFICATION OF BAMBOO AND ITS WASTE

As a Feedstock in Updraft Gasifier

In this success story, **H C Chakrabarti** discusses a successful venture of GP Green Systems Pvt. Ltd, Kolkata that had set up three gasifiers at Mangaldoi, Assam, to produce gas having calorific value 1,250–1,350 kcal/Nm^3 (or 5.25 MJ–5.65 MJ/Nm^3). This gas was meant to replace high speed diesel (HSD) used as a fuel in the biscuit plant of ITC. The venture proved to be a great success to the satisfaction of the customer.

Bamboo and its derivatives fall within the category of biomass, a biodegradable substance, essentially a product of photosynthesis and a natural solar cell storing in some form or other, solar energy, and this energy can be meaningfully extracted through application of appropriate technology. The energy stored in biomass is measured by its heating value. The work so far carried out on biomass has established the fact that on dry mineral matter all types of biomass whether wood, rice husk, biodegradable substances, etc., have the same properties in respect of proximate and ultimate analysis, calorific value, etc. A mere study of such parameters can identify and differentiate biomass from other types of fuels—whether solid or liquid. During World War II, charcoal (de-volatilized wood) was being widely used to produce gas for energy generation and also for driving of vehicles. Though the mechanism was not very successful, it gave a big clue to develop the process of gas production using air in biomass gasification. As it stands today, biomass gasification has proved its success but there is no universal gasifier which can gasify all types of biomass. Certain types of biomass though highly combustible, were not found suitable for gasification and one such material was bamboo and bamboo waste which are abundantly grown in many parts of India, particularly the eastern region. The State Government has been advocating use of bamboo and bamboo derivatives to generate gas to replace costly petro-based fuels, such as LPG, HDO/FO. Keeping in view the patronage of the local government, GP Green Systems Pvt. Ltd, Kolkata, having long experience in biomass gasification took the challenge and set up three of gasifiers (nominal capacity 600 kg/hr biomass) at Mangaldoi, Assam, to produce gas having calorific value 1,250–1,350 kcal/Nm^3 (or 5.25 MJ–5.65 MJ/Nm^3). This gas was meant to replace high speed diesel (HSD) used as a fuel in the biscuit plant of ITC. The venture proved to be a great success to the satisfaction of the customer.

RAW MATERIAL CRITERIA

The important quality parameters of any biomass should include the following:

- Moisture of the biomass as charged in the gasifier which is much higher than that determined by proximate analysis.
- Proximate analysis, that is, determination of moisture, ash, volatile matter, and fixed carbon.
- Determination of bulk density of biomass to be used in gasification process.
- Flow characteristic of the biomass and the physical behaviour of the same.
- Size analysis which will depend on the type of biomass and the size of the gasifier.
- Ash fusion point both initial deformation and hemispherical.
- Reactivity of the material.
- Stability of the material in water and also under heat.
- Physical shape of the biomass.

Briquettes and pellets made from biomass trash and bush often look good and fit for gasification. In reality, it may not be so because briquettes/pellets crumble in powdery form inside the gasifier thereby blocking air and gas passage. However, these materials can be used in small proportion after mixing with the main charge.

The other very important aspect is that the ash fusion point of any biomass should preferably be higher than 1,200 °C. If ash fusion point is low it becomes very difficult or even impossible to gasify a biomass because of slagging effect of the ash blocking air and gas passage inside the biomass. Generally, plants growing near seaside contain high alkali. Even otherwise, the shell of the fruits may contain high alkali causing lower ash fusion point.

The other constraints faced during gasification of different materials are the varying moisture content of the biomass which depends on atmospheric equilibrium moisture content. A freshly cut wood contains 50%–55% moisture which evaporates during storage and the final moisture contents after long storage may not fall below 30% at 60% RH. Similarly, freshly cut bamboo contains about 40% moisture and after storage it quickly falls to around 30%. Evaporation of moisture from bamboo has been found to be much quicker than that in wood. Therefore, the results of gasification, particularly gas generation, varies from day to day, depending on the weather and atmospheric conditions. In this respect, rice husk shows less variation for which moisture content rarely exceeds 15% and in summer it may fall as low as 8%–9%. In this context, it is worth mentioning that rice husk is a biomass with ash content as high as 20%. It is the skin of the paddy and this ash has 88%–90% silica.

Rice husk has low reactivity having low efficiency of gasification. For convenience, gross calorific value of bamboo at 4% ash is computed in Table 1.

Table 1: Gross calorific value of bamboo at 4% ash

Moisture Content (%)	Calorific Value (kcal/kg)
0	4,275
10	3,850
20	3,420
25	3,210
30	2,990
35	2,780
40	2,565

The above figures are approximate and may vary by 1%–1.5% because at different moisture content in biomass, the ash will also change. On dry mineral matter free basis (mineral matter ash% x 1.1) the calorific value of all biomasses is 4,470–4,480. In biomass or even in coal ash does not remain as such. It remains as mineral matter which on combustion produces ash.

OPERATIONAL ASPECT OF BAMBOO GASIFICATION IN THE ITC PLANT, MANGALDOI

The updraft biomass gasification plant at Mangaldoi was designed for rice husk gasification initially. The concept of using bamboo for gasification was proposed by ITC amidst reservations regarding usage of bamboo as feedstock that has low ash fusion point. GP Energy had considered this proposal as a challenge to try bamboo gasification after studying different pros and cons for which the design of the plant and its modus operandi was planned and incorporated accordingly. This called for detailed analysis of the bamboo to be made available for gasification purpose. General analysis of bamboo as used in the NENPL – ITC Mangaldoi plant is furnished in Table 2. It was observed that the bamboo as freshly cut contains more than 45% moisture and after sizing the same to the required size of 40 mm–80 mm the moisture content came down to around 35%. The average moisture in the bamboo chips used in the gasifier would rarely go below 30% which would mean that the heat content in the bamboo would be only in the range of 3,000–3,100 kcal/kg. At times during sunny weather the average moisture content ranged from 20%–25%.The gas from such a feedstock at 40% BST in the blown air (used for gasification) would be around 2 Nm^3/kg of bamboo at 30% moisture content in the feedstock which was considered acceptable. Broad analysis of bamboo as used in ITC Mangaldoi plant is furnished in Table 2.

Proximate analysis and heating value of different parts of bamboo top, middle, and bottom did not show much difference.

SALIENT FEATURES OF THE GP GASIFICATION PLANT

- GP gasifier is based on fixed bed updraft technology capable of gasifying different types of biomass, such as rice husk, wood and woody materials, agro-waste, such as bagasse, corn cob, stalk of wheat and corn, bamboo and bamboo wastes, etc. Thus, it is a multi-fuel system designed to handle even lower ash fusion point biomass in specific cases, like bamboo. The moisture content in biomass may be as high as 40%–45% but generally below 35%.
- It is a continuous operating system which can run on 24×7 basis.

Table 2: Broad characteristics of bamboo used in the NENPL – ITC, Mangaldoi, GPE plant

1.	Proximate and CV (on dry basis) Moisture % Ash % Volatile Matter % Fixed Carbon % Calorific value kcal/kg	Nil 2.50–4.0 77.0–78.0 19.0–21.0 4,100–4,200 (17.10–17.60 MJ/kg)
2	Sulphur and Phosphorus	Trace
3	Bulk density (30% moisture)	280–300 kg/m^3
4	Ash fusion point in °C	1,050–1,100
5	Size of bamboo used	Generally 40–80 mm
6	Average moisture content in sized bamboo	Around 30%

- The gas cleaning system attached to it is unique in type with several stages of cleaning by which particulate matter and tar content in gas can be reduced to less than 10 mg/ Nm^3.
- The heating value of gas can be consistently maintained at 1,250–1,350 kcal/Nm^3.
- The GP gasification system is served with full automation thereby ensuring high efficiency operation with low manpower requirement.
- GP gasifiers can be set up as decentralized standalone systems.
- GP Energy undertakes the

» Gas Cleaning System

responsibility to operate the plant to the satisfaction of the customers by rendering maintenance service.

OPERATIONAL SPECIALITY OF THE NENPL ITC MAN UPDRAFT GASIFICATION PLANT

The plant at Mangaldoi was commissioned in June 2016 and since then it has been in continuous operation. The experience gathered during the 10 months of continuous operation was highly encouraging because a raw material, that is, bamboo over which there had been enormous reservation in respect of its successful gasification was proved to be a mere apprehension in the updraft gasification technique of GP Energy. BST at the level of 60 °C–65 °C in the air introduced from the bottom and also uniformity in the pressure control throughout the system was maintained. At times, the bamboo contained even 40% moisture but this high moisture content did not disturb the operation of the gasifier except increasing the liquor formation. The efficiency of gasification rate was much better than that using wood. Charcoal production in bamboo gasification was much lower (less than 1%) compared to wood gasification where charcoal production was as high as 5%. The plant could be kept neat and clean. The quantity of liquor generated was around 25%–35% of bamboo depending on its moisture content. This liquor was of pyroligneous type having high biochemical oxygen demand (BOD)and chemical oxygen demand (COD) contents. It was also contaminated with light tar. The tar produced also contains 20%–25% moisture (specific gravity: 1.01 to 1.015) and the yield was around 2%–3%. The calorific value of the tar as computed was about 7,000 kcal/kg at 20% moisture.

The gas produced (% V/V) contained: CO_2: 8–11%; CnHm: 0.4–0.6%; O_2: less than 2% (usually 1%); CO: 23–26%; H_2: 9–12%, CH_4: 2.00–2.50%; N_2: 50–54%; CV (gross): 1,250–1,350 kcal/Nm^3 or 5.25–5.65 MJ/Nm^3.

Tar and particulate matter was 10–20 mg/Nm^3.

Moisture content in gas was 2%–3% (depending on temperature of gas and ambient temperature).

CONCLUSION

Gasification of bamboo which was once considered problematic due to low ash fusion point was made viable in the GPE updraft gasifier. The actual bamboo consumption at 30% moisture content was achieved at about 4.50 kg/L of diesel oil, but for the purpose of design one should consider about 5.00 kg/L because of many impediments particularly variation in moisture content in bamboo which at times may be as high as 40%, particularly during rainy seasons. Freshly cut green bamboo will also contain more than 40% moisture. The size and shape of the bamboo contributes towards good operation and higher efficiency of gasification. Introduction of steam in maintaining appropriate BST in the gasifier is a contributing factor towards attainment of gas in quality and quantity. Steam also stabilizes the gas flame in the burner.

The liquor generated will range from 30%–35% of the bamboo fed depending on the moisture of the bamboo. This liquor has all the characteristics of any other liquor produced by the gasification of different biomasses. The liquor is of pyroligneous type and may have to be treated before discharge to satisfy the PCB norms. AU

Shri H C Chakrabarti, Sr. Technical Adviser, GP Green Energy Systems Pvt. Ltd, Kolkata, West Bengal, India. *The author gratefully acknowledges the contribution of Sh. Vivek Banerjee for making the venture a success. His contribution towards plant operation control and plant management deserves appreciation.*

SUCCESSFUL USE OF RENEWABLE ENERGY
And Other Energy-Efficient Equipment

The Chanderpur Renewable Power Company Pvt. Ltd of The Chanderpur Group (CPG) has installed 1 MW biomass gasifier at one of their factories at Mullana, district Ambala, Haryana. This plant is using wood waste from ply board industries. This plant supplies power to all three units of Chanderpur Group through grid. Power produced is directly synchronized with the grid and is being purchased by the Group companies for their daily requirements. It is the first project of its kind in North India.

The project was put up by the Group as a Demonstration Project for the clients intending to install biomass gasifiers for their electricity needs. Ownership towards 'Green India' is a one of the motivating factors for the investment. The Company further plans to install such demonstration projects in East Africa and Western India. This power plant uses waste of plywood industry such as branches of trees, etc. Plywood industry in Haryana uses wood which is grown as agro-forestry. The company further plans to use other agricultural wastes that are available in its region. For this, the company has installed a briquetting plant to seamlessly run it using other waste. This plant also serves as training base for new clients. Further, the company has planned to install a cold storage which will be using waste energy from engine exhaust. This will make it as 'a green power plant'. This plant is not only fulfilling all electricity needs of CPG, rather it is also giving extra income to the farmers by selling their extra biomass waste. The used engine oil by the gas generators in the power plant is being used as coolant in the gear cutting machine after cleaning, so there is no need of fresh cooling oil, thus saving cost.

ASSISTANCE FROM IREDA AND MNRE

This plant is financed by the Indian Renewable Energy Development Agency Ltd (IREDA) and assisted by the Ministry of New and Renewable Energy (MNRE), Government of India, and by installing this plant, CPG has fulfilled its entire electricity requirement from renewable sources of energy.

REPLACEMENT OF LPG BY PRODUCER GAS

The major work of CPG is fabrication of equipment in which pre heat and post heat in welding is a must. Previously, it was done by use of LPG but now CPG has manufactured a small portable gasifier by which this work is done and the fuel used for this system are briquettes made from the waste charcoal and saw dust generated at CPG power plant site. So, on one side this gasifier has eliminated the use of LPG and on the other side, this system is using the waste of the power plant. The process is explained by Picture 1.

By using this portable gasifier efficiently, CPG is now ready to sell these gasifiers commercially.

1 kg of LPG = ₹66
The manufacturing cost of 1 kg of briquettes is ₹4.5/kg. So, the cost of 4.2 kg of briquettes = ₹19, which means savings are ₹47/kg (approx.) excluding labour.
19 kg LPG consumption for 10 hrs: ₹1,240
Cost of using briquettes: ₹360 + electricity of ₹190 (for 10 hrs of running)+ Labour cost of ₹180 = ₹730, even then the saving is of approximately: ₹510/10 hrs

STRESS RELIEVING

In CPG our jobs undergo stress relieving process. Previously this was done by diesel but now we use a dual fuel option in which the equipment is heated with the thermal gasifier and the temperature point is maintained with the help of diesel burner.

Diesel is used in the process which is now around ₹69/litre is replaced by around 4.2 kg of briquettes costing ₹19 and electricity and labour of approximately ₹10, so the saving is around ₹69 - ₹29=₹40/litre of diesel.

» **Picture 1:** This gasifier replaces 1 kg of LPG by around 4.2 kg of briquettes

CNC GAS CUTTING AND INVERTER-BASED MACHINES FOR WELDING

CNC gas cutting has been installed which has reduced the volume of cutting gases to 70% of what CPG uses in manual cutting. All welding machines have been converted from diode/thyristor (silicon controlled rectifier) to inverter-based machines which consume 20%–30% less power.

PLAN TO INSTALL A METHANE GAS GENERATOR

CPG is committed to eliminate the use of fossil fuels and now CPG is planning to install a methane gas generator to run on kitchen waste, so that the kitchen waste should also be used.

LOADING VEHICLES AND HYBRID CARS

CPG is committed to use hybrid cars to reduce the use of petrol. Recently, CPG has purchased a Toyota Camry hybrid car and in future, CPG wants to replace all their cars with hybrid cars.

MODIFIED AIR-CONDITIONING

CPG has also installed fresh air systems which are imported from Japan. It expels 20% of the air in the room outside and replaces it with fresh air and the fresh air is cooled down with the help of heat exchanger from outgoing air. It helps in maintaining the oxygen level in the workplace on one side and also when the outside temperature is comfortable they don't require running the compressor and the rooms are cooled with the fresh air system.

HEAT RESISTANT TERRACE TILES

All roofs of the office are insulated with the insulated tiles which results in huge savings of air conditioning of up to 50% than the normal roofs.

AUTOMATIC DEVICES FOR CORRECTIVE POWER FACTOR

Electrical equipment have been installed that have capacitor banks to maintain the optimal power factor H to reduce energy losses, hence it also improves energy efficiency. AU

Mr Sudhir Chandra, Director, Chanderpur Group (CPG), Jorian, Delhi Road ,Yamunanagar, Haryana, India.

FROM LAB TO ROOM

How I Integrated Renewables in My Life

Dr Shashank Vyas from TERI put theory into practice and made reduced carbon footprint a way of life... How? Read further to know more...

Before solar power became a buzzword, thanks to the plummeting electricity tariffs under the National Solar Mission, it was a part of a silent revolution at my home.

Placed elegantly on the top of the lid of a cylindrical structure made of translucent plastic, a 12-Watt solar photovoltaic (PV) module powered a small light emitting diode (LED) inside the container. The modern day solar lantern came into my household when my father ordered one over the Internet, one and a half decade ago. It provided fulfilling illumination and was a big relief over the Petromax. The irritating, eye-burning luminance of the burning bulb was replaced by the brighter, soothing light of the solar lantern.

Plagued by power cuts as we were in my part of the NCR, the solar lantern helped reduce the darkness in our home at a time when battery-inverter systems had not gained prominence. This was also my first experience with a non-conventional source of energy. It set me on a course where I kept experimenting with unconventional and energy-saving appliances and products.

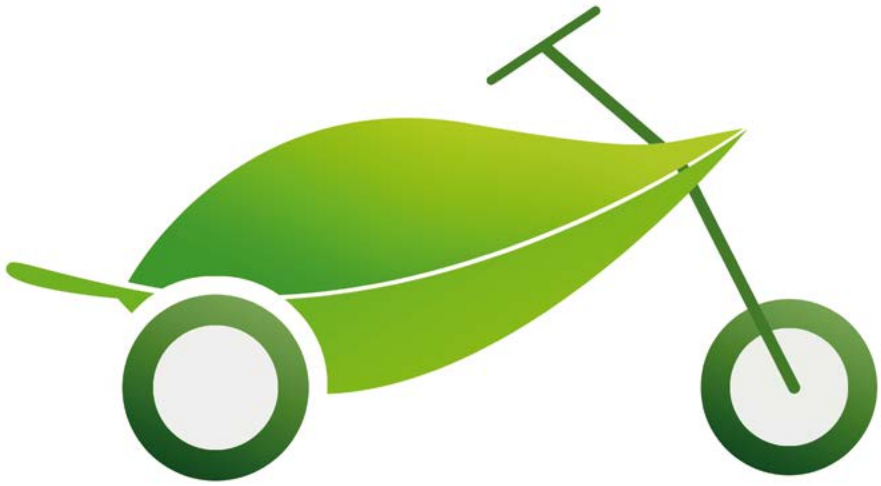
Happy with my solar lantern experience, I also gifted one to a friend for her wedding, which she appreciated a lot. Later, I gifted others a solar power bank and a solar light, all purchased through e-commerce websites. I gifted the power bank to my cousin in Bikaner, and the solar light to his domestic help. She used to charge it on the roofs of the various houses she worked in through the day and would tie it on a wooden pole near her shanty at night for much-needed illumination.

MY EV EXPERIENCE

Taking my quest further, during my last semester of college, I purchased

an electric two-wheeler after lengthy discussions at home. The vehicle brand's tagline, "I don't drink and I don't smoke", gave me the satisfaction of not having contributed to emissions, at least not while driving (I have to concede though that it has a significant charging footprint).

Entering the fifth year of its operation this year, my two-wheeler has undergone one battery replacement and multiple instances of societal mockery. Some fellow commuters were even irritated by its silent presence, as the absence of a roaring engine took them by surprise on the road. A friend of mine, who has graduated to one car and one motorbike in five years, complains about how 'uncool' and slow my two-wheeler is. He is right on the second count. My low-end model can only go up to 25 km/h (with upgradation to 60 km/h possible) while the high-end models, costing over ₹60,000, can go up to 70 km/h. In terms of mileage, once fully charged it can go up to a distance of 50 km. It can be fully-charged by six to eight hours of charging through a wall socket at my home. I can plug it in at night and go off to sleep as it automatically cuts off the supply once fully charged.



THE HUMBLE MITTICOOL

Sustainable cooling solutions too interested me a lot and accordingly I purchased a net-zero energy refrigerator called 'Mitticool', made of clay, when I was pursuing my PhD in Jaipur (at Malaviya National Institute of Technology). My landlord questioned my choice, which was more expensive than a conventional mini-fridge, to which I only had to say, "No vapour compression please". The 20 °C gradient and the earthy feel it gave to my food made it an object of curiosity to visitors to my room. I have also been planning for a long time for a net-metered rooftop solar PV system at home, but the unreliable power grid held me back (in fact, the potential technical problems inspired my PhD research proposal).

My latest find in my quest for a carbon-neutral life is a roll of photodegradable plastic garbage bags that I found at a very unlikely place—a supermarket. I picked them for up for ₹50 a roll as soon as I realized what they were. These bags are supposed to degrade under sunlight and so will hopefully not keep adding to the burden of a landfill somewhere.

With great strides being made in both technology and the human role in environmental degradation, I hope I will not remain alone in my desire to put into practice methods to meet our needs in the modern world without smoking out our planet. AU

Contributed by Dr Shashank Vyas, Associate Fellow, Electricity & Fuels Division, TERI, New Delhi.
Source: http://www.teriin.org

GRID CONNECTED SOLAR ROOFTOP POWER PLANT INSTALLED IN STATE PARYAVARAN BHAWAN IN SHIMLA, HIMACHAL PRADESH

» Solar panels installed in the rooftop of Paryavaran Bhawan, Shimla, Himachal Pradesh

Paryavaran Bhawan, Department of Environment, Science & Technology HP, Shimla, has commissioned first grid-connected solar rooftop power plant of Shimla city having capacity of 35 kW. The solar plant was inaugurated by the Hon'ble Chief Minister of Himachal Pradesh, Shri Jai Ram Thakur on April 6, 2018. In his address he has urged all the government and private departments of the State to adopt renewable energy technologies such as solar plants, etc., in their office premises so that contribution towards saving of energy and environment conservation can be made. All residents should also adopt solar- based energy technologies so that everybody can contribute towards energy saving which in turn would also lead to revenue saving of the state and simultaneously reduce their carbon footprint and protect the environment for future generations.

The work of supply, installation, and commissioning of grid-connected rooftop solar power plant was awarded to M/s Solarshamps Engineers & Consultants, Parwanoo, District Solan. For the 35 kW capacity power to be produced, 112 solar panels of 315 W capacity per panel have been installed in the rooftop. This plant has been installed at the cost of ₹19.23 lakh. One bi-directional meter has also been installed by HP State Electricity Board Ltd. for the functioning of solar power plant in the office premises of Department of Environment, Science & Technology which is essential for energy inflow and outflow from solar plant to main electricity grid. One Grid Tied Inverter/Power Conditioning Unit of 40 kW capacity has also been installed in the office premises.

Through this plant, solar power would be fed to main grid and therefore the consumption of electric power will be reduced. This will lead to power saving and would offset the carbon dioxide (CO_2) in the atmosphere. It has been estimated that the return on the investment made on the installation and connection of rooftop solar power plant will be made in approximately 5 years which will lead to revenue saving of the Government. As per estimation, about ₹97 lakh would be saved in next 25 years. The Ministry of New and Renewable Energy, Government of India, through HIMURJA is providing 70% financial assistance for grid connected solar rooftop power plants in the State of Himachal Pradesh. The State Government has also agreed to provide financial assistance of 10% or ₹4,000 per kW for the current financial year 2018/19. AU

Courtesy: Shri Panna Lal Sharma

ISA AND INDIA SIGN THE HOST COUNTRY AGREEMENT

ISA a Juridical Personality Now

» The Minister of State (I/C) for Power and New and Renewable Energy, Shri Raj Kumar Singh and the Minister of State for External Affairs, General (Retd.) V K Singh at the signing ceremony the Host Country Agreement between MEA and ISA, in New Delhi on March 26, 2018. The Secretary, Ministry of New & Renewable Energy, Shri Anand Kumar and the Interim DG of International Solar Alliance (ISA), Shri Upendra Tripathy are also seen.

The International Solar Alliance (ISA) and the Ministry of External Affairs (MEA), signed the Host Country Agreement in New Delhi on March 26, 2018. The agreement will give ISA a juridical personality and gives it power to contract, to acquire and dispose off movable and immovable properties, to institute and defend legal proceedings. Under this agreement, ISA shall enjoy such privileges, applicable tax concessions and immunities as are necessary for ISA's Headquarter to independently discharge its function and programmes. ISA shall be deriving its status, privileges, and immunities as per Article 10 of Framework Agreement.

The agreement was signed by General (Dr) V K Singh, Minister of State, Ministry of External Affairs and Shri Upendra Tripathy, Interim Director General, ISA in the gracious presence of Shri R K Singh, Union Minister of State (IC) for Power and New and Renewable Energy.

Congratulating the signatories, Shri R K Singh said that ISA has potential to change developmental paradigm in the world. He said that energy will now be available to less developed tropical countries at affordable rates and in an easily deployable manner. The Minister also mentioned that many countries have shown interest to learn from India's experience in renewable energy. He emphasized the need for our industry to go and set up infrastructure in these countries and talked about doing necessary de-risking in this regard.

General (Dr) V K Singh also congratulated ISA and stated that ISA has an onerous task at hand to mobilize over $1,000 billion of investment into the solar sector and deploying over 1,000 GW of solar capacity. He also stated that ISA needs to firm up financial

partnership deals with more multilateral and bilateral donor agencies in order to meet its stated objectives. Shri Upendra Tripathy called the signing of Host Country Agreement an important milestone and thanked the Government of India for its wholehearted support. Secretary, MNRE; Secretary (ER), MEA were among the dignitaries present at the event. AU

Source: http://pib.nic.in/

INNOVATION SUMMIT NEW DELHI 2018

Schneider Electric, the global leader in digital transformation of energy management and automation, hosted its first Innovation Summit in India on March 19 and 20, 2018, in New Delhi. The summit brought together more than 2,000 customers, policymakers, and industry leaders. Leaders shared critical insights on how automation and digitization are helping to manage energy with disruptive technology tools leading to efficiency in business. The summit also reiterated Schneider Electric's commitment to a sustainability agenda and complete alignment with the Indian government's long-term goal of bringing down the carbon footprint.

Addressing the plenary, Mr Amitabh Kant, CEO of NITI Aayog, said that the country is poised for paradigm shifts with huge disruptions in physical infrastructure. "We are creating 100 smart cities with another 50 cities which will be connected by metro and a few connected with bullet trains. The government is converging physical infrastructure with biometric-based digital infrastructure to improve human lives with uninterrupted water and electricity supplies, efficient public transportation, quality education, and healthcare services."

Opening the plenary session of the summit, Mr Anil Chaudhry, Zone President and Managing Director of Schneider Electric India said, "Schneider Electric's technologies are powering businesses and key government programmes, including Make in India, Smart Cities Mission, and Electric Mobility. Nearly 15% of India's solar capacity is based on Schneider technology. Digitization and the Internet of Things (IoT) are going to transform India's energy ecosystem so that all citizens have access to uninterrupted electricity at affordable rates."

The event featured strategic discussions and interactive deep-dive sessions among over 50 expert speakers from Schneider Electric, besides a diverse group of customers and partners from India and across the Asia-Pacific region. It was designed to further accelerate digital solutions to make New India Energy Positive. The expert sessions included those on intuitive industries, living spaces of the future, leveraging IoT in manufacturing facilities, enabling digital hospitals, re-imagining data centres for a connected tomorrow, empowering industrial original equipment manufacturers (OEMs) for the digital era, and inclusive growth of India through skill development and rural electrification.

The summit also showcased Schneider Electric's Innovation Hub, an exhibition of the company's rich portfolio of software, solutions, and services. The integrated zone displayed its next-generation EcoStruxure™ architecture and platform that delivers IoT-enabled open and interoperable solutions across user segments. The company also displayed its new range of IoT-enabled smart home solutions called 'Connected Homes'. It showcased digital demos bringing the innovative platforms closer to its customers as well as to a broader audience.

Given the huge potential in the electric vehicle (EV) charging space, Schneider Electric also displayed its EV charging infrastructure named EVLinks. EVLinks is already available in different markets across the world and the company is keen to tap into the nascent Indian market for the same. The EV charging platform can be installed both at homes as well as public places. AU

Courtesy: www.schneider-electric.com

SHRI R K SINGH INAUGURATES NTPC'S TWO-DAY CONFERENCE ON AGRO RESIDUE AND MUNICIPAL SOLID WASTE TO POWER

» The Minister of State (I/C) for Power and New and Renewable Energy, Shri Raj Kumar Singh addressing at the NTPC Conference on Agro Residue and Municipal Solid Waste to Power, in New Delhi on May 8, 2018.

Inaugurating NTPC's two-day conference on Agro Residue and Municipal Solid Waste to Power in New Delhi on May 8, 2018, Shri R K Singh, the Minister of State (I/C) for Power and New and Renewable Energy, said, "Environmentally Healthy and Clean India is at the core of the Government's long-term goals." He also said the intent is to generate power keeping the environment healthy and contributing to Swachh Bharat. The Minister added that social objective is that of a healthier planet and there are costs attached to attain this objective. The intent is to design policies so that long-term social goals are met for clean India. Agro residue and municipal solid waste can be used both for power generation, this just need to address the challenges to optimally leverage this process.

Speaking on the occasion, Shri A K Bhalla, Secretary, Power, said NTPC is the flagship company of the whole country and complemented the management for bringing in the spirit of innovation to tackle these issues for a clean environment. The conference is an ideal platform for all stakeholders to collate and interact on imperatives and issues facing the sector and use them at power projects on pan-India basis.

In its effort to curb air pollution, the NTPC had invited tender for procurement of agro residue based biomass pellets. It has been successful in obtaining the commitment for receiving approximately 200 metric tonnes per day of agro residue based fuel at NTPC Dadri. It will generate approximately 150 MU of renewable electricity annually.

> **"Environmentally Healthy and Clean India is at the Core of the Government's Long-Terms Goals."**
>
> **Shri R K Singh**

NTPC is actively working to find out the solution for agro residue and municipal solid waste to power the workshop is deliberating issues amongst policymakers, pellets manufacturers, regulators, financiers and power professionals, waste-to-energy experts, and companies in the field of waste to energy. AU

Source: http://pib.nic.in/

Shri R K Singh Inaugurates Solar Lamp Assembly and Distribution Centre

On the occasion of the 127th birth anniversary of Bharat Ratna Dr Bhimrao Ambedkar on April 14, 2018, Shri R K Singh, Minister of State (I/C) for Power and New & Renewable Energy, Government of India, launched a number of initiatives for the welfare of the underprivileged.

At this occasion, Shri Singh expressed the Government's commitment to provide 24×7 power supply to all. He said that every household in country will get electricity connection by December 2018 under 'Saubhagya'. Emphasizing the importance of renewable energy for rural areas, the Minister said, "Off-grid solutions will empower the local women and provide a reliable source of electricity for school going children so they can study and progress well. Thus, it will help in integrating the deprived sections of society with the mainstream."

Of the several initiatives launched, Shri Singh inaugurated Assembly & Distribution Centre for Solar Study Lamps at Mahuli village in Arrah. In this centre, local women Self-Help Groups (SHGs) will assemble solar study lamps and distribute them to underprivileged students who do not have access to electricity. Thus, the Centre will not only provide kerosene-free affordable illumination to students, but also empower rural women with the skills to assemble, distribute, and repair solar lamps.

This initiative is part of the Government of India's scheme of providing 70 lakh Solar Study Lamps in five States where rural household electrification levels are low. In Bihar, the target is to provide more than 18.84 lakh underprivileged students with Solar Study Lamps. Around 4.57 lakh such lamps have already been distributed to students of the State.

Shri R K Singh also laid the foundation (remotely) for a solar photovoltaic (PV) module manufacturing plant in Sherghati block of Gaya district. This plant will be first-of-its-kind in the State, and will be entirely owned and operated by local women Self-Help Group Federations. For this purpose, a Memorandum of Understanding (MoU) was signed between the Bihar Rural Livelihood Promotion Society (BRLPS)—Jeevika, IIT-Bombay, and the Cluster Level Federation of women self-help group members.

Initiating the Government of India's Gram Swaraj Abhiyan, Shri Singh flagged off the UJALA van from Arrah. The van will travel across Bihar distributing the LED bulbs and spreading awareness about energy efficiency and energy conservation. As part of this initiative, 16,000 Indian villages with a significantly large number of low income households will be able to buy LED bulbs for a special price of ₹50 under the Unnat Jyoti by Affordable LEDs for All (UJALA) programme. In Bihar, 635 villages will benefit under this programme. The LED bulbs will equip homes with energy-efficient, cost-effective lighting, and higher lumen output than conventional incandescent bulbs.

The Gram Swaraj Abhiyan is launched by the Government to promote social harmony and apprise rural communities of various government welfare schemes and initiatives. The campaign was implemented between April 14 and May 5, 2018, in 16,000 villages across India.

The event was graced by the officials from Ministry of New and Renewable Energy, EESL, IIT Bombay, Bihar Rural Livelihoods Promotion Society—Jeevika and District Administration of Bhojpur. AU

Source: http://pib.nic.in/

NINTH INDIA–JAPAN ENERGY DIALOGUE HELD IN NEW DELHI

The 9th India–Japan Energy Dialogue was held in New Delhi on May 1, 2018. The Minister of State (I/C) for Power and New & Renewable Energy, Government of India, Shri R K Singh, and Minister of Economy, Trade and Industry (METI), Japan, Mr Hiroshige Seko signed a Joint Statement at the conclusion of the meeting.

Both Japan and India, as the third and the seventh largest economies respectively, recognized that having access to reliable, clean, and economical energy is critical for their economic growth and in achieving this, both Ministers agreed on further strengthening of bilateral energy cooperation for energy development of both countries, while also contributing to worldwide energy security, energy access, and climate change issues.

Both India and Japan with a view to implement Nationally Determined Contributions (NDCs) under the aegis of the United Nations Framework Convention on Climate Change (UNFCCC) recognized the importance of development and deployment of next generation technologies including hydrogen to realize de-carbonization.

Both India and Japan appreciated the relevance of the grid stability given the high penetration of variable renewable energy. Both countries agreed to initiate the discussion towards development of electric vehicles (EVs) by collaborating with "Policy dialogue on next generation/ Zero emission vehicles". Both India and Japan reiterated the continued importance of coal-based electricity generation in the energy mix in both the countries and also agreed to promote the cooperation on environmental measures for coal-fired power plants.

Both India and Japan further confirmed their commitment to work together in promoting well-functioning energy markets and affirmed to promote transparent and diversified liquefied natural gas (LNG) market through the relaxation of destination clause.AU

» The Minister of State (I/C) for Power and New and Renewable Energy, Shri Raj Kumar Singh and the Minister of Economy, Trade and Industry, Japan, Mr Hiroshige Seko exchanging the Joint Statement, at the 9th Japan–India Energy Dialogue, in New Delhi on May 1, 2018.

Source: http://pib.nic.in/

SHRI R K SINGH CHAIRS MEETING WITH BATTERY MANUFACTURERS

Shri R K Singh, Union Minister of State (IC) for Power and New & Renewable Energy, Government of India, held a meeting with battery manufacturers in New Delhi on March 23, 2018, to discuss the creation of an ecosystem for incentivizing battery manufacturing in India.

In the meeting, Shri Singh exhorted the industry to set up battery manufacturing units in India as the future demand was going to be very high with the Government promoting e-vehicles in a big way. "Tenders for procuring e-vehicles have already been issued and we have started procuring the vehicles. This is going to increase", he said. Asserting that the future bids will be for solar/wind hybrid coupled with storage, the Minister said that the Government will soon come out with a policy in this regard, and the focus will be on 'Make in India' in this field.

On the issue of adequate supply of raw materials for manufacturing of batteries, the Minister said that the Government has already initiated interaction with resource-rich countries such as Bolivia.

The industry representatives raised the issue of high GST rates on batteries. They demanded that to promote Make in India, preference should be given to Indian-made batteries in Government procurement. They also stressed upon the need for creating Indian standards for batteries and setting up of field testing facilities for both stationary and mobile sectors.

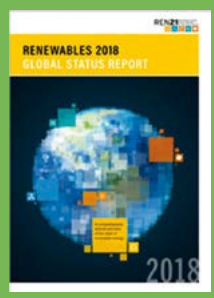
Emphasizing the need for creating a manufacturing base for batteries in the country, the Minister asked the Department of Space and ISRO to share relevant technologies with the Industry. Stressing the need to start manufacturing of cells in India, the Industry representatives requested for a favourable fiscal regime. They also expressed the need to create an enabling environment for recycling of batteries in India.

Shri R K Singh assured the battery manufacturers that the Government would take all possible measures to incentivize battery manufacturing in India.

Shri Anand Kumar, Secretary, MNRE was among the dignitaries present at the meeting which saw participation from major battery and electric vehicle manufacturers, ISRO, MEITY, NITI Aayog, and MNRE.

Source: http://pib.nic.in/

REN21 RENEWABLES 2018 GLOBAL STATUS REPORT



REN21 is the global renewable energy policy multi-stakeholder network that connects a wide range of key actors. REN21's goal is to facilitate knowledge exchange, policy development, and joint action towards a rapid global transition to renewable energy.

REN21 brings together governments, non-governmental organizations, research and academic institutions, international organizations, and industry to learn from one another and build on successes that advance renewable energy. To assist policy decision-making, REN21 provides high-quality information, catalyses discussion and debate, and supports the development of thematic networks.

The Highlights of GSR 2018

First released in 2005, ***REN21's Renewables Global Status Report*** (GSR) has grown to become a truly collaborative effort, drawing on an international network of over 900 authors, contributors, and reviewers. Today it is the most frequently referenced report on renewable energy market, industry and policy trends.

This year's ***Renewables 2018 Global Status Report*** (GSR) reveals two realities: one in which a revolution in the power sector is driving rapid change towards a renewable energy future, and another in which the overall transition is not advancing with the speed needed.

The ***REN21 Renewables 2018 Global Status Report*** (GSR) portrays a dynamic renewable power sector characterized by falling costs, increased investment, record-setting installation and new, innovative business models that are creating rapid change. Thanks to years of active policy support and driven by technology advances, rapid growth and dramatic reductions in costs of solar photovoltaics (PV) and wind, renewable electricity is now less expensive than newly installed fossil and nuclear energy generation in many parts of the world; in some places it is less expensive even than operating existing conventional power plants.

But these positive developments tell only part of the story. The global energy transition is only fully underway for the power sector; for other sectors it has barely begun. The power sector on its own will not deliver the emissions reductions demanded by the Paris climate agreement or the aspirations of Sustainable Development Goal 7 (SDG 7) to ensure access to affordable, reliable, sustainable, and modern energy for all. The heating and cooling and transport sectors, which together account for about 80% of global total final energy demand, are lagging behind.

In 2017, China, Europe, and the US accounted for nearly 75% of the global investment in renewable power and fuels. While investment in these major markets is impressive and needs to continue, there are also examples of significant investment in developing country markets. China had a high level of investment— an increase of 30.7% from the previous year. However, when measured per unit of gross domestic product (GDP), the Marshall Islands, Rwanda, the Solomon Islands, Guinea-Bissau, and many other developing countries are investing as much as or more in renewables than developed and emerging economies. These positive trends need to be scaled up for a global energy transition. Furthermore, a booming global economy combined with weaker improvements in energy intensity led to an increase in energy demand of an estimated 2.1% in 2017 (more than twice the average increase over the previous five years). Energy-related carbon dioxide (CO_2) emissions rose—by an estimated 1.4%—for the first time in four years, at a time when climate scientists say that emissions need to be in steep decline.

There is uneven progress between the sectors and between the different geographical regions, and a fundamental disconnect between commitments and real action on the ground. Simply put, the global renewable energy transition is progressing far too slowly. But, there have been many positive developments that demonstrate the central role that renewables can play in the overall energy system.

The share of renewables in final energy consumption continues to grow globally with some technologies growing very rapidly. To know more, please check http://www.ren21.net/gsr-2018/pages/highlights/. AU

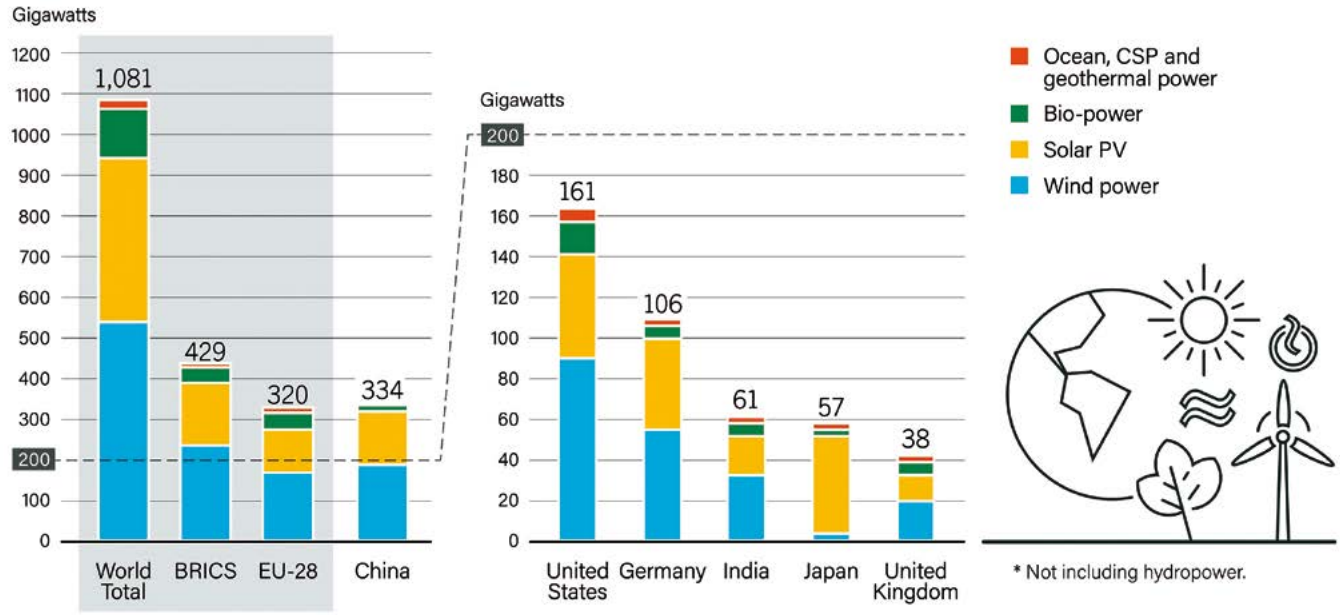
Source: http://www.ren21.net/status-of-renewables/global-status-report/


NATIONAL
June 29, 2018 | Noida, India
CII Clean Tech & Mobility Summit 2018
Website: http://www.cii.in/
July12–13, 2018 | New Delhi, India
India Solar Week 2018
Website: http://solarquarter.com/indiasolarweek/index.php
August 21–23, 2018 | New Delhi, India
World Renewable Energy Technology Congress
Website: http://wretc.in/
September 18–20, 2018 | Greater Noida, India
Renewable Energy India Expo
Website: http://www.renewableenergyindiaexpo.com/
October 11–12, 2018 | Chennai, India
Green Power
Website: http://www.greenpower-cii.com/

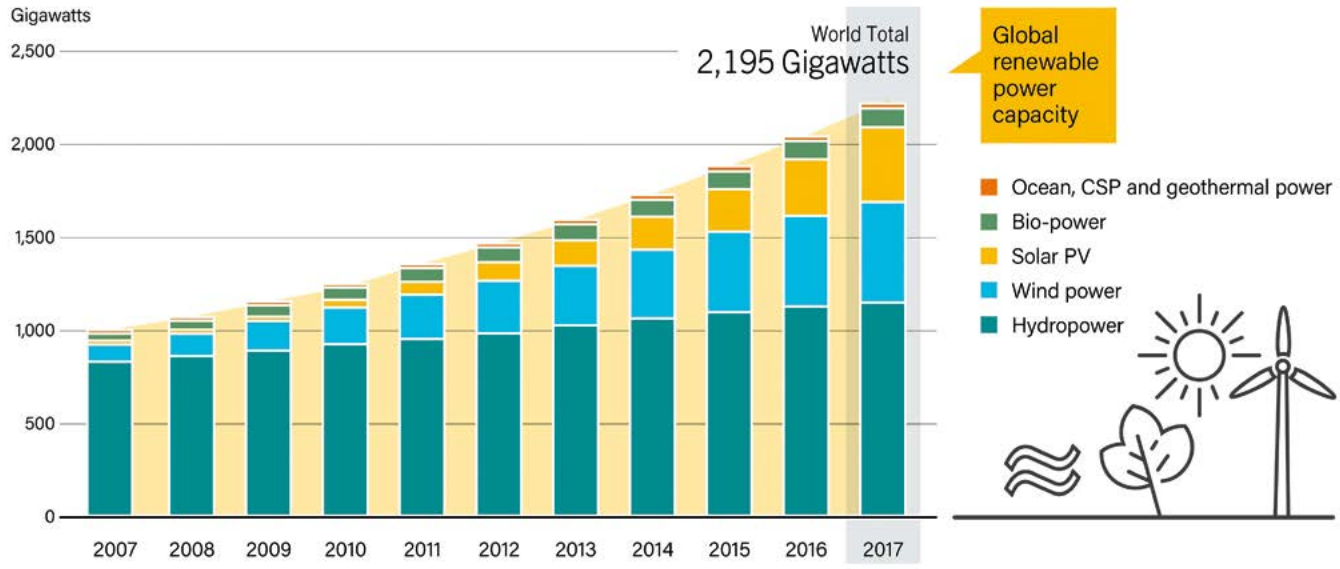

INTERNATIONAL
July 2–3, 2018 | Singapore
Solar and Storage Finance Asia
Website: http://financeasia.solarenergyevents.com/
July 4–6, 2018 | Ankara, Turkey
International Conference on Photovoltaic Science and Technologies
Website: http://pvcon.org/
July 6–7, 2018 | Brighton, UK
The European Conference on Sustainability, Energy & the Environment 2018
Website: https://ecsee.iafor.org/
July 10–12, 2018 | San Francisco, USA
Intersolar North America
Website: http://www.intersolar.us
August 5–8, 2018 | Boulder, Colorado, USA
Solar Conference 2018
Website: https://www.ases.org/conference/

RENEWABLE ENERGY AT A GLANCE: GLOBAL

Renewable Power Capacities in World, EU-28 and Top 6 Countries, 2017



Global Renewable Power Capacity, 2007-2017



Source: REN21, Renewables 2018 Global Status Report