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# Electrical India


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India's oldest magazine on power and electrical products industry






## ESTIMATING THE RESURGENCE OF THE INDIAN POWER SECTOR

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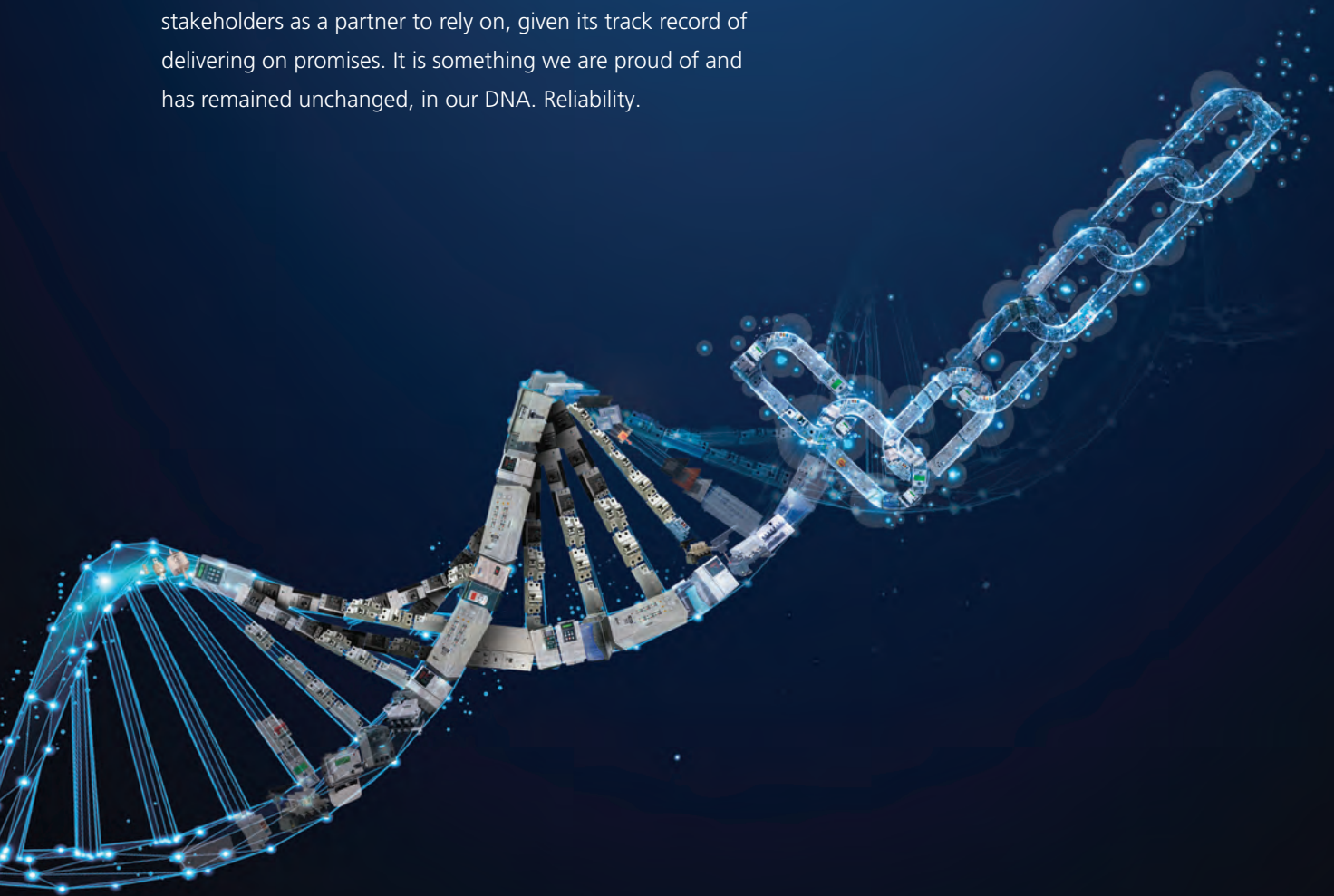
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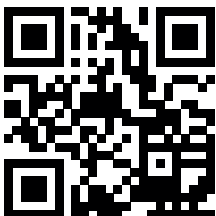


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## Publisher's note

### Crisis management and coping mechanisms

Time and again, while in our homes, we are reminded of how the COVID-19 pandemic has put a stop to our daily activity. And oh, the impact it has had on the industry as a whole! Representatives tell us that the power sector has witnessed a slump in power consumption as industries and manufacturing units stay shut across the nation.

Representatives speak of a drop in commercial and industrial activities which has muted the demand for electricity. Currently, the purchases witnessed in the short-term market are mainly transient leading DISCOMs to buy power, hence reducing the overall power purchase cost.

The issue also focuses on various other stories such as the facets of the Net Metering Mechanism for Renewable Energy. The mechanisms and how it is used for power generation. Also, the article - Kite Generator System discusses basic principals involved in various HWAE technologies, the disadvantages of conventional wind turbine systems, and the need to replace them with kite generator systems in India.

We look forward to the June issue of Electrical India which will be a special issue focussed on energy management from the viewpoint of the power sector. Also, it will emphasize on metering, energy meters, DG sets, generators, inverters, UPS and surge protection devices.

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## Contents

Vol. 60 | No. 5 | May 2020

Cover Story

18

## Estimating the Resurgence of the Indian Power Sector

- Supriya A Oundhakar, Associate Editor

### 24 Decoding the Net Metering Mechanism For Renewable Energy

- Dr L Ashok Kumar, PSG College of Technology, Coimbatore



### Power Talk - Turn to page for key insights from representatives from within the industry

28 - Ajay Kapur, CEO - Aluminium & Power, Vedanta Limited

37 Shreegopal Kabra, Managing Director & Group President, RR Global

### 38 Kite Generator System: The future of Wind Energy?

- Dr Ashwani K Sharma and Siddharth Singh, NIT Kurukshetra



### 30 Significance of Low Voltage Ride Through (LVRT) in Solar Inverters

- Jeykishan Kumar K, Central Power Research Institute, Bengaluru



### 34 Tapping into Potential: renewables

- Dr. Jasmine Kaur Saini, National Institute of Technology (NIT) Hamirpur, H.P.



### Regulars

4 Publisher's Note

8 News

14 Appointments

16 Market Watch

44 Statistics

48 Events

49 Index to Advertisers

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## Khargone Power Plant gets 765kV Khandwa Substation



Khargone Transmission Limited (KTL) project gets a boost as Sterlite Power commissions 765kV Khandwa substation in Madhya Pradesh which is a part of the KTL project. The commissioning of the Khandwa Substation will help in regulating the high voltage 1320 MW power from Khargone Power Plant to further distribute it downstream to 50 million households across Madhya Pradesh, Maharashtra and Gujarat.

Sterlite Power bagged Rs 1,370 crore in the Khargone Transmission project in 2015 through a tariff-based competitive bidding process which was executed under the Build, Own, Operate and Maintain (BOOM) model.

Sterlite Power has so far commissioned 5 out of 6 elements in the project - 765kV substation at Khandwa, 765kV DC Khandwa-Indore transmission line, 400 kV DC Khandwa-Khargone transmission line, 400kV Line in line out (LILO) and Dhule bay extension. With these elements charged, KTL is already generating 55.55 per cent revenue in tariffs. EI

## India will continue to remain a global energy demand centre: Pradhan

During an intervention at the G20 Extraordinary Energy Ministers' video conference hosted by Saudi Arabia, Minister of Petroleum and Natural Gas and Steel Dharmendra Pradhan said that India will continue to remain a global energy demand centre. He said: "India was, and will continue to be, the global energy demand centre."

The meeting was attended by Energy Ministers of the G20 countries, guest countries and the heads of international organisations - OPEC, IEA and IEF.

The Ministers' focused on ways and means to ensure stable energy markets, especially those affected owing to the demand reduction

as a result of the COVID-19 pandemic and the ongoing surplus production-related matters.

Pradhan reiterated Prime Minister Narendra Modi's call for G20 taking a human-centric approach for overcoming challenging hardships, especially for the vulnerable. In terms of the on-going energy market fluctuations, he said that India has always advocated for a stable oil market, which is reasonable for producers and affordable for consumers. He appreciated the collective efforts of OPEC and OPEC-plus countries to balance the supply-side factors which is imperative for long-term sustainability. EI

## Rashmi Rare Earth to manufacture 1.20 lakh surgical masks per day

Rashmi Rare Earth Limited (RREL), the electronics manufacturing unit of a multi-dimensional business conglomerate Rashmi Group, plans to produce surgical masks to support the fight against COVID-19 pandemic.

To cater to the demands of the medical industry, RREL will commence manufacturing masks by mid-April. In its initial days, the company aims to produce 6,000 surgical masks per hour which can be ramped to 18,000 masks per hour within April by installing three production lines. RREL has the capacity to produce 1.2 lakh surgical masks per day.

In addition to manufacturing

triple-layer surgical masks, RREL is also in the process to commence production of N-95 masks, along with thermopile and infrared temperature sensors. Thermopile infrared non-contact temperature measurement sensors are the need of the hour, as preliminary signs of COVID-19 include a high temperature and early detection through such devices can save lives. RREL will start production of N 95 masks and thermopile infrared temperature sensory by April end. Supporting 'Make in India' initiative of the government, a major chunk of raw materials will be sourced domestically and some essentials might be imported, the company said. EI



## Tata Power Solar to build 300 MW CPSU-II for NTPC

Tata Power Solar post reverse auction held on February 21, has received the Letter of Award (LoA) to build the 300 MW CPSU-II for NTPC at an all-inclusive price of Rs 1730.16 crore. The Commercial Operation Date (COD) for the grid-connected solar photovoltaic project is set for September 2021 (18 months). "It is projects like these which demonstrate the trust in Tata Power's project management and execution skills. This order is a motivation for us to continue focusing on delivering the best to our customers, as per their expectations," said Praveer Sinha, CEO & MD, Tata Power.

Ashish Khanna, MD & CEO, Tata Power Solar and President, Tata Power (Renewables), said: "Tata Power Solar is proud to consistently win large and challenging grid-based solar EPC contracts from industry-leading public sector undertaking like NTPC. This being a DCR project, we will be building the project with our own cells and modules."

In September 2019, post reverse auction, Tata Power Solar had received a LoA to develop a 105MWp Floating Solar Project worth approximately Rs 343 crore including a 3-year O&M. The project is a floating solar project in the country and the venture is executed on the reservoir of NTPC in Alappuzha, Kerala and is to be commissioned no later than 21 months. E1

## Vikram solar bags 300 MW solar project

The National Thermal Power Corporation Limited (NTPC) has awarded a 300 MW solar plant project for Rs 1,750 crore under CPSU-II scheme to Vikram Solar, a module manufacturers and comprehensive EPC solutions & rooftop solar provider.

Vikram Solar bagged the project in a reverse bidding auction, and the solar plant will be spread across 1,500 acres of land in Rajasthan. Tendered under the DCR category of the CPSU, the project is expected to take 18 months to be completed

Saibaba Vutukuri, CEO, Vikram Solar said: "NTPC has always focused on supporting the green energy transition in India and we

are proud to be a part of NTPC's recent effort towards solar growth. I am certain that this 300 MW plant will see successful execution within the agreed time frame and our partnership will continue to support India in providing 'Power for All'."

Venkat Muvvala, Head of EPC and O&M, Vikram Solar, said: "Vikram Solar has had a long-standing business relationship with NTPC. Previously, we have executed 50 MW solar plant projects in Mandsaur, Madhya Pradesh and 130 MW solar projects in Bhadla, Rajasthan for NTPC. It is projects like these that demonstrate the trust in Vikram Solar's project management and execution skills." E1

## ABB partners with NASSCOM for new-age tech jobs in India

In a major push for skill development in the technology industry, ABB, in association with the National Association of Software and Services Companies (NASSCOM) have developed a standardised qualification criterion for two IoT-related job roles – IoT Network Communications and IoT Cyber Security. This collaboration will facilitate the much-needed uniformity and formalization by aiding the hiring and evaluation of these high-skilled jobs across the sector. The Qualification Packs (QPs) define the competency standards that will provide a framework for academic institutions to design their course curriculum to better conform to industry hiring standards. The qualification packs for the two job roles have been approved by National Skill Development Corporation


(NSDC), National Skill Development Agency (NSDA), and National Skills Qualifications Committee (NSQC).

The standardised assessments will lead to the creation of skilled and certified talent for IoT from which the industry can hire the right talent for new-age jobs, thereby reducing the cost of hiring and increasing the time for productivity. The QPs will be promoted across the industry for the purpose of hiring, promotions and curating learning & development (L&D) programs, thereby laying the foundation for standardised employment practices for skilled jobs in the IT-ITeS industry. NASSCOM estimates that nearly 40 per cent of the country's workforce needs to be reskilled if they are to work in the artificial intelligence (AI), internet of things (IoT), machine learning and blockchain spaces. E1

## ABB Power to strengthen grid infra at IOCL

ABB Power Grids stated in a release that it has bagged a project worth Rs 165 crore by state-owned refiner Indian Oil Corporation Limited (IOCL). The project will ensure a reliable grid connection at its Barauni refinery in Bihar. The refiner has plans of expansion at its crude oil processing capacity at the plant by 50 per cent to 9 million tons per annum in the next three years. And this project will ensure power quality for its future operations there, ABB said in a press release.

ABB Power is delivering its 220/33 kilovolt gas-insulated switchgear (GIS) substation which will assimilate power from the Bihar State Power Transmission Corporation Ltd and IOCL's captive generation plants and deliver it with efficiency to the Barauni refinery. The GIS substation will also save space - nearly 70 per cent by virtue of its compact, robust and low-maintenance design.

In addition, ABB Power Grids is equipping the substation with its advanced substation automation and network management tools to control and protect IOCL's grid real-time and ensure maximum power availability. It is also deploying its industry-leading power transformers (125 mega volt amps) to further enhance grid safety and efficiency. 

## Cellular IoT: Infineon's eSIM solution offers pre-integrated network coverage in 200+ countries

**Infineon Technologies AG announces the launch of their eSIM solution of IoT-enabled devices and applications.**




Infineon Technologies AG stated in a press release that cellular networks will be the communication backbone for billions of mobile devices and machines that are connected to the Internet of Things (IoT). To shape this development, Infineon Technologies AG is launching an eSIM solution of IoT enabled devices and application. The security hardware promises to be equipped with pre-integrated carrier-agnostic cellular coverage in over 200 countries and territories. The company has partnered with Tata Communications and offers its customers global reach by leveraging the Tata Communications MOVE mobility and IoT platform.

Lars Wemme, Head - IoT Security, Infineon's Digital Security Solutions division, said: "With the progressive rise of IoT devices and the pervasiveness of cloud-based platforms and 5G deployment, cellular

IoT connectivity will become a leading technology within the next few years." As per a research conducted by ABI, a total eSIM shipment for machine-to-machine (M2M) applications such as asset tracking, energy management or mobile healthcare is expected to grow with a compound annual growth rate of 18 per cent from 101 million units in 2019 to 232 million by the year 2024.


The remote activation and configuration of IoT devices over the air enables a more automated, secured approach to bringing large numbers of devices online.

Furthermore, manufacturers can select connectivity providers after production, shipment and deployment of the device and can change them throughout its lifecycle, increasing ease of use as well as flexibility regarding selecting MNOs and data plans. 

## L&T Construction wins major orders for power T&D

The Power Transmission & Distribution business of L&T Construction has bagged orders in India and abroad.

In Kuwait, the company bagged a project to upgrade substations and related power facilities in KNPC's Mina Al Ahmadi oil refinery. The revamped network of distribution substations with latest technology will enhance the reliability of power supply and facilitate expansion, L&T said in a statement. The Power Transmission & Distribution business has also won a 400 kV Grid Station order in Oman which will be a crucial element in the Sultanate's major transmission initiative to interconnect the grids in the south and north with the PDO Area. In Egypt, an order to design, supply, construct and commission a 220 kV Gas Insulated Substation has been bagged from a reputed client, L&T's statement adds.


The renewable arm of the business has won large EPC orders on the domestic and international fronts to establish solar photovoltaic plants totalling more than 500 MW. These grids connected to power plants also entail related power evacuation and interconnection systems. India, L&T has won an order to strengthen the urban HT distribution network in Chennai with Main Units and Feeder Remote Terminal Units. 

## Sterlite Power partners with leading EPC and OEM players for Green Energy Corridor

Sterlite Power has joined hands with GE T&D India, Unitech Power Transmission (UPTL), Tata Projects (TPL) and Associate Power Structures (APSPL). This partnership will implement state of the art OEM & EPC solutions in the execution of its Green Energy Corridor (GEC) project Lakadia Vadodara Transmission Project Limited (LVTPL).

As a part of these partnerships, GE will design, construct, test and commission 765kV GIS substation at Vadodara and 765kV AIS substation at Lakadia in Gujarat. While TPL, APSPL and UPTL will provide EPC related supply, erection, testing and commissioning of 343kms of transmission lines for the project. Sterlite Power had won this very critical




GEC project through tariff-based competitive bidding process last year, which will contribute towards India's renewable energy target of 175GW by 2022. Renewable energy is indeed the need of the hour to combat climate change and reduce carbon emissions across the globe by creating an alternative to fossil fuel-based energy. Pratik Agarwal, Managing Director, Sterlite Power said, "This Green Energy Corridor project is very special for Sterlite Power since it will help our country to achieve its RE target." 

## ReNew Power commits Rs 20 crore in fight against COVID-19

ReNew Power announced that it will contribute to the central and state governments' efforts to combat the COVID-19 pandemic in India. ReNew is initially committing Rs 20 crore to this initiative. Out of this, Rs 10 crore will be contributed to the PM CARES fund, and Rs 5 crore will go towards the Chief Minister's relief fund in various states. The rest will be spent on several activities targeted to directly help communities impacted by the lockdown and to bolster the health infrastructure to tackle the pandemic.

ReNew Power will focus on feeding migrant labourers, daily wage workers and locals around its sites spread across the country by distributing dry ration packets in conjunction with the

local administration. The company will be working across its sites in the states of Gujarat, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu, Telangana, Madhya Pradesh and Maharashtra and will cover around 140 villages. ReNew is adopting a village in Haryana, where around 350 vulnerable households will be provided with dry ration and hygiene kits. In addition, ReNew employees, led by their CMD and other members of the senior management, are also contributing a part of their salary to fund various activities to fight COVID-19. Meanwhile, ReNew Power's senior leadership team has also joined with other corporate leaders from Gurgaon to provide critical support to the authorities. 

## Wind projects delayed owing to COVID-19

Germany-based renewables developer PNE anticipates that the company's implementation of projects as well as supplies may be delayed by a year in the wake of the Coronavirus outbreak. However, it observes that the pandemic shouldn't have had a significant long-term impact on business. PNE is a Morgan Stanley-backed company in which Morgan Stanley Infrastructure Partners is the largest (almost 40%) shareholder.

"At present, we assume that there may be shifts in our operating business as regards the sale of project rights and project implementation from 2020 to 2021 and from 2021 to 2022, due to the current developments concerning the spread of the COVID-19 virus," Markus Lesser, CEO, PNE said while presenting the company's 2019 earnings results.

He added: "This has already been taken into account in the guidance. At this point in time, we assume that there should be no significant impact on our business in the medium to long term."

A statement issued by PNE said that although there is justified optimism, PNE sees possible consequences for society and the market resulting from the spread of the COVID-19 virus. PNE responds to this threat with a large number of measures to protect employees, but also to safeguard the implementation of projects as well as supplies. **ET**

## US lost over 106,000 clean energy jobs in March due to COVID-19

The US has lost over 106,000 clean energy jobs in March, and hundreds more are expected in the months to come due to the COVID-19 pandemic and its economic fallout. California, North Carolina, Pennsylvania, Massachusetts and Michigan were the states hit hardest by the sector's losses. The job loss estimates are based on an analysis of unemployment data released by E2 (Environmental Entrepreneurs), the American Council on Renewable Energy (ACORE), E4 TheFuture and the BW Research Partnership.

An analysis conducted by the Department of Labor found that 1,06,472 workers in clean energy occupations filed for unemployment benefits last month, wiping out all 2019 clean energy job gains across renewable energy, energy efficiency, clean vehicles, energy



storage and clean fuels. The clean energy jobs, as defined in the report, include electricians, HVAC and mechanical trades technicians and construction workers who work in energy efficiency, solar installers, wind industry engineers and technicians, and manufacturing workers employed by electric and other clean-vehicle manufacturing companies and suppliers.

Clean energy is one of the US economy's biggest and fast-growing employment sectors **ET**

## KEC International wins new orders of Rs 1,047 crore

KEC International, an RPG Group Company, has secured new orders of Rs. 1,047 crore across its various businesses.

**Transmission & Distribution:** T&D business and SAE Towers have secured orders of Rs. 669 crore for T&D projects in India, SAARC, Middle East and the Americas.

**Civil:** The civil business has secured orders of Rs 153 crore for defence (setting up a data centre) and residential projects in India.

**Solar:** The Solar business has secured orders of Rs. 104 crore for solar projects in India and Middle East.

**Cables:** The Cables business has secured orders of Rs 121 crore for various types of cables or cabling projects.

Vimal Kejriwal, MD & CEO, KEC International Ltd, said: "We are delighted with the new order wins secured across our business verticals amidst the current market scenario. The orders in T&D will enable us to further strengthen our portfolio in the international markets. We are particularly encouraged by the second order in the defence segment secured by our civil business." **ET**

## Schneider Electric reinforces its commitment to sustainability

Schneider Electric is recognised around the globe as an essential business providing service continuity to critical infrastructure such as hospitals, data centers, IT networks, the temperature-controlled food supply chain, energy, transportation, water treatment and vital industries. Ensuring continuity of service, 24x7, to critical industries in all the countries and communities where Schneider Electric operates is the Group's first responsibility and its main contribution to the fight against COVID-19. In this context, the Group is focused on maintaining operations to service critical infrastructure, in compliance with health and local government regulations. In response to the Covid-19 crisis the Group has enhanced its existing global benefit standards (Life, Health and Family Care) for all of its employees worldwide, for the duration of the crisis. Additionally, and consistent with its sustainability commitments, Schneider Electric is actively supporting hospitals and the most vulnerable communities and participating in several other efforts including boosting the production of ventilators.

During these challenging times Schneider Electric would like to announce the creation of a fund dedicated to COVID-19 support as part of the Schneider Electric Foundation. E

## Siemens and Uniper join forces to de-carbonise power generation

Uniper and Siemens Gas and Power signed a cooperation agreement for the development of projects on the de-carbonisation of power generation and promoting sector coupling. It extends the long-standing partnership between the two companies. It is important to look at the energy, mobility and industry sectors together because they all can and must contribute to reducing greenhouse gases. One focus of the planned cooperation is the production and use of "green hydrogen" – in other words, hydrogen from renewable energy sources. The companies intend to implement projects in this field together, addressing the entire value chain.

The scope of the new cooperation agreement also includes the



evaluation of the potential of Uniper's existing gas turbines and gas storage facilities for the use of hydrogen. The focus of the work is to define what role hydrogen can play in the future evolution of Uniper's coal power plants. Uniper recently announced that it would close or convert its coal-fired power plants in Europe by 2025 at the latest. Uniper's coal-exit plan is instrumental to make the company achieve its objective of becoming carbon neutral in Europe by 2035. E

## E.ON secures energy supply in crisis mode

After more than a month of energy supply in corona crisis mode, E.ON's initial interim assessment is positive. The power, gas, and heat networks that E.ON uses to secure the energy supply in large parts of Europe are running stably, even in this difficult operational mode. Among the roughly 14,000 employees whom E.ON has defined as critical personnel for secure network operations and placed under special protection, there are virtually no infected individuals.

E.ON immediately activated prepared pandemic and crisis plans, and consequently brought them into operation. This has made it possible to maintain all elementary functions at all times. The most important

measures have included strict adherence to hygiene and distancing rules, and the isolation of particularly sensitive areas such as network maintenance. For several weeks now, only employees with a permanent workplace at such sites have been allowed to enter. The working areas of these key personnel are separated from each other; there is little to no mixing between shifts, and shift handovers are carried out without contact. Technicians who have to work on-site on the grid are equipped with special equipment to minimize the risk of infection.

Secure network operation also includes protecting the infrastructure from cyber-attacks. E

## Siemens sets course for next-gen of management

Siemens announced in a press release that it will be establishing the next generation of management. Siemens President and CEO Joe Kaeser (62) has informed the Supervisory Board of Siemens AG that he will not be pursuing an extension of his contract. He will be proposed as Chairman of the Supervisory Board of Siemens Energy. The board has appointed Roland Busch (55), who is presently the Deputy CEO to be President and CEO of Siemens AG. At the latest, this appointment is to be effective at the end of the next ordinary Annual Shareholders' meeting, which is to take place on February 3, 2021. He is receiving a new contract for five years and will be responsible for the planning and implementation of the budget for the fiscal year 2021, and will be assuming all relevant responsibilities within the Managing Board.

Joe Kaeser in addition to his current duties, will assume responsibility within the Managing Board for Siemens Energy, including Siemens Gamesa Renewable Energy.

At its extraordinary meeting today, the Supervisory Board of Siemens AG also appointed Christian Bruch (49), who is Executive Vice President of Linde plc and CEO of Linde Engineering, to be the new CEO



Christian Bruch

of the Gas and Power Operating Company and designated CEO of Siemens Energy, effective May 1, 2020. On an acting basis until May 1, 2020, operational management of Siemens Gas and Power will be in the hands of Tim Holt, Chief Operations Officer and Chief Human Resources Officer of Gas and Power. Maria Ferraro (46), who is currently CFO of the Digital Industries (DI) Operating Company, has been appointed the new CFO of Siemens Energy, effective May 1, 2020. Michael Sen and Klaus Patzak, Siemens Energy's designated CEO and CFO, are leaving by mutual agreement.

The new CFO of DI will be Rudolf Basson (51), who is currently CFO of Siemens in China. His successor as CFO in China will be Bo Ouyang (48), who is presently CFO of Siemens in Canada. Natalia Oropeza (53) will, in addition to her current role as Chief Cybersecurity Officer, succeed Maria Ferraro in her role as Chief Diversity Officer of Siemens AG. Jim Hageman Snabe, Chairman of the Supervisory Board of Siemens AG, said, "The Siemens Supervisory Board will be strengthening the Siemens Energy leadership team substantially and has decided on the succession process for the top leadership of Siemens AG even faster than originally planned." E

## Radhashyam Mahapatro appointed as Director of NALCO

The government has cleared the appointment of Radhashyam Mahapatro, Director (Personnel), Central Coalfields Limited (CCL) as Director (Human Resource) (HR) in National Aluminium Company Limited (NALCO) .

Mahapatro took over as Director (Personnel), Central Coalfields Ltd (a Subsidiaries of Coal India Ltd.) on and from 8th June, 2015. Before taking over as Director CCL, he has more than 26 years of experience in power, oil and coal sectors in different capacities. Mahapatra has handled many areas of HR functions, liaison and coordination. During his tenure in NHPC, Ell and CCL, Ranchi, he had worked for the



Radhashyam Mahapatro

introduction of a productive work culture. He had won the Greentech Environment Award for outstanding performance during his tenure in NHPC.

He has undergone training in Advanced Management Programme in Germany, Sweden on advanced technology and organisational culture sponsored by Coal India. Mahapatro's areas of interest include improving productivity, rural development, poverty alleviation, environment and ecology. He passionately worked for reforms in administration to make it responsive to the need and aspirations of the communities. His forte is transparency & leadership and believes in teamwork. E

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## Genset Market on an upward trend

*Reports indicate that the increase in construction activities, heavy investment in the development of public infrastructure sector will lead to an up-take for gensets within the industry...*

**D**igitisation refers to generating the demand for huge volumes of data that thereafter leads to an increasing demand for data centers. According to Prescient and Strategic (P&S) Intelligence Market report, there is a spike in demand for data centers and digitisation. As a result, the global genset market is predicted to reach USD 22,777.8 million during the year 2024 - from USD 17,592.6 million in 2019, at a 5.2 per cent CAGR during the forecast period (2020–2024).

The report said that the diesel division generated the highest revenue in the genset market in the year 2019 as this fuel is available around the world. Even though gas gensets of low power ratings are cost-effective as compared to diesel variants, natural gas is not easily available everywhere, which is why the uptake of gas gensets is lower. Till the year 2024, the 76 kVA–375 kVA category will dominate the genset market, on account of the high demand for these variants from small industrial complexes, commercial offices, telecom towers, and hotels. Further, with the increase in construction activities, heavy investments in the development of public infrastructure, and expanding manufacturing industry, the uptake of 76 kVA–375 kVA gensets is projected to rise, the report added.

The Middle East and African (MEA) region is expected to grow the fastest during the genset market during the forecast period, as the grid connectivity in many regional countries is poor. Additionally, nations

including the UAE, Saudi Arabia, Egypt, and Turkey is witnessing rapid industrialisation and increasing commercial activities that also leads to a demand for power generation equipment. Infrastructure development for World Expo 2020 (Dubai) and 2022 FIFA World Cup (Qatar) under Saudi Vision 2030, as well as regional governments' focus on reducing their dependence on oil and gas are resulting in the expanding construction sector in the MEA.

Further, the P&S market report states that genset market players are either raising the production capacity of their existing plants or setting up new ones, in order to meet the increasing demand for gensets and stay ahead in the competition. For instance, in April 2017, a new gas and diesel genset production line was added by Caterpillar at its Seguin plant in Texas. With 2.2–18 liter engines, the gensets coming out of this line can produce up to 500 kW of power.

Similarly, in March 2017, Hipower Systems bought a manufacturing facility in Kansas for USD 24 million to serve as its new corporate headquarters. Here, designing, engineering, manufacturing, sales, and support operations are carried out, including those for its MTU Detroit portable generators, which comply with the Tier 4 Final emission standards. Cummins, Caterpillar, AB Volvo, Kohler Co, General Electric Company, Denyo Co Ltd., Escorts, Kirloskar Oil Engines Limited, Siemens AG, and Generac Holdings are the major companies in the global genset market.



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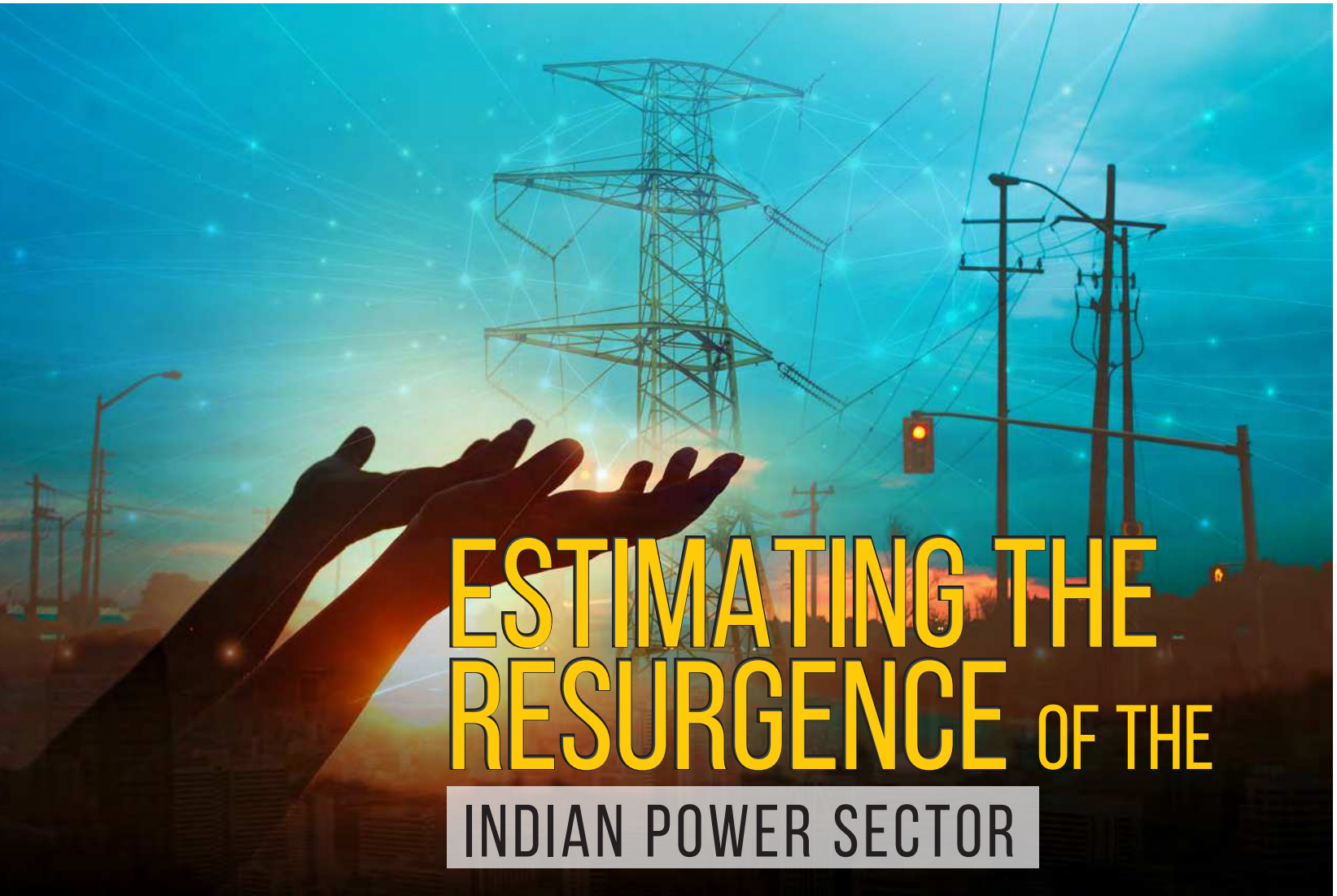
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# ESTIMATING THE RESURGENCE OF THE INDIAN POWER SECTOR

*Industry representatives discuss the various challenges faced by the Indian power and electrical sector owing to the COVID-19 pandemic. The article is a healthy discussion among representatives on the impact while estimating a comeback for the industry as a whole...*

**- By Supriya A Oundhakar,  
Associate Editor**

The Indian power sector has been reeling since 2018 with dwindling industrial activity leading to a slump in the demand for power. Prior to the COVID-19 outbreak, the Indian economy, industrial production, and manufacturing industry especially the capital goods sector were already witnessing down-ward trend. This is evident from Indian Electrical & the Electronics Manufacturers' Association (IEEMA) statistics show that electricity generation dipped to 0.1 per cent during December 2019 against a growth of 4.5 per cent in December 2018. The Electrical

equipment industry declined by 10.4 per cent during the period of April – December 2019.

The novel Coronavirus disease COVID-19 has further worsened the situation not only in India but all across the globe.

So far, India has reported more than 29,000 active Coronavirus positive cases (as on 28th April 2020). The United Nations Trade Report assessed the severe impact of the Coronavirus pandemic on the global economy and has estimated that the world economy will go into recession this year with loss of trillions of dollars of global income. India also cannot escape adverse impact of this crisis on its economy. The COVID-19 pandemic is also expected to have an adverse impact on the Indian power sector.

### **Studying the impact on the Power Sector**

Nationwide Lockdown for the prevention of COVID 19 across the nation has led to a significant reduction in demand for power from the industrial and commercial sector. However, the demand from other areas - domestic demand due to work from home, healthcare infrastructure and utilities, has witnessed a spike.

DISCOMs and generators have been under financial stress due to new and challenging economic realities and due to demand contraction.

With no revenues from remunerative commercial and industrial consumers, the utilities might see a revenue shortfall of Rs 15-20,000 crore, informs Rajesh K Mediratta, Director – Strategy and Regulatory, Indian Energy Exchange. He says: “Most of the generation



**“WE HOPE THAT INDIA AND THE WORLD WILL COME OUT OF THE COVID-19 MENACE AT THE EARLIEST AND THE INDIAN ELECTRICAL INDUSTRY WILL EMERGE EVEN MORE STRONGER.”**

**- HITESH KARANDIKA, DIRECTOR, ERDA**

in the country is operating at sub optimal levels and payment default risks have elevated. Renewables are exposed to curtailment risks and off-take from thermal generators has reduced significantly. As a result, the short-term market prices have also plummeted in March and April,” says Prabhajit Kumar Sarkar, Managing Director & CEO, Power Exchange India Limited (PXIL).

Assessing the impact of COVID 19, Hitesh Karandika, Director of ERDA states that power generation, transmission and distribution being on the essential need list was almost unaffected. Power generation continued without much hindrance though demand for load was greatly reduced. So, the thermal power plants operated on a much lower Plant Load Factor (PLF).

Transportation and commercial activities came to a halt due to COVID 19; as a result manufacturers, particularly in the MSME sector, and workers in the transmission and distribution sector

have suffered a setback. Cash flow also has been severely hit and they face an existential crisis. Karandika says: “As per an initial IEEMA estimate, total overdue outstanding of 135 member organisations of IEEMA was Rs 6,500 crore. With such huge outstanding and severe cashflow problem, many MSME equipment manufacturers or component manufacturers will not be able to recover quickly even after normalcy returns. This will create a huge churning in the electrical equipment manufacturing sector and finally affect the equipment availability and supply chain of electrical equipment in the distribution sector.”

Raising the concerns about the government projects, Anil Saboo, Chairman and Managing Director of Elektrolites (Power) Pvt Ltd, says: “Power sector is already witnessing logistical delays in all over India. Government’s projects and ongoing tenders are undersubscribed because developers are unable to bid for them in time.”



**“WE HAVE A NEW REAL-TIME MARKET(RTM) EMERGING - THE SCHEDULED LAUNCH IS THE 1ST OF JUNE.”**

**- RAJESH K MEDIRATTA, DIRECTOR – STRATEGY AND REGULATORY, INDIAN ENERGY EXCHANGE**



**“THE DROP IN COMMERCIAL AND INDUSTRIAL ACTIVITY HAS MUTED THE DEMAND FOR ELECTRICITY AND HAS IMPACTED SHORT-TERM TRADING VOLUMES.”**

**- PRABHAJIT KUMAR SARKAR, MANAGING DIRECTOR & CEO, POWER EXCHANGE INDIA LIMITED (PXIL)**

On the other hand, the Indian Energy Exchange (IEX) has been at the forefront working relentlessly to provide uninterrupted 24\*7 operations and seamless connectivity.

From the 25th of March, with contraction in demand, the sell liquidity on exchange has been very high - nearly 2.6 times the demand, which keeps the prices in check. The average price in the day-ahead market from March 24 until April 20 is just at 2.36 Rs per unit. The low prices on the Exchange platform provide an attractive opportunity for the distribution utilities to replace their costly generation through exchange procurement, thereby optimising their procurement cost and conserving precious cash in this difficult moment.

A few distribution utilities such as Andhra Pradesh, Maharashtra, Gujarat, Tamil Nadu have been leading the way for others to emulate. These utilities have stepped up procurement through Exchange to multiply their savings. For instance, a

distribution utility in South procured 14-20 MU per day and saved about Rs 42 crore in procurement in just about 20 days.

Ashish Mangal Managing Director of Dynamic Cables, says: “I personally view it as an opportunity to strategise effectively, plan efficiently, enhancing manufacturing skills and inventing new marketing strategies. This is the time when one can upgrade skills,” he says.

### **Impact on the Solar Sector**

Development of Solar Parks and Ultra Mega Solar Power Projects has been giving good results since last decade. As a result, today, India has over 35 GW solar installed capacity.

Darshan N Shah, Executive Vice President - Sales & Marketing-UPS & Solar, Hitachi Hi-Rel Power Electronics, shares the impact COVID-19 has had. He says: “Major impacts on the solar segment is the complete disruption of the supply chain leading to a

standstill situation pertaining to the execution of the projects, a drop in electricity demand by almost 50 per cent due to lack of activities across the major business segments and cash crunch situation amongst most of the solar developers or EPC firms.”

Indian solar sector is dependent on China for import of solar modules. The COVID-19 outbreak has also caused a slowdown of China’s economic growth. Indian solar manufacturing industry is set to be affected as over 80-90 per cent of solar components are imported from China.

“India is assuming shipment delays of several months risking multiple and huge solar projects falling behind schedule. Also due to the Coronavirus outbreak, the Indian solar manufacturing industry believes that there is an opportunity in this crisis as the nation looks to position itself as an alternative manufacturing destination for global firms,” says Bharat Bhut - Founder and Director, Goldi Solar.

### **Impact on Business**

Mediratta Indian Energy Exchange Limited highlights that there has been 25-30 per cent correction in demand for power since the announcement of the preventive lockdown on March 25. The reduction in demand has also impacted volumes traded on the Exchange platform by two of our key customer segments namely the commercial and industrial consumers as well as from the distribution companies. In view of the reduction in clearing prices from 3.2 to 2.4 YoY due to lockdown, DISCOMs have raised their purchases to save on



**“WE ARE FOCUSING ON SHARPENING THE SKILLS OF OUR TEAMS THROUGH THEIR PARTICIPATION IN WEB-BASED TRAINING PROGRAMS.”**

**- DARSHAN N SHAH, EXECUTIVE VICE PRESIDENT - SALES & MARKETING-UPS & SOLAR, HITACHI HI-REL POWER ELECTRONICS**

their purchase costs. They have shutdown their plants with higher energy cost. Therefore, the impact on our business is marginal.

PXIL has been providing uninterrupted services to all its customers during the lockdowns. The Exchange is committed to continue supporting its customers and provide assistance in alleviating the difficulties imposed due to the lockdown.

Sarkar of PXIL informs, “With the drop in commercial and industrial activities, the electricity demand is muted which has impacted the short-term trading volumes. Therefore, currently the purchases witnessed in the short-term market are mainly transient in nature, where DISCOMs are buying power to reduce their overall power purchase costs.”

PXIL is ensuring availability of its transaction platform on a 24x7 basis and ensuring that customers can make most of the situation by transacting in all products seamlessly from any location, he adds.

“We would focus on further strengthening of our core business operations and critical functions to ensure business sustainability so that all the needs of our customers are satisfied,” informs Sarkar.

Due to the lockdown, ERDA will remain closed for at least 40 days. ERDA has an outstanding of more than Rs 20 crore to various states and central utilities. “This will adversely affect the cashflow and operational viability of ERDA in the short run. We are hopeful that the utilities will expeditiously pay the old outstanding to the industry as well as to ERDA as REC has already disbursed Rs



**“THE MODULE ASSEMBLY CAPACITY MIGHT EVENTUALLY BE AFFECTED, HAMPERING THE INDIAN SOLAR MANUFACTURING INDUSTRY UP TO A GREAT EXTENT.”**

**- BHARAT BHUT, DIRECTOR, GOLDI SOLAR.**

2500 crore to various utilities to pay to the suppliers of DDUJGY and Saubhagya schemes,” informs Hitesh Karandikar of ERDA. He further says that in the long run this will help ERDA to come out of this difficult phase and continue to serve for the betterment of Indian power sector and electrical equipment manufacturing industry.

Nearly 50 percent of ERDA’s revenue comes from power utilities directly. ERDA is expected to be restored quickly, may be within a month of returning to normalcy. But 50 per cent of ERDA’s business which comes from direct customers and from international market shall be severely disrupted for a longer period of time, which could be even for a year or more.

Elektrolites Power too is facing a tough time as the company is not able to dispatch the ready material because due to problems with logistics. Saboo says: “We are facing contractual issues. Manpower is not available. The lockdown will have a severe impact on cash flow.”

In order to tackle the situation post-COVID-19, Saboo says that it will take time to find the new norms for marketing after COVID-19, but we have started preparing the marketing strategy for post-COVID-19. He further adds that the company is developing on digital teamwork.

Hitachi Hi-Rel Power Electronics is one of the major solar inverter suppliers and are associated with solar projects that are operational or under development across the country. There are projects attributing to almost 37 GW which are under implementation and projects of almost similar capacity of the solar projects are tendered last year i.e. in 2019. “This disruption in operation has brought all the project activities to a standstill, as mobilisation of material as well as the manpower has been completely disrupted,” says Shah. He adds that there has been considerable delays also in evaluation and award of ongoing tenders and that also would lead to delays in receipt of orders and also the realisation of revenues for



**“WE ARE FACING CONTRACTUAL ISSUES. MANPOWER IS NOT AVAILABLE. THE LOCKDOWN WILL HAVE A SEVERE IMPACT ON CASHFLOW.”**

**- ANIL SABOO, CHAIRMAN AND MANAGING DIRECTOR OF ELEKTROLITES (POWER) PVT LTD**



**“EFFICIENT AND CAREFUL FINANCIAL DECISIONS WILL BE THE MAJOR FOCUS AND CONCERN.”**

**- ASHISH MANGAL, MANAGING DIRECTOR, DYNAMIC CABLES**

its products, in coming few months. Shah estimates that with respect to previous year a drop of almost 25 per cent in terms of the total market potential for his range of products for FY 20-21.

As China supplies more than 80 percent of solar raw material in India, it more or less controls the maximum value chain from silicon to ingot, wafer, module, and cell. “Now amid the Coronavirus chaos, it is believed to bring potential strain, radically impacting the national solar manufacturing market. The module assembly capacity might eventually be affected, hampering the Indian solar manufacturing industry up to a great extent,” informs Bhut.

Ashish Mangal has emphasised on the adoption of a new style of working with a changed mindset. He says: “Efficient and careful financial decisions will be the major focus and concern. Investments might take a back seat. The supply chain needs to be re-energised with stronger players.”

### **Strategies to make a comeback**

Power industry experts have geared up to curtail the losses due to COVID 19 pandemic. Here, they reveal their plans to make a comeback with resilience.

IEX has prioritised to assure distribution utilities and the nation

of uninterrupted 24x7 access to its platform to support the utilities supply uninterrupted power during the crisis. “We have been working relentlessly to provide round-the-clock operations with seamless connectivity and security to enable round the clock supply,” says Mediratta.

He further adds that since the announcement of the lockdown, our platform has been seeing sell side liquidity at 2.7 times the buy keeping the prices under check and at lower end while simultaneously indicating that there is adequate power available in the market.

The distribution utilities have an opportunity to leverage the Exchange market to ensure 24X7 power supply to essential services, particularly, the stressed healthcare sector at the lowest possible price and supports utilities to relieve the stress on the procurement costs.

“We have also highlighted the importance of leveraging flexibility offered by our platform to ensure adequacy of power to meet fluctuating domestic demand in current times,” informs Mediratta.

IEX have planned to focus entirely on its customers’ needs post-COVID. “Further, the Exchange will keep evolving new products. One such new market segment to pan out immediately is Real-time Market (RTM), which is scheduled

for launch from 1st June,” Mediratta of IEX.

Sarkr suggests that PXIL has completely revamped its technology offering, which has allowed seamless operations to take place on a 24x7 basis even during this period of lockdown.

“On the business side, PXIL’s primary focus has been on the term-ahead and REC markets. Now, we have enough liquidity to also scale up our operations in the day-ahead spot market,” states Sarkar.

“We expect a huge surge in the liquidity on the Power Exchanges on the back of new opportunities which are on the cards in the power sector,” states Sarkar. In short to medium term, the Exchange has plans to introduce new products under categories such as Real Time Markets, Ancillary Services and Longer Tenure Contracts that will help in deepening of power markets. “As an exchange, we are continuously pushing the boundaries and prepared to take advantage of the opportunities that the power markets present to us,” he adds.

ERDA is a not for profit scientific and industrial research organisation dedicated to the services of electrical utilities and industries. During this period ERDA remarkably supported Gujarat utilities with the urgent evaluation of equipment required to maintain continuity in distribution of power throughout the state of Gujarat. However, ERDA took full care of the safety and security of its employees and maintained social distancing even during such emergency operation.

Karandikar informs that inspite of not generating any revenue for more

than 40 days; ERDA has paid salaries and wages to all its employees before time to tide them over during this critical time. ERDA has also paid all the legitimate bills of its service contractors and suppliers on time.



ERDA has prepared a micro-planning for restarting its operations with limited but essential manpower to serve its customers efficiently. “ERDA is fully geared up to take up all the pending testing at the shortest possible time. We hope that India and the world will come out of this COVID-19 menace at the earliest and the Indian electrical industry will emerge out of these testing times stronger,” states Karandikar.


Hitachi Hi-Rel Power Electronics is utilising lockdown period to develop a post-COVID 19 business blue print in terms of strategic work force planning, mapping of existing and forthcoming business opportunities. “We are also focusing on sharpening the skills of our teams through their participation in various web based training programs. We believe that with such strategic actions, we shall be fully ready to come back as soon as the situation normalises,” informs Shah.

Elektrolites Power is planning to connect with its existing customers for their new requirements as well as development of new cost-effective

projects. Saboo states that the company is reducing expenses and making plan to sustain with lower overheads.

Dynamic Cables has given the priority to safety first. “Our entire focus to respond to this calamity is ensuring best of safety norms adhering for our associates in all plants by minimising the risk of spread of infections among employees,” emphasises Ashish Mangal of Dynamic Cables. “Meanwhile, we also have to maintain our production to help protect the operations of our customers and suppliers, the jobs of our employees and the interests of all our stakeholders,” he adds.







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— Supporting —





# DECODING THE NET METERING MECHANISM FOR RENEWABLE ENERGY

*The article gives an overview of the net metering mechanism for renewable energy sources for power generation systems.*

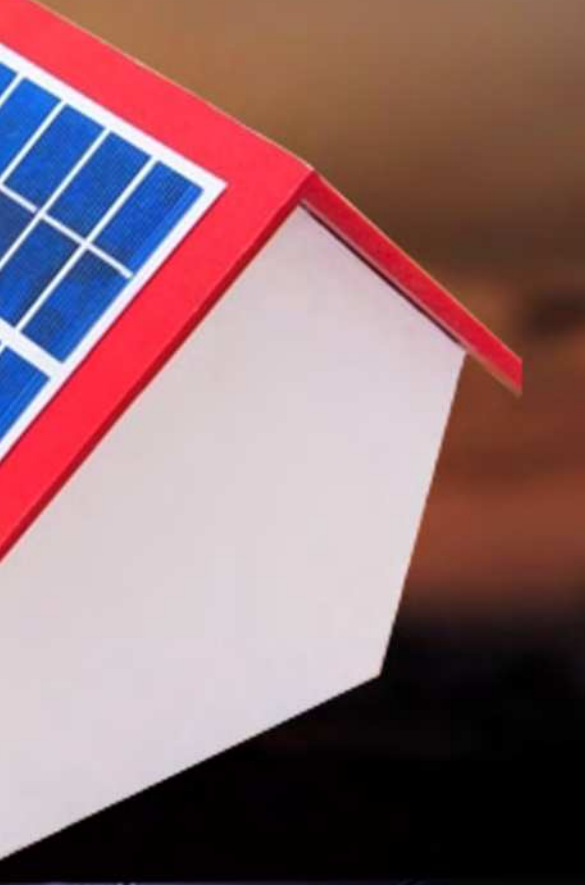
A feed-in tariff (FiT) scheme provides a guaranteed premium price to the green electricity producer and puts an obligation on the grid operators to purchase the generated electricity output. The price is typically guaranteed for a long period in order to encourage investments in new renewable energy sources for power generation (RES-E) plants.

## **The Net metering concept**

Net metering is an electricity policy which allows utility customers to off-set some or all of their electricity

use with self produced electricity from RES-E systems. Net metering works by utilising a meter that is able to spin and record energy-flow in both directions. The meter spins forward when a customer is drawing power from the utility grid (i.e.using more energy than they are producing) and it spins backward when energy is sent back to the grid (i.e. using less energy than they are producing). At the end of a given month, the customer is billed only for the net electricity used. Net metering works only for grid





connected systems and what makes it so beneficial, besides offsetting a home's energy consumption with a RES-E system is that excess energy sent to the utility can be sold back at retail price. If more energy is produced than consumed, the producers receive benefit for this positive balance, such as renewable energy credits (REC) which is then credited to the customer's account towards the next billing cycle. If at the end of the year a surplus remains, then the customer depending on the utility policy may (a) pay for the total REC collected at avoidance cost rate or retail cost rate; (b) the total REC collected can be transferred and could be used as a compensation for a possible negative balance in the following years; (c) the total REC collected are granted back to the utility.

### **Benefits and Misconceptions**

There are benefits that accrue to the utility, the customer, and the community from net metering.

For the utility, a well-designed net metering policy provides a simple, low-cost, and easily administered way to deal with PV residential systems. Utilities obtain electricity and capacity from small, distributed PV installations. This is electricity that they don't have to generate themselves or purchase from the market. For PV systems, this generation takes place every day of the year with a very high correlation with utility peak loads. Utilities call this a high load carrying capability since sunshine is relatively easy to predict. Thus, utilities obtain the benefit of additional capacity in their service territory paid for by their customers. PV residential systems can also strengthen the distribution grid, especially, in rural areas. This is because voltage tends to drop at the end of long distribution lines when loads are high, and if it drops below a threshold level, the breakers will trip and a temporary blackout occurs. Grid connected PV systems tied to the distribution grid strengthen voltage and improve overall service. And this grid support can defer maintenance and upgrades in the power distribution system, which is a tangible benefit to utilities. Customers benefit from net metering of PV residential systems because they obtain a long-term guarantee of low utility bills. Communities benefit from the investment in local generation. This investment not only increases local property values but increases local business opportunities as well. It is the difference between paying rent and paying a mortgage.

There are also some misconceptions about net metering, such as that net metering hurts the utility bottom-line by reducing

revenues. This argument is similar to the one against energy efficiency where customers reduce their purchases of electricity and it hurts utility revenues. This would be true if all households bought a PV system and put it on their roofs. The current market is small and does not affect even a fraction of a percentage point on the bottom-line of any utility that reports these figures publicly. Nevertheless, a net metering policy should receive regular review to monitor progress of the technology and development of the market. If PVs, and especially, energy efficiency, which has a much larger potential for impacting rates than PVs, gets to the point where it actually reduces utility revenues, then rates should be restructured to guarantee that service.

Another misconception is that net metering represents a subsidy from one group of customers to another. This argument has to do with the methodology that utilities use to charge customers. The argument is that utilities charge all customers in the same class of a single rate, which represents an average cost of doing business plus profit. Thus, a household that uses a lot of electricity during the day when the cost of obtaining electricity is higher pays the same as the household that uses electricity at night during off-peak hours. One could argue that one type of consumer subsidizes another based on patterns of consumption, etc. Utilities and their customers have supported this averaging formula for years. For example, building a new home represents a cost for a utility because it must invest in new generating capacity in order to

supply this electricity. Therefore, customers subsidise solar systems through net metering no more than they subsidize construction of new homes. Both represent expanding business opportunities, and electric utilities have figured out a way to accommodate this economic growth through existing rate structures for more than a century.

A final misconception is that net metering represents a burden on small utilities. The opposite is actually true because large organisations are better equipped to handle more complicated arrangements. Net metering is as simple as it gets to administer because it requires no special equipment, no new rates to establish and no new procedures. All that is required is that the utility adds a line in the ledger for each net metering customer to carry forward credits until the end of the year. Compare this with the alternative of FiT supporting scheme, which requires installation of another meter. Then the utility must make special trips to read this meter and re-adjust its accounting procedures to keep track of another meter for a single account. A survey found that the cost of reading the extra meters for residential PV systems alone outweighed the cost of net metering.

## **Net metering schemes around the world**

In this section, the current existing electricity net metering schemes that are in operation in different countries around the world are presented.

### **Europe**

In Europe, only Belgium, Cyprus,

Denmark, Italy and the Netherlands are using net metering.

In particular, in Belgium, in the Brussels region small RES-E auto producers with a capacity up to 5kW are eligible for net metering. In order to benefit from net metering, the installation shall be equipped with two different meters, a bi-directional and a green meter, which would measure the electricity produced by the RES-E auto producer.

In Cyprus, the net metering concept was recently investigated and as a result the net metering scheme will be initially introduced in a pilot phase for residential PV installations at different geographical locations in Cyprus.

In Denmark, the regulation on net metering for the electricity producers for own needs is based on the act on electricity supply and authorises the exception of certain producers from Public Service Obligation (PSO), which is a surcharge that every consumer is obliged to pay and it depends on each consumer's individual level of consumption.

In Italy, RES-E systems up to 20kW or from 20kW up to 200kW, which have been commissioned after 31 December of 2007, can consume as much energy they produce for free.

In the Netherlands, RES-E systems which are connected to the electricity grid through a small scale connection up to 240A are eligible and would have to pay energy taxes only to the net electricity consumption of their systems. However, the RES-E producers have to pay a grid use charge for injecting electricity to the grid.

### **Australia**

In some Australian states, the FiT is actually net metering, except that it pays monthly for net generation at a higher rate than retail. A FiT requires a separate meter, and pays for all local generation at a preferential rate, while net metering requires only one meter. The financial differences are very substantial.

### **Canada**

Ontario of Canada allows net metering for up to 500kW, however, RECs can only be carried for 12 consecutive months. Should a consumer establish a REC where they generate more than they consume for 8 months and use up the RECs in the 10th month, then the 12-month period begins again from the date that the next credit is shown on an invoice. Any unused RECs remaining at the end of 12 consecutive months of a consumer being in a REC situation are cleared at the end of that billing.

### **Thailand**

In Thailand, solar, wind, micro hydroelectricity, biomass or biogas generators up to 1MW per installation that produce less than they consume in a monthly period receive the retail tariff rate for electricity fed onto the grid. For net excess production, producers are compensated at the bulk supply tariff, which is the average cost of generation and transmission in Thailand and it is about 80 per cent of the retail rate.

### **USA**

In the USA, all public electric utilities are required by legislation to make available upon request net metering service to their

customers. Overall, 47 states apply the net metering mechanism for the promotion of RES-E technologies, with the exceptions being Alabama, Mississippi, South Dakota and Tennessee. Most of the states place a capacity limit for the eligible RES-E technologies for net metering, except for the customers of investor-owned utilities (IOU) and the electric cooperatives of the state of Arizona, the state of New Jersey, Ohio and for the customers of Ashland Electric in the state of Oregon. Also, 28 states employ aggregate capacity limit for their net metering mechanism which is expressed as a percentage of the state's utility's peak demand. In 30 states any customer's net excess generation (NEG) is credited to the customer's next electricity bill for a 12-month billing cycle at the retail rate, whereas in 5 states it is credited at the state's utility's avoided cost rate. Also, in four states the NEG is credited at various other rates, such as (a) the TOU rate (b) a rate predetermined by the utility and (c) as a percentage of either the retail or the avoided cost rate. Furthermore, in 8 states the NEG is credited to the customer's next electricity bill via a combination between retail rate and avoided cost rate or, between retail rate and any one of the other various rates as mentioned above. The actual type of NEG credit is decided by a number of set criteria, such as the type of RES-E technology, the RES-E capacity limit, the type of customer and the type of utility.

### Indian state Net-metering system


Net metering is a mutual agreement between electrical utility and

consumer and this agreement allows the electricity generation from renewable energy source example solar PV system the solar PV cell system owner can sell the excess solar energy to the utility company. In Maharashtra state government there is a large potential of renewable energy sources from the generation of electricity this state promotes mainly on renewable energy system like wind, solar methods according to the policy framed by Maharashtra State electricity distribution company limited (MSEDCL) and Maharashtra energy development agency. The paper mainly focuses on two important aspects around the case studies of electricity usage for residential users in the city of Nagpur in India. The survey was on the electricity bill before connecting the net metering and after connecting the net metering system with a grid environment. They were installed rooftop solar unit for net metering infrastructure with capacity of 3 kilowatt and there is cost of renewable energy system approximately three lacs.

This paper is reviewed according to the comparison between consumption of energy in terms of units and their respective electricity bill. This comparison is taken in two aspects and the first bill details before connecting the net metering system to the smart grid and second aspect is billing table after connecting net metering with the smart grid while connecting this net metering to our smart grid the electrical bill charges almost reduced after connecting net meter. Tamil Nadu State Government also adopting net metering system policy and

the main aim of the solar energy policy 2012 was to generate 3 megawatt solar energy by 2015. This vision can be achieved by many ways especially PV system in residential consumer. This residential consumers also provide the net metering system along with considerable factor framed by Tangedco also this net meter is a bi-directional meter with AMR compatibility for import and export the electrical energy. Tangedco maybe paid the 75 per cent solar tariff if excess energy is generated at the end of the year. The state government of Tamil Nadu provide subsidy for residential PV system for 1 kilowatt panel capacity. The first net meter was installed in Mumbai by Tata Power company followed by 3 kilowatt solar net metering power plant with backup for residence at Telanganastate. The Karnataka state government also install 10 kilowatt solar PV system for residential consumer for implementing the net metering plants.

### Conclusion

In this work, an overview of the net metering mechanism for RES-E systems has carried out. In particular, the net metering concept was examined with its benefits and misconceptions. Furthermore, a survey of the current operational net metering schemes in different countries has carried out. 



**Dr L Ashok Kumar,**  
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Coimbatore



## “Domestic consumption of aluminium to double in 5 years,” highlights CEO

**Tell us about Vedanta’s Aluminium and Power business – what is the size of your power portfolio and tell us about the green-field power plant in Punjab...**

As you know, Vedanta’s Aluminium & Power business is the largest producer of primary aluminium in India. Our smelting capacity of 2.2 million tonnes is backed by integrated power plants, as aluminium production is an energy-intensive operation. So, power is crucial to our operations. It is our second most important raw material after alumina. The size of our power portfolio, captive and independent combined is close to 8,000 MW and that puts us among India’s top 5 power producers. Given the criticality of power, we look at the business through a micro lens and ensure that we adhere to global standards, we adopt cutting-edge technology to improve our operational efficiency and adapt to the changing times. We operate Punjab’s largest greenfield independent power plant – Talwandi Sabo Power Ltd. (TSPL) - with a capacity of 1,980 MW in Mansa which supplies 100 per cent of the power generated to the state of Punjab. Likewise,



**As consumption increases in the coming decade, we are committed to ensuring that we contribute to the ‘Make in India’ initiative while focusing on the country’s self-sufficiency vis-à-vis aluminium, says Ajay Kapur, CEO - Aluminium & Power, Vedanta Limited - By the Electrical India content team**

we have IPP units in Tamil Nadu and Odisha which supply power to the state grids. So, we have a good mix of IPPs and CPPs.

Going forward, our focus would be inward and wherever we have expenses in terms of

KPIs and also study the future road map. We want to keep looking at opportunities because we also know that other assets are available from time to time. And we continue to look at it from our growth and also to look at the standalone business.

**How big is the Aluminium & Power business in terms of volume?**

The Aluminium & Power business is one of the largest and most diverse sectors in the Vedanta Group’s portfolio. The business has produced 1.95 million tonnes of primary aluminium in FY19, which was the highest-ever production from any single domestic producer till date. We operate two state-of-the-art aluminium smelters at Jharsuguda (Odisha) and one at BALCO in Korba (Chhattisgarh). The smelter in Jharsuguda is the world’s largest single-location aluminium smelters, outside China. Our world-class 2 MTPA alumina refinery at Lanjigarh in Kalahandi district (Odisha) has made Vedanta a premier manufacturer of metallurgical grade alumina for the company’s aluminium smelters.

In terms of top-line, that’s almost \$ 4 billion – a mammoth

business, and if you talk about the Vedanta Group as a whole, we are \$ 15 billion and growing. Vedanta Limited is the world's 6th largest diversified natural resources conglomerate, proudly contributing 1 per cent to India's GDP.

### What is the percentage of growth that you foresee?

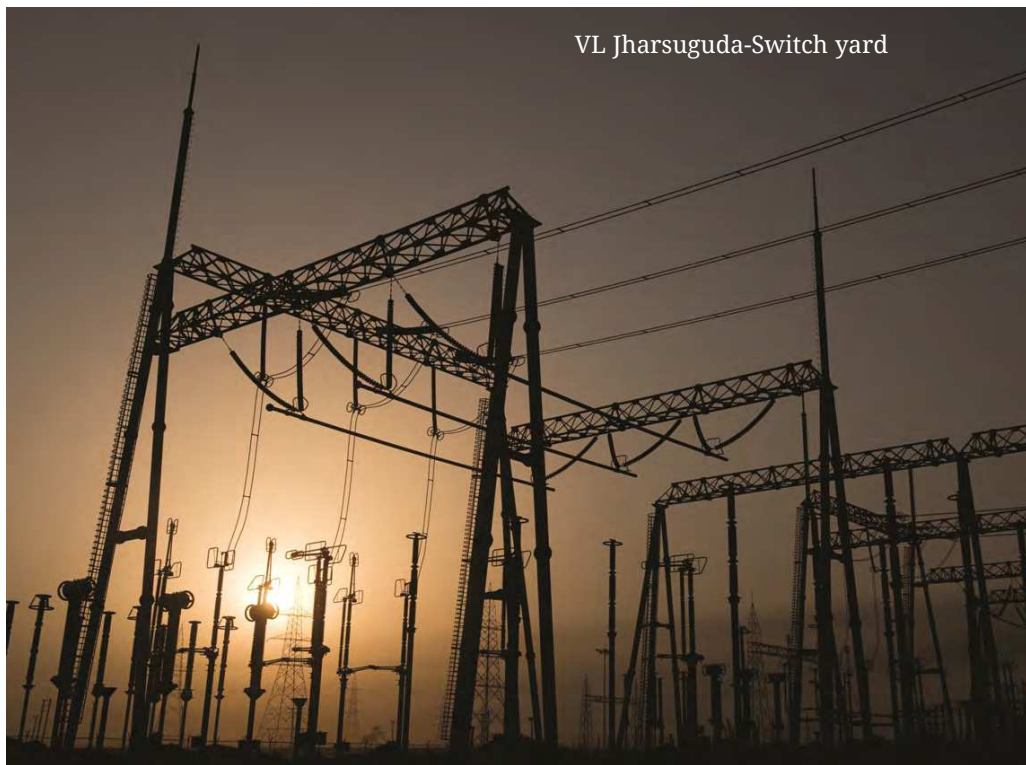
We have steadily grown at 6.5 to 7 per cent over the years. Aluminium is the fastest growing commercial metal today, owing to its criticality in diverse industry sectors. However, India's per capita aluminium consumption of 2.6 kg is a stark contrast to the global average of 11 kg. I believe that as the Indian economy takes an upward turn, we shall see a rising trend in aluminium consumption with per-capita numbers going up from 2.5 kgs to 5 to 6 kgs, owing to an increase in investment in sectors like rural electrification, infrastructure, transportation, aviation etc. With consumption posed to increase in the next decade, we are committed to ensure that we contribute to 'Make in India', with a focus on increasing the country's self-sufficiency vis-à-vis aluminium. We are a global company with strong Indian roots. Today we have a production of nearly 2 million tonnes which also sees us cater to global markets. As we see domestic consumption growing, and we anticipate the domestic consumption of aluminium to double in just 5 years, we have plans to increase our production capacity and value-added offerings to serve the demands of the growing market.

### Tell us more about your export market...

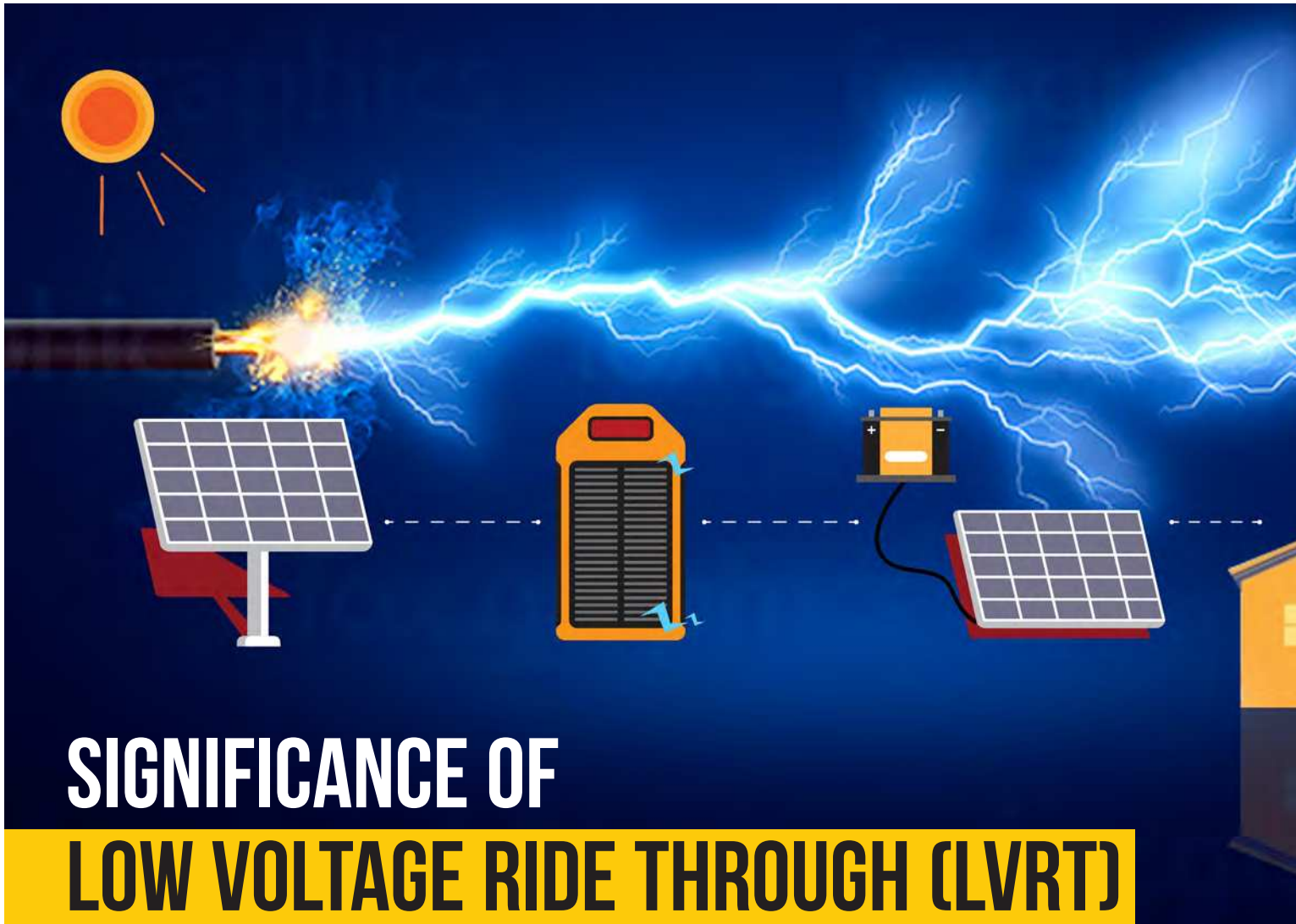
Vedanta's products are very successful in evolved markets across the world. The company aligns itself to meet the growing needs of diverse applications across sectors and we cater to our customers' unique requirements through focused R&D and carefully developed new value-added products with highest quality and sustainability standards. We have a strong presence in Europe, Asia and the US. We are also opening up to markets in the Middle East and South Africa. We are the largest producer of wire-rods globally, ex-China. The government has a lot of ability to introduce it to every village and a lot of new grids have been made. Also, we foresee new opportunities in new grids for renewable energy. Underground cabling is also an important area.

Our wire rods also find usage in the automotive segment as wirings and harnesses.

Vedanta is the only company in India to produce flip coils for the steel industry. Our billets are in great demand in the quality-sensitive international markets, like the US, and form the biggest chunk of our export volumes. Primary Foundry Alloys are the latest addition to our strong portfolio of value-added products, which are extensively used in the automotive industry. Slabs and rolled products form the next segment of our value-added portfolio and find usage in packaging, consumer durables, machinery and equipment, automotive, industrial engineering and, building and construction. Besides these, we also have developed Aluminium Silicon T-Ingots which are used for coating purposes by the steel industry.



VL Jharsuguda-Switch yard



# SIGNIFICANCE OF LOW VOLTAGE RIDE THROUGH (LVRT) IN SOLAR INVERTERS

Grid stability is one of the important aspects of energy supply. The article speaks about the LVRT technology that helps power generation companies to stay connected to the grid in order to avoid power outages.

Solar power plants have been increasing in number each year in India and we also see an increase in the use of renewable energy. The use of renewable energy enables the country to become more independent. Solar power plants mainly consist of solar PV modules, grid connected inverters and transformers. Owing to increasing number of power plants, the demand for inverters will be high considering we have a target to achieve 175 GW by the year 2020 and 500 GW by 2025. With one of



the leading developing countries, India is pushing onward with a large scale addition of renewable energy by the year 2030. Because of the availability of high renewable energy systems, the stability of the power system needs to be safeguarded. Grid stability is one of the important aspects to consider with regard to energy supply. In order to avoid power outages, it is necessary that power generating plants have control capabilities and protection mechanisms. In the past, these requirements were fulfilled by conventional power plants. In the meanwhile, however, the share of renewable energy sources in the total electricity generation has become so significant that these sources too must contribute to grid stability. Therefore, the transmission system operators have established so-called grid codes with certain critical values and control characteristics that the generating plants have to fulfill. An important part of these requirements is the so-called LVRT

capability of generating plants. But what exactly does this term mean? LVRT is a short-form for Low Voltage Ride-Through and it describes the requirement that generating plants must continue to operate through short periods of low-grid voltage that does not disconnect from the grid. Short-term voltage dips may occur, for example, when large loads are connected to the grid or as a result of grid faults like lightning strikes or short-circuits.

In the past, renewable generating plants such as wind turbines were allowed to disconnect from the grid during such a fault and try to reconnect after a certain period of time. Today, because of the significant share of renewables, such a procedure would be fatal. If too many generating plants disconnect at the same time the complete network could break down, a scenario which is also called a 'blackout'. For this reason, the LVRT requirement has been established which is meant to guarantee that the generating plants stay connected to the grid. Additionally, many grid codes demand that the grid should be supported during voltage drops. Generating plants can support the grid by feeding reactive current into the network and so raise the voltage. Immediately after fault clearance, the active power output must be increased again to the value prior to the occurrence of the fault within a specified period of time. These requirements which at the beginning only applied to wind turbines, now also have to be fulfilled by photo-voltaic systems (PV) and most recently by combined heat and power plants (CHP). Figure 1 shows the result of

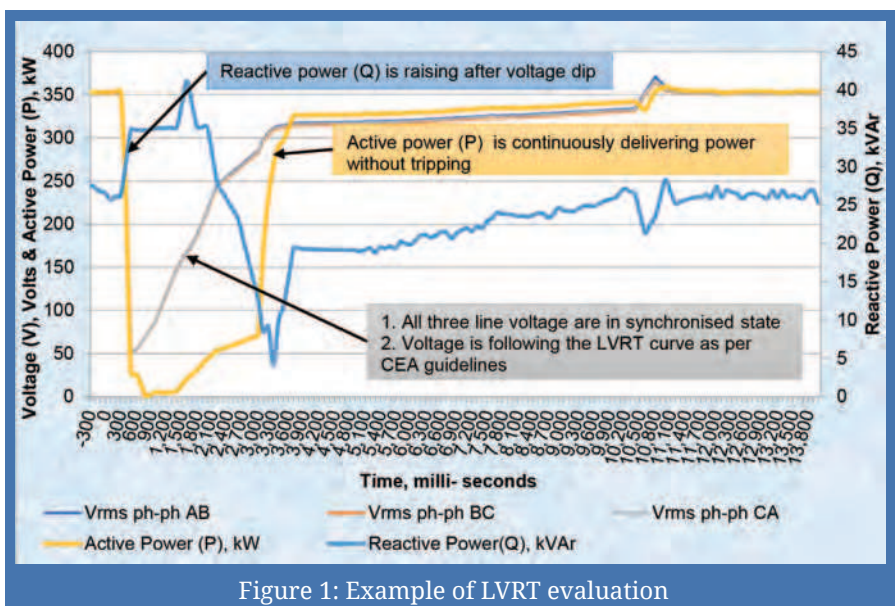


Figure 1: Example of LVRT evaluation

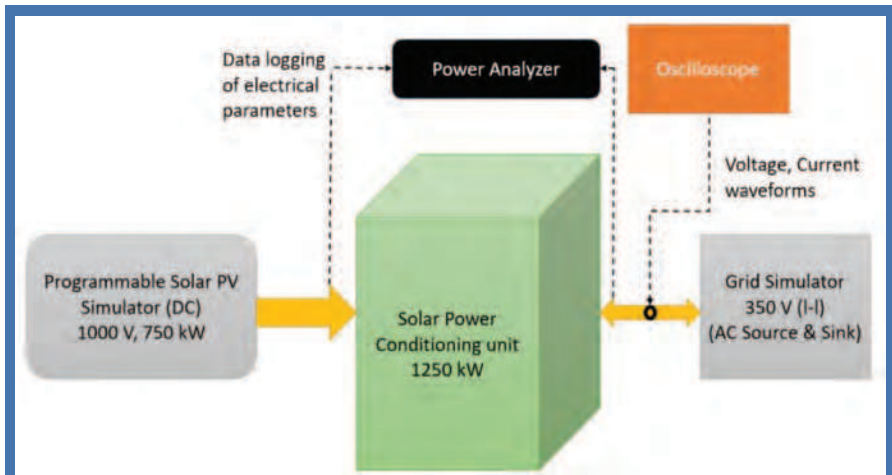


Figure 2: Test equipment for the simulation of LVRT

## Simulation of LVRT

The simulation of voltage dips requires a special technology. Most grid codes and guidelines have specific requirements for the test equipment. According to the international standard for the measurement of power quality characteristics of wind turbines (IEC 61400-21) for example, an inductive voltage divider is recommended which is to be connected ahead of the plant to be tested. For India, CEA Regulations, 2019 for grid connected equipments. Clause 4(c), Clause B2, Sub Clauses of Central Electricity Authority (Technical Standards for Connectivity to the Grid) (Amendment) Regulations, 2019, Ministry of Power, Notification (New Delhi, dated 6th February, 2019) Part III Section 4 provides the requirement for grid connected equipment for LVRT (see Figure 3).

By using the grid simulator, the voltage dip can be configured. Depending on the respective grid code, different depths of voltage dips have to be simulated, for wind turbines, usually the dip is less than 5 per cent, 25 per cent, 50 per cent and 75 per cent of the rated voltage are required; for grid connected inverters usually the dip is 85 per cent. The duration of the dip is 300 ms only. In some cases, the duration can also be extended to several minutes. German and international guidelines demand the simulation of three-phase as well as two-phase faults. In England, guidelines additionally demand one phase faults against earth. The test system is normally stored in especially equipped standard sea containers and mainly contains the

a LVRT test on a Solar Inverter of 1250 kW tested at 350 kW.

In this diagram, the voltage drops to about 85 per cent of the nominal voltage for a time of 300 ms. The PV inverter recognises the voltage drop and feeds a reactive current of approximately 100 per cent of the nominal voltage into the system for the duration of the fault in order to support the grid. After fault clearance, the active power output is increased to the value prior to the occurrence of the fault within 1 second. Before a generating plant can be connected to the grid, the transmission system operator normally requires a test report or

certificate. One of the certification requirements is the measurement of electrical characteristics that includes a test of the LVRT capability. In India, this test can be carried out by a laboratory at the Central Power Research Institute (CPRI), Bengaluru. CPRI is having 540 kVA grid simulator and 750 kW (1000 V & 1800 A) programmable DC source (see Figure 2). During the test, voltage dips are simulated and the behaviour of the inverter is measured and evaluated. The results are documented in a test report which together with other reports forms the basis for certification.

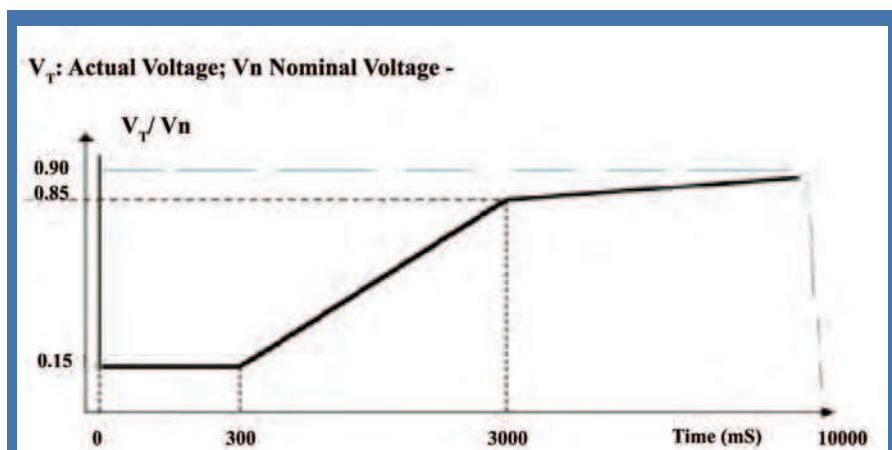
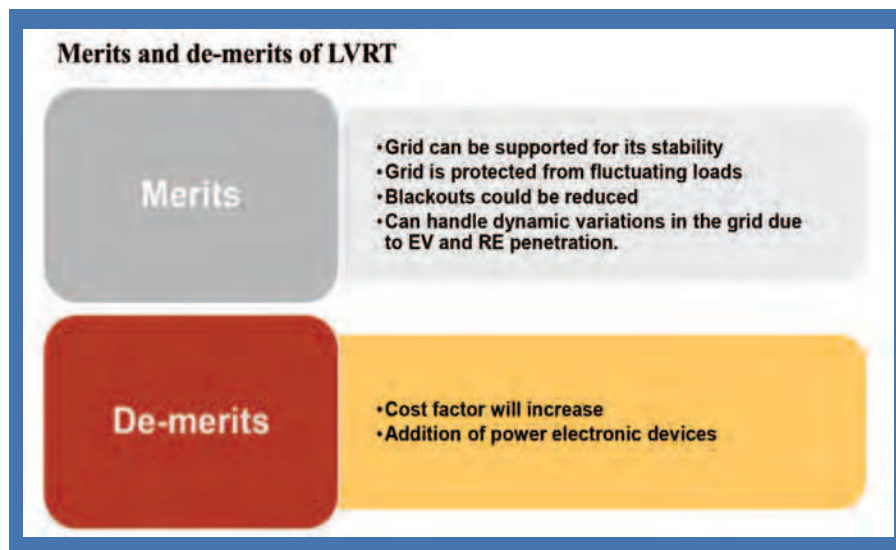


Figure 3: LVRT curve (Source: CEA Regulation, 2019)



coils and switching devices. Large-size test systems (for generating plants in the multi-megawatt range), often require two or more 40-foot containers. The mobile test system can thus be transported to the respective test site for free-field measurements. PV systems are often tested in the laboratory where the LVRT test system is normally part of the test facility. In cases, however, where manufacturers do not have their own test facility, mobile test containers are used instead. As an independent measuring institute, CPRI has recently started testing the LVRT capability of grid connected inverters. Since very recently, CPRI is also able to perform fault ride-through tests with own test systems. These consist of a smaller system for testing generating plants up to 0.5 MW, in grids up to 415 V. The test system is also well equipped for future requirements because it is possible to simulate so-called HVRT tests (overvoltage tests) and FRT test (frequency ride through from 47.5 Hz to 52 Hz). The first projects with CPRI's own test setup have already been completed successfully on a solar based grid connected inverter of 1250 kW capacity, tested at 350 kW. CPRI is accredited by the NABL (National Accreditation Board of Laboratories), according to ISO/IEC 17025:2017. Other terms frequently used and describing the same subject are: Fault-Ride-Through, response to voltage drops, performance in case of voltage dips, voltage dip- tests, transient stability, network faults, double dip test, voltage drops, and performance during network disturbances and behavior during network disturbances.



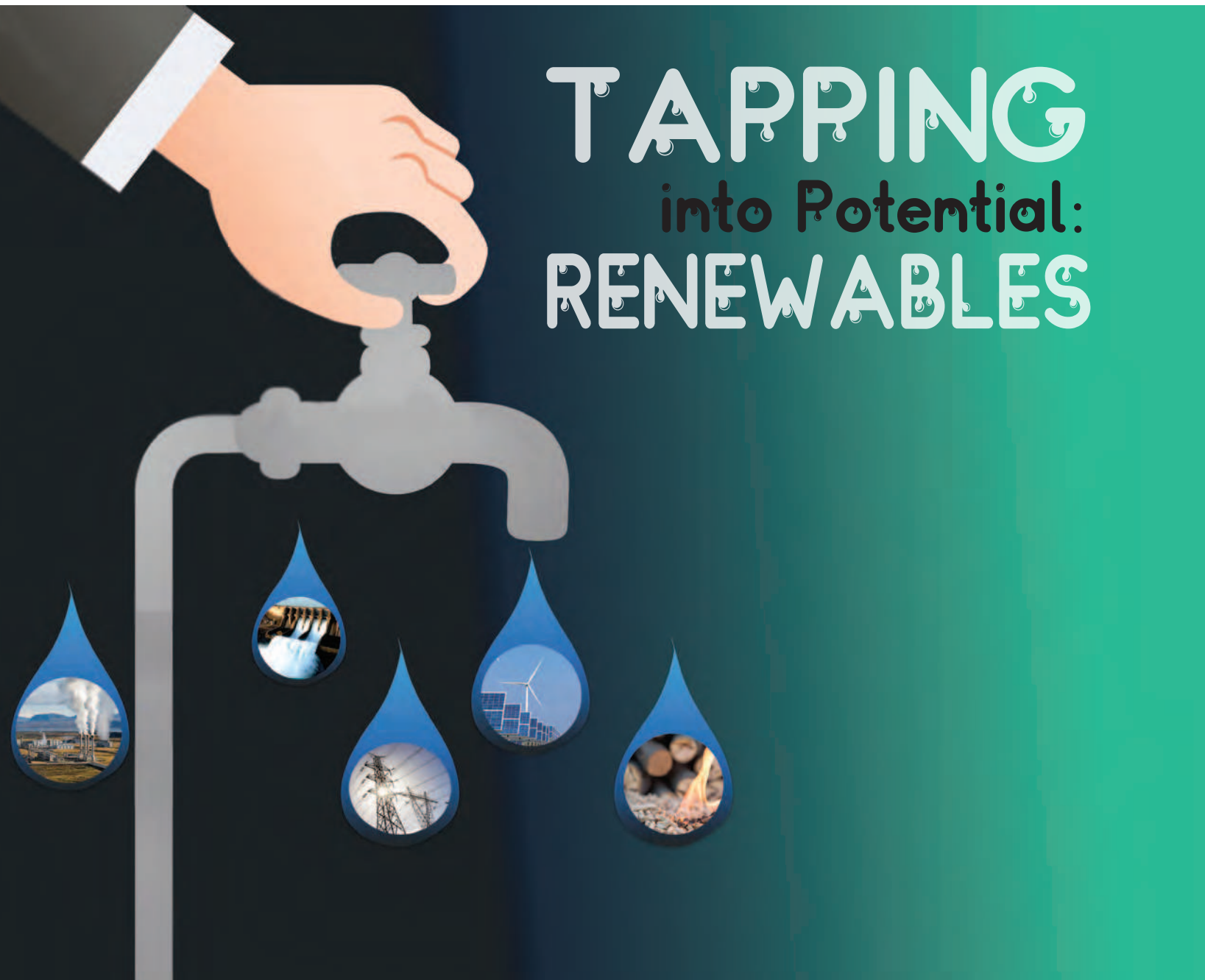
### Examples of LVRT in Solar Power Plants

- For short system faults (lasting up to 150ms or 300 ms) the inverter in the solar plant has to remain connected to the grid.
- For High voltage grids, voltage dips of longer durations like 500 ms or 1000 ms or higher , the inverter in the solar power plant has to remain connected to the grid up to more than 2 ½ minutes. As the curve shown in CEA says the inverter to be on top of the curve if voltage follows it.
- During grid faults or brownouts a solar power plant has to supply maximum reactive current to the grid without exceeding the transient rating of the plant. This will boost the voltage of the grid to maintain stability.
- On HV grids, during voltage dips lasting more than 300 ms the active power output of a solar plant has to be retained at least in proportion to the retained balanced HV grid voltage.

### LVRT for Electric Vehicle Charging Infrastructure (EVCI)

Grid connected inverters need to have LVRT feature in-built in them to support the grid. As electric vehicle supply equipment (EVSE)/ EVCI contains the grid connected inverter for V2G power flow, the importance of LVRT is increased. EV loads are going to be fluctuating and this making the existing conventional load curve of each region or entire country different than present scenario. EV loads may not increase the load in the near future but will vary the load curve. Multiple EVCI's connected to the grid can really help the grid if they possess the LVRT feature in them apart from taking power from EV to the grid (V2G). LVRT based grid connected inverters in the EVCI's can play a major role in maintaining the grid stability and security of the country. 🇮🇳





# TAPPING into Potential: RENEWABLES

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*Energy management does not restrict itself to the conservation of energy but draws attention to the utilisation of available renewable energy sources.*

The development of renewable energy sources and associated technologies have shown an accelerated global rise in the past few decades. The employment of RES-based technologies is being given a nudge by governments across developing nations worldwide. Efforts have been made for the promotion of renewable technology, and this includes improvising the

efficient usage of energy and also establishing the conservation plans. The intermittent nature of RES is covered by using conventional sources along with the renewable ones. Also, the combination of RES with conventional sources to the isolated loads which are far off from the main grid will ensure a continuous, regular supply. A hybrid-system comprises of various generating sources, it holds the potential to finish the need of fossil fuels and thus, encourages energy sustainability. RES prove to be the most effective when it comes to providing high-quality electricity to various remote locations. The role of an efficient energy management system comes into picture whenever more than one source is required to supply loads. Minimising the cost to energy production is another major area to be explored, protecting components from damage due to overloading and hence increasing the stability of the power system. The control of energy flow is a major role of energy management strategy.

### Microgrid Deployments in India

Microgrids in India are deployed to fill in for an unreliable utility grid. They reach new off-grid customers, save money, and reduce carbon emissions. People who could afford it have long used diesel generators to back up the utility grid, but are increasingly moving to microgrid options consisting of solar photovoltaic and energy storage. India's aggressive electric-vehicle targets should also contribute to the increasing number of microgrid growth as homes, campuses, and companies seek to ensure adequate

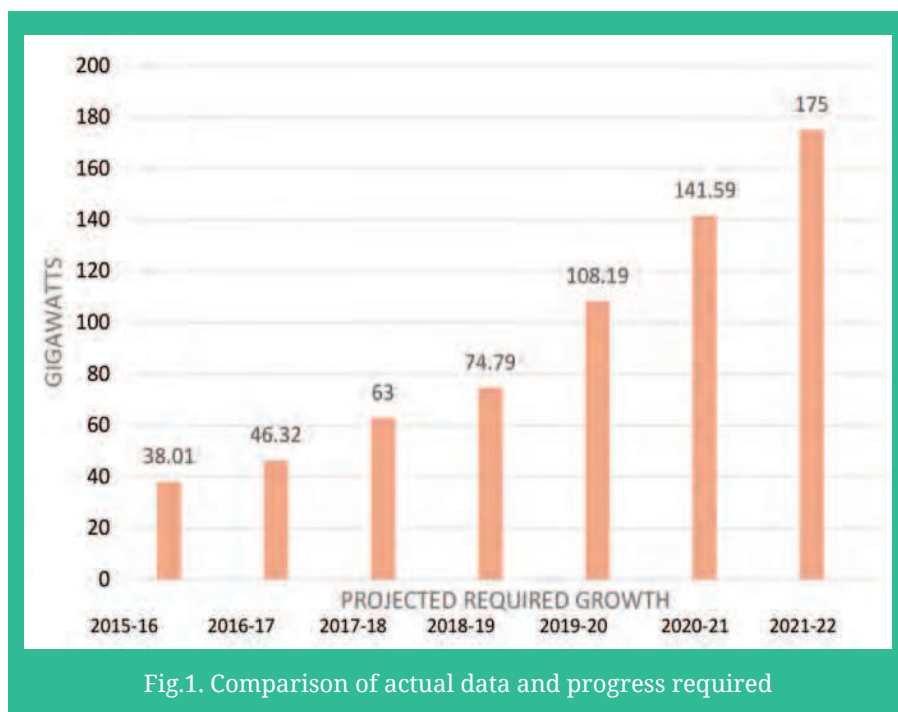


Fig.1. Comparison of actual data and progress required

electric supply to meet surging demand. The Indian Government is offering to utilise EV-batteries as a grid resource to meet national renewable targets. The SELCO Foundation in Karnataka has deployed a number of solar-storage remote microgrids to provide energy access in Baikampady Mangalore, Neelakantarayanagaddi Village, Mendare Village, and Kalkeri Sangeet Vidyalaya. Each of these are DC microgrids. There is another operational microgrid operated by the Indian Coast Guard. It is located in Andaman Island. Another one is located at Chief Ministers Official Residence in Bihar India, with a 125-kW solar microgrid. Dharnai village has a microgrid. Greenpeace has gone beyond activism to solar microgrid deployment.

The rapidly emerging Indian microgrid market has multiple factors to its credit. This includes ambitious government programs and chronically unreliable main

utility grids aimed at adopting green energy and improving energy access – particularly for rural Indians. A country-by-country assessment of investing in green energy, according to a report by Climatescope, shows that India ranks second on the track to become third largest solar power succeeding China and US.

According to a report by Bloomberg New Energy Finance, rooftop solar alone shows a USD 23 billion investment opportunity in India. India leads in the world's largest auction for renewable energy. It has recently embarked on major incentives for renewable energy development. The overall comparison of the Indian subcontinent's actual data and the progress required for meeting the RES targets is as shown in Fig.1.

India is leading in solar for developing countries. As of mid-2018, India scaled up its renewable energy goals. Over the next four years, with 40 GW of the goal which

represents rooftop solar. With the price of rooftop solar has dropped, the cost of power has risen by about more than 20 per cent. It would lead to strong growth in the rooftop photovoltaic market. However, homeowners still lack financing options. India is a major driving force for renewable energy sources amongst developing countries.

It has created the International Solar Alliance. It is the international headquarters for this treaty-based intergovernmental organisation. It now includes over 120 nations. Membership in the USA is limited to the countries which receive a lot of sunshine. i.e. those clustered around the equator which collaborate to advance renewable energy sources through solar-friendly policies.

## Energy Access Programs: India

India has a lot of major programs in place to reduce energy poverty. Millions of people still lack access to electricity. Most of them are connected users which do not have a reliable supply. The major energy access programs in India is '24x7 Power to All'. An intensive effort to improve energy access to individual households is being done. The SAUBHAGYA (Pradhan Mantri Sahaj Bijli Har Ghar Yojana), which is a USD 4.4 billion project. It was launched in 2017, it is now delivering low-cost or free home solar kits to many households. Till the year 2018, a number of Indian states have achieved 100 per cent electrification. The number is doubled as compared to the previous year, and we give most of the newly electrified regions credit to the SAUBHAGYA program, for

their energy access improvements.

India has its village electrification program. It is called Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGY). The objective of this was to launch improvements to the existing electric grid. So far, thousands of villages have been electrified, few are remaining before the final goal is reached. 'Electrification' is defined as energy access for only 10 per cent of the houses in each village. The government has decided to move away from that definition. It has shifted its goal to provide electricity for every individual household. According to Bloomberg New Energy Finance, a lot of families served by solar systems are moving on to relatively larger devices.

## Managing Energy with Microgrids

The accessibility to the grid is now open to many Indian homes as well as villages. They do not have access to electricity. Most families cannot afford to pay for power, while to others, electricity via the main grid is limited to only few hours a day. The microgrids are a befitting solution to this long-pending issue. It is the best suitable for remote areas where no access to grids is available. Ministry of New and Renewable Energy (MNRE) India, in 2016, had planned to install around 10,00 microgrids with a cumulative capacity of 500 MW by 2021. Microgrids are defined as green energy based distributed generation, primarily under 10 kW.

Microgrids may operate on a stand-alone basis or grid-connected to the utility grid. Mini-grids have the same functionality but large capacity, of over 10 kW. Both

Microgrids as well as mini-grids play an important and cost-effective alternative to the extension of the main utility grid. Hybrid green microgrids are meant to provide energy access in a cheap manner as compared to transmission, owing to the low prices of solar and batteries. The microgrids could be scaled-up by community owners whenever it is necessary. More reliable power could be produced at a better quality. Grid expansion creates power losses where transmission and distribution distances are increased. Microgrids do conform to the new Indian regulations which mandates a good number of renewables in the country's energy system, where they deliver more reliable power, that too at a much rapid rate than the government's main grid extension program. If equipped with smart meters, microgrids have the ability to provide better monitoring of energy theft. Microgrids provide vital services to the main grid. While users connect to microgrids, it can be insulated from power outages, the mini-grids or microgrids that are connected to the main grid do have the potential to support it. Microgrids could thus, single-handedly, solve energy management issues like electricity transmission over remote areas, reduced dependence on fossil fuels and promote optimal utilisation of the available renewable energy sources. EI



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# Emphasizing fire safety – The cable and wire industry

## Assess the electric wire and cable industry in India

The industry has not been doing well for the past two years and the financial and real estate sector is under stress. Prices are not decreasing, as a result, the condition is likely to affect sales. Businesses in this sector are dependent on three things – industry, infrastructure and electricity boards. Fortunately, the government is spending a lot of money in these categories especially because of the scheme - Power to All. The government has given up 12 crore connections and for the last two months, hence we do see an upward trend in demand and we expect around 8-9 per cent growth.

## RR Kabel emphasizes safety and innovation, tell us about what you have introduced lately?

Innovation is there – we have recently introduced the fire alarm

**Fire safety is a key issue to consider when we talk of the electric cable and wire industry, Shreegopal Kabra, Managing Director & Group President, RR Global, tells us more... - By the Electrical India Content team**


cable and a cable of 266 KV range. But, more importantly, we are fighting for the regulation. The country lacks standardisation in terms of making and using cables that are fire safe.

## How do you see the business growing in the overseas market as well as in the domestic market?

The year 2019 was not a good

year concerning the business, and we see this scenario world-over. Hopefully, this year will be different as measures have been taken to protect the domestic market. But due to the unfortunate Coronavirus issue in China, overseas markets may see a further slowdown before things start to improve later this year.

## What's your comment on ELECRAMA as a business platform?

The best part is that IEEMA is doing well, and is getting approximately 600 people from overseas. I feel, apart from the utilities, ELECRAMA should focus on other sectors as well and real estate of course. The kind of money and time we spend at ELECRAMA, we want ELECRAMA to focus on other sectors as well otherwise it will be difficult for us to participate. 

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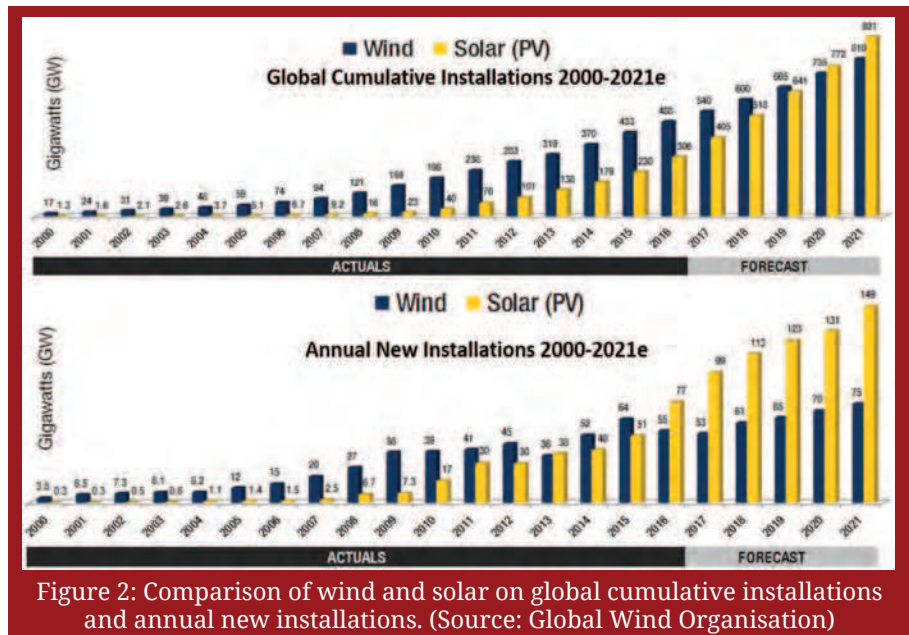
# KITE GENERATOR SYSTEM: THE FUTURE OF WIND ENERGY?

*The article discusses the principals involved in various HWAE technologies, the disadvantages of conventional wind turbine systems, and the need to replace them with the kite generator systems especially in India.*

## A comparison of wind and solar in terms of forecasted growth and consumption

This is to highlight the fact that harnessing solar energy is preferred over wind energy due to the difference in the cost of conversion system required i.e. the cost of solar converters are much cheaper than that of wind when compared per unit energy generation. As a result of massive price declines in recent years, solar power is now widely recognised as a cost competitive and reliable source of energy. The only advantage of installing wind conversion systems is that winds are available during the night.

Figure 1 shows that bio energy will remain the predominant source of renewable energy. However, its share of total renewable energy declined from 50 per cent (in 2017) to 46 per cent (in 2023) as the expansion of both solar PV and wind accelerates in the electricity sector.



The corresponding growth of wind power is from 9 per cent to 12 per cent (33.33 per cent growth) and of solar power is from 4 per cent to 8 per cent (50 per cent growth).

Figure 2 shows a comparison of wind and solar on global cumulative installations and annual new installations. The figures have a close approximation to actual data

till the year 2017, beyond that we have predictions till the year 2021.

Over the years, solar has lagged significantly behind wind power in terms of annual installed capacity and cumulative capacity but is rapidly closing the gap in annual installations. Already by 2019, it is predicted that solar will surpass wind in new installed capacity. In 2013, as

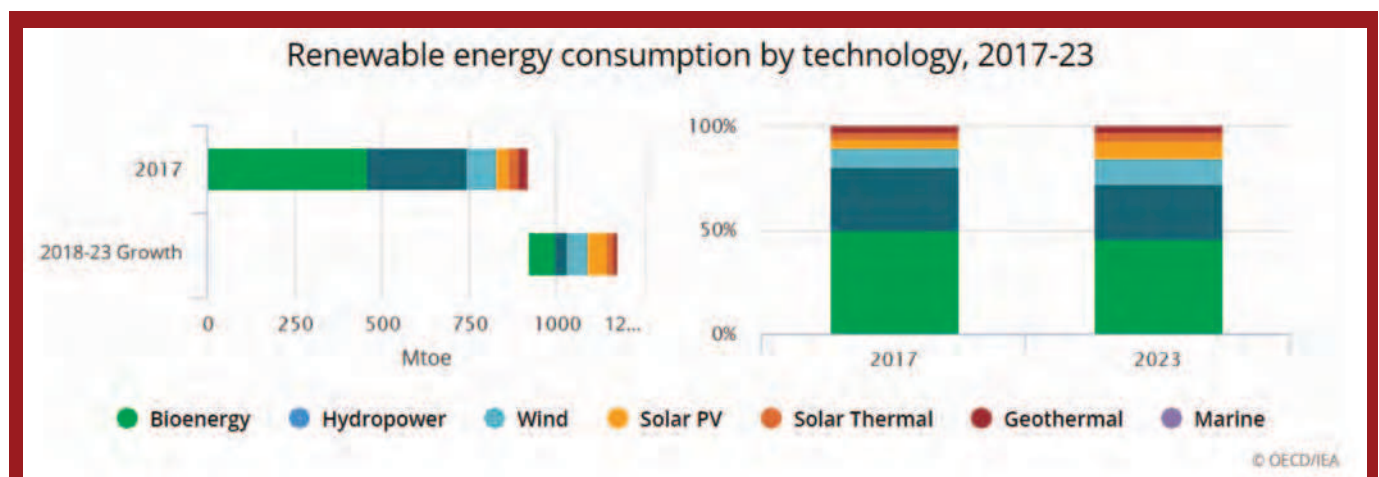


Figure 1: Bio energy to remain prominent source of renewable energy. (Source: OECD/IEA website)

the wind power industry experienced a big slump in new capacity, solar for the first time surpassed wind in annual installations. Wind retook the lead in new installations in 2014 and 2015 but in 2016, solar opened up a wide gap with 77 GW in new installations or 22 GW ahead of wind. In 2017 (preliminary figures), new PV installations were almost twice as high as wind (99 GW vs 53 GW). A year of strong growth is predicted for 2018 with new installations expected to surpass the 100 GW mark for the first time with an increase of more than 14 per cent to 113 GW, up from 98.9 GW in 2017.

## Why India should focus on improving wind technology?

India has a huge energy potential, as the statistics by Global Wind Atlas shows that the mean wind speed and mean wind power density in India is far better than the world average. In addition, India has not yet realised even the quarter of its on-shore wind potential and has not invested in off-shore wind conversion.

Figure 3 shows the comparison of Wind Energy Installations among the continents. One can clearly observe that Asia stands on the top.

The credit goes to China. In 2017 (preliminary figures), China was by far the largest country by both new installed capacity (19.5 GW) and total capacity (188.2 GW). Moreover, India has contributed only a small fraction of wind power to Asia by both new installed capacity (4.148 GW) and total capacity (32.848 GW) despite of ranking 2nd all over the continent.

The data matches with various sources. As published by IRENA, total wind installed capacity of the world is 513,547 MW out of which 494,821 MW is on-shore out of which India contributes only 32,848 MW on-shore capacity with no off-shore generation. Similarly, statistics from IEA electricity information shows that total wind electricity generation of the world till 2016 is 957,694 GWhr and that of India is only 44,856 GWhr. The examples clearly show that India is lagging behind in this field and it needs to perform better.

## Classification of Wind Energy Conversion Technologies

- Wind Turbine (Horizontal axis or Vertical axis)
- High Altitude Wind Energy Technologies

- Air Rotor Systems
- Airborne wind turbines
- Tethered airfoils (kites)

Among these, Tethered airfoils (kites) generator systems are mostly preferred.

The principle of the 'air rotor systems' developed by Magenn (MARS) Power Inc, shown in figure 3, is that a helium-filled balloon stationary at an altitude between 200 meter and 350 meter rotates around a horizontal axis in response to wind because of the Magnus effect, generating electrical energy via a generator connected to its horizontal axis. The energy produced is then transmitted to the ground by a conductive cable. Magenn tested a 2 kW prototype in 2008, and in 2010 has started manufacturing and commercialising a 100 kW balloon.

The second solution adapted by Sky Wind Power, Joby Energy, and Makani Power is to use airborne wind turbines to harness energy directly in high altitude winds and send it to the ground through conductive cables. Figure 4 shows the airborne wind turbines proposed by Joby energy. This solution has some technical complexities, high cost and heavy structures. Only Makani, acquired by Google.org as part of GoogleX, has passed to the production phase. They have already started producing a 1MW airborne wind turbine named 'Makani M1.'

The third option is to use power kites as renewable energy generators such as the 'Kite Wind Generator' of Politecnico di Torino, and the 'Laddermill' of the Delft University of Technology as shown in figure 5. In this case, mechanical power is generated when the kites are pulled

**Figure 3: Wind Energy Installations comparing the continents**

World Region	End 2016	Net New 2017	End 2017	Change
Asia	204,104	24,447	228,542	12.0%
Europe	161,891	16,845	178,096	10.0%
North America	97,485	7,836	105,321	8.0%
Latin America/Caribbean	15,312	2,578	17,891	16.8%
Pacific	4,948	245	5,193	5.0%
Africa & Middle East	3,917	621	4,538	15.9%
<b>World Total MW</b>	<b>487,657</b>	<b>52,573</b>	<b>539,581</b>	<b>10.6%</b>

Source: Global Wind Energy Council (GWEC)





Figure 3: Principle of the 'air rotor systems' developed by Magenn (MARS) Power Inc



Figure 4: Airborne wind turbines proposed by Joby Energy

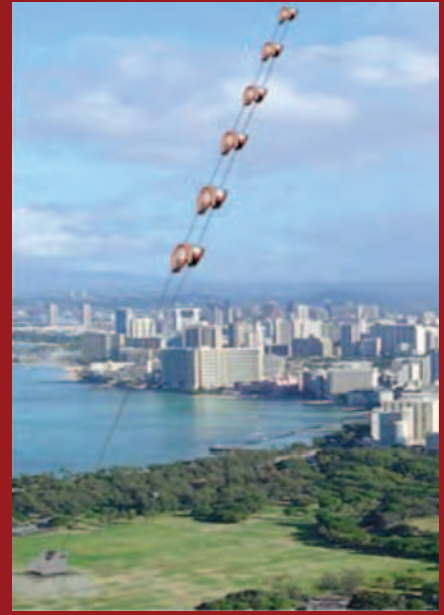


Figure 5: 'Laddermill' of the Delft University of Technology

by wind, transformed them into an electrical one using an on-ground generator. This allows the flying part of the system to be much lighter and avoid using conducting cables. This technology is expected to produce huge amounts of power using a much simpler and safer structure.

The figure 6 shows the basic elements of a Kite Generator System (KGS). On the top is the kite in a shape of a parachute. The natural path followed by this kite is upward with the wind in an eight shaped orbit. The tether is a cheap rope made of fiber having good mechanical strength. The one end of the tether is connected to the kite and the other end is wound on a drum. The drum rotates to unroll the tether and the kite goes upwards. An electro-mechanical energy conversion (EMEC) device is connected on the same shaft as the drum through a gearbox. Hence, the linear kinetic motion of the kite is converted into rotational motion

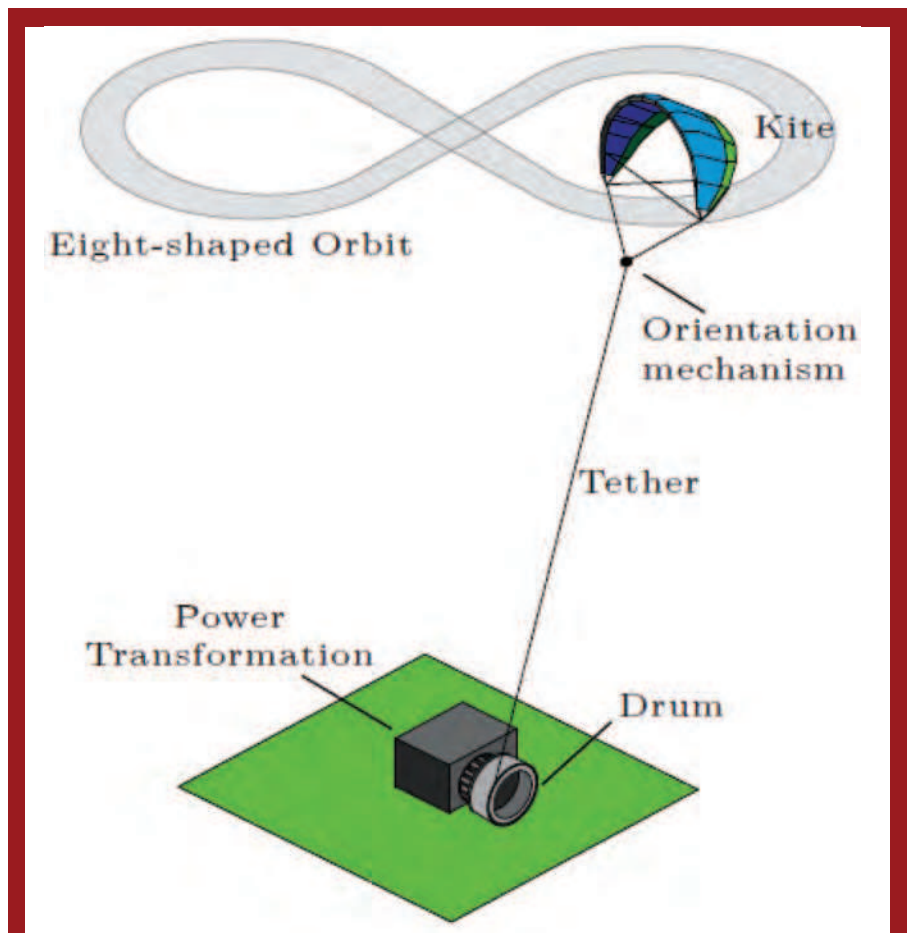


Figure 6: The basic elements of a Kite Generator System (KGS)

of the drum and is used to generate electricity using an EMEC device.

The Kite Generator System (KGS) is a Relaxation Cycle System; it is composed of a Traction phase. In Traction phase, the kite goes up following an eight shaped orbit, hence, drum unrolls and EMEC device acts as generator. In the recovery phase, the electrical energy is consumed to bring the kite back down, the EMEC device acts as a motor to deliver the power to the shaft and the drum rolls back the tether.

The need to operate kite in a specific range of height (generally 350 to 500m) is explained in figure 9. The figure 8 shows the different kite power region which are in the shape of a quarter spheres, considering the direction of wind going into the page. There is a lower limit under which the kite has a risk of falling. Slightly above is the maximum power region where one gets a peak in the power curve and then comes the medium power region where power output is almost constant with an increase in height. The efficiency above a certain height is low. Hence as soon as kite reaches minimum power region, a relaxation cycle is initiated

in order to bring the kite back in the maximum power region of operation.

## Comparison of Wind Energy Conversion Technologies

From the grid connection point of view, wind turbines are not able to produce their rated power continuously due to wind irregularity at their working altitudes, a problem that is less significant in the case of HAWE systems which are supposed to be working at an altitude higher than 400m where the winds are more regular.

Concerning the quality of generated power, it depends whether the system returns power to the energy source or not, meaning whether it has a recovery phase or not. In general, a classic turbine has only one phase of functioning that is generation, which means that while generating, the resulted power is continuous as long as the turbine is in the power region limited by its cut-in speed and cut-out-speed. This is the case of stationary air rotor systems also.

Meanwhile, kite-based systems and airborne wind turbines have a recovery phase whose goal is to maximize the average generated power and the respect of the

systems constraints, but reflects negatively on the generated power which becomes intermittent. This, however, may be balanced out by the high reversibility of these systems that allows using two or more systems with a suitable choice of the kite's orbits to filter the resulted generated power.

Furthermore, HAWE systems offer mobility and can be invested hugely as it works at a high altitude where strong wind could be present with little or no wind at low altitudes. Besides, they offer a very high adaptability, as their rated power, as well as, generation or consumption phases can be modified by changing the orbit the kite is following e.g. size, rotation and inclination, or changing the altitude. Notably, a kite-based system rated power can be adjusted by changing the kite surface. These adjustments are important to optimise the system's generated power for changing conditions and constraints on it, e.g. Wind speed and direction.

Cost-wise, HAWE systems economise the manufacturing, transportation and construction cost as compared to a wind turbine, e.g. they eliminate the turbine mast cost. Finally, a kite-based system backs down when it comes to the real-time control issue. That is due to the complexity of the system's behaviour, a matter that will not be a problem thanks to the rapid development in computer and information technology, allowing having fast and reliable real-time data processing.

## Advantages of High-Altitude Wind Energy (HAWE) systems over Turbines

The four major reasons why people

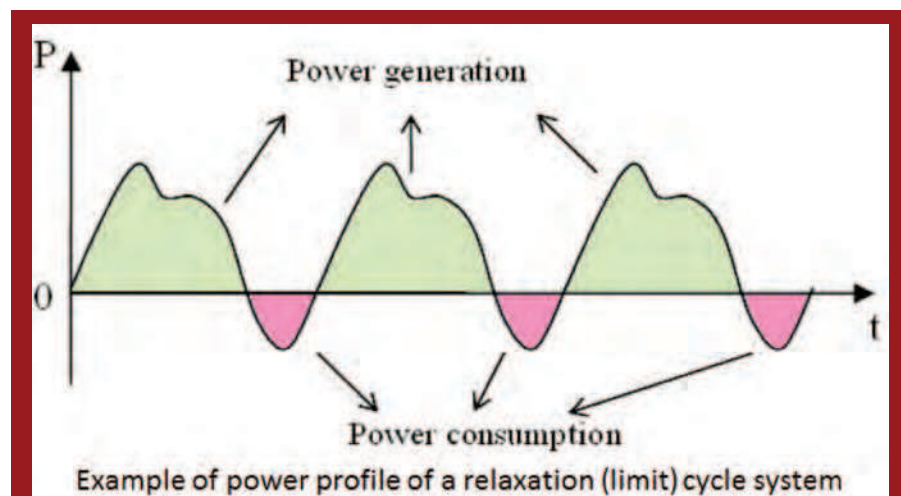


Figure 7: Example of power profile of a relaxation (limit) cycle system.

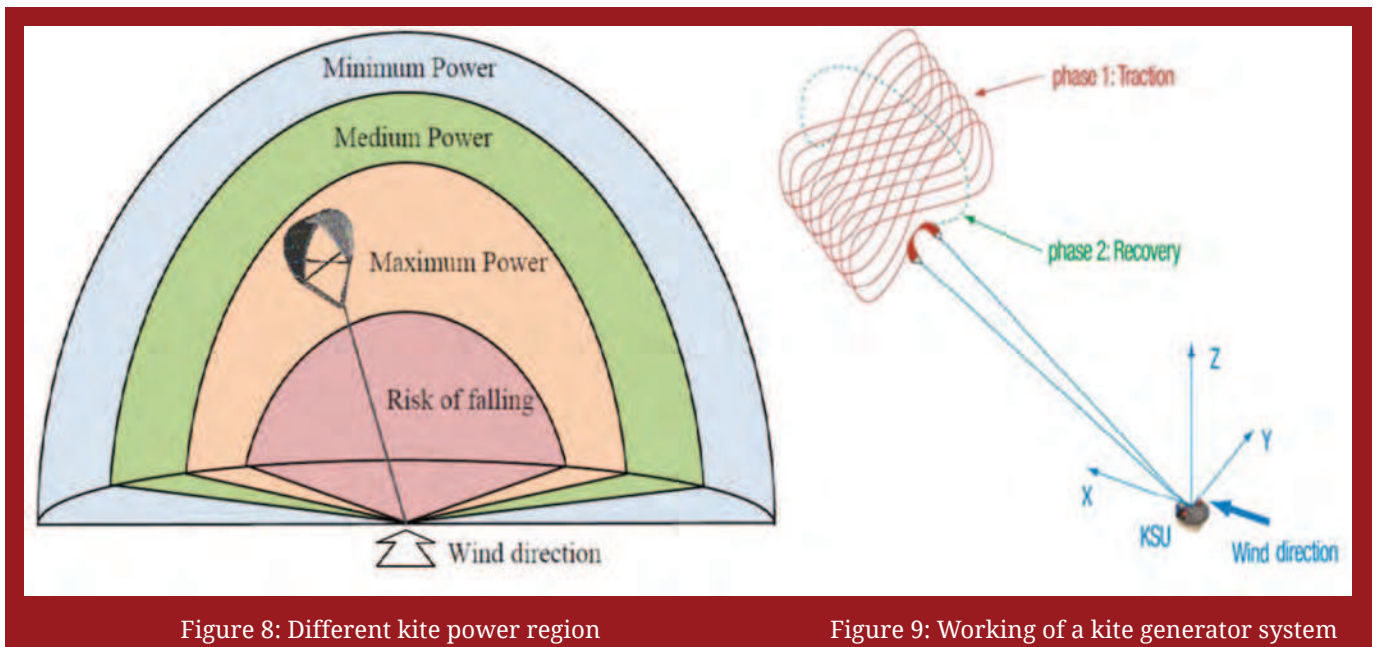


Figure 8: Different kite power region

Figure 9: Working of a kite generator system

are interested in airborne wind energy for electricity production are the following:

First, like solar, wind power is one of the few renewable energy resources that is in principle large enough to satisfy all of humanity's energy needs, and are available at night.

Second, in contrast to ground-based wind turbines, airborne wind energy devices might be able to reach higher altitudes, tapping into a large and so far unused wind power resource. The winds in higher altitudes are typically stronger and more consistent than those close to the ground, both on and off-shore.

Third, since the equipment are portable and lightweight, same equipment could be adopted for both on-shore and off-shore.

Fourth, airborne wind energy systems might need less material investment per unit of usable power than most other renewable energy sources. This high power-to-mass ratio promises to make large scale deployment of the technology possible at comparably low-costs. In fact,

the initial investment is ten times lower and the cost of maintenance is negligible when compared to conventional wind turbine.

The reasons are strong enough to force a developing country like India to invest in HWAE technologies.

### Challenges in adopting Tethered airfoils (Kites) generator system

The power electronic circuitry to act as an intermediate between the grid and the generator is easily available. But it is difficult to design a power electronic circuitry which will act as an intermediate between the generator and the Tethered airfoil (kite) because of the variations in speed. Further, it is difficult to design control mechanism for the orientation, curvature of the kite and the gearbox. Finally, the most difficult task is to control and optimise the trajectory of the kite. But the solution to the problem exists and is adopted by various organisations like Makani, Kitegen etc all over the world.

### Conclusion

KGS are being adopted worldwide; it is the future of the power industry. Since India is having huge wind energy potential, it should start focusing on the technology. As India's on-shore wind capacity remains underutilised and off-shore wind capacity is un-utilised, KGS provides an economical solution to the problem. This technology has the potential to pace up the growth of wind energy contribution to the whole world and it may outperform existing solar PV modules.

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NIT Kurukshetra

**Siddharth Singh,**  
Student, Pursuing MTech,  
NIT Kurukshetra

**ALL INDIA INSTALLED CAPACITY (IN MW) OF POWER STATIONS**  
(As on 31.03.2020)

Region	Ownership/ Sector	Mode wise breakup								Grand Total
		Thermal					Nuclear	Hydro	RES * NRE)	
		Coal	Lignite	Gas	Diesel	Total				
Northern Region	State	16659.00	250.00	2879.20	0.00	19788.20	0.00	5777.25	701.01	26266.46
	Private	22425.83	1080.00	558.00	0.00	24063.83	0.00	2817.00	15788.13	42668.96
	Central	14354.96	250.00	2344.06	0.00	16949.02	1620.00	11491.52	379.00	30439.54
	<b>Sub Total</b>	<b>53439.79</b>	<b>1580.00</b>	<b>5781.26</b>	<b>0.00</b>	<b>60801.05</b>	<b>1620.00</b>	<b>20085.77</b>	<b>16868.14</b>	<b>99374.96</b>
Western Region	State	21740.00	1040.00	2849.82	0.00	25629.82	0.00	5446.50	555.54	31631.86
	Private	32847.17	500.00	4676.00	0.00	38023.17	0.00	481.00	24652.05	63156.22
	Central	18347.95	0.00	3280.67	0.00	21628.62	1840.00	1695.00	666.30	25829.92
	<b>Sub Total</b>	<b>72935.12</b>	<b>1540.00</b>	<b>10806.49</b>	<b>0.00</b>	<b>85281.61</b>	<b>1840.00</b>	<b>7622.50</b>	<b>25873.89</b>	<b>120618.00</b>
Southern Region	State	19512.50	0.00	791.98	159.96	20464.44	0.00	11774.83	586.88	32826.15
	Private	12747.00	250.00	5340.24	273.70	18610.95	0.00	0.00	41277.52	59888.47
	Central	11835.02	3240.00	359.58	0.00	15434.60	3320.00	0.00	541.90	19296.50
	<b>Sub Total</b>	<b>44094.52</b>	<b>3490.00</b>	<b>6491.80</b>	<b>433.66</b>	<b>54509.99</b>	<b>3320.00</b>	<b>11774.83</b>	<b>42406.30</b>	<b>112011.12</b>
Eastern Region	State	7450.00	0.00	100.00	0.00	7550.00	0.00	3537.92	275.11	11363.03
	Private	6153.00	0.00	0.00	0.00	6153.00	0.00	96.00	1211.86	7460.86
	Central	13682.05	0.00	0.00	0.00	13682.05	0.00	1005.20	10.00	14697.25
	<b>Sub Total</b>	<b>27285.05</b>	<b>0.00</b>	<b>100.00</b>	<b>0.00</b>	<b>27385.05</b>	<b>0.00</b>	<b>4639.12</b>	<b>1496.97</b>	<b>33521.13</b>
North Eastern Region	State	0.00	0.00	497.71	36.00	533.71	0.00	422.00	233.25	1188.95
	Private	0.00	0.00	24.50	0.00	24.50	0.00	0.00	100.95	125.45
	Central	770.02	0.00	1253.60	0.00	2023.62	0.00	1155.00	30.00	3208.62
	<b>Sub Total</b>	<b>770.02</b>	<b>0.00</b>	<b>1775.81</b>	<b>36.00</b>	<b>2581.83</b>	<b>0.00</b>	<b>1577.00</b>	<b>364.20</b>	<b>4523.02</b>
Islands	State	0.00	0.00	0.00	40.05	40.05	0.00	0.00	5.25	45.30
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.84	7.84
	Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10	5.10
	<b>Sub Total</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>40.05</b>	<b>40.05</b>	<b>0.00</b>	<b>0.00</b>	<b>18.19</b>	<b>58.24</b>
ALL INDIA	State	65361.50	1290.00	7118.71	236.01	74006.21	0.00	26958.50	2357.03	103321.74
	Private	74173.00	1830.00	10598.74	273.70	86875.45	0.00	3394.00	83038.35	173307.79
	Central	58990.00	3490.00	7237.91	0.00	69717.91	6780.00	15346.72	1632.30	93476.93
	<b>Total</b>	<b>198524.50</b>	<b>6610.00</b>	<b>24955.36</b>	<b>509.71</b>	<b>230599.57</b>	<b>6780.00</b>	<b>45699.22</b>	<b>87027.68</b>	<b>370106.46</b>

Figures at decimal may not tally due to rounding off

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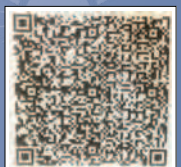
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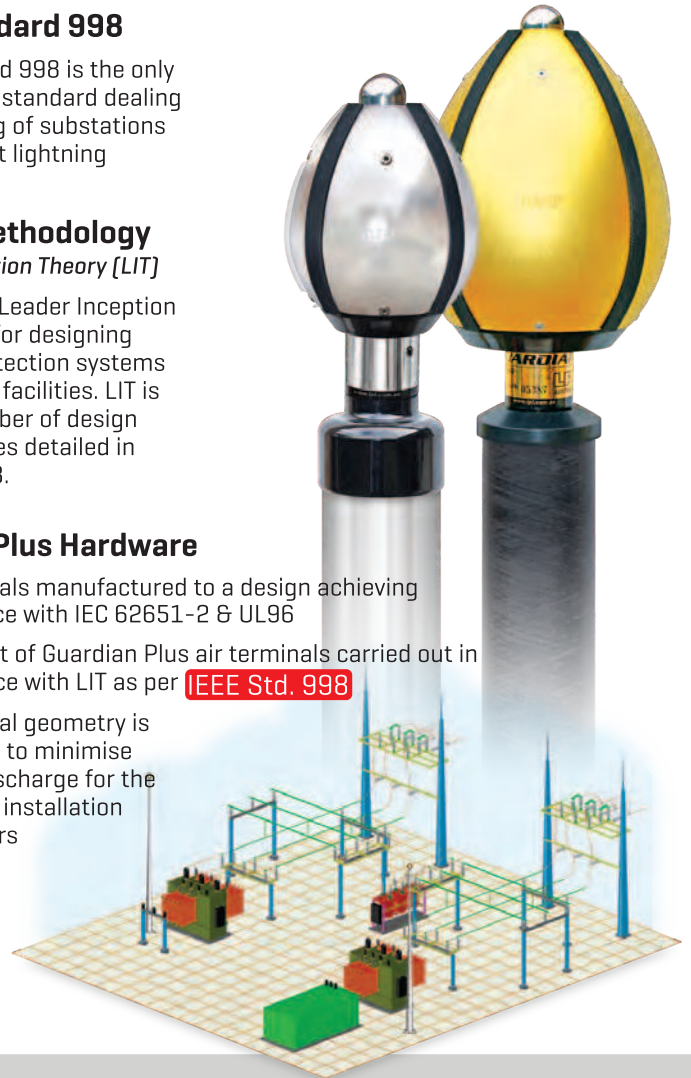
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# The perfect connection for a world of possibilities

## Polycab Cables

Besides powering India for over 50 years, Polycab cables and wires are being exported to over 40 countries. Polycab's multi-location, state-of-the-art manufacturing facilities ensure ready availability. Not just a wide range of cables and wires, Polycab boasts of rich gamut of electrical products and solutions to connect with global thought and endless possibilities.



Power & Control Cables: Low Voltage – up to 1.1 KV | Medium Voltage - 3.3 KV to 33 KV(UE) | Extra High Voltage – 66 KV to 220 KV | Instrumentation Cables: Individual & Overall Shielded | Railway Signalling Cables | Telecommunication: Optical Fiber Cables, Jelly Filled Telephone Cables | Solar AC/DC Cables | Specialty Cables: E-beam Irradiated Cables, Rubber Cables, Fire Survival Cables, Auto Cables, EV Cables, Cathodic Protection Cables, Marine Oil & Gas, Traffic Signaling, Aircraft, Submersible Cables | Other Cables: Overhead Conductors, Aerial Bunched Cables | Wires & LDC: Building Wires | Single/Multi Core Flexibles | Braided Cables | Welding Cables | Telephone Cables | Co-axial Cables | LAN Cables | Speaker Cables | CCTV Cables

Management System Certifications - BS OHSAS 18001: 2007, ISO 14001 : 2015, ISO 9001 : 2015 International Quality Standards Compliance - BASEC, UL, IEC etc. NABL Accredited Laboratory

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