

Since 1961

# Electrical India

India's oldest magazine on power and electrical products industry

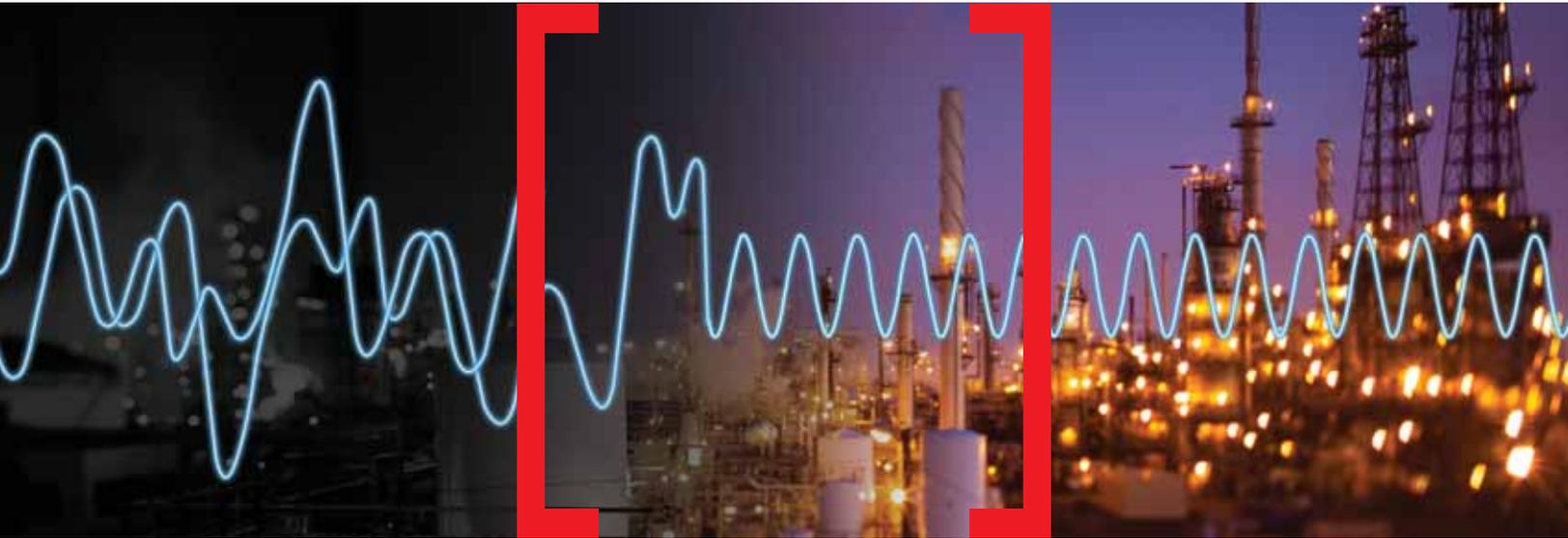


**Delta's 3.0MW-1000Vdc and 2.5MW-1500Vdc Solar Inverters, technologically advanced with guaranteed returns on investment.**

### Key Product Features

- Compatible with both Thin Film and Crystalline PV panels
- Outdoor inverter with Advanced Liquid Cooling System
- Does not require dedicated control room or container
- Plug and play design with internally drawn auxiliary power and inbuilt UPS
- Night time reactive power up to the inverter rated capacity
- Can deliver 10% extra power up to 40°C and full power up to 55°C
- Passive anti-PID for extended panel life
- HMI interface with data logging and cloud compliant

# Smart is In Better Power Quality Management



Power Capacitors      Capacitor Duty Contactors

Thyristor Switching Modules      APFC Controller

**Reactive Power Management Solutions**

Active Harmonic Filter

Detuned Harmonic Filter Reactor

**Harmonic Filtering Solutions**

L&T Electrical & Automation, India's leading switchgear solutions company, provides Power Quality Management Solutions that help industrial and infrastructural installations operate more cost-efficiently.

### Lower Bills. Higher Productivity.

Higher use of energy-saving devices leads to increased harmonics. This lowers productivity through overheating of equipment, electrical component failure and ultimately, expensive shutdowns, besides having an adverse impact on the power factor.

Our Active and Passive Harmonic Filtering Solutions help reduce harmonic distortions. Combined with our range of Reactive Power Management Solutions, they enhance the power factor and help reduce your electricity bills.

For more information on how our 'smart' Power Quality Management Solutions can ensure continuing productivity and profitability, visit [www.Lntebg.com](http://www.Lntebg.com)

### Customer Interaction Centre (CIC)

BSNL/MTNL (Toll free): 1800 233 5858    Reliance (Toll free): 1800 200 5858  
Tel: +91 22 6774 5858    Fax: +91 22 6774 5859    E-mail: [cic@Lntebg.com](mailto:cic@Lntebg.com)



Since 1961

# Electrical India

India's oldest magazine on power and electrical products industry



WE ARE **KNOWN** BY THE **COMPANY** WE **KEEP**.

**ANNUAL 2017**

Logos included: HAVELLS, LARSEN & TOUBRO, Finolex Cables Limited, FLIR, SIEMENS (Ingenuity for life), NPL (POWER OF TECHNOLOGY), ABB, Megger (Power on), FLUKE, GreatWhite Electricals, SCOPE, DELTA, RIELLO POWER SYSTEMS, NEXT GEN (INNOVATION), igus, GUPTA POWER (Making Light better in-India), RISHABH (R), MOTWANE, Underwriters Laboratories (UL), isa (we know how.), MERSEN, LEONI.

visit us at

**inter solar**  
 connecting solar business | INDIA  
 5th to 7th Dec 2017  
 BEC, Mumbai

**ELEC RAMA**  
 we are all about electricity  
 10th to 14th March 2018  
 NOIDA

*and many more...*

OUR CLIENTS **OUR STRENGTH**



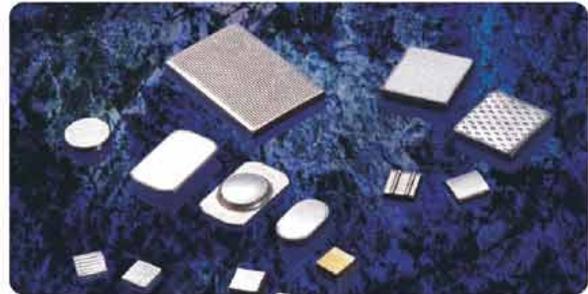
Scan the QR Code to know more about EI Website

# THE POWER OF SILVER CONTACTS

MAKING THINGS WORK, WITH THE RIGHT CONTACTS



## CONTACT ASSEMBLIES



## SILVER CONTACT TIPS (AgC, AgCdO, AgNi, etc.)



**CONTACT MATERIALS**  
PURE SILVER (Ag999)  
SILVER CADMIUM OXIDE (AgCdO)  
SILVER TIN OXIDE (AgSnO<sub>2</sub>)  
SILVER NICKEL (AgNi)  
SILVER GRAPHITE (AgC)  
SILVER COPPER (AgCu)

Visit us at –



**ELECRAMA**  
we are all about electricity  
Hall 2, Stall no. H2F3

**ELECTRACON  
PARADISE**  
LIMITED

A - 7, (G.F.) Mayapuri Industrial Area, Phase-2, New Delhi - 110 064 (INDIA)

+91 8800138383 • +91-11-28115275/5475 • +91-11-45017688

E-mail: sales@paradiseind.com • Website: www.electracon.in • www.paradiseind.com



# EMPOWERING HUMANITY BY ADDRESSING THE TOUGHEST CHALLENGES OF ENERGY DELIVERY

**///Sterlite Power**

[www.sterlitepower.com](http://www.sterlitepower.com)



Hello and welcome once again to *Electrical India*. Nothing moves without power. So the saying goes. But in an industrial world, in reality, that is a fact. And when the economy of a country of the size and population like India has to grow at around 7 to 8%, power is definitely one of the most crucial inputs of infrastructure. There is going to be an exponential demand for electricity in the country and it is expected to increase in the next few years, what with the government marketing its Make in India campaign vigorously.

At a time when the world is talking of containing pollution and saving the environment and rightly so, we will be doing massive addition to the installed capacity for generating more power to meet the ever-increasing demand for electricity. India's power sector is one of the most diversified in the world. We still depend to a large extent on thermal power and according to an analysis done by the Centre for Science and Environment coal-based power sector will continue to be a major violator of new emission norms, which were enacted by the government in 2015.

That said and done, electricity demand will continue to sustain the economy of a billion-plus strong country. We already have the fifth largest power generation capacity in the world and rank third globally in terms of electricity production. What is, however, going to be a significant factor is the effort by the government in increasing the solar power generation capacity. India is expected to have around 100 GW of solar power in the next five years.

However, to help the local solar panel manufacturers, the government might impose anti dumping duty on imported solar panels, mainly Chinese and Taiwanese, from where almost 90% are sourced. The world is importing from China not for any love for that country, but because it comes cheaper. The government should see that the cost of locally-manufactured solar panels is at par with the imported ones else the cost of setting up of solar power plants would be higher thus making the projects not viable. I must add here that of late there has been a lull in the country's solar industry. The already-struggling industry could be further hit by any such decision and this in-turn could hit the set target of achieving 100 GW in the next five years.

Hope you enjoy reading this voluminous issue as much as we have in bringing this to you. Should you have any suggestions or comments please send email at [miyer@charypublications.in](mailto:miyer@charypublications.in).

*Mahadevan*

**Publisher & Editor-in-Chief**

**Vol 57. Issue No. 11 • November 2017**

**Directors**

Pravita Iyer  
Mahadevan Iyer

**Publisher & Editor-in-Chief**

Mahadevan Iyer  
[miyer@charypublications.in](mailto:miyer@charypublications.in)

**Editorial Department**

**Associate Editor**

Supriya Oundhakar  
[editorial@charypublications.in](mailto:editorial@charypublications.in)

**Sub Editor**

Dhanya Nagasundaram  
[edit@charypublications.in](mailto:edit@charypublications.in)

**Editorial Co-ordinator**

Nafisa Kaisar  
[nafisa@charypublications.in](mailto:nafisa@charypublications.in)

**Advertising Department**

**Director Advertisement**

Pravita Iyer  
[pravita@charypublications.in](mailto:pravita@charypublications.in)

**Advertising Manager**

Yasmeen Kazi  
[yasmeen@electricalindia.in](mailto:yasmeen@electricalindia.in)

**Advertising Executive**

Nafisa Khan  
[adv@electricalindia.in](mailto:adv@electricalindia.in)

**Design**

Nilesh Nimkar  
[charydesign@charypublications.in](mailto:charydesign@charypublications.in)

**Subscription Department**

Priyanka Alugade  
[sub@charypublications.in](mailto:sub@charypublications.in)

**Accounts Department**

Dattakumar Barge  
[accounts@charypublications.in](mailto:accounts@charypublications.in)

Sonali Pugaonkar

[mktg@charypublications.in](mailto:mktg@charypublications.in)

**Digital Department**

Ronak Parekh

[dgmarketing@charypublications.in](mailto:dgmarketing@charypublications.in)

**Chary Publications Pvt. Ltd.**

906, The Corporate Park, Plot 14 & 15,  
Sector 18, Vashi, Navi Mumbai 400703  
Phone: 022 2777 7170 / 71

Single Issue: ₹ 100 / Annual Subscription: ₹ 1000

**Disclaimer**

Chary Publications does not take responsibility for claims made by advertisers relating to ownership, patents, and use of trademarks, copyrights and such other rights. While all efforts have been made to ensure the accuracy of the information in this magazine, opinions expressed and images are those of the authors, and do not necessarily reflect the views/ collection of the owner, publisher, editor or the editorial team. Chary Publications shall not be held responsible/ liable for any consequences; in the event, such claims are found - not to be true. All objections, disputes, differences, claims & proceedings are subject to Mumbai jurisdiction only.

Printed, Published and owned by Mahadevan Iyer from 906, The Corporate Park, Plot 14 & 15, Sector 18, Vashi, Navi Mumbai 400703 and Printed at Print Tech., C-18, Royal Indl Estate, Naigaum Cross Road, Wadala, Mumbai - 400 031. **Editor: Mahadevan Iyer**





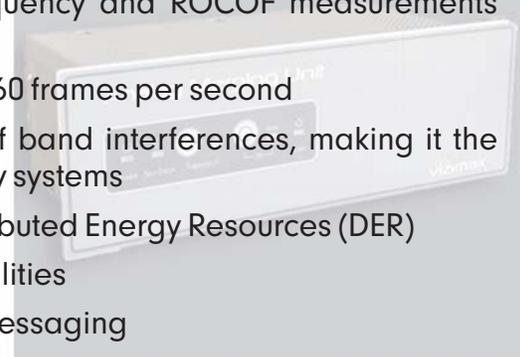
## Phasor Measurement Unit (PMU)

- **Fast, reliable and accurate** current and voltage phasors, frequency and ROCOF measurements exceeding C37.118 requirements for both M and P classes
- **P class accuracy** equals M class accuracy for reporting rate up to 60 frames per second
- **Highly resilient and reliable at rejecting harmonics** and out of band interferences, making it the ideal approach for microgrids, power islands or renewable energy systems
- **Outstanding performances in stressed power systems** and Distributed Energy Resources (DER)
- **Unique adaptive algorithms** allowing 3 phases & 1 phase capabilities
- **Complies with:** C37.118 (2005 and 2011) and IEC 61850 GOOSE messaging
- **Compact and rugged design**

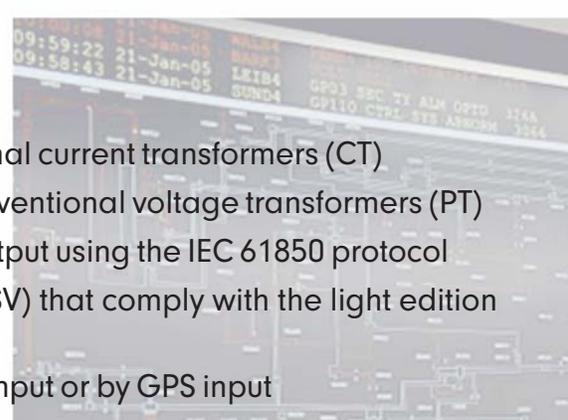
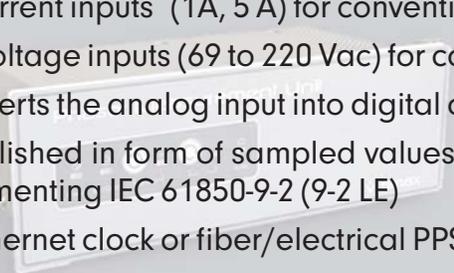
## Analog Merging Unit (AMU)

- **Current acquisition:** Four (4) current inputs (1A, 5 A) for conventional current transformers (CT)
- **Voltage acquisition:** Four (4) voltage inputs (69 to 220 Vac) for conventional voltage transformers (PT)
- **IEC 61850-9-2 conversion:** converts the analog input into digital output using the IEC 61850 protocol
- **Digital value publication:** Published in form of sampled values (SV) that comply with the light edition (LE) of the UCA guide for implementing IEC 61850-9-2 (9-2 LE)
- **Time synchronization:** 1588 Ethernet clock or fiber/electrical PPS input or by GPS input

## Analog Merging Unit - AMU



## Synchrophasor - PMU



### Corporate Office

402, Aurus Chamber, Annex - A, S. S. Amrutwar Marg, Worli, Mumbai 400 013, India  
Phone : +91 22 4344 4244 FAX : +91 22 4344 4242

e-mail: [marketing@scopetnm.com](mailto:marketing@scopetnm.com)  
Website: [www.scopetnm.com](http://www.scopetnm.com)





42

The sector is rightly poised to witness a strong growth subject to continued policy impetus. The tremors of the state's unilateral action could jeopardise the bankability of projects and could risk the 175GW renewable plan of federal government, if left unchecked...

## ARTICLES

42 Power Sector – A Glass Half Full  
– Siva Subramanian, Divya Charen

48 Prospects of Lighting Industry in India  
– Dr Prakash Barjatia

62 Sustainable Improvement  
– Chandan Mishra

74 Nuclear Energy & Challenge for India  
– Gopalkrishna Dhruvaraj Kamalapur

86 Indian Journey from Grids to Smart Grid  
– Dr. Anuradha Tomar, Anzar Hussain, Karan Sharma

94 Power Electronics for Energy Efficiency  
– Dr S S Verma

106 Challenges for India's Solar Energy Growth  
– Dr. Sarat Kumar Sahoo, Manu Rajesh Menon

126 Wind Power Development in India  
– Jeevan Kumar Jethani



48



86

## DEPARTMENTS

Publisher's Letter.....	06
News .....	12
Appointments .....	30
Awards .....	34
Market Watch.....	40
Pre Event Report - Intersolar India .....	195
Event Calender .....	199
Statistics.....	204
Product Avenue.....	208
Index to Advertisers.....	212



74

Visit Us at-



INDIA EXPO MART

10-14 March, 2018

Greater Noida, NCR, India

Stall No. H1aA41



Visit Us at-



INDIA EXPO MART

10-14 March, 2018

Greater Noida, NCR, India

Stall No. H1aD34



**apitz**  
high voltage equipment



- Impulse Voltage Generator
- Impulse Current Generator
- Mobile Impulse System
- Oil/Water Cable Termination



- Portable AC/DC Hipot
- Ultra High Voltage DC Test System
- High Current Circuit Breaker Test Systems
- Series/ Parallel Resonant Test System (Lab / Mobile)
- HV Cable Testing Solution
- Partial Discharge & RIV Measurement Equipment
- Motor Test System (Core Loss Tester)
- High Voltage Divider (100-500 KV AC/DC)



**ENERGY SUPPORT**

- Mobile GC Portable Gas Chromatograph (DGA Kit)
- Oil Sampling Kit
- SIGMA 2000 Interfacial Tensiometer
- TOP-TOGA GC
- TOP-TOGA Autosampler
- Pocket Titrator KF
- Tan Delta/ BDV- Oil
- Oil Acidity Tester

**Tekmeasure Technologies Pvt. Ltd.**

140, Bhagyashree Colony, Opp. Vijay Nagar Police Station,  
Indore-452010 (M.P.) Ph: 0731-6555601-02 Email -info@tekmeasure.org  
URL: www.tekmeasure.org

## ARTICLES

- 136** Technological Breakthrough for Insulators  
– Dr. Vikramaditya Dave, Er. Sujit Kumar
- 142** Challenges Ahead  
– Dr. P. B. Karandikar, Seema Mathew
- 152** Diagnosing Health of Smart Meters  
– Vithal Narasinha Kamat
- 162** Smart Switchgears for Smart Grid  
– Ashok Upadhyay
- 166** Challenges for IoT-based Smart Grid  
– Dr L Ashok Kumar
- 176** Vast Potential for Development  
– Jay B Thakar
- 180** Solar Energy Potential in Bihar  
– Saurabh Mishra
- 184** Power Scenario in Haryana  
– Sahil Bansal
- 188** Power Scenario in Tamil Nadu  
– Manisha Singh
- 188** Renewable Power Scenario in Jammu & Kashmir  
– Munazama Ali

## FEATURES

- ABB Technology Powers Mandela's Prison **56**
- Schmersal India Wins Award for Best SME in Machine Safety **72**
- Diagnostic Testing On Transformers **114**
- Visit Largest China Sourcing B2B Show in India **125**
- Diagnostic Testing On Transformers **114**
- DEIF Brings Revolutionary Solutions to Solar Sector **148**
- Lighting Concepts at Lii2018 **179**
- Displaying All Current Trends from Dec 5-7 **195**
- Thermography that is Smart & Networked! **200**
- Smart Technologies for a Better Tomorrow **202**

## INTERVIEWS



Dynamic navigation towards nurturing growth ensuring sustenance

**58**

**Ashish Mangal**

Managing Director,  
Dynamic Cables Ltd



"Concentrated efforts can certainly make India a major hub for renewable energy"

**68**

**G M Pillai**

IAS, Founder Director General, World Institute of Sustainable Energy (WISE)



"UL India can help renewable energy sector adapt to the highest standards"

**90**

**Suresh Sugavanam**

Vice President and Managing Director,  
UL South Asia



"We aim to maintain our leadership position in India"

**102**

**Prasanta Das**

Director-Marketing, Fluke Corporation



"EESL seeks to be a \$1.5 bn company by 2020"

**120**

**Saurabh Kumar**

Managing Director,  
Energy Efficiency Services Ltd (EESL)



"Targets have given a direction, but there is still a long way to go"

**196**

**Aruna Kumarankandath**

Programme Manager, Renewable Energy Programme, Centre for Science and Environment



---

# Integrating renewables to the Grid

The grid today is continuously evolving with a growing need for integration of renewable energy. Integrating green energy invites various new challenges, like grid stability and reactive power support to grid operators and power producers.

ABB's Power Consulting has global experience in integrating renewable power plants with grids, using advanced tools and detailed models to ensure that new grid connections are fully grid code compliant. With expertise knowledge of technologies, standards, and local grid codes, ABB's Power Consulting contribute in improving the performance for power plants and grids, worldwide. [new.abb.com/power-consulting](http://new.abb.com/power-consulting)

## AIIB Partners on New Investments for improvements

The Asian Infrastructure Investment Bank (AIIB) continues its collaborative approach to address the infrastructure gap in Asia by investing US\$150 million in the IFC's Emerging Asia Fund and co-financing a project with the Asian Development Bank (ADB) to improve energy connectivity in India by strengthening its power transmission system.



D. J. Pandian

Aligned with its commitment to promote cooperation and partnership with other multilateral development institutions, AIIB will become one of the major investors in the IFC Emerging Asia Fund. This fund will have positive economic impacts on emerging markets by promoting job creation through the

availability of capital and expertise.

The fund, managed by the IFC Asset Management Company, will among other things, help promote the private equity asset class in emerging markets.

D.J. Pandian, Vice President and Chief Investment Officer, AIIB, said, "To mobilise sufficient funds to address the huge infrastructure needs across Asia, multilateral development institutions must collaborate

with each other and a range of other partners. We will continue to welcome opportunities to combine our investments and talent with other international financial institutions to drive positive economic outcomes for people in the region." 

## NTPC Unchahar creates National Record

NTPC Unchahar has set a National Record with 686 days of continuous generation by its 210 MW Unit-I surpassing APL Mundra achievement. Unchahar is located at Rae Bareilly district of Uttar Pradesh with an installed capacity of 1060 MW which includes 10 MW Solar.

NTPC is the largest power utility company in India with a total installed capacity of 51708 MW (including 7,216 MW through JVs/Subsidiaries) comprising of 48 NTPC Stations (20 Coal based stations, 7 combined cycle gas/liquid fuel based stations, 1 Hydro based station), 9 Joint Venture stations (8 coal based and



one gas based) and 12 renewable energy projects.

The Company has presence in Coal, Gas, Solar PV, Hydro and Wind Power Generation and Coal Mining. 

## PM launches Pradhan Mantri Sahaj Bijli Har Ghar Yojana 'Saubhagya'

The Prime Minister Narendra Modi has launched a new scheme Pradhan Mantri Sahaj Bijli Har Ghar Yojana - 'Saubhagya' to ensure electrification of all willing households in the country in rural as well as urban areas.

The total outlay of the project is Rs. 16,320 crore while the Gross Budgetary Support (GBS) is Rs. 12,320 crore. The outlay for the rural households is Rs. 14,025 crore while the GBS is Rs. 10,587.50 crore. For the urban households the outlay is Rs. 2,295 crore while GBS is Rs. 1,732.50 crore. The Government of India will provide largely funds for the Scheme to all States/UTs.

The States and Union Territories are required to

complete the works of household electrification by the 31st of December 2018.

The beneficiaries for free electricity connections would be identified using Socio Economic and Caste Census (SECC) 2011 data. However, un-electrified households not covered under the SECC data would also be provided electricity connections under the scheme on payment of Rs. 500 which shall be recovered by DISCOMs in 10 instalments through electricity bill.

The solar power packs of 200 to 300 Wp with battery bank for un-electrified households located in remote and inaccessible areas, comprises of Five LED lights, One DC fan, One DC power plug. 



## Reliable Power for a Sustainable World.



**Riello UPS win**  
**New Product Innovation Award 2015**  
**FROST & SULLIVAN**

### Global Leaders in Uninterruptible Power Supply Systems

**Riello: 1st European manufacturer to rate its product for Eco-Energy Level efficiency**

- Riello is one of largest manufacturer of UPS System
- Complete range from 1kVA - 6400 kVA
- Riello Power India has delivered over 10000 successful installations in India & Indian subcontinent
- Technical Support Team at your service 365 days 24 x 7
- PAN India presence with offices in all major cities

**When it comes to expertise in Uninterrupted Power supplies Riello Power India has it all**

- IGBT Rectifier / IGBT Inverter with built in galvanic isolation transformer
- Advanced Battery Management
- Very Low Total Harmonic Distortion (THDi < 3%)
- High Input Power Factor > 0.99
- High Output 0.9 (High Watt)
- Overall efficiency upto 95%

**Riello Power India Pvt. Ltd.**  
(A 100% Subsidiary of RPS S.p.A., Italy. Formerly known as Riello PCI India Pvt. Ltd.)



318, 3rd Floor, Time Tower, MG Road, Gurgaon, Haryana – 122002  
 Tel: +91-124-4727134 • Mob:07838552211 • Email: ups@riello-power.com • Web: www.riello-ups.in

## EESL to procure 10,000 Electric Vehicles from TATA Motors

**E**nergy Efficiency Services Limited (EESL), under the administration of Ministry of Power, Government of India (GoI), will procure 10,000 electric vehicles from Tata Motors Limited. The company was selected through an international competitive bidding aimed at increased participation. Tata Motors won the tender and will now supply the Electric Vehicles (EVs) in two phases – first 500 e-cars will be supplied to EESL in November 2017 and the rest 9,500 EVs will be delivered in the second phase.

The tender floated by EESL is the world's largest



single electric vehicle procurement. Three leading manufacturers – Tata Motors Limited, Mahindra & Mahindra (M&M) and Nissan participated in the tender and the bids for TATA Motors Limited and Mahindra and Mahindra (M&M) were opened.

EESL is driven by the objective of facilitating faster adoption of disruptive technology solutions while balancing economic development and environmental sustainability. With this specific initiative EESL seeks to create the market for electric vehicles, a technology which is poised to boost e-mobility in the country. 

## Power Minister reviews the Power Sector Development in J&K

**U**nion Minister of State (IC) for Power and New & Renewable Energy, R. K. Singh reviewed power sector development in the State of Jammu & Kashmir in Srinagar. The senior functionaries from Ministry of Power, Government of India, Central Power Sector Undertakings (CPSUs) and key officials of Government of Jammu & Kashmir were also present during the review meeting.

During the review, Singh reiterated the commitment of Government of India to provide uninterrupted



**R. K. Singh**  
Power and New & Renewable Energy

reliable power supply to all the citizens of the country including Jammu & Kashmir and advised all concerned to ensure electrification of remaining 100 census villages by December 2017. These villages exist in remote areas with difficult hilly terrain in the districts of Kishtwar, Kupwara, Reasi, Bandipore, Leh, Kargil & Rajauri. Electrification of these villages would ensure electricity access to 100%

census villages of the State and catalyse desired improvement in the quality of life of people of the State. 

## India gets Lowest Wind Tariff of Rs. 2.64 per kWh

**T**he wind tariff in India touched lowest level of Rs.2.64 per kWh in the second wind auction conducted by the Solar Energy Corporation of India (SECI) on behalf of Ministry of New & Renewable Energy, Government of India. The tariff discovered is much lower than first wind auction concluded at Rs. 3.46 per kWh in February this year. With improving technology and reducing tariffs Ministry is not only confident of achieving the target of 175 GW by 2022 but exceeding it.

Against the 1000 MW capacity SECI received 12 number of bids totalling to 2892 MW capacity of which 9 bids with a cumulative capacity of 2142 MW

were shortlisted for e-reverse auction. The auction started at 3 pm on 4 October and continued for over 13 hours.

Five winners selected for total 1000 MW capacity wind power projects include ReNew Power for 250 MW projects quoting Rs.2.64/kWh, Orange Sironj for 200 MW projects quoting Rs.2.64/kWh, Inox Wind for 250 MW projects quoting Rs.2.65/kWh, Green Infra for 250 MW projects quoting Rs.2.65/kWh and Adani Green for 50 MW projects quoting Rs.2.65/kWh. These wind projects are to be commissioned within 18 months from the date of issue of Letter of Award by SECI to successful bidders. 



**GreatWhite**<sup>®</sup>  
THE FUTURE OF BRIGHT

HAR  
DESIGN  
MEIN  
**WOW**

Add a futuristic look to your living spaces with beautifully designed titanium color switches & accessories. Experience our elegant accented switches, perfectly encapsulated in a flawless glass plate - adorned with a stylish chrome bezel. Sure to make you go wow.



**myrah**<sup>®</sup>

IMAGINATION UNLIMITED

## Tech Mahindra and Power Ledger unite to unleash the power of MaaS

**T**ech Mahindra, a well known provider of digital transformation, consulting and business reengineering services, and Power Ledger, a blockchain-based peer-to-peer electricity trading platform provider have announced a series of technology trials that aim at bringing the benefits of energy microgrid developments to India's booming urban population, through Microgrid-as-a-Service (MaaS).



Atul Kunwar

Incubated by Tech Mahindra, Microgrid-as-a-Service or MaaS is an integrated platform which helps in creating a disruptive model in the electricity market by enabling building owners, campuses, smart cities

and communities to produce and manage their own electricity affordably and even trade in case of excess generation. During the trials, the partners will deploy Tech Mahindra's MaaS platform integrated with Power Ledger's blockchain-enabled energy trading capability at the test sites in India.

Atul Kunwar, President and CTO, Tech Mahindra, said, "Tech Mahindra's belief in its internal start-up to bring digital disruptions

to different industries is proved by the success of MaaS in the energy industry. This disruptive technology will provide a model for energy service provision for thousands of communities across India. "

## TERI enters into sustainability partnership

**A** Memorandum of Understanding (MoU) was signed between the Capital Region Development Authority of Andhra Pradesh (APCRDA), State Energy Efficiency Development Corporation of Andhra Pradesh (APSEEDCO) and The Energy and Resources Institute (TERI) for implementation of Green Buildings and Sustainable Habitat at the upcoming new capital township of Amaravati. The MoU was signed by Dr. Sreedhar Cherukuri, Commissioner, APCRDA, A. Chandra Sekhara Reddy, APSEEDCO and Dr. Ajay Mathur, Director General, TERI in the presence of N. Chandrababu Naidu, Hon'ble Chief Minister of Andhra Pradesh.

Amaravati, the People's capital of Andhra Pradesh, is envisioned to be a city of world-class standards with a vision of increasing Andhra Pradesh's prominence in the world. The new capital township aims to provide cutting edge, sustainable & smart urban infrastructure, comfortable livelihood and immense prosperity for the people of Amaravati.

TERI shall support APCRDA in design of upcoming new buildings and infrastructure at Amaravati as green buildings and sustainable habitats. In addition, TERI will also provide technical assistance to APCRDA in all aspects of sustainable urban and infrastructure development.

## Ministries help overcome temporary crisis

**P**ress reports have highlighted the issue of the rise in price of power on the Power Exchange on 16th October 2017 to Rs 10.8 per unit. Power Prices on IEX on 17th October 2017 on an average for the day was Rs. 5.45 per unit, and maximum prices were Rs 10.80 only for half an hour from 6.30 PM to 7.00 PM. The prices on 18th Oct 2017 has dropped to average for the day of Rs 4.33 per unit.

It also needs to be noted that the volume of power being traded in the market is to the tune of about 150 Million Units (MU) per day against the total generation of around 3750 MU per day (which is around 4%). Discoms are largely meeting their demand through

long term / Medium term contracts and the impact of the current spike in the exchange price is marginal.

R K Singh, Minister of State (IC) for Power and Piyush Goyal, Minister of Railways and Coal jointly reviewed the status and also spoke to concerned States, which have requested for enhanced supply of coal. They also noted that supply to States like Maharashtra, has improved and efforts will be made to improve the coal stock in all the power stations with low stocks. It was also agreed that issues with some DVC power plants which are affected due to closure of Dhanbad – Chandrapura railway line would be resolved expeditiously.

**TRAX**

# all-in-1\*

## TRANSFORMER & SUBSTATION TESTING SYSTEM

*Saves time. Saves effort. Saves money.*



With transformers accounting for up to 60% of the value of the equipment installed in substations, knowledge of their technical health and performance assumes significance. Meet **TRAX**, the multi-functional test system that replaces numerous individual testing instruments thereby serving as a complete and cost-effective solution in transformer testing. By simplifying testing not only does it speed up the process, it also enables cost-reductions by freeing up skilled man hours for other tasks.



**TRAX** provides up to 800 A and 2200 V test signals (2000 A and 12 kV with accessories) with a frequency range adjustable from 5 to 500 Hz (1 - 500 Hz for insulation testing). Delivering the most comprehensive picture of transformer health, the tests measurements can be organized and reported as separate tests or as a combined full set of test results. Highly user-friendly, TRAX can be used with an integrated touch screen or external computer device.



Megger is the electrical test industry leader, a position that comes from continually designing world class products. The range of test systems and **TRAX** is brought to you by PCI, the company that has earned the reputation for bringing the finest of global technologies to India for over 30 years now.

- Winding resistance ● Demagnetization ● Load tap-changer (OLTC) continuity and dynamic resistance ● Turns ratio ● Excitation current ● Short-circuit impedance (Leakage Reactance)
- FRSL (frequency response of stray losses) ● Optional switchbox for one-time 3-phase connection ● Magnetic balance ● CT testing ● VT testing ● Voltage withstand ● Circuit breaker
- Single-phase relay ● Ground/ earth/ impedance ● Tan delta/ power factor and capacitance

\* To learn how TRAX can empower your Transformer Asset Management Plan & operational efficiency just us a call.



## **PCI LTD.** POWER & ENERGY DIVISION

**CORPORATE OFFICE:** Prime Tower, 287 - 288 Udyog Vihar, Phase II, Gurgaon 122 016  
INDIA Tel: 91 124 4111999 (30 lines), 91 124 6656999 (30 lines) Fax: 91 124 4871698 - 99  
E-mail: [info@prime-pci.com](mailto:info@prime-pci.com) Web: [www.primegroupindia.com](http://www.primegroupindia.com)

**BRANCH OFFICES:** | Delhi | Mumbai | Hyderabad | Bangalore | Chennai | Kolkata  
| Bhubhaneshwar | Cochin | Ahmedabad | Gurgaon

**Megger.**  
Power on

PCI offers  
state-of-the-art  
equipments for

ELECTRICAL TESTING & MEASUREMENT ● VIBRATION CONDITION MONITORING ● PREDICTIVE & PREVENTIVE MAINTENANCE  
● THERMAL IMAGING ● PARTIAL DISCHARGE MEASURING ● CABLE FAULT LOCATORS ● ONLINE DGA & MOISTURE MANAGEMENT  
SYSTEMS ● EMERGENCY RESTORATION SYSTEMS ● METERS & POWER QUALITY ANALYZERS ● POWER CONDITIONING SYSTEMS

## Azure Power to Electrify Ministry of Health & Family Welfare

Azure Power, a well known independent solar power producer in India, revealed that it has won a 1.3 MW solar rooftop project in an auction conducted by NTPC Vidyut Vyapar Nigam (NVVN), a wholly owned subsidiary of the National Thermal Power Corporation (NTPC). Azure Power will provide power for 25 years to Ministry of Health and Family Welfare, Government of India facilities in the states and union territories of Delhi, Puducherry, Uttar Pradesh, West Bengal and Assam. The power will be sold at a tariff range of INR 3.19 – 4.11 (~US\$ 0.05- 0.06) per kWh based on location.



Inderpreet Wadhwa

Inderpreet Wadhwa, Founder, Chairman and Chief Executive Officer, Azure Power, said, "Azure Roof Power offers tremendous value to our customers across various segments. We are pleased to announce our latest win with NVVN to electrify Ministry of Health and Family Welfare facilities across five states. With this win, we have once again demonstrated our strong project development capabilities and are delighted

to make this contribution towards the realisation of our Hon'ble Prime Minister's commitment towards clean and green energy, through solar power generation." 

## Eaton inaugurates state-of-the-art innovation centre in Pune

Power management company Eaton revealed the inauguration of its India Innovation Centre at Magarpatta City in Pune. The new Eaton India Innovation Centre (EIIIC) is a strategic program that is focused on enhancing organisational capabilities by leveraging high-end engineering talent and best-in-class infrastructure. Eaton's chairman and CEO, Craig Arnold and Ram Ramakrishnan, executive vice president & chief technology officer, Eaton, were present during the inauguration.

The new EIIIC is a vertically integrated engineering organization that will deliver complete product design lifecycle management solutions for Eaton's global



Craig Arnold, chairman and CEO, Eaton inaugurating the Eaton India Innovation Centre in Pune

businesses. The innovation centre currently employs more than 1500 engineers. Sudhakar Potukuchi, vice president – Technology, heads the EIIIC. 

## Inox Wind maintains successful track record

Inox Wind Limited, one of India's well known wind energy solution providers, has won 250MW in the SECI-II auction representing a 25% market share. The bid was won at a fixed price of Rs2.65/unit for 25 years. This win is on back of the 300MW order win from the SECI-I auction held earlier in the year. This win enhances our auction based order book to 550MW.

Inox wind would be developing the SECI-II project in the Kutch region in the state of Gujarat. The project would be executed over the next 12 months. Kailash Tarachandani, Chief Executive Officer of Inox Wind Limited, said, "We are delighted with



Kailash Tarachandani

winning 250MW in the SECI-II auction. This win solidifies our belief that Inox Wind would be a major beneficiary in the auction based market regime, due to its inherent cost-competitive advantage which allows us to execute these projects on a profitable basis.

We would continue to build our order book and gain significant market share in the auction regime on back of future SECI & State auctions. We will begin a new phase of robust growth for the wind industry critical for reaching the 60 GW wind power capacity goal by 2022 for the country." 

# A NEW LINK BETWEEN PV & GENSET POWER PLANTS

DEIF has a strong track record in developing emergency, standby and backup power solutions for mission-critical facilities and businesses.

Designed to serve as a link between photovoltaic (PV) power plants and genset power plants, DEIF's Automatic Sustainable Controller (ASC Plant Management) is an automated, safe and reliable control solution for PV/genset hybrid plants.

The ASC Plant Management solution is suitable for stand-alone applications with or without DEIF controllers and for power management applications equipped with DEIF's AGC Plant Management Controllers. It supports numerous communication protocols for inverter interfacing, including the widely used SunSpec protocol.



## UNIQUE CONTROL SOLUTION FOR PV/GENSET HYBRID PLANTS

- Simple graphical configuration
- Maximised PV penetration
- Minimum genset load requirement
- Spinning reserve demand
- Monitoring and supervision
- Record-time commissioning with DEIF Emulation

**SPECIALIST POWER CONTROL SOLUTIONS.**



The DEIF Group: Sales, Training & Competence Centres in 16 Key Markets.

DEIF India Pvt. Ltd., 602, Town Centre II, Andheri, Kurla Road, Sakinaka Andheri (East), Mumbai 400 059 MH, India  
Tel.: (+91) 22 4245 2000, Fax: (+91) 22 4245 2020, india@deif.com, www.deif.com

## L&T bids lowest for EESL's tender for Smart Meters

Larson & Toubro (L&T) has emerged as the lowest bidder of the tender issued by Energy Efficiency Services Limited (EESL) to procure 50 Lakh smart meters. The company has been selected through an international competitive bidding. The meters will be installed over a period of 3 years in a phased manner in Uttar Pradesh (UP) and Haryana. L&T quoted the lowest price of Rs. 2722, per single phase smart meter.

The tender floated by EESL, a company under the administrative control of Ministry of Power, Government of India (GoI), is the world's largest single Smart Meter procurement. Fourteen leading

manufacturers from around the world participated in the tender. 40 lakh smart meters will be deployed in UP and the remaining 10 lakh in Haryana. The price quoted by L&T is 40-50% lower than the current market rates.

Smart meters are a part of the overall Advanced Metering Infrastructure Solutions (AMI) aimed at better demand response designed to reduce energy consumption during peak hours. The overall AMI solution will also have a system integrator who will be responsible for meter installation, data storage on cloud, preparing dashboards, etc. The bids for the system integrator will open on October 31, 2017. 

## Mahindra Susten launches India's first Mobile PV Testing Lab

Mahindra Susten, one of India's largest and most trusted solar EPC Company, has revealed the launch of India's first Mobile PV laboratory for testing of the Solar PV modules on site. The mobile PV lab, developed in-house, has an innovative design, which combines all the key tests required for PV modules in a compact lab. This solution will make world-class testing facilities available to solar asset developers, EPCs and the O&M operators at the location of their own plant.



India's First Mobile PV Testing Lab Designed inhouse by Mahindra Susten

(Provisional patent No. 201721017370)

Basant Jain, CEO, Mahindra Susten, said, "We at Mahindra Susten, are key endorsers of Government of India's vision to transform India's energy mix and to make it independent of fossil fuels not just in terms of MW Capacity installed but more in terms of contribution

in the MW-hours generated. In our quest to help the nation get more out of their PV assets and adding to India's power generation, we have invested in India's first ever mobile PV testing laboratory". 

## ReNew Power launches ReNew Centre of Excellence

ReNew Power, India's leading renewable energy company, today announced the launch of the 'Sumant Sinha ReNew Centre of Excellence (CoE) for Energy & Environment' at the Indian Institute of Technology (IIT), Delhi. The CoE was inaugurated by Sri Prakash Javadekar, Hon'ble Union Minister for Human Resource Development, Government of India.



Sumant Sinha

members & students of IIT Delhi.

Sumant Sinha, Chairman & CEO, ReNew Power, said, "We, at ReNew Power, are delighted to be partnering the Indian Institute of Technology (IIT), Delhi and I consider myself fortunate to start this initiative in my alma mater. I would like to thank the IIT team for their support and collaboration in setting up this Centre of Excellence. We are confident that this

partnership will facilitate innovative research and help develop leading edge clean energy solutions to preserve the Earth for future generations." 



DILO. Sustainably tight.

## Advanced Gas Management for GIS / GIL / GIT



### DILO Gas Handling

## Zero emissions and maximum gas re-use

Technology and environment in harmony is the clear commitment of DILO towards staff, customers and partners all over the world. Our philosophy is based on "Zero Emission" and "Maximum Gas Re-use" in a fully integrated cycle.

Our ambitions, strategies and the courage to design innovative products have turned DILO into the world's leading brand in SF<sub>6</sub> gas handling during the past 50 years.

Driven by quality, innovation and responsibility towards the environment we put all our energy in SF<sub>6</sub> technology and handling alternative gases with the aim of a sustainable environmental protection. This demand for ecological responsibility is also guaranteed by our product strategy with in-house production and quality "Made in Germany".

**DILO. Advanced and sustainable gas handling.**



#### You benefit from:

- High-end German manufacture
- Highest product quality, efficiency and reliability
- Complete range of emission-free SF<sub>6</sub> gas handling
- In-house manufacture of oil-free and gas-tight compressors
- Specialists with more than 50 years of experience



#### NEW AGENT AND LOCAL SERVICE CENTER

Super Phoenix (India) LLP  
Evershines Millennium Paradise, Building No 6, Flat No 101,  
Thakur Village, Kandivali (E),  
IN - 400101 Mumbai

Tel. +91-90 08 46 07 51

E-Mail [info@superphoenixllp.com](mailto:info@superphoenixllp.com)



DILO Armaturen und Anlagen GmbH  
Frundsbergstrasse 36 | D-87727 Babenhausen  
Tel: +49 (0) 83 33 - 302-0 | Fax: +49 (0) 83 33 - 302-52  
E-Mail: [info@dilo-gmbh.com](mailto:info@dilo-gmbh.com) | [www.dilo-gmbh.com](http://www.dilo-gmbh.com)

## Schneider Electric introduces security management solution

Schneider Electric, well known in digital transformation of energy management and automation, introduced EcoStruxure Security Expert, a new integrated security management solution that provides high performance access control and intrusion detection functionality to ensure the most secure building environment possible.



Puneet Dhiman

EcoStruxure Security Expert is the latest addition to Schneider Electric's EcoStruxure, its IoT-enabled, plug-and-play, open architecture, which delivers end-to-end solutions in six domains of expertise - Power, IT, Building, Machine, Plant and Grid.

Puneet Dhiman, Global Director, Security Offer Management, Schneider Electric, said, "Security Expert marks an evolution of intelligent building integration that aligns security and IT for enhanced building efficiency and performance. By bringing together previously disjointed building and security systems, facility managers and security personnel can work more effectively, better manage emergency situations and glean insights that lead to improved building efficiency. We are committed to providing our customers with the world's most open and innovative security solutions to help make more informed decisions and ultimately drive savings." 

## Tata Power signs MoU with CBIP to bridge the skill-gap in power sector

Tata Power, India's well known integrated power company, revealed that the Company has signed an Memorandum of Understanding (MoU) with Central Board of Irrigation & Power (CBIP) to co-create, develop, and impart training and skill-development courses to the youth as well as employees of the power sector.



MoU signing ceremony

As per the MoU, CBIP will provide access to Tata Power to their vast library of Periodicals, Technical Information &

Database, Information on technological developments, and state-of-the-art technologies. Tata Power, in return, will provide guidance to CBIP in setting up labs and other required infrastructure for up gradation of the COE.

Both the parties, per the business scenario and need analysis, will prepare an Annual training calendar & Plan, and employees would be nominated for these trainings as per individual need. 

## Wärtsilä to offer Energy Storage Solutions in India

The technology group Wärtsilä, a well known global supplier of flexible and efficient energy solutions, will offer technically and environmentally advanced energy storage solutions to the power markets in India. Following the acquisition, in May 2017, of Greensmith Energy Management Systems Inc., a market leader in grid-scale energy storage software and integrated solutions, Wärtsilä Energy Solutions has become a leading global system integrator, providing both stand-alone energy storage as well as hybridised energy systems, control software and integration expertise.



Neeraj Sharma

Neeraj Sharma, President & Managing Director, Wärtsilä India, said, "Wärtsilä energy storage solutions will significantly improve efficiency by increasing back-up capacity and creating new opportunities in electricity markets. Energy storage has become an integral part of every power system, with features like frequency support and reserves, peak demand management, demand charge reduction (C&I) and energy shifting. Customer benefits include peak demand management, demand charge reduction (C&I), electricity market opportunities and back-up capacity." 

## SWITCH TO COMFORTABLE AND GLARELESS LIGHTING SOLUTIONS.



### Be SMART To Choose



Surge Protection



Low Glare



Consistent Light Output



Wide Voltage Range



Uniform Lighting



Better Heat Dissipation



Fire Resistance



**Anchor Electricals Pvt. Ltd.**

A member of the Panasonic Group

3rd Floor, B Wing, I-Think Techno Campus, Pokhran Road No 2, Thane (West), Thane - 400 607. Maharashtra

T: (9122) 30418888 | F: (9122) 30418884/5/6/7 | Email: ledlighting@anchor-world.com | For more information visit : [panasonic.net/ecosolutions/](http://panasonic.net/ecosolutions/)

## The Abraaj Group and ENGIE to develop a Wind Power Platform

The Abraaj Group, a well known investor operating in growth markets, and ENGIE, a popular multinational utility company and the largest global independent power producer, revealed a partnership to build a wind platform in India (the 'Platform').

Together, Abraaj and ENGIE have identified a robust pipeline of wind power projects representing over 1 GW in several key states. By leveraging Abraaj's clean energy sector expertise and ENGIE's operational experience, the partnership will address a large and growing demand for clean energy from the Indian Government as well



Saad Zaman

as businesses in the country.

Saad Zaman, Partner at The Abraaj Group, said, "The Indian renewables sector has seen strong growth in recent times and we expect demand for power across the country will continue to increase. In line with our commitment to addressing the Sustainable Development Goals, our partnership with ENGIE marks Abraaj's second investment in the clean energy

sector in India.

Buoyed by a strong regulatory framework, the renewables sector is a significant long-term, sustainable investment opportunity for Abraaj." 

## Dubai to get Solar Power Day and Night without subsidy at Lower Cost

An ACWA Power led consortium has been awarded the fourth phase of the Mohammed Bin Rashid Al Maktoum Solar Park, by far the largest single-site CSP plant in the world, which will provide reliable and dispatchable electricity to the emirate during the day and throughout the night just as a fossil fuel power plant does. With a capacity of 700 MW, the project has set a new global record for the lowest levelised cost for renewable base load electricity at USD 7.3 cents per kilowatt hour in an IPP tender without the benefit of any



subsidy including any carbon credit.

This plant which will be commissioned in stages with the first phase set for end of Q4 2020 will cover 3,750 hectares, the equivalent of more than 4,500 football fields mostly covered with mirrors concentrating the sunrays,

and will feature a combination of a tower and a field of troughs, which will all collect heat and store that heat in molten salt medium to supply electricity on demand at all hours of the day and night, even when the sun is not shining. 

## Adani signs PPA for Rugby Run

Diversified infrastructure and energy company, Adani, has taken a significant step forward to realise its strategy to become Australia's largest renewable energy producer by 2022.

Adani Chairman, Gautam Adani, revealed that Adani Renewables has signed a Power Purchase Agreement (PPA) with a significant power retailer.

The PPA covers electricity generated by Adani Renewables' solar plant at Rugby Run, near the central western Queensland town of Moranbah. Adani said Adani Renewables plans to have a number of renewable energy generation projects in Australia with a total capacity of 1,500MW within the next five years.

Adani Renewables CEO, Dr Jennifer Purdie, said the

PPA was a significant step forward for the Rugby Run Solar Plant which recently was given Development Approval by the Isaac Regional Council.

The PPA will remain in place until June 30, 2030. Construction of Phase One is scheduled to start this month with completion due in October 2018. Preparatory work, including Cultural Heritage surveys and engineering design, had commenced with orders for critical equipment now being secured. The 65 MW first stage of Rugby Run Solar Farm - to be built on a 600-hectare block that was part of the Rugby Run grazing property - is expected to use the latest mono-PERC technology and single axis tracking systems developed to improve efficiency and output. 



Smart solutions.  
Strong relationships.



# A wide range of energy-efficient products



**LOW VOLTAGE ROTATING MACHINES**



**LARGE ROTATING MACHINES**



**DRIVES**



**AVANTHA**  
GROUP COMPANY



Gurgaon: 0124-4392000  
Mumbai: 022-67558601

Kolkata: 033-22821312  
Chennai: 044-42247500

[www.cgglobal.com](http://www.cgglobal.com)

## BVGA and Renewable Resources International partners

**B**VG Associates (BVGA) and Renewable Energy Resources International are delighted to reveal a partnership that will see Andy Geissbuehler lead BVGA's US offshore wind business.

As Managing Partner with Virginia based Renewable Resources International, Andy brings extensive commercial and operational experience in the global energy business. Andy brings a proven track-record accelerating new business opportunities, reliably executing large contracts and orienting organisations for global



Andy Geissbuehler

engagement. Andy has held executive positions with major multinationals such as ABB, Alstom and GE.

Andy, an American and Swiss citizen, holds a Master's in Engineering and Industrial Management (ETH Zurich), an MBA (William & Mary Mason School of Business, Virginia) and pursued various executive education such as INSEAD's Advanced Management Program. His background also includes serving as Chairman of the Board for several renewable energy Special Purpose Companies. 

## ENERCON reveals new wind energy converters for 3 MW segment

**E**NERCON is developing two new types of converter for its 3 megawatt platform (EP3). E-126 EP3 and E-138 EP3 are designed for sites with moderate and low winds respectively, and are scheduled to go into production in late 2018 and late 2019. As well as promising much improved performance and efficiency, the two new converters will benefit from optimised processes for production, transport and logistics, and installation.



challenges facing converter technology in the important 3 MW segment. The greater efficiency will come mainly from an increase in swept area and in nominal power. The E-126 EP3 will have a rotor diameter of 127 metres and a nominal power of 3.5 MW, and is being designed for sites with

The machines are ENERCON's response to new

moderate wind conditions in Class IIA (IEC). The E-138 EP3 will also have a nominal power of 3.5 MW, but with a rotor diameter of 138 metres it is intended for use at low-wind sites in Class IIIA (IEC). 

## JinkoSolar supplies 12.7 MW of PV Modules for a Solar Plant

**J**inkoSolar, well known in the photovoltaic (PV) industry, revealed that it supplied 12.7 MW of PV modules to Hitachi Systems, a subsidiary of Hitachi, Ltd., for a solar plant owned by Farmdo Corporation in Ulan Bator, Mongolia.

JinkoSolar delivered 12.7 MW of its high efficiency PERC modules and custom built 36-cell and 48-cell dual glass modules. This shipment marks JinkoSolar's first to the country. The power plant is the country's first utility scale solar plant which covers 28 hectares of land and is expected to be connected to the grid in November 2017. Supported by the Japanese Ministry of the



Gener Miao

Environment, 40% of the project's construction fees will be financed using a government subsidy. JinkoSolar is currently bidding as a competitive candidate for two other projects managed by Hitachi Systems where construction is expected to begin in 2018.

Gener Miao, Vice President Global Sales and Marketing of JinkoSolar, said, "We are very pleased to have the opportunity to cooperate with Hitachi Systems on this project. This is a big step for us in expanding our presence in Mongolia. We look forward to creating a bright future for solar energy there." 



# HAVELLS

## Kompact *plus* Switch Disconnecter Fuse

### Safe. Compact. Smart.



New Coach Bolt

New Phase Separators

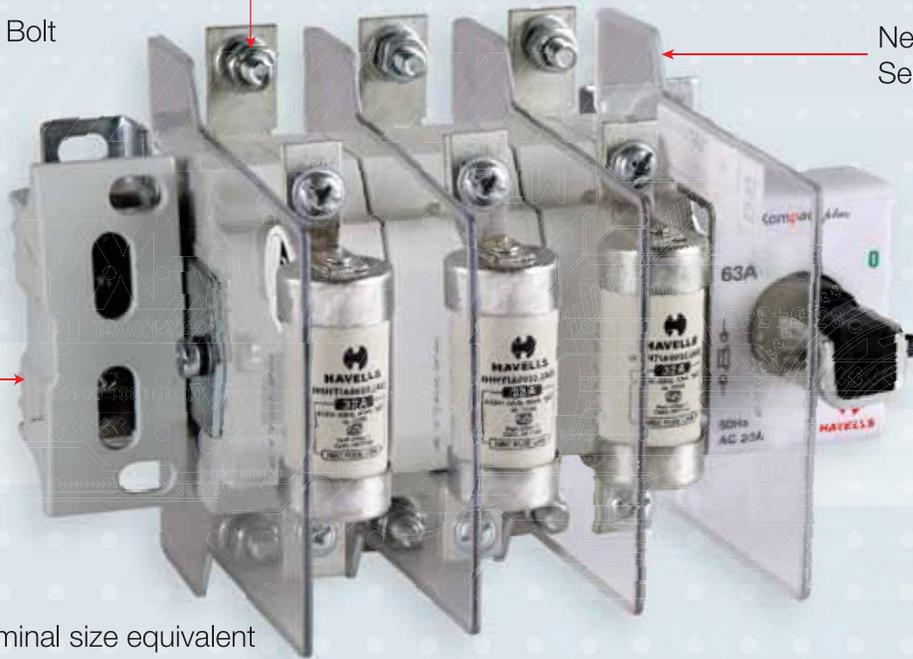
New Neutral Link Assembly



Neutral Shroud



Terminal size equivalent to phase terminal



#### Technical Information:

Ref Standard: IS / IEC 60947-1&3

Range: 32A to 125A

#### New Features:

- Improved aesthetics
- RoHS compliance
- Neutral link assembly with liberal terminal size
- Superior phase separators

Execution: DP, TPN, & FP

Utilisation Category: AC-23A

- Coach Bolt instead of Standard Bolt M6 for ease of termination
- Enclosure with Spreader Boxes

\*Design registered

www.havells.com  
marketing@havells.com



/havells



/havellsindia



/havellsindia



/havells\_\_india



HAVELLS  
CONNECT

Toll Free No.: 1800 11 0303 (Toll Free), 011-4166 0303  
(Landline), 1800 103 1313 (All Connections).  
For dealer interested in opening new Havells Galaxy Store,  
please e-mail at: galaxy@havells.com

\*Conditions apply.

## NTU to deploy Singapore's first long-span wind turbine

Ushering in winds of change in clean energy, Nanyang Technological University, Singapore (NTU Singapore) and ENGIE have jointly deployed the nation's first long-span wind turbine at Semakau Landfill, which is one of several to be installed in Singapore's drive towards sustainable energy solutions.

At 14 storeys high, the turbine comes with three 10.5-metre long-span rotor blades that produces an electrical output rating of 100 kilowatts, enough to power 45 four-room HDB units a year.



The wind turbine is also sensitive enough to generate power even with wind speeds as low as 3 metres/second, up to a maximum of 20 metres/second.

Professor Lam Khin Yong, NTU's Acting Provost, Chief of Staff and Vice President for Research, said, "The deployment of Singapore's first wind turbine is a big milestone in the nation's commitment in developing clean energy technologies for the region. As a leading global university, NTU is proud to support Singapore's efforts in meeting its sustainability objectives and pave the way towards a greener future." 

## Sembcorp to increase its Stake in India

Sembcorp Industries (Sembcorp) revealed that its wholly-owned subsidiary Sembcorp Utilities has entered into an agreement to acquire IDFC Private Equity Fund III (IDFC's remaining stake in Sembcorp Green Infra (SGI), for INR 1410.2 Crores (approximately S\$301 million). With this, Sembcorp will become the sole owner of SGI.

Pursuant to the prevailing shareholders' agreement between the parties, Sembcorp Utilities has exercised its contractual right to acquire IDFC's remaining shares in SGI. Neil McGregor, Group



Neil McGregor

President & CEO of Sembcorp Industries, said, "Buying IDFC's stake in SGI reaffirms Sembcorp's commitment to a long-term presence in India. The deal will allow us to drive SGI's growth as the 100% owner, and increase our investment in a wind and solar generation portfolio that strongly complements our thermal power assets in the country. Strengthening our investment in renewables will also help us stay abreast of advances in greener power generation, and will enable us to deliver electricity to our customers in an increasingly sustainable manner." 

## SGRE inaugurates the first blade plant in Africa the Middle East

Siemens Gamesa Renewable Energy (SGRE) has officially inaugurated its new rotor blade factory in Tangier (Morocco), an event chaired by Morocco's Minister of Industry, Investment, Trade and Digital Economy, Moulay Hafid El Alamy, and Markus Tacke, CEO of Siemens Gamesa.

The first blade plant of a wind turbine manufacturer in Africa and the Middle East is ready to offer wind turbine blades '100% made in Morocco'. To equip the SWT DD-130 platform turbines (up to 4.2MW power rating) To equip the SWT-DD-130 platform turbines (up to 4.2MW power rating), B63-10 blades with a length of



Markus Tacke

63 meters are produced for export to Europe, Africa and the Middle East, as well as for local projects. Markus Tacke, CEO of Siemens Gamesa, explained the solid business rationale for this project. "This factory is good for our company and a solid business decision. We invest where we see strong business opportunities, and the opportunities here in Morocco are stronger than ever before. This location in Tangier provides us with direct access to some of the most important markets of tomorrow – here in Morocco, throughout the Middle East, in Europe, and in the Mediterranean Region." 



**HAVELLS**

More **Power** and  
**less energy**  
consumption with  
**Havells**  
**IE2 & IE3 motors**



IE2 and IE3 Motors are equipped with AEG Technology ranging from 0.12 HP to 470 HP, that are accepted worldwide for utilizing energy efficiently. So your savings are generated automatically.

**Features:**

- All Aluminum Motors come with multi-mount construction and easy change of terminal box position (up to 160 frames)
- 6 Lead Terminal Box • Suitable for standard VFD drives • Low weight-to-output ratio • Better heat dissipation
- Cast iron motors from frame 80 to 355 with good aesthetics and surface finish

Wide range of Motors



Prima Series  
**CE IE2 IE3**  
**HAVELLS-LAFERT MOTORS**

[www.havells.com](http://www.havells.com)  
[marketing@havells.com](mailto:marketing@havells.com)



**HAVELLS**  
**CONNECT**

Toll Free No.: 1800 11 0303 (Toll Free), 011-4166 0303  
(Landline), 1800 103 1313 (All Connections).  
For dealer interested in opening new Havells Galaxy Store,  
please e-mail at: [galaxy@havells.com](mailto:galaxy@havells.com)

Conditions apply.

## Enphase Energy appoints Badri Kothandaraman as President & CEO

**E**nphase Energy, a well known energy technology company and the supplier of solar microinverters, revealed its Board of Directors has appointed Badri Kothandaraman as the Company's new President and Chief Executive Officer and member of its Board of Directors. Prior to joining Enphase in April 2017 as chief operating officer, Kothandaraman gained strong technical, operational, strategy, and leadership experience during his 21-year career at Cypress Semiconductor. An engineer by training, Kothandaraman received his B.Tech degree from IIT Madras and an M.S. degree in materials science



Badri Kothandaraman

from U.C. Berkeley. He started his career with Cypress Semiconductor in 1995 and worked in process technology development and chip design before becoming vice president of the Asynchronous SRAM Business in 2008. Kothandaraman was subsequently promoted to executive vice president of Cypress's Data Communications Division in November 2011 and spent the next five years building the USB 3.0, USB-C and the Internet of Things businesses. He also served as the executive director of Cypress Semiconductor Technology India Private Limited from 2012 to 2016. **ET**

## New Director (Finance) takes charge at BEL

**K**oshy Alexander has taken charge as the new Director (Finance) of Navratna Defence PSU Bharat Electronics Ltd (BEL) on September 25, 2017. He was GM (Finance) & Chief Financial Officer before his elevation.

Koshy Alexander joined BEL-Bangalore in June 1986 as Accounts Officer after completing his Chartered Accountancy, securing the 19th and 16th ranks in the CA Inter and Final examinations, respectively. Koshy Alexander took over as GM (Internal Audit)/BEL-Corporate Office on December, 2012. He later served as GM (Finance)/ BEL-Corporate Office from June 2014.



Koshy Alexander

Alexander has served as Finance Head of many of the BEL's Strategic Business Units of Military Radar, Naval Systems, Components etc., and also headed the Finance of BEL-Ghaziabad Unit.

He had also served as Assistant Regional Manager at BEL's New York Office.

Alexander played a key role in Capital structuring and integration of technology in the business process. He has managed the financials of major Defence contracts. He has attended Advanced Management Programme on sustainable development in Europe. **ET**

## Supervisory Board extends appointment of Siemens CFO Thomas

**T**he Supervisory Board of Siemens AG has extended the appointment of Ralf Thomas as Chief Financial Officer (CFO) ahead of schedule. His term of office will now continue until September 2023. Following the early extension of CEO Joe Kaeser's contract in August, this move is a clear signal of the company's commitment to continuity.

"Ralf Thomas has played a key role in increasing Siemens' value over the last few years. Through precise analyses and unerringly accurate forecasts,



Ralf P. Thomas

Ralf Thomas has made a major contribution to improving the company's cost structures, transparency and risk management and thus to increasing its value sustainably and successfully. These are just some of the reasons why he enjoys an excellent reputation in the financial market - and within the entire Supervisory Board. We are very much looking forward to continuing our collaboration with him," said, Gerhard Cromme, Chairman of the Supervisory Board. **ET**



**HAVELLS**

# Reactive Power Solutions

Dynamic Range of Havells Reactive Power and Harmonic Solutions.



[www.havells.com](http://www.havells.com)  
[marketing@havells.com](mailto:marketing@havells.com)

[f/havells](https://www.facebook.com/havells)  
[t/havellsindia](https://www.tumblr.com/havellsindia)

[y/havellsindia](https://www.youtube.com/havellsindia)  
[i/havells\\_india](https://www.instagram.com/havells_india)



**HAVELLS**  
CONNECT

Toll Free No.: 1800 11 0303 (Toll Free), 011-4166 0303  
(Landline), 1800 103 1313 (All Connections).  
For dealer interested in opening new Havells Galaxy Store,  
please e-mail at: [galaxy@havells.com](mailto:galaxy@havells.com)

\*Conditions apply.

## PHD Chambers Of Commerce appoints Simarpreet Singh

**O**n the inaugural session of three day long Archibuild conference 2017 held in City beautiful Chandigarh inaugurated by the Hon'able Governor VP Singh Badnore. PHD Chambers of Commerce has constituted a Regional Committee on Power & Renewable Energy and Simarpreet Singh, Director of Hartek Group has been appointed as the Chairman.



Simarpreet Singh

He has been instrumental and the person behind the solar and smart city vertical at HARTEK.

The Hartek Group is one of the fastest growing EPC companies in the power sector and one of leaders in renewable and smart city solutions

Simarpreet is looking forward to start awareness programmes among the citizens on various ways of adoption of smart and renewable energy through the platform of PHD Chambers.



The young entrepreneur from HARTEK who is just 27 is one of the youngest to hold this position.

## Vinit Kumar appointed as new Chairman, Kolkata Port Trust

**V**init Kumar, an I.R.S.E.E. officer of 1993 batch took over charge as Chairman, Kolkata Port Trust on 9th October, 2017. Before joining as Chairman, Kolkata Port Trust, he was Chief Electrical Engineer in Mumbai Railway Vikas Corporation Ltd. and was looking after the World Bank funded MUTP Project. Kumar held administrative post of Secretary, Central Railway and gained multi-dimensional experience in general administration.



Vinit Kumar

system in the world in maintenance and operations of rolling stock and traction installations. He also worked in Pune and Nagpur in independent charge of traction assets and locomotive workshop. He has wide experience in operation, maintenance, infrastructure development and general administration. He did BE in Electrical Engineering from Delhi College of Engineering, Delhi and obtained PGDBA in marketing from Symbiosis Institute, Pune. Kumar attended training programme on Management in ICLIF, Malaysia and INSEAD, Singapore.



Kumar worked in Central Railway in Mumbai suburban system, one of the densest suburban

## Georgia Power names Xia Liu executive VP, CFO and Treasurer

**T**he Georgia Power's Board of Directors has elected Xia Liu as executive Vice President (VP), Chief Financial Officer (CFO) and Treasurer, effective October 1. In her new role, Liu will be responsible for overseeing the company's accounting and financial functions.



Xia Liu

rates and pricing, and forecasting functions.

Liu earned a bachelor's degree and master's degree in finance from Renmin University of China and a master's degree in business administration from Emory University. She is a chartered financial analyst (CFA) and has completed two years in the economics Ph.D. program at Emory University. Additionally, Liu is also an International Woman's Forum Leadership Foundation fellow and has attended executive programs at Harvard University and INSEAD School of France.



Most recently, Liu served as vice president, chief financial officer and treasurer for Gulf Power where she was responsible for overall accounting, financial planning and analysis, budgeting, treasury, internal controls, regulatory,

**Trusting in experience.  
Benefitting from innovation.  
Perfecting explosion protection.**

Maximum security for hazardous areas:  
Pepperl+Fuchs supplies the global process  
industry with extremely reliable products and  
solutions in the field of explosion protection.  
Benefit from a comprehensive portfolio and  
pioneering Innovations – paving the way  
towards fully networked processes for the  
applications of the future.

[www.pepperl-fuchs.com](http://www.pepperl-fuchs.com)



91-80-3352 6000

[pa-info@in.pepperl-fuchs.com](mailto:pa-info@in.pepperl-fuchs.com)

Your automation, our passion.

**pf** PEPPERL+FUCHS

## BEML bestowed with Raksha Mantri Award

**B**EML Limited, a Mini Ratna Category-I Public Sector Company under the Ministry of Defence, has received the prestigious 'Raksha Mantri's Award for Excellence' under the Group Award category for Design & Development of 180 Ton Class Electric Hydraulic Excavator BE1800E. At a function held at Manekshaw Centre, New Delhi, Deepak Kumar Hota, Chairman and Managing Director, BEML received the Cash Award on behalf of the Company from Arun Jaitley, Hon'ble Defence Minister while Dr. Subhash Bhamre,



India.

BEML BE1800E, a 10 Cubic Metre loading capacity, the biggest ever Excavator designed and developed in India, is packed with leading-edge technologies, offers a host of advantages, maintainability and operator comfort, as well as low operating costs. **ET**

Hon'ble Minister of State for Defence, presented the Certificate of Excellence to BR Viswanatha, Director (Mining & Construction), BEML in the presence of AK Gupta, Secretary (Defence Production), Govt. of

## BHEL wins Six National Safety Awards

**A**mong a host of public and private sector companies in the country, six 'National Safety Awards' have been won by Bharat Heavy Electricals Limited (BHEL) for outstanding achievements in terms of the longest accident free period and lowest accident frequency rate at their works.

The high level of quality & reliability of BHEL products is due to adherence to international standards by acquiring and adapting some of the best technologies from leading companies in the



accredited to Quality Management Systems (ISO 9001).

The awards were received by Atul Sobti, Chairman & Managing Director, BHEL from Santosh Kumar Gangwar, Hon'ble Union Minister of State, Labour & Employment (Independent Charge). **ET**

world, together with technologies developed in its own R&D centres.

BHEL divisions like Manufacturing units, Engineering centres and Business Sectors like Power Sector, Industry sector, International Operations are

## Capula triumphs at UK Energy Innovation Awards

**C**apula, an Imtech company, is celebrating an award win at the prestigious UK Energy Innovation Awards for the 'Best Innovation Contributing to Quality & Reliability of Electricity Supply' award.

Supported by industry partners COPA-DATA, Capula demonstrated the significant impact the innovative IMPERIUM solution has on the reliability of electricity supply. IMPERIUM addresses modern energy challenges and has the powerful capability to reduce electrical outages to just a few hours rather than the



(L2R) Host for the event the Gadget Show's, Jason Bradbury, Capula's Lead Engineer, Ian Bennion and a representative from Award sponsors West Water Utility

unit (Capula's dual central control unit (DCCU) is an innovative portable unit designed to temporarily assume control of all existing Remote Telemetry Units within substations so that upgrade works can safely be carried out. **ET**

days or weeks typically associated with substation upgrade or maintenance projects. It combines four essential elements; a unique database structure developed over twenty years by Capula engineers, the unique capabilities of a portable DCCU

# SWITCH TO STYLE, SIMPLICITY, AND RELIABILITY.

Honeywell MK presents a range of modular wiring devices and cable management solutions, which are of distinctive design and unparalleled quality. Be it home or commercial applications, they add timeless sophistication and versatility to your interiors. Honeywell MK also offers lighting control solutions that help you save energy.



Elements



Blenze Plus



Citric



Midas



Masterseal



Sentry



Video Door Phone

## Honeywell



Honeywell India, Unitech Trade Centre - Block C, Sector-43, Sushant Lok Phase-1, Gurugram - 122 002, Haryana, India  
www.honeywell.com HBTIndia@honeywell.com 1800 103 3848 +91 81306 91299



## CBS ArcSafe SecureConnect Remote Operator awarded

The CBS ArcSafe SecureConnect Remote Operator for Allen-Bradley CENTERLINE 2100 Motor Control Centres (MCCs) remote racking system has won Occupational Health & Safety (OH&S) magazine's 2017 New Product of the Year Award in the Electrical Safety category. This honour is CBS ArcSafe's eighth New Product of the Year Award for innovative safety products that protect electricians and maintenance personnel from arc-flash danger. Designed in cooperation



with Rockwell Automation, the 13-lb. SecureConnect Remote Operator allows technicians to remotely disconnect an individual plug-in SecureConnect unit from the CENTERLINE 2100 MCC vertical power bus while the enclosure door is closed and while standing up to 300 feet away. Prior to the introduction of the SecureConnect Remote Operator unit, technicians manually operated the SecureConnect while standing in front of an MCC. E

## Chair of IEA Photovoltaic Power Systems TCP honoured in Amsterdam

Dr Stefan Nowak was awarded the European Becquerel Prize for Outstanding Merits in Photovoltaics at the EU PV Conference in Amsterdam. This prize, established by the European Commission in 1989, was awarded to Dr Nowak in honour of his significant contributions in the field of integration of solar photovoltaic electricity into the global energy system.



Dr Nowak is well recognised for his longstanding commitment to the promotion of European and global cooperation on PV research, market

assessment and deployment. In particular, the prize also rewards Dr Nowak's long-lasting activities as Chair of the Executive Committee of the IEA Photovoltaic Power Systems Technology Collaboration Programme (PVPS TCP) since 2001. The PVPS TCP aims to promote the role of energy from solar PV technologies as a cornerstone in the transition to sustainable energy systems. It conducts a variety of collaborative projects relevant to solar PV technologies and systems.

(Source: [www.iea.org](http://www.iea.org)) E

## Vikram Solar conferred a title for Solar Modules

Vikram Solar, the globally recognised leading solar energy solutions provider was conferred the 'Leading Renewable Energy Manufacturer - Solar - Modules' at Renewable Energy India Expo 2017 (REI).



The Annual Renewable Energy India Awards was held at the India Expo Centre, Greater Noida on 19th of September. The company was recognised as the winner in the Solar

Manufacturing category. Ivan Saha, CTO and BU Head-Solar Manufacturing, Vikram Solar received the award at the ceremony that was attended by industry leaders & visionaries from across the country.

Vikram Solar is on its course to contribute significantly to the 100 GW solar targets in the coming years. The company's module manufacturing capacity has been ramped up to 1 GW. E

# TURBINOL

## A revolution for a life time

HP Turbinol Grades have revolutionized the power generation industry. Consistent performance, impeccable quality and hassle-free operations make them a popular choice across all categories. They are premium quality turbine oils made from Group II Base Stocks having excellent oxidation and chemical stability. These properties are further enhanced with incorporation of carefully selected antioxidants, rust inhibitors and anti-foam agents. Excellent demulsibility and quick release of entrained air make it a long service oil. These turbine oils ensure flawless operations and coupled with a team of skilled HP Technical Service Engineers surely make it a revolution that will last for the years to come.

**POWER**  
**TO PERFORM**



**LUBRICANTS**

**PREMIUM TURBINOL OILS**

For Details Log on to: [www.hindustanpetroleum.com](http://www.hindustanpetroleum.com) | Email: [lubescare@hpcl.in](mailto:lubescare@hpcl.in)  
Toll Free: 1800 120 4725 / 1800 121 4725 | Phone: +91 22 23030000  
Follow us on : [www.facebook.com/hplubricantsfromhindustanpetroleum](https://www.facebook.com/hplubricantsfromhindustanpetroleum)





# INDUSTRY KNOWS, WHAT THEY WANT

We know, what the industry wants.....



For all your promotional and branding needs we have the best platform

LOOK NO FURTHER

“We will help you **promote your products** and services in the most effective manner.”

**HURRY!** Don't loose time. Just keep your branding needs ready and come to us.

Apart from print we also have the digital platform for you to explore.

CONTACT THE AD DEPARTMENT

022 2777 7170

022 2777 7196

022 2777 7180

info@charypublications.in

yasmeen@electricalindia.in

Since 1961

# Electrical India

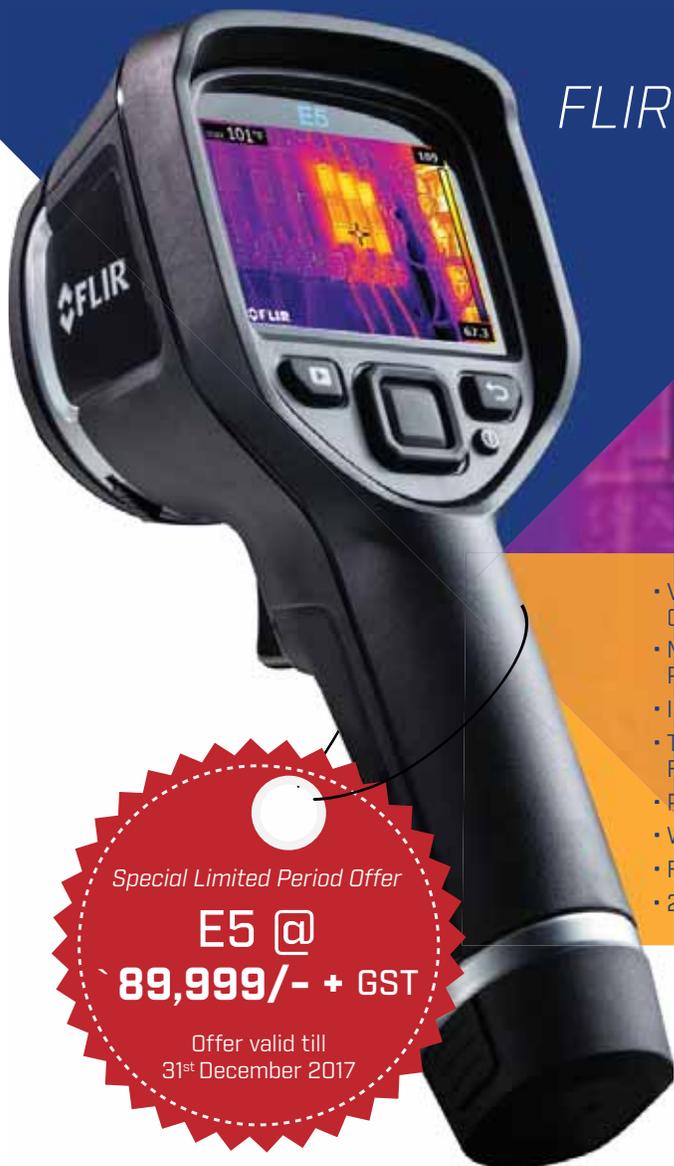
India's oldest magazine on power and electrical products industry



www.electricalindia.in

# NEVER MISS ANOTHER OPPORTUNITY TO FIND HIDDEN HOT SPOTS WITH FLIR E5.

Thermal Imaging Camera for electrical troubleshooting  
now available at **THROW AWAY PRICE**



## FLIR E5<sup>®</sup>

- VISIBLE & THERMAL IMAGES IN ONE CAMERA
- MSX<sup>®</sup> ENHANCEMENT FOR DETAILED PERSPECTIVE
- IR RESOLUTION 120 X 90 PIXELS
- TEMPERATURE MEASUREMENTS FROM -20°C TO 250°C
- POINT AND SHOOT THERMAL CAMERA
- WIDE ANGLE LENS 45° X 34°
- FOCUS FREE
- 2 METER DROP TEST

Special Limited Period Offer

**E5 @  
89,999/- + GST**

Offer valid till  
31<sup>st</sup> December 2017



\*After product registration on [www.flir.in/warranty/ins](http://www.flir.in/warranty/ins)

To grab this offer, please call us on: +91-11-4560 3555 or write to us at [flirindia@flir.com.hk](mailto:flirindia@flir.com.hk)

**FLIR Systems India Pvt. Ltd.**

1111, D Mall, Netaji Subhash Place, Pitampura, New Delhi - 110034

Fax: +91-11-4721 2006

**WWW.FLIR.IN**



# Smart Meters Market Worth 19.98 billion USD by 2022

The global market is witnessing a significant growth, which is driven by government policies, energy conservation, increasing smart grid deployment, and utilities urge to enhance distribution efficiency...



The smart meters market is expected to grow from an estimated USD 12.79 billion in 2017 to USD 19.98 billion by 2022 registering a CAGR of 9.34% from 2017 to 2022. The global market is witnessing a significant growth, which is driven by government policies, energy conservation, increasing smart grid deployment, and utilities urge to enhance distribution efficiency.

## Residential – the largest smart meters market by application

The smart meters market in this report has been classified based on application, into three segments, namely, residential, commercial, and industrial. The residential segment accounted for the largest market size, in terms of value, in 2016. The meters measure the electricity, water, and gas consumption and communicate this to the central utility system. The installations of these devices in the residential sector helps in reducing CO<sub>2</sub> emissions globally as the consumer's inclination towards peak time savings of energy would increase. The increasing residential construction activities and government mandates such as the European Union 20-20-20 policy, which aims to convert 80% of the installed meter base to smart one, have ensured the growth in the demand for smart meters.

## “The AMR technology segment would dominate the global smart meters market”

The Automatic Meter Reading (AMR) segment was

estimated to be the largest market for smart meters in 2016. AMR is a metering technology that collects consumption data from the meters and transfers it to a central database (in the utility station) for billing and other purposes (one-way communication only). It is the initially developed smart metering technology and, hence, it has widely been adopted since its inception. North America and Europe are the regions that have

much embraced this technology. It is less costly when compared to the Advanced Metering Infrastructure (AMI) and, hence, has a high market size.

## North America: Leading market for smart meters

The North American market dominates the smart meters market during the forecast period. In North America, the growth of the smart meters market can be attributed to focus on electricity, water, & gas, monitoring & prevention of leakage, and the repair & upgrade of aging infrastructure. Lot of smart meters rollouts are taking place in countries such as the US, Canada, and Mexico which would impart growth in the North American region. To provide an in-depth understanding of the competitive landscape, the report includes profiles of some of the leading players in the smart meters market, namely, Itron, Inc (US), Kamstrup A/S (Denmark), Holley Metering, Ltd (China), Honeywell International, Inc (US), and Toshiba Corporation (Japan). Leading players are trying to penetrate the markets in developing economies and are adopting various strategies to increase their market share. 





# **FIRE SAFE**

**PROVEN UP TO 400kV**

**PROTECTS THE ENVIRONMENT**

# **SAVES MONEY**

---

# **MIDEL**

---

**ESTER-BASED**

---

**TRANSFORMER**

---

# **FLUIDS**

---

[midel.com](http://midel.com)

+91 (0)11 6517 7114 -16

[midelsales@mimaterials.com](mailto:midelsales@mimaterials.com)

[@midelfluids](https://twitter.com/midelfluids)

**[MIDEL®]**

**SAFETY INSIDE**

a product of  
 **M&I MATERIALS**

# Power Sector – A Glass Half Full

The sector is rightly poised to witness a strong growth subject to continued policy impetus. The tremors of the state's unilateral action could jeopardise the bankability of projects and could risk the 175GW renewable plan of federal government, if left unchecked...



## Transformation to Clean Energy Not Without Challenges Ahead

Mixed trends are emerging in the power space with surging renewable capacity additions and plateauing thermal capacity

installations, sudden spurt in spot prices and oscillating coal availability at the plants typical of an evolving sector. Power is a key ingredient for the success of 'Make in India' initiative and India's chances of competing with

Energy			
Year	Requirement	Surplus(+)/Deficits(-)	
	(MU)	(MU)	(%)
2009-10	8,30,594	-83,950	-10.1
2010-11	8,61,591	-73,236	-8.5
2011-12	9,37,199	-79,313	-8.5
2012-13	9,95,557	-86,905	-8.7
2013-14	10,02,257	-42,428	-4.2
2014-15	10,68,923	-38,138	-3.6
2015-16	11,14,408	-23,558	-2.1
2016-17	11,42,929	-7,595	-0.7
2017-18 (August 2017)	5,17,085	-3,306	-0.6

international players will be determined by the seamless availability of power at economical rates. The sector is rightly poised to witness a strong growth subject to continued policy impetus. The tremors of the state’s unilateral action could jeopardise the bankability of projects and could risk the 175GW renewable plan of federal government, if left unchecked.

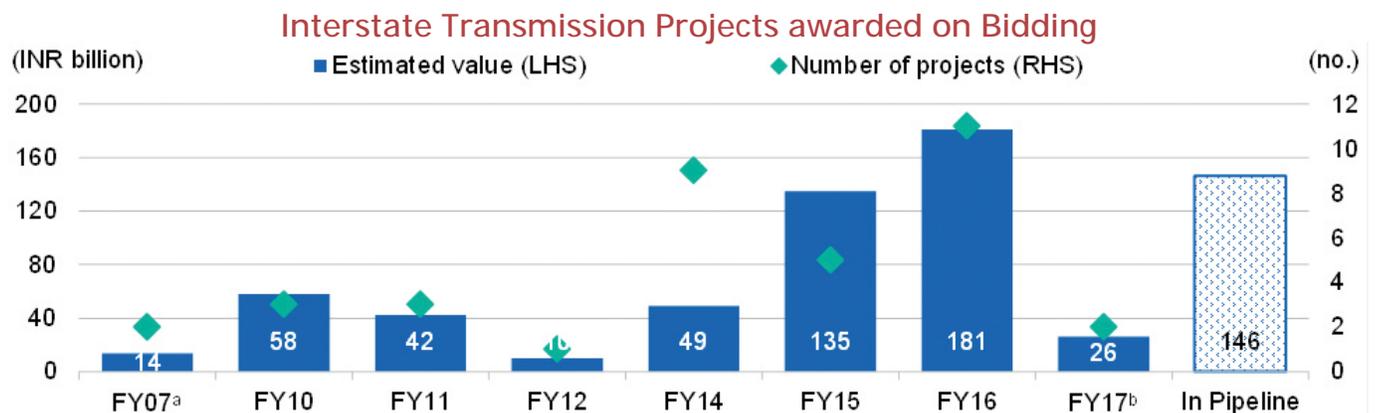
### Power Surplus Riddle, Soaring Generation and Distribution Challenges

Because of high thermal capacity addition in last five years and improvement in transmission system, power supply improved to match the demand. Present low PLFs indicate that the installed capacity can meet demand increase for next few years comfortably. Also, the pipeline of thermal plants at about 50 GW is not insignificant. Quality of supply and reach of power

supply is not up to the mark and improvement in the same, like the ongoing effort in Uttar Pradesh, is likely to boost the demand. Uttar Pradesh recorded 16.5% increase in energy supply during April – August 2017 compared to the same period in last year. In FY17, renewable capacity addition (11.31GW) exceeded thermal additions (10.6 GW).

Transmission projects have been awarded on the tariff based competitive bidding (TBCB) and the award of projects has slowed down as the pipeline is low. Given several villages is yet to be electrified and the need for 24x7 power for all, the transmission sector is in the path of strong growth. However, there is a greater need for the transmission project to be bid out by the states similar to the Centre TBCB model. Improving the transmission system at the state level would allow for seamless power transmission across regions.

UDAY scheme launched in end 2015 is gradually making inroads and some early signs of revival are seen



<sup>a</sup> Awarded based on agreements different from those adopted from FY10  
<sup>b</sup> Till 30 November 2016

Source: CEA, Ind-Ra



although premature to confirm the success. UDAY is likely to provide three fold benefits firstly the transfer of debt load to states to reduce the substantial interest burden leading to immediate release of liquidity for the discoms.

Interest savings to the discoms are over INR 100 bn. States issued bonds of INR2321.63bn which is about 87% of the total bonds originally envisaged. Consequent to this, some states have exhibited marginal dip in payable days to generators. Secondly, the tariff hikes by states reduces the gap between ACS and ARR, the impact of this varied and is early to decide on the success. Thirdly, overall AT&C losses showed minor reduction, however, several states underperformed with respect to these targets.



## Debates Rage on PPA Renegotiation, New Litmus Test for Sector

Increasingly, discoms succumbing to the power purchase renegotiation contagion and threatened to repudiate the contract. One of the thermal power plants received a notice of termination letter from UPPCL and the state utility stopped making payments to the generator. Earlier similar attempt from another state utility (GUVNL) to renegotiate was quashed by the order from APTEL. PPA is sacrosanct and the investor and lenders commit long term funds depending on the power purchase agreement. Wind projects are also facing threats akin to the solar and thermal portending risk to overall target of 175GW of renewable capacity by 2022 and more importantly the bond market. Several renewable players are embarking on capital market access, hence the recklessness of utilities to this could unsettle the nascent bond market. Indian Banks Association, Wind Associations and MNRE has emphasized the sanctity of the PPA and not to unilaterally cancel the power sale agreements.

## Key Policy Implications

Other policies actions like coal rationalization and energy efficiency measures (UJALA) are some of the impactful policies. Low hanging fruits of the coal rationalization policies impacted the cost of production for some of the central and state owned plants and the variable costs have nearly halved. Gradually, the impact would widen to other plants including private generators and would positively impact the margins.

Scheduling and forecasting measures to tackle the renewable jump provides salutary effect for evacuation to power and timing the maintenance for the coal plants. National Institute of Wind Energy played a pivotal role in educating and undertaking this, resulting in increased evacuation of power supply from Tamil Nadu. Refurbishing the old coal power plants to leverage the space and created transmission network is likely to provide some visibility to the equipment manufactures like. The capacity under consideration is about 40GW.

Extension of Mega Power Policy for 25 projects from March 2017 to March 2022 would reduce the interest burden for several sponsors which otherwise would have placed burden on developers and lenders.

# The Smartest deal !



**Limited period only.**  
**testo 872 @ ₹ 1.94 L\***  
**Get testo 605i & 770-3**  
**FREE.**

\*Offer valid on orders from 1<sup>st</sup> Nov to 15<sup>th</sup> Dec 2017

## New Bluetooth thermal imager testo 872

- More convenience: Operation and documentation by smartphone
- More quality: best price-performance ratio in its class
- More flexibility: wireless connectivity to testo Smart Hygrometer 605i and Clamp meter 770-3
- More economical: Pays off quickly.

## True-RMS Clamp on Meter testo 770-3

**Free**

- Revolutionary clamp grab for greater safety & easy operation
- Power and in-rush current measurement
- Both AC/DC current measurement
- Auto-mode for all parameters and big display
- Temperature measurement with Thermocouple adapter

## Smart Probe Hygrometer testo 605i

**Free**

- Measurement of air humidity and temperature
- Measurement data analyzed and sent via testo Smart Probes App



### Testo India Pvt Ltd

#### Head Office:

Plot No. 23, Sind Society, Baner Road, Aundh, Pune - 411007, Maharashtra, India  
 Tel: +91 20 6560 0203 | Fax: +91 20 2585 0080 | Email: info@testo.in

#### Regional Offices / Representatives:

Ahmedabad | Baroda | Bengaluru | Chandigarh | Chennai | Guwahati  
 Hyderabad | Indore | Kolkata | Mumbai | New Delhi | Raipur

[www.testo.com](http://www.testo.com)

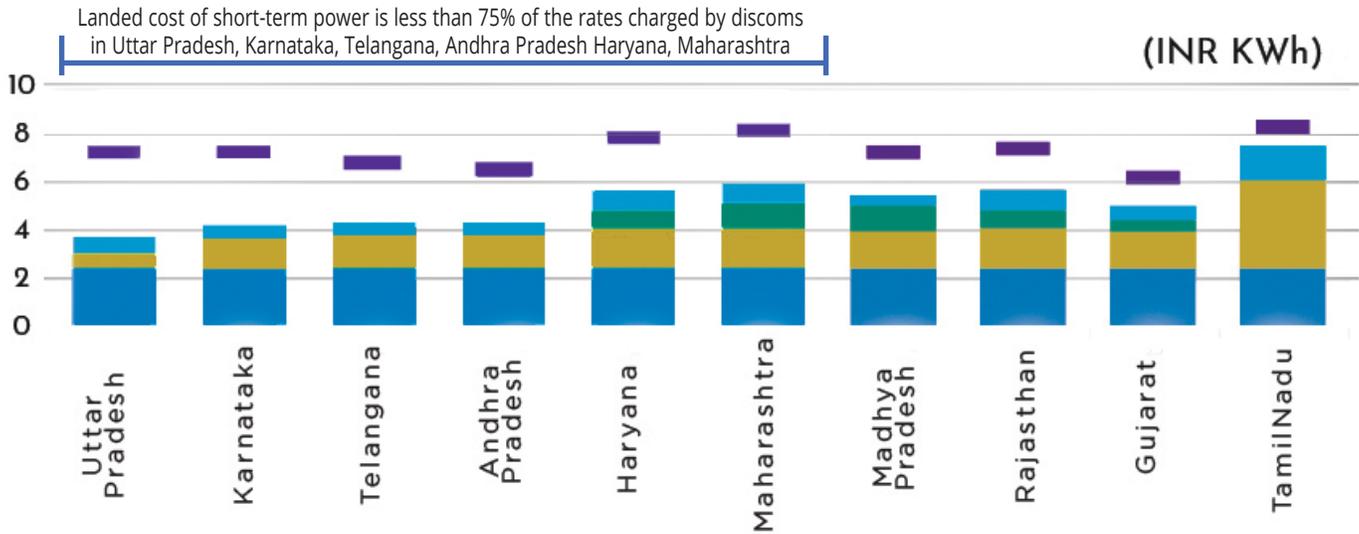


**MADE IN GERMANY**

\*GST & Calibration extra. Conditions Apply.

SS400CA17H-OFFER

Short-Term Power Economical Compared with Discom Power



Note: cost of power in short-term transactions may vary based on transmission losses and minor other applicable charges; refer to Annexure 2 for absolute surcharge figures. Source: SERC orders, Ind-Ra

Active Spot Market Phase Kicks on

Green shoots of recovery are emerging in the power sector to boost the short-term power market. However, the sector’s growth is inhibited by impediments such as transmission constraints, opaque processes on open access within most states and steep cross-subsidy charges. Despite the imposition of surcharges, short-term power remains competitive to discom power for bulk consumers in the 10 states analysed by India Ratings & Research. To reduce overall losses and retain high-yield consumers, discoms levy excess charges and curb direct procurement from the short-term market. As a percentage of industrial tariff, cross-subsidy stands at 10%-50%.

Momentary blips in the spot market like latest on 13 September were triggered by lower generations from renewable sources and back downs of nuclear power. These distortions are bound to happen unless the states implement forecasting and scheduling of demand and renewable generations.

Cracks in Façade

The weakest link in the power sector value chain is discom, the facelift to the financials and operational performance is a long drawn process. State ownership, lack of political will to alter tariffs and embracement to the populist policies continues to hamper the progress. Privatization of part or some aspects of the

distribution and collection functions could pave way for improvement in some key parameters.

The solution is to take the business decisions out of the hands of politicians and devolve authority to lowest level. Creating distance between an elected official and an executive decision and creating transparency in the decision making process is a way to limit the impact of politics.

Outlook

Although the sector in patches is performing reasonably well, signs of stress emanates often. Discoms would benefit from the low cost of power purchases and will increase the share of short-term purchases in the next two to three years gradually. Strengthening the payment mechanism for the power generators would go a long way in stabilizing the sector’s fortunes.



Siva Subramanian

Associate Director  
Infrastructure Ratings,  
India Ratings & Research



Divya Charen

Senior Analyst  
Infrastructure Ratings  
India Ratings & Research

Attracting Tomorrow



# Superior Solutions for Power Quality.

## EPCOS key components

- LV and MV PFC capacitors (MPP, APP, gas-filled)
- Power factor controllers (4 to 16 steps, single and three CT sensing)
- Anti-resonance detuned harmonic filter reactors
- Tuned harmonic filters
- Capacitor duty contactors
- Thyristor switching modules (TSM)
- APFC panels (LV and MV)
- Power quality audits

[www.global.tdk.com](http://www.global.tdk.com) · [www.epcos.com](http://www.epcos.com)

EPCOS India Pvt. Ltd. · A TDK Group Company

Mumbai: 022-25 75 08 00 · Noida: 0120-4 50 58 01 · Kolkata: 033-24 19 88 15 · Bengaluru: 080-40 39 06 40 · [sales.in@epcos.com](mailto:sales.in@epcos.com)

# Prospects of Lighting Industry in India

Now-a-days, India struggles to meet the increasing electricity demand with its exceptional growth in the economy leading to build more power plants for sustaining the higher electricity demand of its widely growing population...

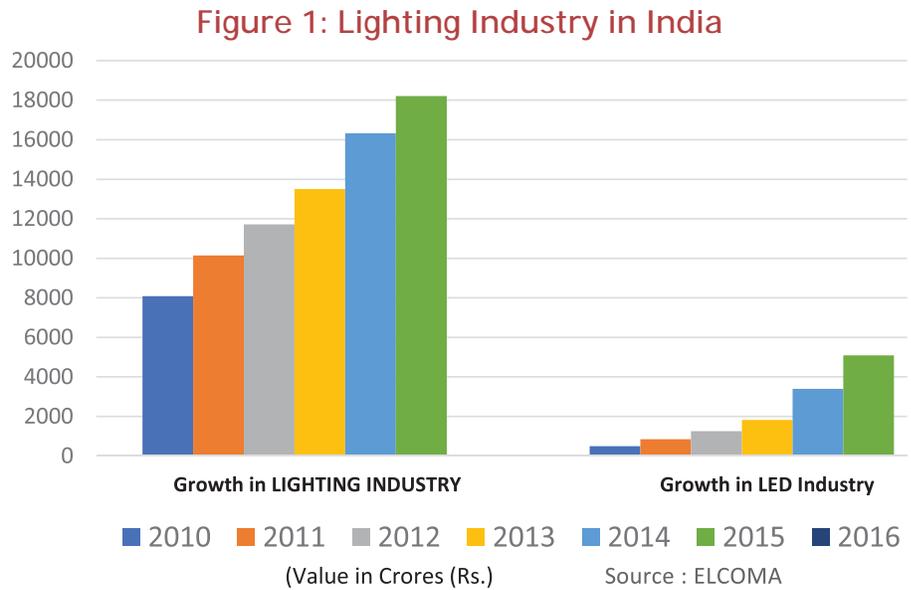


Being the second most populous country and fifth major electricity consumer, India has been witnessing widening electricity demand-supply gap. A substantial portion of world's total electricity generation is consumed for lighting by illumination sources and systems alone. The consumption is continue to increase due to emergence of new areas of applications such as Entertainment Lighting, Advertisement Lighting, Biological Lighting, Aqua Tissue Culture, etc. However, the production of electricity cannot be increased beyond certain limits due to fast

depletion of natural resources. It is, therefore, essential that the appliances consuming less electricity, and also using natural sources of electricity like sun, wind etc need to be developed. New technologies are being continuously used to improve lighting efficiency and energy conservation. Lighting is the single most important element in the visual environment. Effective lighting improves productivity and strengthens security. Lighting consumes upto 40 percent of the energy used in our buildings. A well designed lighting system reduces energy, maintenance, and potential liability costs. Both public and private interests are served by more effective lighting and reduced operating costs. Rapid improvements in lighting systems and equipment offer potential solutions, yet they have also made lighting practice more complex. On the other hand, the use of inefficient light sources and controls, and the wasteful usage of lighting results in polluting the environment leading to global warming.

### Growth Potential for LED Industry

LED lights have been growing at such a big rate all over the world. Certainly, India is no exception. In reality, LED lighting has vast potential in India owing to power shortages and high electricity costs. Now-a-days, India struggles to meet the increasing electricity demand with its exceptional growth in the economy leading to build more power plants for sustaining the higher electricity demand of its widely growing



population. But there is also another very simple solution; just change light bulbs to the new LED technology and this can surprisingly reduce the country's electricity demand by as much as 40 percent. With the biggest benefit of energy saving, long lamp life and environment friendly technology, LEDs would notably lessen the lighting load, peak demand and overall energy consumption of India, even without compromising on the environment and safety. As India has been declared as one of the polluted countries in the world, such eco-friendly aspect of LED lighting would definitely add more strength to the future growth of Indian LED light segment. As such, usage of energy efficient products such as LED lighting products is expected to grow in the coming years. Moreover, rising government support and introduction of innovative LED lighting products by manufacturers has resulted in reduction in prices of these products, thereby, offering consumers with more options to

choose from, according to their needs and preferences. Rising government initiatives, increasing awareness among customers regarding lower power consumption of LED lighting products, and innovative product offerings to drive LED lighting sales is evident from the figure 1.

Considering the growth potential of LED industry based on the above figures wherein a growth rate of 50 % was recorded in 2015, the LED lighting market in India is projected to register a CAGR of 26.6% during 2017-23. Basis for this projection is due to rise in personal disposable income, growing government initiatives encouraging use of LED lights, and focus on Smart City Projects. For instance, Government of India announced plans to develop additional 30 cities under Smart City Mission, totaling to 90 cities. Further, recently in September, 2017 Prime Minister Narendra Modi launched Pradhan Mantri Sahaj Bijli Har Ghar Yojana - Saubhagya, with an aim to provide

electricity free of cost to over four crore underprivileged families in rural and urban areas by December 2018. These initiatives are expected to further increase government emphasis on energy efficient lighting products such as LEDs in the coming years. Favourable government initiatives and policies through state and national level programs that offer LED lighting products at subsidized rates is contributing in a huge way towards boosting LED adoption in the country. In India, not a complete ban, but through the Ujala Scheme launched in 2016 decided to replace 770 million incandescent light bulbs with LED bulbs by 2019. This is expected to reduce energy consumption by over 100 billion kWh annually and reduce annual electricity bills by ₹400 billion (US\$6.2 billion). As of April 2017, 229 million LED bulbs had been distributed across the country. The states of Tamil Nadu, Kerala and Karnataka in India have banned the use of incandescent bulbs in government departments, public sector undertakings, various boards, cooperative institutions, local bodies, and institutions running on government aid. Further, under Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), 273 lakhs LED bulbs are to be distributed to BPL households.

### Vision for Development of LED or Lighting Industry

During deliberation on the subject, there are two specific major issues – education and testing - which need to be addressed to develop lighting

industry in general and LED industry, in particular.

### Skilled Manpower or Lighting Professionals

More specifically, if we talk about the latest light source – the LED, there is likely to be exponential growth in next five years. This will require significant number of trained lighting professionals under various disciplines- designing, manufacturing, quality, marketing, and so on. The above graph clearly indicates that the lighting industry in India is in its maturing stages. With an estimated market of about ₹20,000 crore, the lighting industry is witnessing tremendous growth. Further, in LED segment alone, there is a growth of more than 80%. As such the main issue being faced by LED industry is the lack of skilled manpower. But regrettably nothing much has been done to develop the professionals or skilled manpower in this vital field of lighting or LED or solar energy, who can further progress with more scientific and innovative approach.

### Industry Requirement Employment Opportunities

The lighting industry is now poised to take a broad look into the future by considering the diverse trends and uncertainties acting among its many constituents. The lighting industry needs to play a critical role so in the context of the larger issues of energy, health and sustainable growth. However, till now unfortunately, there is a lack of formal education in this vital field. Since as mentioned in the earlier paragraphs, the lighting has been taken for granted as

other commodities, the necessity of formal education is not felt so far. With the advancement in technology and the presence of lighting in the form of electromagnetic waves in all spheres of life, starting from lighting as illumination for proper visibility to the communication by mobile phones through satellite, the necessity of formal education is being felt by users as well as industries to achieve following objectives:

- Productive man force from day 1 of joining employment
- Higher standards in delivering quality of service
- Reduced in- house training cost due to industry ready personnel

### Present Scenario

There's more to lighting than meets the eye. Lighting is not just about lamps and fixtures, it is a complete subject in itself to understand the art and science of lighting for a particular environment. However, there are only few institutions or universities in India who are providing only one of the elective subjects on Illumination Engineering or Technology. At one or two places, the PG Programs are being run, but these are also on the Illumination Engineering or Technology and not on lighting technology or management. As per information available till date, the following institutes are imparting lighting education of different levels.

#### 1. Jadavpur University: School of Illumination Science, Engineering and Design

Established in December 1999, the school is running a two years'

# Synch - with Difference



**LUMEL**  
EVERYTHING COUNTS



- Input Signal: 50...150 V or 150...400 V
- Direct or Indirect Measurement
- Additional Control Input:
  - BLK - Lock Synchronization
  - START - Start Synchronization
- Programmable Hysteresis
- RS485 Modbus & Ethernet Interface



Measure



Control



Record



Analyze

**RISHABH INSTRUMENTS PVT. LTD.**

Trishala Unit, C-6, NICE Area, MIDC, Satpur, Nashik - 422007, India.

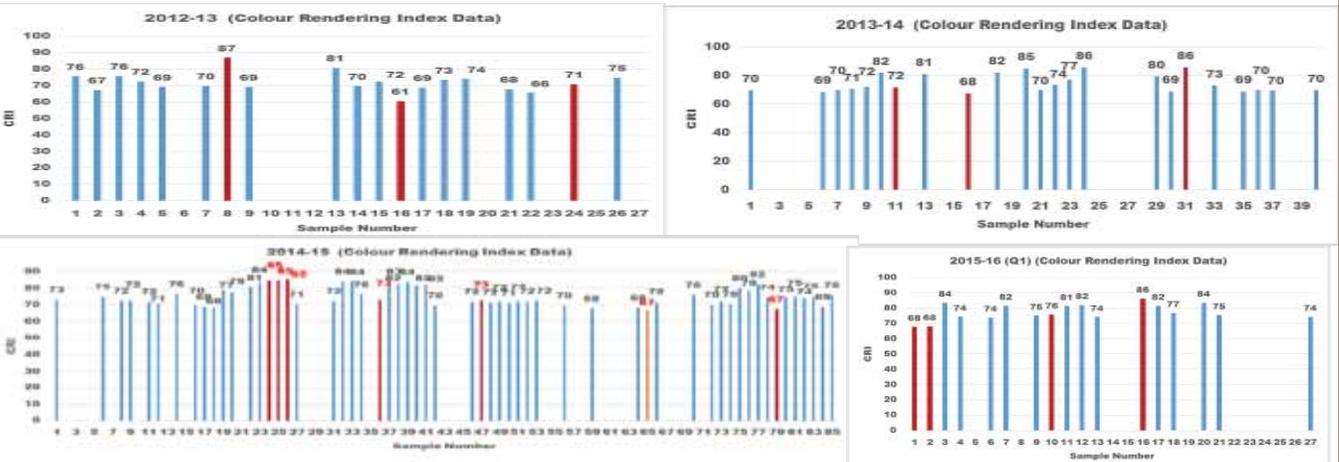
Tel: +91 253 2202028 / 031 | Fax: +91 253 2351064 | E-mail: marketing@rishabh.co.in | www.rishabh.co.in

Figure 2: Data - Luminous Efficacy



The maximum value observed was 120 lm/W and minimum value observed was 28 lm/W. The data variation implies that there is large variation between different samples and this is mainly due to usages of LED chips of different efficacy (lm/W) and lumen packages, and thermal management design.

Figure 3: Data - CRI



The maximum value observed was 87 and minimum value observed was 61. The data variation is not much if we compare Maximum, Minimum and Median data of each year and is mainly due to good colour properties of LED chip.

PG Program of Master of Illumination Engineering. Also at the under graduate level, the Illumination Engineering is being taught as an elective subject.  
 2. Manipal University: Manipal Institute of Technology

A two years' MTech Program in Energy Management, Auditing & Lighting is being conducted by the Department of Electrical and Electronics Engineering. One subject as elective in the Illumination Technology at BE level

is also being offered at this institute.  
 3. MIT School of Technology Management (Lighting & Energy), Pune  
 PG Diploma in Management (Lighting Technology & Energy



**TRANSTRON**  
transforming energy efficiently



- **Established in 1998**
- **Modern Plant 60 Kms from New Delhi**
- **Strict quality Standards**
- **Top Quality Standards**

### **Product Range:**

- Power Transformers
- Distribution Transformers
- Furnace Duty Transformers
- Double Output Transformers
- Custom made Products
- B.I.S. Approved

**Leading Manufacturer of Power & Distribution Transformers from India**

Products are designed, manufactured and tested strictly as per IS-1180 (2014)/ IS-2026 / BS-11171 / IEC-60076 standards.

### **TRANSTRON ELECTRICALS PVT. LTD.**

(AN ISO 9001: 2008 Certified Company)

A-1 Industrial Estate, Partapur, Meerut- 250 103, India  
Tel. : +91-121-2440646, 2440647, 2440838, 6532838  
Fax: +91-121-2440646, 2440666  
Email: info@transtron.co.in Website: www.transtron.co.in

**100% RATING  
GUARANTEED**





Management).

Considering the vacuum of lighting professionals, specifically, for the management roles, this unique Techno-Managerial Program is being conducted at MIT, Pune. In this two years full time program, both management and technology have been blended - the majors being lighting and marketing and the minor is energy. The syllabi includes 45 % contents on each marketing management and lighting technology & management and remaining 10 % on energy management.

#### 4. Mumbai / Pune University

Lighting / Illumination as one of the elective subject in BE Electrical Course is being taught at under graduate level in few colleges under Mumbai / Pune University.

#### 5. Architectural & Interior Design Schools

Few colleges like SNTD, Raheja, Rachna Sansad, Mumbai, Bharati Vidyapeeth PG College of Architecture, Pune etc are also teaching lighting – as one of the subjects. Similarly, NIDA Ahmedabad and Delhi also teaches lighting.

### Testing Facilities

In spite of bold claims on performance and life of LED light sources even by multi-nationals, it is a fact that they do not prove to be up to their claims. This has led

to doubt in the mind of the users who opt for LED in spite of high cost. A summary of performance of LEDs in a reputed laboratory is appended in figures 2 and 3.

Considering the varied performance of LED and its aggregates, specifically, which are being dumped in the country from China, Korea and other South Asian Countries, Bureau of Energy Efficiency (BEE), Government of India has already declared LED Light Source under their Star Rating Program. On a study, it is seen that very few accredited testing facilities are available in the country. As such without adequate testing facilities, such programs may not result in effective implementation. Further to improve quality and reliability, there is a need of standardisation with the following objectives:

#### Standards & Regulations

##### Performance characteristics

- Photometry: luminous flux, light intensity distribution
- Color: Chromaticity (cx, cy), Correlated Color Temperature (CCT)
- Color Rendering Index (CRI), Color Uniformity
- Thermal: Light output changes with Temperature Efficacy (Calculated)
- Durability • Lumen maintenance,

color stability

- Subsystem and system efficiency degradation
- Reliability
- Rated life Safety
- Prevention of fire and shock hazards
- Photo biological safety EMC
- Harmonics, surge

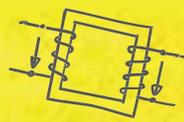
### Conclusion

Although the Government is encouraging industries or institutes or industry associations to develop educational and testing facilities, it has not got satisfactory results. Apart from above to bring confidence in the mind of the users, following aspects also need to be addressed:

- Increase energy efficiency in India to create consumer awareness for LED lamps and luminaires and thereby generate demand for them, to bring down the power consumption at the national level.
- Quality Benchmark Develop Standard and Laboratories for LED Testing, lay down standards for imported and indigenously manufactured parts and create our quality benchmark for exporting Make in India LED products.
- Local demand increase manufacturing capability to cater to the local Indian market



**NEW**



**REDUCED WIRING**

TTR

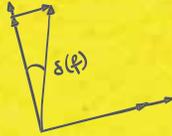
POWER FACTOR

**SPEED UP TESTING**

DEMAGNETIZATION



LEAKAGE REACTANCE



THREE-PHASE TEST SET



**POWER TRANSFORMER**



Cornelius Plath  
Product Manager

## Quicker and easier transformer testing than ever before ...

... was our vision for our new powerful and lightweight test set. **TESTRANO 600** is the world's first portable, three-phase test system which supports all of the common electrical tests done on power transformers.

With just one setup for multiple tests, **TESTRANO 600** significantly reduces the wiring effort and testing time. Its specially designed power amplifiers ensure a new level of accuracy. And the multi-touch color display enables smart and comfortable operation.

Visit us at ELECHEMA 2018, March 10 -14, Hall H1, Stall H1B28

[www.omicronenergy.com/newTESTRANO600](http://www.omicronenergy.com/newTESTRANO600)



## Perspective

to discourage importing sub-standard parts and products.

- Technical advancement keeps the stakeholders aware of recent advancements in the field of LEDs through seminars, conferences, workshops, bulletins on website etc.
- Cost effectiveness be instrumental in bringing down the cost of LEDs in India to make it affordable for commercial and domestic use through monitoring, smart controls and a common pool of resources.
- Global presence provide impetus for India to rise on the world map for quality and safe LED products and its contribution to a cleaner and

greener environment. It is further felt that there is a huge potential for the unemployed rural youth to train them for the operation and maintenance of all these solar systems empowering them to solve their problems at their community level.

Although tremendous scope or potential exists, but considering the present status of MSMEs in solar and LED which includes manufacturers, assemblers, designers, academicians and students, nothing much has been done in this direction to develop infrastructural facilities specifically in the areas of skill development and quality monitoring. An

integrating approach is, therefore, required to promote and form a consortium of solar, and LED professionals or MSMEs. Although Indian Society of Lighting Engineers (ISLE) is instrumental in developing academic courses since 1988, still there appears to be a lack of interest in students and their parents to opt for career in this upcoming field. 



**Dr Prakash Barjatia**

Adviser-MIT School of Technology Management (Lighting & Energy)

Governing Body Member & Director-CIE (India), Indian Society of Lighting Engineers

### ABB Technology Powers Mandela's Prison

Long a prison colony whose most famous inmate was Nelson Mandela, Robben Island, South Africa, is now site of a museum, where former political prisoners serve as guides. But the harsh geography that made the island hard to escape also posed challenges to providing steady electricity – until ABB arrived with a solar-powered solution. A World Heritage Site, Robben Island, lies 9 kilometers off the coast of Cape Town and

previously relied on fuel-thirsty, carbon-emitting diesel generators as the only source of electric power. Now the island, visited by 2,000 tourists a day, is sustainably self-sufficient as a result of a solar-powered ABB microgrid – essentially a small-scale electric grid – that enables Robben Island to run on sun energy at least nine months of the year. The project is part of a sustainable tourism initiative funded by the South African Government.



The microgrid captures energy from solar panels capable of generating 667 kilowatts -- equivalent to the average power needed for about 130 homes.

# CITIZEN METALLOYS LTD.

An ISO 9001, ISO 14001 & BS OHSAS 18001 Company  
Govt. Recg. Star Export House



*Manufacturer of*  
**World Class Quality, Oxygen Free  
& ETP Grade High Conductivity Copper**



## **COPPER FLAT / BUS BARS**

Cross Section area upto 5000 sq.mm.

## **COPPER ROD - (Round, Square, Hexagon)**

Size: Diameter 3 mm to 115 mm

## **COPPER PROFILE / SECTIONS**

Wide range of profiles & sections developed like J,C,L,Z sections etc.

and also can develop as per customer requirements.

## **COPPER COMPONENTS**



### **Processes :**

Cutting, Punching, Bending, Plating, Coating, Sleeving, Turning, Tapping, Twisting, Milling, Drilling, Stud Fixing, Forging, Forming, Ultrasonic Welding and specialized in Cold Forming.

## **EXPORT TO 37+ COUNTRIES**

**"AWARDED FOR EXPORT EXCELLENCE - STAR PERFORMER FOR FOUR CONSECUTIVE YEARS FROM EEPC"**



**10-14 MARCH 2018 Hall 1 | Stall no. H1 B10**

### **Registered Office:**

808, Sukh Sagar Complex, Nr. Hotel Fortune Landmark, Usmanpura, Ahmedabad - 380 013, Gujarat, INDIA.

Tel: +91 79 2755 0272 | 2755 0227 | e-mail: [info@citizenmetalloys.com](mailto:info@citizenmetalloys.com) | [sales@citizenmetalloys.com](mailto:sales@citizenmetalloys.com)

[www.citizenmetalloys.com](http://www.citizenmetalloys.com)





## Dynamic navigation towards nurturing growth ensuring sustenance

**Dynamic Cables Ltd** began its journey 30 years ago by taking up manufacturing of conductors, from those humble beginnings the company has grown into one of the leading manufacturers and suppliers of MV and LV Aerial Bunched Cables, MV & LV XLPE Power Cables, LV PVC Power & Control Cables & ACSR /AAA/AA conductors used for transmission and distribution of electricity. The government is bolstering the power sector in India by providing fresh impetus to the completion of electrification projects apart from commissioning additional capacity. This has helped the overall industry tread on a healthy growth trajectory, informs **Ashish Mangal, Managing Director, Dynamic Cables Ltd** in an interaction with **Electrical India...**

### **Please take us through the journey of Dynamic Cables Ltd..**

Dynamic Cables Ltd were initially formed as a partnership company in 1986, as “Dynamic Engineers”. We were manufacturing only super enamelled and DPC wires for the transformer industry till about 1995-96, whereupon, we started manufacturing overheads conductors to cater to requirements of majority of electricity boards in India.

With quality products and excellent customer services, we started getting queries of other related products also from the present customers as well as new prospective clients. This prompted us to plan a major

expansion project in the year 2003, whereupon, we decided to enter into cable segment, especially, the aerial bunched cable. The unit was successfully established in the year 2006.

Planning forward, we started work on our next expansion in the year 2007 and the third unit, spread over 100000 sq ft was established in Vishwakarma Industrial Area (Jaipur) to manufacture LT and HT cables up to 33 KV, using Sioplas technology. With increasing demand from the market, we planned our fourth unit. This unit had been planned in the year 2016 over an area of 200000 sq ft and is established at Khatushyamji Industrial Area, Reengus, Rajasthan. The

plant is expected to be operational by December 2017. With state-of-the-art technology, this plant includes a CCV line with the latest Dry Curing technology to manufacture XLPE cables with online curing.

Our biggest asset towards realization of these milestones has been the support of a dedicated & motivated workforce, which is a perfect mix of technical, managerial & operational personnel, which in turn give the company a solid base for further growth and expansion.

**What are the products offered by the company catering to power industry?**

Currently, our product range caters to the Distribution & Transmission Sector and comprises of LT & HT XLPE/PVC power cables, LT & HT XLPE Aerial bunched cables, LT PVC Control Cables, Communication cables, ACSR, AA, AAA & bare/Insulated copper conductors. We are also manufacturing and supplying the AL 59 type of conductors, these types of conductors are a new invention in the conductors industry. With our new Reengus plant getting operational by December 2017, we will be proudly adding the 66 KV high voltage cables to the existing range of cables.

**What is the current scenario in cables and conductors segment?**

The cable and conductor industry is highly capital intensive. A lot of capital is required to set up plants and machineries and then there is gestation period of about couple of years, before you can actually start producing and the capital has cost attached to it. Hence, this kind of industry requires a lot of patience, market intelligence, customer service (to retain and expand) and finally quality products to keep your plants working. Yet, power is one of the most critical components of infrastructure crucial for the economic growth and welfare of nations. The existence and development of adequate infrastructure is essential for sustained growth of the Indian economy. Hence, the government is bolstering the power sector in India by providing fresh impetus to the completion of electrification projects apart from commissioning additional capacity. This has helped the overall industry tread on a healthy growth trajectory. All in all there is a huge growth potential for the wire and cable sector in the years to come not only in India but also in various developing countries as well.

**How is your cable vertical performing in the market?**

If we talk about the markets, we forayed into cables during 2006. We were successful in getting orders from EPC contractors which is a big sector in the

power transmission and distribution industry. Our mainstay still is supplying to Electricity utility Boards in India and overseas. Our overseas markets have grown gradually and at present we are supplying to around 30 countries, consistently adding on 3-4 more countries per year.

Our main focus was on building a solid base on which we can capitalize through our comprehensive cables portfolio to expand and globalize the Dynamic Cables Ltd. brand. For FY 2016-17, our turnover has been around INR 331 crore, out of which almost 40 per cent is conductors and 60 per cent is cables. In view of the above, our cable vertical is performing admirably and with new products in the pipeline, we will be looking to add more volume and revenue from the cables segment not only in India but also from exports. Dynamic Cables Ltd has recently been bestowed with Rajasthan State Award for Export Excellence for stellar performance in exports for 2013-14 by Rajasthan Government.

**What technological innovations would like to incorporate in your products in order to make them more superior and competitive as compared to your peers?**

We have been continuously working towards providing a world class product to our customers. Our facilities that are ISO 9001:2015 & OHSAS ISO 14001 compliant enable us to ensure this. Our products are regularly type tested from internationally recognized testing labs like CPRI & ERDA. Our main USP has always been that we offer high quality products with highly competitive prices and an excellent delivery service backed up by highly qualified personnel that are supportive on every step of order execution. We also offer customizable solutions to our clients based on their specific requirements.

The new plant which will be an amalgamation of Indo-German technology with state-of-the-art equipment and a world class internal testing lab shall also further help us establish a benchmark in technological advancement, production, testing, environment & manpower safety standards and thus help us achieve a definitive edge over our peers.

**What kind of modern technologies are in demand in India now-a-days as far as cable segment is concerned?**

With the Indian Government proposing to build smart cities across, the emphasis is now more on energy saving hardware, fibre optics, fire survival cables and state-of-the-art quality standards in cities. With our strategy towards setting up a fibre optic plant, we



wish to cater to this requirement as currently there are only a handful of manufacturers in this space.

Further, impetus by India and other countries on renewable energy has given solar and wind energy sector a new lease of life. Due to this the requirement of solar dc cables and flexible cables, torsion cables has been generated worldwide. Many solar parks and wind farms are currently being setup and this development is a positive one as focus has shifted towards developing renewable Energy and opens up a new market for cable manufacturers.

Further, in India emphasis has been given on rural electrification and distribution and strengthening and upgrading of the current electric grid system, hence the demand for High Voltage (HV) and Extra High Voltage cables (EHV) is developing. In short, with the constant evolution of the transmission and distribution systems, there will always be an evolution in cable technology.

**With regards to cable industry, what challenges and issues do you see as affecting the growth of the industry?**

To sustain the envisaged annual GDP growth rate of around 8-9 per cent over the next 20 years, India will be required to increase the electricity generation capacity from around 180 GW presently to over 800 GW by 2032. This would require a matching up gradation and enhancement of the electricity transmission & distribution (T&D) segment. The opportunity is humongous and so are the challenges being faced by the industry. Some of them include:

- Lack of domestic availability of critical inputs/Raw materials
- Skill gap and manpower issue
- Lack of standardization of product specifications and design parameters
- Inadequate domestic testing and calibrating infrastructure
- Bureaucratic hurdles as most of the clients are either state or central government

- Absence of culture of innovation and R & D in industry
- Strong competition from neighbouring countries
- Land acquisition issues
- Low levels of exports

**What kind of opportunities do you envisage for your company with the government's project of 100 smart cities, 'power for all' scheme etc?**

100 smart cities project is a boon to the cables industry as the scope lies in modernised sub stations, underground power distribution & robust IT connectivity and digitization. Dynamic Cables Ltd is already supplying to various private companies which are executing various electrification centric projects in selected cities. With our product range and established terms with private contractors, we are aiming towards catering to the Infrastructure sector as well as the power sector.

**How was the last fiscal? What kind of turnover do you envisage for 2017-18 fiscal? Do you have any expansion plans?**

Our growth has been cautious and consistent over the past decade. For the past three years, we have been able to consolidate our earnings which have resulted in a steady increase in our turnover. With an increasing overseas footprint and a new plant in the offing, we are targeting to maintain this positive upward trajectory towards not only revenues but also product range and market expansion. This perfect culmination of all aspects has contributed to a 15-20 per cent consistent growth in turnover and we expect the same in the next fiscal year as well. Our proposed turnover target is of INR 360 crore for the fiscal year 2017-18.

**What are your plans to introduce new products?**

With our most technically advanced Reengus plant getting operational by December 2017, the company will add the 66 KV High Voltage cables to the existing range of cables. The next phase is manufacturing 132 KV cables for which the infrastructure is being established.

The company also has plans to manufacture railway signaling cables for RDSO (Research Designs & Standard Organization), a division of Indian Railways. Further plans are also being worked for a new optical fiber cable plant. Through which we can look towards catering to the requirement of Optical Fibre cables in India & overseas. These are planned phases which shall be executed in the coming five years, which would give Dynamic Cables Ltd a formidable and expansive portfolio in coming times. 19



# Innovative Cable Solutions



EN 50618  
CERTIFIED

Over  
1,00,000 KMs  
Installed

**ELECTRON BEAM IRRADIATED SOLAR & WIND MILL CABLES**

**1.8 KVDC, 120° C OPERATING TEMPERATURE EB-XLPE CABLE**

## SOLAR CABLES

- EN 50618:2014, TUV 2PFG 1990/05:12 and TUV 2PFG 1169/08.2007 Certified Cables
- Annealed Tinned Flexible Copper
- XLPO Insulation and XLPO Sheath
- Zero halogen Low smoke
- Electron Beam Crossed Linked
- Ultra Violet Rays and Ozone Resistant
- Rated for 1.8 KV DC operation
- Max operating temperature 120° C
- Cables life > 25 Years

Rodent proof cables also available

DC cables with AL Conductor also available

## COMMUNICATION CABLES

- RS 485 cables
- Single Mode/Multi Mode Fibre Optic Cables

## HT XLPE / LT XLPE CABLES

- 1KV to 66 KV XLPE Cables
- Single Core cables up to 1000 mm<sup>2</sup>
- Multi Core cables up to 400 mm<sup>2</sup>
- Armored or Unarmored type

## PVC POWER and CONTROL CABLES

- Power Cables up to 11 KV
- Control Cables up to 61 Cores

## WIND MILL CABLES

- Largest Supplier of Wind mill Cables in India
- 1.1 KV LT to 33 KV HT Rubber Flexible Cables for Nacelle Application
- Designed to withstand High Torsion Conditions
- Flexible PCP and FRLS CSP, CPE Sheath options
- Electron Beam or Chemical cross linking options
- Good UV and Ozone Resistance and Fire performance
- Reduced bending radius Aluminium Rubber Insulated cables
- XLPE Insulated 1.1 KV to 33 KV cables
- Medium Voltage Covered Conductors

# OUR ESTEEMED CUSTOMERS



**APAR INDUSTRIES LTD.(Unit : Uniflex Cables)**

12/13, Jyoti Wire House, O. Veera Desai Road, Andheri (West), Mumbai - 400 053

Phone: 022-26740001/2/3 Fax: 022-26740600 Email: info.cable@apar.com Web: www.apar.com

# Sustainable Improvement

The sector is rightly poised to witness a strong growth subject to continued policy impetus. The tremors of the state's unilateral action could jeopardise the bankability of projects and could risk 175GW renewable plan of the government...



Indian power sector witnessed unprecedented exuberance in mid 2000s and up to early 2010 on account of a massive unserved demand, policy and regulatory reforms, investment conducive policies backed by financial and fiscal incentives. However, this was followed by a phase of rapid decline during 2012-2015, which saw a stagnation in reported demand, dwindling financial health of utilities, surging bad debts and stranded investments. All this left the sector with billions in non-performing assets, eroded investor confidence and investors struggling

to meet operating costs, let alone service debt. The new government in 2014 acted fast, drawing up mission mode plans and execution of those plans. As a result, the sector is undergoing a revival phase and is likely to emerge more mature and stronger. Some of these initiatives include:

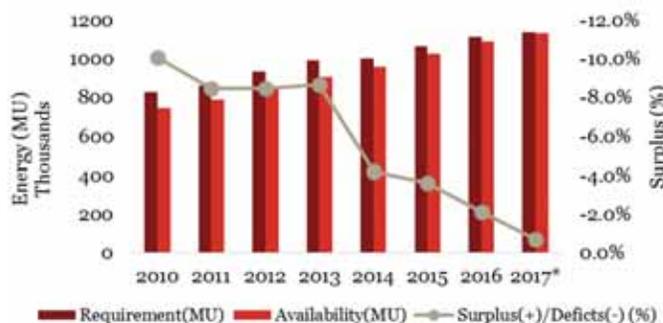
- The UDAY scheme aimed at a one-time clean-up of the balance sheets of the distribution utilities, coupled with a recovery plan, agreement on performance targets to be achieved, and with a constant monitoring framework;

- A insolvency and bankruptcy code to revive stagnated projects and support the banking sector;
- Massive thrust to add RE, coupled with transparent competition to discover competitive tariffs; and
- Initiating deliberations of decade old acts and policies including scrapping of financial incentives in viable sectors

Sustained efforts in improving country's energy security, energy equity and environmental sustainability. As a result, India has improved its global position in key indicators (i) moving from 99th position (2014) to 26th position (2016) in 'Getting Electricity' indicator in the World Bank's Doing Business 2017 Report and (ii) moving from 115th position (2011) to 91st position (2016) in the World Energy Council's Energy Trilemma Index.

### Trends defining Market scenario

Demand seems to stagnating but there is scope to increase demand



Demand growth over the last 5 years has not taken off as anticipated. Energy requirement in FY2016-17 grew ~ 3% against a projected 9%, while peak demand growth was half of the anticipated growth rate (pegged at 8%). While it has been reported that the country will experience peak (7%) and energy surplus (9%) first time in history; 240 million Indians do not have access to electricity (Bloomberg – January 2017) which is 17% of our population. On other hand, per-capita consumption of electricity is far lower than similar large emerging economies (BRICS) with ~ 240 million people without access to electricity.

**Long term power sale opportunities have dried up leading to lower capacity utilizations of existing thermal power plants**

In India, bulk of power is sold through long term contracts. With merchant prices lower than cost of generation, pure merchant power plants are unviable.

The last long term procurement of power through competitive bidding (which allows private generators to sell power to distribution utilities) was ~ 3 years ago. No new long term power procurement bid has come up since then. This is partly owing to the falling prices of renewables, rock bottom prices of short term power on exchanges and cash crunch of the distribution utilities to commit payment for additional power in long run.

As a result, utilization of existing assets have come down and a large number of plants commissioned over last 5 years are stranded leading to financial troubles for investors and lenders. The stress on thermal power sector is compounded by lack of evacuation facilities especially in case of change in destination to sell power (our existing policies are quite stringent and flexibility is hard to achieve) and backing down of generation as distribution companies do not draw power due to low merchant tariffs and liquidity issues.

### Renewable capacities will denominate in terms of new capacity additions

At 59 GW capacity additions in renewables has been strong - installed capacity of grid connected renewable energy is 59 GW (as of August 2017), tariffs are affordable - solar and wind is now cheaper than thermal power even without any financial incentives and investor confidence is strong – FDI of USD 1.8 billion in renewable energy sector in just over two years (April 2014 – September 2016).

Draft National Electricity Plan (2016) states that no thermal power capacity shall be added till 2027. Renewable energy growth, thus, will continue and this will lead to slowdown in thermal power sector.

### Government's Initiatives for Sector

Government has implemented (or in the process of implementing) some key policy and structural reforms. The initiatives were aimed at sustainable improvement of the overall sector, set a roadmap for next 15 years and enhance transparency in allocation and usage of national resources. Some of the initiatives include:

- Design and implementation of e-auction process for transparent allocation of coal blocks
- Implement policy to use of washed coal in power plants where coal is transported for more than 500 km as a climate change initiative.



- Implementing auction process for awarding long term fuel supply agreements to power, steel and cement industries.
- Clean Coal Tax (Carbon Tax) increased to INR 400 per tonne (2016) from INR 50/ tonne in 2014 which is used to promote renewable investments
- New flexible policy on FSA and coal swapping for state power utilities
- Improving productivity of Coal India, resulting in reduction in coal imports (savings of USD 4 billion)
- Investment into better and modern coal handling, evaluation and transportation facilities.
- New stringent climate change norms notified for thermal power plants SOx and NOx emissions and water usage. It is envisaged that plants would have to invest Rs. 0.5 - Rs. 0.75 lacs in order to meet the new standards.
- Zero import thrust for state power plants
- Notification of draft cross border electricity trade agreement to enhance energy cooperation within SAARC, ASEAN and BBIN nations
- Successful launch and implementation of UDAY Scheme to provide impetus to power sector
- Demand and consumer focussed programmes such as "24 x 7 Power for all" and Saubhagya Scheme aims at increasing the power demand by providing electricity access to all on a mission mode basis
- Initiatives (URJA, GARV, MITRA and Discovery of Efficient Electricity Prices) to promote infrastructure upgrade, technology adoption and digitization and IT enabled decision making in power distribution.

## Opportunities

### Distressed assets sale and resolution

Government of India notified the Bankruptcy Code to allow lenders to take over control and attempt to

turnaround the assets through appointment of independent resolution professionals. In case, no turnaround plan is implemented within six months (extendable by additional three months), assets would be liquidated through a transparent auction process. This would offer PSUs or state utilities or financial institutions to take over generation assets at low valuation, turnaround the assets and thus, reviving the massive stressed assets.

### R&M and replacement of old assets

Central Electricity Authority (CEA) had identified 72 units (16.5 GW) for Life Extension (LE) works and 23 units (4,971 MW) for R&M (FY2012 to FY 2017). A large number of them are almost 40 years old and approaching end of their useful technical life span. According to Association of Power Producers, 188 out of a total 396 TPPs in India (i.e. nearly 35%), are more than 25 years old (economic life span).

These plants are less efficient, consuming more coal, producing less power (operating PLFs of less than 40%) and are a major contributor to air pollution. However, little progress has been made with constraints of funding, time and cost overruns. Rehabilitation and replacement of these old power plants would save in cost of land and select balance of plant equipment and also reduce hassles of land acquisition and lengthy clearance processes.

### Coal mining, benefaction and washing

In order to boost domestic coal mining, private sector participation is planned to be allowed in mine development, construction and transportation for commercial sale. However, the pricing and the cost of coal mining among other things are still under debate. Once draft guidelines are finalized it can open new doors of business for the investors. In addition to this, private mining companies have opportunities to participate in MDO bids awarded by states or PSU for newly awarded coal mines. New stringent coal norms have now been put into place, which includes:

- Use of beneficiated coals (with ash content < 34%) in power plants in urban and sensitive areas.
- Coal transported over 500 km distance to be washed prior to usage,

Both of these new norms offer new opportunities.

## Challenges

### Sale and tariff

The challenge for thermal power plant is to sell



## Best way to predict future is to design it.

Founded in 1956, the HPL Group is an established player in Indian electrical industry with a commitment to modern technology for manufacturing electric equipments. HPL Group has been serving the nation for the last 59 years modern & trusted products. The HPL range of products are quality products that are technologically upgraded and enjoys significant brand recall and customer loyalty in the LV switchgear market, increasing its presence across other switchgear products in the industrial and residential segments.



**Switchgear**



**Metering**



**MCB & DB**



**Wires & Cables**



**LED Lighting**



**Modular Switch**



power at cost reflective prices. This is not possible at the exchange where electricity is traded as low as 50% of the overall average cost of generation. The inability of the Discoms to sign new long-term PPAs has compounded the problem leading to loss of investor confidence in thermal power assets.

## Stress assets

Stress assets in power sector (bulk of which is due to thermal power projects) contributes to around 17% of the overall lending of the banks. The industry has not seen any major deal activity in case of debt laden thermal power assets under cases of Strategic Debt Restructuring (SDR) and Corporate Debt Restructuring (CDR). Leading power players Tata Power and Adani Power have not been able to offload stakes in their troubled thermal power projects in Mundra. RBI in its Report forecasts a further rise of NPAs from 9.6% in March 2017 to 10.2% in March 2018. The Insolvency & Bankruptcy Code, 2016 aimed at improving the ease of doing Business by reducing not only NPAs but also delays in resolution of bankruptcy cases & recovery of debt. But nothing has been seen turning heads on the ground as of now.

## Low domestic gas production

Out of ~24 GW gas-based power plants in India, 14.3 GW are stranded or partly inoperative because of paucity of gas. All India average PLF of gas based power plants is ~ 22.51% in FY 2017. The subsidized imported R-LNG available to these plants under PSDF Scheme through e-Auction route has been discontinued since April 2017. Petronet LNG and RasGas Co. Ltd. are in talks to create a SPV that will provide gas to revive these distressed units. If not resolved, this might result in a further investment of INR 60,000 crore turning NPAs.

Additionally, there are further challenges pertaining to lack of evacuation infrastructure, land acquisition, contracts which falter in case of unforeseen risks, bankrupt investors, change in international law affecting viability of assets in India, lack of proper arbitration and dispute resolution mechanism (judicial process takes long time), state ownership of utilities (who do not operate efficiently or on prudent business principles) and politicization of power tariffs (thus sending wrong signals to both consumers & investors).

## Market Outlook

- Implementation of Bankruptcy Code and subsequent plan of liquidation of assets has attracted investors to re-look at thermal power sector. Some of these investors come with deep pockets and/or operational expertise, such as Tata-ICICI-CDPO, Piramal-Bain, Apollo and Brookfields. This is a positive signal, even though there has not been any major deal activity yet.
- However, the stressed assets problem in the sector is less likely to abate without PPAs getting signed and demand being boosted. As the financial stability of discoms improves through UDAY and electricity demand picks up again opportunities for power sale will pick up. Policy makers have also been working on a framework to enable sale of power for stressed assets.

**The stressed assets problem in the thermal power sector is less likely to abate without PPAs getting signed and demand being boosted.**

- In past, we have witnessed issues with coal production which may crop up once stranded capacities start operationalizing. Monopoly in a sector will create performance and price issues in future. Thus, it is important that initiatives such as allowing commercial mining and captive coal block auctions should move forward.

Thermal power plants would continue to serve as base load power plants in a country like India. Grid connected renewables do have limitations as they will require additional investment in grid, hydro or gas based peaking plants to manage the variable nature of power from renewables (solar/ wind).

However, falling prices of renewable power, stringent environmental norms requiring additional investment and low operating efficiencies due to evacuation, merit order (renewable plants with must run status), fuel (in past) and power sale related constraints will have an impact on the overall growth expectations of thermal power sector. 



**Chandan Mishra**

Director  
Power & Utilities, PwC, Mumbai

# High-tech cables & systems

for rolling stock  
applications in tropical  
and hot climates

Circuit integrity up to  
**180 minutes**



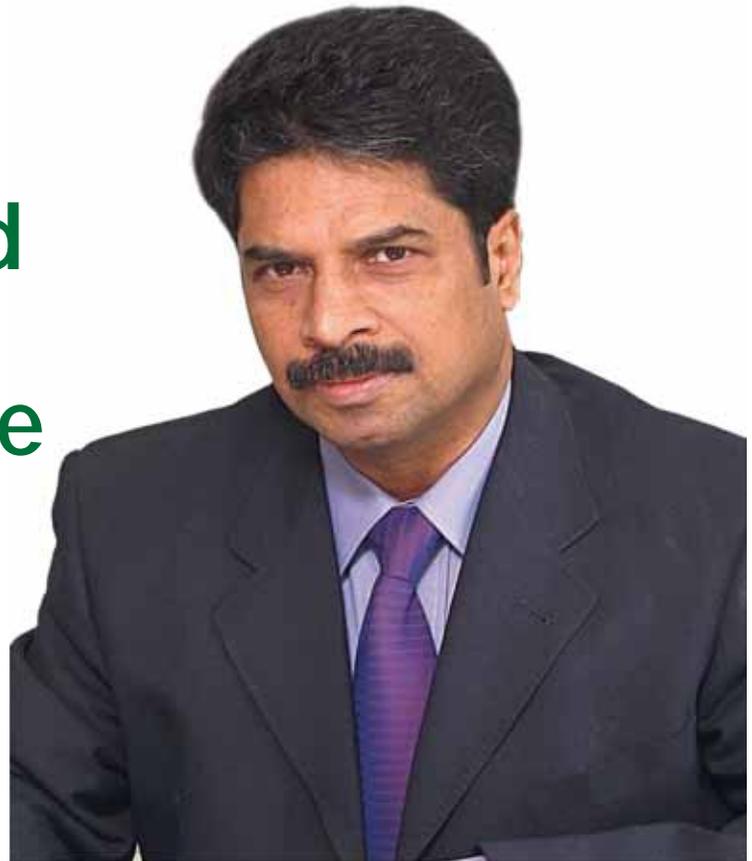
**BETAtrans® GKW**  
**BETAtrans® GKW-INX**  
**BETAtrans® GKW FE180**

**Intrinsic fire proof and  
fire survival cables**

- Irradiation cross-linked
- Flame-retardant
- Halogen-free
- EN 50200
- BS 6387
- IEC 60331
- EN 45545
- PN-K-02511
- UIC 564-2
- GOST 31565
- GOST R 54965-2012
- NFPA-130:2010
- RDSO ELRS-0019 rev.2

**LEONI**

# “Concentrated efforts can certainly make India a major hub for renewable energy”



With enhanced target of achieving 175 gigawatts of clean energy by 2022, it is necessary to ensure policy stability, continuity and improve the financial health of electricity utilities. With only five years left to reach 2022, our achievement is 46 GW. That means in the remaining five years, we need average annual capacity addition of 25 GW. It is a herculean task, informs **G M Pillai, IAS, Founder Director General, World Institute of Sustainable Energy (WISE)** in an interaction with **Electrical India...**

## **What kind of role does WISE play to achieve goals of sustainable energy in India?**

WISE is mainly engaged in facilitating development of sustainable energy in India through our contributions in four major areas: Policy and regulatory analysis and intervention, consultancy support to investors, developers and industry, training of professionals in the sector and outreach dissemination of knowledge and information. As a pioneering institution working in the sector since 2004, we have undertaken

numerous initiatives and projects in all these areas.

## **Following climate commitments made at the Paris Summit, the Indian Government gears up to achieve 175 gigawatts of clean energy by 2022. According to you, what kind of potential will it generate for Indian renewable energy sector?**

Certainly, it is a massive leap forward in terms of objectives and targets. Aiming very high is a good thing to keep everybody on their toes. This target will result in huge market expansion which in turn could

result in increased investments in all areas from R&D, manufacturing and capacity installation. Besides, renewable sector is employment intensive and will hence generate sizeable job opportunities. Along with this enhanced target, it is necessary to ensure policy stability, continuity and improve the financial health of electricity utilities. With only five years left to reach 2022, our achievement is 46 GW. That means in the remaining five years, we need average annual capacity addition of 25 GW. It is a herculean task.

**What are the initiatives taken by the government for generating the momentum in the sector?**

First and foremost, the decision to go in for competitive bidding will help in discovering the real cost and advancing the achievement of grid parity by wind and solar power. From the latest round of competitive bidding, one can say that these two technologies have already achieved grid parity. The flipside to the bidding process could be unhealthy competition, which I believe will even out in the medium-term. Another important step is to encourage SECI and major PSUs to invest in the sector. Investment by the public sector is a standard practice in many countries to promote new technologies. A third major initiative has been the UDAY scheme to revitalize the financial health of the public sector electric utilities in the country. That scheme needs to be taken to its logical conclusion with the support and cooperation of the state governments. When financial health of the utilities is restored, it will ensure payment security to investors.

**Can India become a renewable energy hub with these initiatives? Please elaborate.**

For India to become a renewable energy hub, we perhaps need to do much more. Low tariffs in competitive bids have prompted the electricity regulatory commissions to re-visit the Feed-In-Tariffs set by them. The capacity realized through bidding is only a portion of the annual needed capacity additions. The remaining will have to come from investors in the open market. If and when the regulators downsize the FIT, which will be soon, it could erode the return on investments and in turn dampen investments.

Already, except for those IPP investors sourcing low-cost finance from abroad, the returns are poor compared to many other sectors. One major step which can kick start investments is an interest subsidy to domestic debt for the RE sector. Agreed that the prognosis in the country for interest rates is a trajectory of gradual lowering, but it doesn't always get reflected adequately for loans. I have been proposing for many years that the clean energy cess collected from coal should be utilized for subsidizing RE debt. Unfortunately, that cess money is being diverted for other purposes. India also needs to invest more in R&D, build up a strong solar manufacturing base-covering the entire value chain and focus on exports.

**For India to become a renewable energy hub, we perhaps need to do much more. Low tariffs in competitive bids have prompted the electricity regulatory commissions to re-visit the Feed-In-Tariffs set by them. The capacity realized through bidding is only a portion of the annual needed capacity additions.**

Concentrated efforts on all these areas can certainly make India a major hub for renewable energy development.

**What are the stumbling blocks in achievement of targets by 2022? According to you, what are the solutions for tackling of these hurdles?**

In my answer to the previous question, I have given answers to many points which need to be covered here – both hurdles and solutions. In addition, I would think that while the Central government is on the right path, many state governments don't share the same enthusiasm. This has been a perpetual problem arising from a lack of vision about the future at the state level. Many among the provincial leadership still believe that business-as-usual will continue forever. This mind set has been the main stumbling block and it is the most difficult barrier to overcome. Even though mandated by law, open access connectivity for RE power is still a problem in many states. The regulators need to step in to solve this problem by enforcing RPO. The MNRE could take on a more proactive role in identifying grass roots level and local issues and then focus on solving them. Such a nut and bolt approach can go a long way in really mainstreaming renewables in the next five years. Talking about a

post-oil world, another ambitious initiative of the government of India is the target for electric mobility. Again a full conversion by 2030 may be too ambitious, but as I said earlier, aiming high is very good. For electric vehicles to be really 'green', the power will have to come from renewable sources. So, it would be great if we can evolve strategies to link growth in electric mobility to enhanced renewable power

**Currently the mature and viable technologies with universal resource availability are wind and solar power. There is no point in grading any one technology as good or bad. As far as the economics goes, we should leave it to the market to determine who will survive or whether all will survive in a multiverse of renewables.**

generation. There are many ways of doing this, which I do not wish to elaborate here. Another important area is innovation in the area of renewable regulation. With renewables racing to grid parity, the role of regulators in determining FIT will be reduced. They should then discover new areas needing regulatory attention to spur growth in the sector and not to constrain it. Open access is a critical area where regulatory attention would help. Mainstreaming of renewables may also necessitate suitable rationalization of provisions relating to RE in the Electricity Act 2003. So, a comprehensive approach to identifying and solving impediments in the sector would help propel the sector as a major energy and employment provider in our country.

**Which is the best source of energy considering the economics and cost of electricity?**

All renewable sources are essential in a post-fossil fuel world. Many technologies are already mature, and a few are evolving. Currently, the mature and viable technologies with universal resource availability are wind and solar power. There is no point in grading any one technology as good or bad. As far as the economics goes, we should leave it to the market to determine who will survive or whether all will survive in a multiverse of renewables.

**Where does India stand on the global scale in terms of generation of renewable energy?**

As per the REN 21's "Renewables 2017 Global Status Report" the global installed renewable power capacity (excluding hydro) stood at 921GW and that of India is

of 46 GW by the end of 2016. If we add hydro capacity then these figures will stand at 2017 GW and 94GW respectively for the world and India. Globally, the estimated renewable energy share of global electricity production is of 24.5% of which hydro amounts to 16.6%; which means that renewable energy (excluding hydro) contributes 7.9% of the total electricity production in the world. Similarly, in India the renewable power generation accounts to 7.6% of the total electricity generation. So, it is comparable to the global average. In terms of installed capacity, India ranks fifth in the world, behind China, USA,

Germany and Japan. However, China has an installed capacity of 258 GW and India's total installed capacity is less than one fifth of that.

**How can India learn from the experience of other countries and rapidly scale up renewables?**

India has enough learning experience in the sector, since we were an early entrant in the sector and one of the first countries to set up a separate department and ministry for development of renewables. All we need to do is stitch together our act into a coherent framework covering policy, regulation, R&D, manufacturing, low-cost financing, open access, health of electricity utilities etc. It is doable. A comprehensive approach, beyond a target orientation, is all that is required.

**What is your outlook for the renewable energy sector for 2017-18 fiscal?**

The year 2016-2017 saw the peak in capacity installation with 11,320 MW of total RE power generation capacity installed in India. The process of tariff discovery through competitive bidding may temporarily slow down the sector in 2017-18, judging from the capacities installed till October 2017. But this may be a mid-course hurdle in a process of cost discovery. The sector had, in the past, overcome much bigger hurdles.

I am sure they will emerge stronger out of this one also. I don't want to put out any numbers at this point. It is enough to say that the performance of last year may not be repeated this year; though it may be a temporary slowdown.



# Schmersal India Wins Award for Best SME in Machine Safety

The Navabharat SME Business Excellence Award 2017, intends to felicitate the achievements in the SME sector to encourage & support the SMEs ...



Sagar Bhosale, Managing Director, Schmersal India Pvt Ltd, speaking about the need and importance of Industrial Safety at Navabharat SME Business Excellence Award 2017.

Schmersal India wins Award for the Best SME in Machine Safety at the Navabharat SME Business Excellence Award 2017 held in Mumbai on October 28, 2017.

The Navabharat SME Business Excellence Award 2017, intends to felicitate the achievements in the SME sector to encourage & support the SMEs that have the potential to be world-class enterprises and offer them the platform to promote themselves in partnering for sustainable growth. The awards were given in several categories and based on the size of the company, the amount and the type of work performed. It was an evening event, with a Panel Discussion on 'GST & De-monetization - Its impact on SME Sector', followed by awards night in the presence of 200+ delegates like SME Entrepreneurs, Officials from Industrial Association, Government Officials - Shiv Pratap Shukla - Minister of State Finance, Govt of India & Industry Minister of Maharashtra Subhash Desai,

delegates from SME Chambers and Print & electronic media.

Sagar Bhosale, Managing Director, Schmersal India Pvt Ltd, was a speaker at this event. He stated, "The Indian SME sector is growing at an exceptionally fast pace and has truly become the backbone of India's GDP growth." Educating the audience about the need of industrial safety, he made an earnest request to take initiatives in implementing safety at their workplaces.

The jury's citation expressed that the Schmersal India's decade of efforts have been bearing positive results in spreading awareness on industrial safety. Starting from a small office to setting up a manufacturing plant, Schmersal India is excelling and firmly committed and dedicated to improving the safety aspects in the industries across India.

"Receiving an award in safety excellence is really rewarding and it makes me immensely happy that we are able to spread smiles along with safety at the workplace. Despite having won this industry accolade, we will endeavor to pursue our path of turning workplaces into safer places with exceptional determination," expressed Sagar Bhosale. 



Shiv Pratap Shukla, Minister of State Finance, Govt of India and Industry Minister of Maharashtra Subhash Desai handing over the award to the Schmersal India team.

# Hartek Power Bags HVPNL Order for GIS Substation

The scope of the project, which will cater to the power needs of the 31-acre campus includes complete EPC of the 132-KV substation right from survey, design and engineering to supply, construction and project management..



**F**irming up its standing as one of India's prominent transmission and distribution (T&D) companies excelling in adoption of latest technologies, Hartek Power, the Engineering, Procurement and Construction (EPC) arm of the Hartek Group, has bagged a prestigious order from the Haryana Vidyut Prasaran Nigam Ltd (HVPNL) for executing a 132-KV gas-insulated substation at the 31-acre National Cancer Institute of the All-India Institute of Medical Sciences in Jhajjar. The scope of the project includes complete EPC of the 132-KV substation right from survey, design and engineering to supply, construction and project management.

This GIS project, which is scheduled to be completed by September next year, will cater to the electricity requirements of the entire National Cancer Institute campus comprising a 710-bed hospital, 15 laboratories for principal investigators and a separate diagnostics block.

Safer, low-weight, maintenance-free and more reliable with fewer outages, gas-insulated substations have emerged as the preferred choice in large cities, indoor locations, underground stations and hilly areas.

Being set up on the lines of the National Cancer Institute of USA at a cost of ` 2,035 crore in Bhadsa

village of Jhajjar district near Delhi, the AIIMS National Cancer Institute will cater to about 10 lakh patients every year and hire 2,700 employees at full capacity. Said to be the largest public health project of Independent India, the institute will act as a nodal centre for all cancer-related research with linkages with all Regional Cancer Centres of the country.

Terming the HVPNL order as an acknowledgement of Hartek Power's expertise in the EPC of power systems,

Hartek Group Chairman and Managing Director Hartek Singh said, "This GIS project, which happens to be our first one, reflects our commitment to invest in most up-to-date technologies like GIS and thereby, contribute to the country's smooth transition to a smart and more reliable power infrastructure. The first GIS project of Hartek Power, it marks a high point for us in the adoption of the latest know-how."

Hartek Power has created immense value in the T&D value chain, as reflected in its execution of more than 150 high-voltage and extra high-voltage substations and transmission lines. Some of the key projects executed by the company include 13 bays of a 220-KV substation at the first in-house 4x300-MW thermal plant of Reliance Energy at Shahjahanpur, UP, 132-KV substation projects for a 40-MW solar plant in Rajasthan and a 132-KV substation for L&T's 40-MW project at Dhansa, Rajasthan.

An emerging player in renewable energy and a part and parcel of India's solar sector, the company also provides complete solar EPC, turnkey and rooftop solar installation solutions. It has so far connected about 600 MW of solar power to the grid for leading independent power producers. 

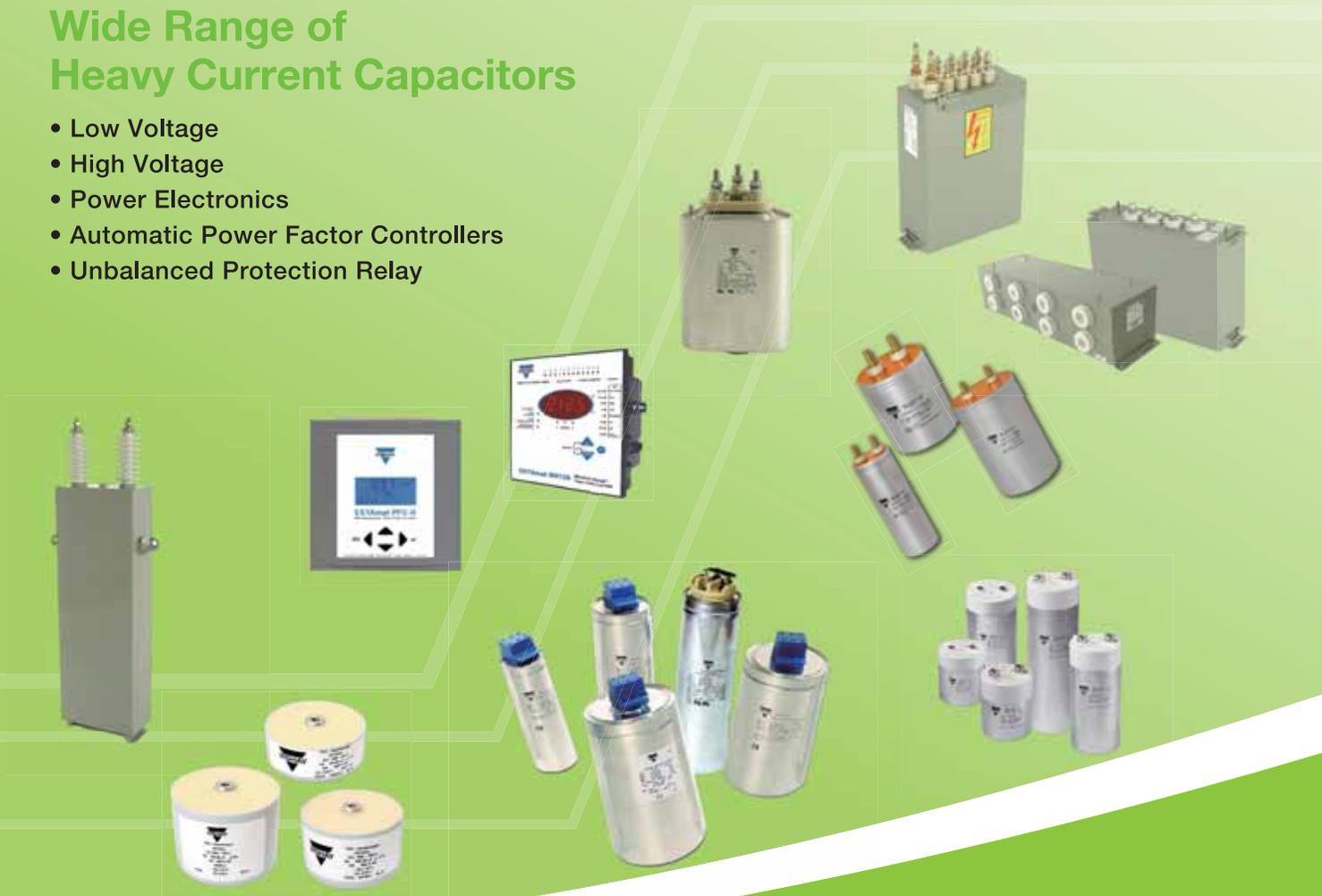


## Vishay ESTA - A Specialist in Power Capacitors

The major focus is on customer-specific high-power solutions and installations. With the latest trends in renewable energy and smart grids, power management requirements and applications are significantly changing. Low-voltage, high-voltage and power electronic capacitors are now more widely used. Vishay ESTA supports customer requirements with the focus on these products.

### Wide Range of Heavy Current Capacitors

- Low Voltage
- High Voltage
- Power Electronics
- Automatic Power Factor Controllers
- Unbalanced Protection Relay



One of the World's Largest Manufacturers of  
**Discrete Semiconductors and Passive Components**

**Vishay Components India Private Limited**

Loni-Kalbhor, Near Pune (C Rly) Pune 412201, India • T: +91 20 26913285/39215500 • Email: ESTAsales@vishay.com  
<http://www.vishay.com/capacitors/power-heavy-current>

# Nuclear Energy & Challenge for India

The challenge for the nuclear community is to assure that nuclear power remains a viable option in meeting the energy requirements of the next century. It could be a major provider of electricity for base load as well as for urban transport in megacities. It can play a role in non-electric applications in district heating, process industries, maritime transport...



**“We should create a world where the environment doesn’t need protection”.**

India's present electricity generation capacity is grossly inadequate to meet needs of the industries as well as of the rural and urban households even for the current population. As a result, the country is witnessing routine load-shedding and a very large number of villages even do not have electricity connections. Moreover, if the country has to achieve a somewhat higher

economic growth rate for the rising population, the electricity generation capacity has to increase considerably in the coming years and for this we need to fully exploit all options that are available. The option of hydrocarbon based fuels, which has maximum share in the electricity generation, is known to have adverse effect on the climate and the international community is deeply concerned about it. Also, when the known resources of these fossil fuels get scarce in a not very distant future and the renewable sources alone are not able to fill the deficit, there may be no choice left except to fully exploit the nuclear energy option. In some developed countries, a large fraction of its electricity production is already from nuclear energy. Therefore, a major goal of the Department of Atomic Energy (DAE) in India has been to carry out research and development in this field to develop the required technologies to harness nuclear energy and to install nuclear power stations. While India is vigorously pursuing the nuclear energy programme, nuclear energy has always been a subject of much debate world-wide including India.

Furthermore, rising oil prices and growing environmental concerns over the last decade have led to a reconsideration of sustainable energy fuels. In this context, nuclear power has resurfaced as a keen contender for large-scale energy generation.

India has an installed electricity generation capacity of 274 GW; whereas, it presently requires 1,100 billion kWh of electricity, which is stated to go up to 1,524

billion kWh by 2016-17, 2,118 billion kWh by 2021-22 and 3,880 billion kWh by 2031-32 considering an average GDP growth rate of 8%. As a measure to bridge this gaping hole, India has been investing heavily to augment its nuclear power generation capacity. It has already installed a few nuclear reactors and is in the process of setting up a few more. India initially plans to increase its nuclear electricity generation from present 5,780 MW to 63 GW by 2032, but the target was revised in 2011 to a more realistic 27.5 GW. The Atomic

**The challenge for the nuclear community is to assure that nuclear power remains a viable option in meeting the energy requirements of the next century. It could be a major provider of electricity for base load as well as for urban transport in megacities.**

Energy Commission envisages a target of 500 GW of nuclear energy generation by 2060.

In India, there are 22 operating commercial nuclear power reactors with an installed capacity of 6,780 MW. At the end of August 2017 gross generation is 14,380 million units having capacity factor 63% and availability factor 65%. The reactor fleet comprises two Boiling Water Reactors (BWRs) and 18 Pressurised Heavy Water Reactors (PHWRs) including one 100 MW PHWR at Rajasthan which is owned by DAE, Government of India and two 1000 MW VVER reactor KKNPS-1&2, in this, latest addition to the fleet is the unit-2 of Kudankulam Nuclear Power Station, a 1000 MW VVER (Pressurised Water Reactor type), which has started its commercial operation on March 31, 2017. Currently, NPCIL has eight reactors

under various stages of construction totaling 6,200 MW capacities.

Several analysts have argued that given India's limited and low-grade uranium reserves, the development of the nuclear programme beyond 10,000 MWe would imply increasing dependence on uranium imports. However, this viewpoint tends to overlook the logic of India's three stage nuclear power programme planned by Dr Homi Bhabha, which envisages large-scale utilization of India's significant thorium reserves.

It is in order to tide over the transition from fast breeder reactors to the thorium cycle that India needs uranium. Therefore, unlike the case of coal or oil or gas, where imports appear to be a permanent reality, uranium dependency would be for a limited period of time till India graduates to the thorium cycle. As far as India's three stage nuclear power generation is concerned, we are just at the beginning of the second stage. India is among the very few countries pursuing this technology.

## Potential of Nuclear Power

The challenge for the nuclear community is to assure that nuclear power remains a viable option in meeting the energy requirements of the next century. It could be a major provider of electricity for base load as well as for urban transport in megacities.

It can play a role in non-electric applications in district heating, process industries, maritime transport, water desalination, hydrogen production, and for applications in remote areas. It can contribute substantially to security of energy supply and it has the potential to be an almost inexhaustible long-term energy resource through the use of breeder reactors.

However, the current lack of public support could unquestionably constrain the introduction of new plants. It will be necessary to openly discuss the concerns that have limited nuclear power's acceptance. But discussions of health and environmental impacts along with severe accidents and waste disposal must not be done in isolation as is too frequently the case. As no energy source is risk free, comparative impacts of the various energy systems must be extensively reviewed. Studies of nuclear, fossil, and renewable energy chains show that there are significant issues and impacts inherent in all options.

Authoritative comparative assessments illustrate the potential of nuclear power to mitigate energy-related health and environmental damage—it can be shown to be one of the most environmentally acceptable means of generating electricity. If external factors such as the societal costs of climate change, environmental damage, and health effects were included in all analyses, a clear nuclear advantage would arise over fossil fuels and the economic competitiveness of nuclear power

in a radically changing financial environment would escalate.

If a significant contribution from nuclear power is to take place by the middle of the next century, a large amount of new generating capacity would be required averaging as high as 20 new units annually. There are a number of issues relevant to the fuel cycle and the type of reactor desired that must be dealt with now, in order to provide the best conditions for an increased nuclear role. They included those brought about by slowdown in nuclear power growth and large amounts of plutonium expected to be recovered from dismantled nuclear warheads. In an increasingly competitive and international global energy market, a number of key factors will affect not only the energy choice but also the extent and manner in which different energy sources are discussed below. These include optimal use of available resources, reduction of overall costs, minimizing environmental impacts, convincing demonstration of safety and meeting national and global policy needs.

For nuclear energy, these factors will determine the future fuel cycle and reactor strategies. Obtaining public acceptance has not been included as a key factor; it is in reality a vital one for nuclear energy. It will be necessary to communicate the real benefits of nuclear power to the public and policy makers in an open and credible manner.

### **a) Maximizing Resource Utilization**

Known and likely resources of uranium should assure a sufficient

nuclear fuel supply in the short and medium term even with reactors operating primarily on once-through cycles with disposal of spent fuel. However, as uranium demand increases and reserves are decreased to meet the requirements of increased nuclear capacity, there will be economic pressure for the optimal use of uranium in a manner that utilizes its total potential energy content per unit quantity of ore. A variety of means is available to accomplish this during the enrichment process and at the operational stage. Over the longer term, recycling of generated fissionable material in thermal reactors and introduction of fast breeder reactors will be necessary. Thorium could also be a valuable energy resource in the longer term.

### **b) Uranium Fuel Cycle**

Isotopic separation technology enables lowering the U-235 content in the enrichment process waste tailings. This results in extraction of more of the original 0.7% fraction of this fissionable isotope existing in the natural uranium ore that consists primarily of non-fissionable U-238. At the operational stage, higher fuel burn-up cycles will utilize more of the U-235 contained in the enriched uranium fuel elements - concurrently reducing the amount of spent fuel relative to the energy produced. However, reprocessing of spent fuel instead of disposal would allow the recycling of generated plutonium through mixed oxide fuel in thermal reactors as well as in fast breeder reactors and also make available uranium with its fissionable



## MANUFACTURER & EXPORTERS OF :

- ACSR,AAA & AA Conductors
- HT & LT Aerial Bunched Cables
- HT & LT XLPE UG Power Cables
- LT PVC Power & Control Cables
- Bare & Insulated Copper Conductors
- Airdac, Communication & Concentric Cables
- Solar Power Cables
- FR/FRLS/LSZH Cables



# Dynamic Cables Ltd.

(A Govt Recognised Export house)

-An ISO 9001:2015 Company -

**Established in 1986 : Three decades of excellence**

**Widely accepted by:**

Major Discoms & EPC Contractors.

NTPC , PGCIL , BHEL and many more.

Power Utility Companies.

EPC Consultants.

Industrial Projects in India & Abroad.

[www.dynamiccables.co.in](http://www.dynamiccables.co.in) | [info@dynamiccables.co.in](mailto:info@dynamiccables.co.in)

Contact : Mrs. Pretty Agrawal | Sr. Manager (Marketing)

Email: [pretty@dynamiccables.co.in](mailto:pretty@dynamiccables.co.in)

Mob : +91 9001805444 | Tel: +91 141 4042005

JAIPUR

NEW DELHI

MUMBAI

HYDERABAD

KOLKATA



isotopes that are contained in spent fuel. Reprocessing would significantly increase the energy potential of today's uranium resources - theoretically by a factor of around 70-and also substantially reduce the quantity of troublesome long-lived radioactive elements in the remaining waste. By far, recycling provides the best use of available uranium resources. The current policy of interim spent fuel storage before ultimate disposal preserves the potential for future reprocessing to extract fissionable material, particularly plutonium.

#### **c) Thorium Fuel Cycle**

Although uranium is likely to remain the main natural resource for nuclear power systems, in the longer term the use of fertile thorium as a feed material is possible. While uranium contains a fissionable isotope, thorium does not. It must be enriched with either fissionable U-235 or plutonium to start the fuel cycle. The U-233 that is subsequently generated in the reactor from thorium conversion is fissionable. The thorium fuel

cycle, with its lower operating fuel temperatures, has advantages in the physical performance of fuel elements and also with respect to the characteristics of the core physics. The existence of indigenous thorium in a number of countries that have limited uranium deposits would make this an attractive option. Thorium-based fuel cycles have been developed in a number of countries. The thorium fuel cycle can be used in all types of current systems-light and heavy water as well as high temperature gas and fast reactors without requiring significant changes in the reactor design or safety concepts. However, present knowledge of the extent of thorium resources in the world is poor even though extensive deposits with high grade ore have been found. Extraction of thorium from ores is a somewhat difficult process, and its economics are not established. There are also difficulties of separation of the produced U-233 from the spent fuel. But the remaining waste is

significantly easier to deal with than the waste from the current uranium based fuel cycle without reprocessing.

#### **d) Maximizing Economic Benefits**

As fuel costs are relatively low, reduction of overall costs by decreasing development, siting, construction, operation, and initial financing expenses is essential to the overall economic viability of nuclear energy. Removing the uncertainties and variability in licensing requirements, particularly, before commissioning, would allow for more predictable investment and financial strategies.

#### **e) Development, Capital Costs**

The high costs associated with new design development will likely result in less expensive evolutionary improvement of today's reactor systems rather than the more expensive introduction of revolutionary new designs and technologies. Governmental development funding has substantially decreased over the years and as

# Pioneer in Silicone Rubber Products in India

## PRODUCT RANGE

Our product range includes **Silicone transparent platinum cured tubings**

- Silicone rubber tubes (ITI Approved) • Transparent tubings • Silicone connector
- Industrial tapes • LED Gaskets • Nozzle • Silicone caps • Silicone washers
- Inflatable gaskets • Cords • Strips • Squares • Profile • Sections • Gaskets • Cables
- O rings • Oil seals • Sponges • Sheets • Autoclave Gaskets • Corona Treater Sleeves
- Braided Hoses • Viton Rubber • Also available as per drawings / specifications.



[www.sevitsil.com](http://www.sevitsil.com)



**SURESH**  
ENTERPRISES

SOLUTIONS IN SILICONE

**ISO 9000-2008 Certified Company**  
C1/55, GIDC Phase-2, Dediyan, Mehsana-384002, Guj, INDIA.  
Phone: +91-2762-224814 / 224240 / 224239  
Sales Head: +91-97277 38001 | Sales Dep.: +91-99250 28109  
Email: [info@sevitsil.com](mailto:info@sevitsil.com), [sevitsil@gmail.com](mailto:sevitsil@gmail.com)





strategies will be needed to meet evolving and changing investment goals. The large initial capital investments required for nuclear power projects could be easier to raise in the framework of multinational funding arrangements. Build, operate and transfer arrangements may be used in developing countries that allow for adequate returns on non-domestic investments before shifting ownership. Incremental investment strategies through modular energy systems would also decrease initial financing needs.

#### **h) Maximizing Environmental Benefits**

Although nuclear energy has distinct advantages over today's fossil burning systems-in terms of fuel consumed, pollutants emitted and waste produced-further reducing environmental concerns can have a major influence on public attitudes. As the overall health and environmental impact of the nuclear fuel cycle is small, attention will be directed at improved techniques to deal with radioactive waste. This would support global sustainable development goals and at the same time increase competitiveness with other energy sources that will be required to adequately deal with their waste. Reactor systems and fuel cycles can be adjusted to minimize waste production. Design requirements to decrease waste quantities and volume reduction techniques such as ultra-compaction will be employed. Advanced technologies to contain and immobilize high-level waste are under development.

with all mature technologies, the source of funding will shift entirely to the private sector.

The need to reduce high initial capital costs will encourage economies in siting and construction. It will lead to multi-unit sites at existing locations that will also maximize infrastructure investments. There will be more emphasis on plants with standardized systems and components as successfully employed in France. Plant size and unit power levels will be matched to regional needs and the choice of suppliers will be based on long-term economics rather than on short-term advantages.

In the operational area, reduction in costs will require high availability and load factors brought about by high quality systems, long core fuel cycle periods, short shutdown times and the ability to rapidly return to power. There will be a continued

evolution of separate organizations providing various plant and fuel cycle services, particularly, on a regional basis.

#### **f) Licensing**

Some of the high capital costs of new facilities and extended construction periods are related to the uncertainties and demands in licensing requirements. Uncertain waste management and decommissioning requirements and costs deter investments. These factors may lead to a rationalization of the licensing process leading to more certainty in regulation and a concurrent decrease in the time from site selection to operation. Waste and decommissioning requirements based on comparative assessments of other industrial practices may lead to a more practical approach to radioactive material without compromising safety.

#### **g) Financing**

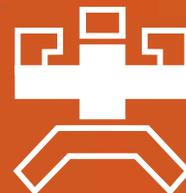
Innovative and novel investment



# Arc Guardian™ Pro

Clothing solutions for protection from electric arc flash and fires

This range of PPC has been developed with the most reliable, performance proven, comfortable and environment friendly, permanently flame retardant (PFR) materials. These are available in various colour and styling options, as well as complete kits in different ATPV ratings from HRC I - HRC IV.



*Your safety, our mission*



A brand owned by ACCENT INDUSTRIES LTD.

**Corporate Office:**  
Accent Industries Ltd.

430/B, Kewal Industrial Estate, Senapati Bapat Marg  
Lower Parel, Mumbai - 400 013, Maharashtra, India  
Tel: (022) 43110120; Fax: (022) 43110114  
Email: [agp@atlasprotectiveproducts.com](mailto:agp@atlasprotectiveproducts.com)  
Website: [www.atlasprotectiveproducts.com](http://www.atlasprotectiveproducts.com)

Exclusively made in India with fabrics from



MUMBAI | NEW DELHI | CHENNAI | KOLKATA | BENGALURU | PUNE | VADODARA | GURGAON | CUTTACK

But, of most significance, programmes are currently in place to demonstrate the adequacy of deep underground disposal of high-level waste. The construction and operation of a geologic repository in the next decade could allay public concerns over the safety as well as cost of disposal. If deemed necessary, the long-lived isotopes (actinides) that are radioactive for many thousands of years can be transmuted in actinide burning reactors. The necessary technology exists for these reactors and their associated chemical separation plants. Thorium fuel cycle results in less long-lived isotopes and lower disposal requirements.

### i) Maximizing Reactor Safety

With more than 442 reactors operating for more than 20 years on average, nuclear power generally has an excellent safety record. Three accidents—Three Mile Island in 1979, Chernobyl in 1986 and Fukushima in 2011, demonstrated that a very severe nuclear accident has a potential to cause national and regional radioactive contamination. Although safety and environmental impacts are becoming a key issue for all energy sources, many in the general public perceive nuclear power as particularly and intrinsically unsafe. The safety concerns coupled with the associated regulatory requirements will, in the near term, continue to exert a strong influence on nuclear power development. In order to reduce the magnitude of real and perceived accidents, a number of approaches will be used in new

facilities. Extraordinarily effective barriers will reduce the likelihood of significant off-site radiological accident consequences to an extremely low level to eliminate the need for emergency action plans. Enhancing the integrity of the reactor vessel and reactor systems will also decrease the likelihood of onsite consequences. International collaboration will provide reactor and system designs that incorporate globally accepted safety and engineering standards. It will contribute to assuring safety worldwide and encourage country-of-origin licensing as an acceptable basis for national licensing of imported reactors. Plant designs and processes are more intrinsically safe by incorporating passive safety features rather than active protection systems. High temperature gas-cooled reactors that employ ceramic graphite fuel can limit the potential for the release of radioactive material and may emerge as a viable option.

Continued development of a strong global nuclear safety culture brought about by international collaborative efforts aimed at strengthening safety worldwide would contribute to public awareness of the strong international commitment to assuring safety. A wide range of international agreements, non-binding safety standards and international review and advisory services already exists in what is now distinctly seen as an international nuclear safety regime.

The safety record of Indian nuclear plants is no exception and experience gained in overcoming the consequences of a few incidents has helped confirm validity of the safety features. Though these safety standards are excellent, there is a need to further improve them to obviate the need for public evacuation after a severe accident, which contributes to the negative public mind-set about nuclear energy.



# Over Five Golden Decades of Dedicated Service To Power Sector

# CPRI

For over five decades now, one name has facilitated Applied Research in electrical power engineering, enabling Testing and Certification of electrical Power Equipment as an Independent Third Party laboratory -CPRI. The Institute is renowned Internationally as a reputed brand and well-recognised for its Quality and Excellence. CPRI is adequately equipped with advanced Infrastructure to handle Collaborative Research with Academic Institutions and Training to Utilities/Industry.

## RESEARCH

- ✦ Collaborative Research between R&D Institutions, Industry and Academia
- ✦ Sponsored Research Projects of relevance to Power Sector
- ✦ Coordination of National Perspective Plan Projects
- ✦ Dissemination of expertise through education initiative and advanced degree programmes.

## TESTING & CERTIFICATION

- ✦ State-of-art Test facilities for High Power Short Circuit, Ultra High Voltage, High Voltage testing of Transformers and Switchgears, Cables, Capacitors, Transmission line Towers, Seismic Qualification, Power System Studies, Material characterization, Conductor Vibration studies, Transformer Oil testing, Refrigerator and Air Conditioner testing
- ✦ Facilities for testing equipment of 800kV/1200kV and  $\pm 1200$ kV HVDC test system
- ✦ Protocol testing for Energy-meters and Smart meters
- ✦ Pre-Qualification tests on Cables & accessories upto 400kV
- ✦ Impulse Current Laboratory exclusively for type tests on ZnO blocks/prorated sections
- ✦ Testing of Solar Lantern, Solar Street Lighting System, LED's, Solar water pumping system

## CONSULTANCY

- ✦ Distribution Automation System
- ✦ Third Party Independent evaluation agency for Energy Accounting and SCADA/DMS Consultant for R-APDRP
- ✦ Participation in Govt. of India Programmes – RGGVY, DDUJY, IPDS
- ✦ Diagnostics & Condition Monitoring of Power equipment
- ✦ Power System Studies, Real Time Simulation of Power System Controls, Power System Protection Audit
- ✦ RLA and R&M, Energy Efficiency & Audit Services
- ✦ Third Party Inspection Services & Vendor Assessment

## TRAINING

- ✦ Customised Training Programmes for Utilities

## ACCREDITATIONS

- ✦ Accredited as per ISO/IEC 17025
- ✦ Member – Short Circuit Testing Liaison (STL)
- ✦ Intertek (ASTA), UK
- ✦ ISO 9001:2008 Certification for Research and Consultancy activities
- ✦ INMETRO, Brazil for conducting tests on Transformers
- ✦ Corporate Member in DLMS UA, UCA IUG
- ✦ Association with UL, TUV
- ✦ EHS System under implementation



follow us on



cprimop CPRLMeP

**HEAD QUARTERS: BANGALORE**

**UNITS: BHOPAL, HYDERABAD, NOIDA, NAGPUR, KOLKATA, GUWAHATI**

Your Trusted Partner in Research and Testing in Power Sector



**केन्द्रीय विद्युत अनुसंधान संस्थान**  
**CENTRAL POWER RESEARCH INSTITUTE**

(Autonomous Society under Ministry of Power, Govt. of India)

Prof. Sir C.V. Raman Road, Sadashivanagar P.O.,

P.B. No.: 8066, Bangalore - 560 080. INDIA

Ph: +91-80-2360 2329 Fax: +91-80-2360 1213

E-mail: drvarughese@cpri.in / kamala@cpri.in /

anands@cpri.in / ramdas@cpri.in

Website: [www.cpri.in](http://www.cpri.in)

Important safety issues are radiation effects, radiation waste management, decommissioning and accident risks in reactors. These have been adequately addressed and improvements continue. The radiation doses to operating personnel and the public during normal operation are well within limits prescribed by the Atomic Energy Regulatory Board. Nowhere in the world have the effects of radiation been noticeable in normal operation of nuclear facilities.

Radiation waste is isolated from the biosphere while the gases from fossil plants are entering the atmosphere. India developed the

flooding the reactor with coolant, the reactor also has several passive shutdown systems that will automatically activate in the event of a hot shutdown, prolonged shutdown, or loss of coolant accident. During normal operation, coolant is circulated by natural convection instead of pumps, so a loss of power will not cause a loss of coolant. If a loss of coolant accident did happen, the rising temperature would cause the automatic release of a reactor poison into the system, which would kill the reaction. If this system were to fail, and the temperature continued to rise, the large gravity driven water pool at

of energy sources are of paramount national interests. With nuclear power, security of supply concerns are lessened as adequate strategic inventories can be relatively easily established with low financial costs. Today's global energy mix has an almost 90% fossil component. Clearly, where indigenous fossil fuel resources are lacking, nuclear energy can contribute substantially to the energy mix in India.

The overall safety is much better than it was 10 years ago, but we still have vulnerabilities in safety, as well as in security. In the nuclear domain, the role of governments goes beyond setting national energy goals. Nuclear energy, if produced safely, offers promise. The requirement hence is to fast-track civilian nuclear expansion while maintaining the highest standards of nuclear safety and security. Today's world has to carefully make the right choices to assure the future generations of a brighter and secure tomorrow.

### Conclusion

Nuclear power is likely to remain a major part of India's energy plan. Though it has had some success, notably, the development of some expertise over most steps in the nuclear fuel chain, India's atomic energy program has not achieved any of its promises. The most important failure has been that after more than 60 years, nuclear power constitutes only less than three percent of the nation's electricity generation capacity. To some extent, this has been a result of international sanctions imposed on India after its nuclear weapon

**The overall safety is much better than it was 10 years ago, but we still have vulnerabilities in safety, as well as in security. In the nuclear domain, the role of governments goes beyond setting national energy goals. Nuclear energy, if produced safely, offers promise.**

technology for radiation waste management well in time and new breakthroughs are not required. Further developments are expected in the technology of partitioning and actinide burning which will considerably reduce the storage time.

#### j) Safety Features of the Indian Thorium Advanced Heavy Water Reactor Design

The Indian thorium fuelled Advanced Heavy Water reactor has been designed with safety as top priority. It has several innovative and passive safety features that would effectively shut down the reactor in the event of any foreseeable accident. Along with the conventional active shutdown capabilities such as scrambling or

the top of the reactor building would automatically start flooding the bottom the reactor cavity, effectively submersing the whole reactor core. If the reaction rate continues to increase, there is enough coolant to keep there is enough coolant to keep the reaction in check for 72 hours, more than enough time for the operator to step in and manually shut down the reactor.

#### k) Satisfying Key Policy Needs

Energy independence along with non-proliferation concerns and excess military plutonium are high on the list of policy factors at the national and international level that strongly influence the nuclear option. In a political world, energy independence through security of energy supply and a balanced mix

tests. An important lesson from this experience is that while export controls and other trade restrictions might not cause a nuclear program to completely shut down, sanctions may slow its growth. The limited amount of nuclear electricity generated has been at a relatively high cost. The DAE's reactor construction costs have not dropped over the years and, despite their claims of improved construction practices, show little evidence of learning. The operational efficiencies of reactors have improved over the decades, however. The agency in charge of regulating safety at nuclear facilities comes under the

administrative control of the AEC, and is therefore not truly independent. The effects of the NSG waiver remain uncertain.

India is blessed with aplenty of sunshine and a nearly inexhaustible resource of Thorium. Our future depends on how efficiently these two resources are utilised. With India's entry into international nuclear cooperation, the opportunity for a rapid growth in the installed capacity helps in accumulating fissile inventory at a faster pace. In the meantime, several enabling indigenous technologies have been developed for thorium utilization. Focused developments in solar and

Thorium energy can lead to a stage when India do not have to look onwards for meeting its energy demands for several centuries, in harmony with environment. We should not protect the environment; we should create a world where the environment doesn't need protection. Thus, a long term energy security and a clean environment for the country can be achieved. ❶



**Gopalkrishna  
Dhruvaraj Kamalapur**

Professor in Department of Electrical and Electronics Engineering  
S D M College of Engineering and Technology, Dharwad

## TEST & MEASURING INSTRUMENTS

An ISO 9001:2015 Company

<p style="text-align: center;"><b>DIGITAL ELCB TESTER MODEL - KM 1812EL</b></p> <p><b>FEATURES :</b></p> <ul style="list-style-type: none"> <li>● Microprocessor Controlled &amp; 2 Lines x 16 Characters L.C.D.</li> <li>● EN 61010-1 CAT III 240V.</li> <li>● Polarity Trip indicator (Positive or Negative Phase).</li> <li>● Automatic data hold function.</li> <li>● Very Low Power Consumption &amp; Menu Driven.</li> <li>● Accurate digital readout of disconnection Time.</li> <li>● Measure voltage and frequency between Line and Earth before testing.</li> <li>● User selectable 17 different ranges of leakage current.</li> </ul>	<p style="text-align: center;"><b>PERSONAL SAFETY (NCV) HIGH VOLTAGE DETECTOR MODEL - 286SVD/287SVD</b></p> <p><b>FEATURES :</b></p> <ul style="list-style-type: none"> <li>● Distance of starting warning : 80cm for 11.4kV (286SVD) 85cm for 22.8kV (287SVD)</li> <li>● Frequency : 50/60Hz</li> <li>● Min. sensing Voltage : 1.1kV</li> <li>● Volume: 70dB or higher at 1meter distance.</li> <li>● Equipped with self-testing functions.</li> <li>● Sound &amp; flash light warning.</li> <li>● Able to sense all kinds of AC High Voltage System.</li> <li>● Water-proof design (Ip65) (287SVD)</li> <li>● Low power consumption</li> <li>● CE Certified</li> </ul>	<p style="text-align: center;"><b>HANDHELD THERMAL IMAGING CAMERA MODEL - LT3-P</b></p> <p><b>FEATURES :</b></p> <ul style="list-style-type: none"> <li>● Display : 3.5" TFT LCD, 640 x 480</li> <li>● Array size : 160 X 120</li> <li>● Resolution : 160 X 120</li> <li>● FOV/min focus distance : 25° X 19° / 0.1m</li> <li>● Thermal Sensitivity : ≤ 0.06°C@30°C</li> <li>● Temp. Range : -20°C ± 350°C (can expanded to 650°C)</li> <li>● Encapsulation : Ip54</li> <li>● Drop test : 2m</li> <li>● Spatial resolution : 2.72mrad</li> <li>● Palette : Color palette 11 palettes changeable.</li> <li>● Image Storage : 2G SD card, Max 16G</li> <li>● Build-in CCD camera : 1,300,000 pixels</li> </ul>
--	--	--

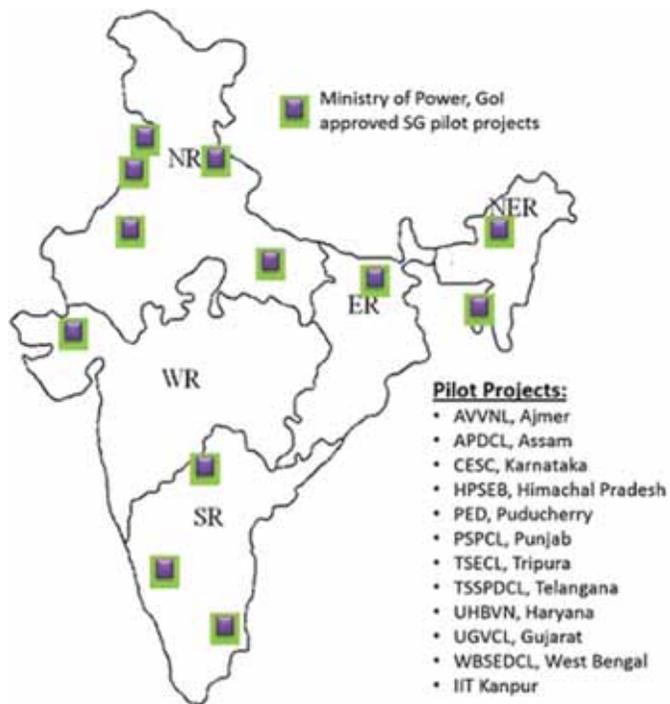
G-17, Bharat Industrial Estate, T. J. Road, Sewree(W), Mumbai - 400 015. INDIA.  
Sales Direct : 24156638 Tel.: 27750662, 24181649, 24124540 Fax : (022) 24149659 E-mail : sales@kusam-meco.co.in

# Indian Journey from Grids to Smart Grid

For making electricity readily available in all parts of India, current means of production and transmission and distribution are not capable. We need smart grids to achieve this goal. Therefore, research and innovation in this area is a must for a cleaner and more advanced India...



As we all know that India is a developing country with lots of open and new opportunities which are provided in all the active and newly active sectors. These active sectors include the production units or the distribution units. The production units include the production of market resources. As a developing country, India also requires more power for continuous development. The major part of continuous power development in India is



**Figure 1: Pan India map of Smart grid pilot projects sanctioned by MoP, GoI**

basically achieved from the traditional power generating unit and grid. These power generating units use coal, hydroelectricity, and some of them also use nuclear reactions to generate electricity.

The downfall of these power units is that coal is a non-renewable energy source; a large amount of coal is used to generate a small amount of energy as compared with pollution. Continuous use of coals in large amounts will eventually lead to the depletion of coal. Whereas, for generation of hydro-electricity, the plants can only be placed at the places where high tides occur very frequently or can be placed along with the dams. This leads to the last option for electricity generation, that is, via nuclear reactions. The method is very dangerous as there is chance of getting exposed to the radio-activity and handling of nuclear waste is very difficult.

So, what is the solution for the safe, unconstrained and fair electricity generation to meet the necessary requirements? The only answer to this problem which comes is to use the renewable energy sources along with the smart grid technologies for the production and transmission of the generated electricity. In some parts of India, there are industries and companies which use the renewable energy sources to meet their requirements or to use electricity generated

from the coals or nuclear reactors in fewer proportions. So, what happens is that the stress of producing large amount of electricity on the plants gets reduced and the companies get lesser amount to pay.

The use of the renewable energy sources like wind, solar, hydraulic, and thermal are highly situation, location and weather dependent. For example, the solar energy can only be harvested where the input of sunlight is high and for the long durations. For instance, in some parts of India like Rajasthan (Bhadla Solar Park) and Tamil Nadu (Kamuthi Solar Power Project) solar energy is harvested. The wind energy can only be used where the flow of air/wind is continuous and wind comes with high forces. Same goes for the hydraulics and thermal energy.

Once the generation of electricity is done by either of the sources, renewable or non-renewable, if that electricity is not delivered to the consumer then that energy is of no use. Here comes the role of smart grids. Grids are basically used for the transmission of electricity from one place to another. The traditional grids provide one-way communication, that is from the plants to the consumers and which leads to the loss of energy.

But a smart grid provides a two-way communication, from plants to consumer and from consumer to plants, making sure of reducing the losses. The Smart Grid is a system of networked utility and consumer devices, through technologies that ensure secure, reliable and efficient production, delivery and consumption of energy.

## Implementation Ways

The Smart Grid will need to be implemented on three inter related layers. These layers are instrumented, interconnected and intelligent. The instrumented layer monitors everything on the grid, ensuring the safe transmission of electricity. Remote monitoring devices tell when and where faults occur, and where the inefficiencies are, enabling smarter sourcing and distribution of power.

The interconnected layer provides real time line of sight to key data and information. Interconnection also combines the virtual market-places between consumers and providers, allowing consumers to trade flexibility in usage for lower costs.

The intelligent layer provides the informed decision making throughout the value chain. The power grid which uses the sensors, smart meters, digital controls

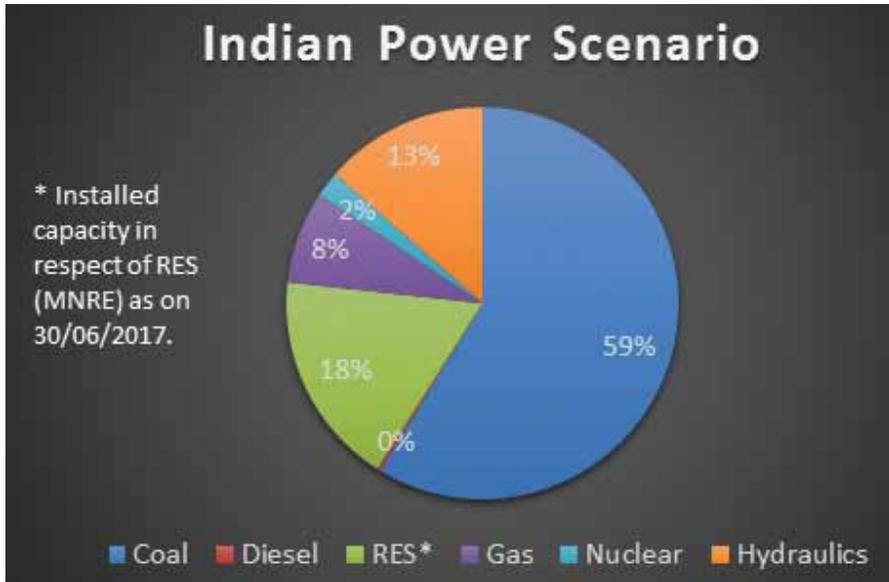


Figure 2: Total installed capacity fuel wise [2]

and analytic tools to automatically monitor and control two-way energy flow is also called as intelligent smart grid layer. The main condition for using the smart grid technologies is to have a smart consumer. The main directive is to provide a full time power supply.

## Smart Grid Footnotes in India

The first step to make a smart grid is to provide the real time data from the consumer to the distributing authority; it can be done feasibly by installation of smart meters. Ministry of Power has approved 14 pilot projects in India that will be implemented by various state owned distribution utilities (figure 1), one of the major pilot project sponsored by the Ministry of Power is going to be setup in Assam Incorporated with Assam Power Distribution Company Limited (APDCL) covering Guwahati distribution region covering 15083 consumers. Getting 7593 single phase and 5601 three phase smart meters installed.

These smart meters will tell about the power consumption for every consumer with each minute record and send it to the Meter Data Management System (MDMS) and Meter Data Acquisition System (MDAS), which is connected to a smart meter with primary power distribution center and also this is linked with RLDC and the analysis of smart meter data will compile and shows that when the requirement for power is more and then Solar PV cells which are installed in the area for power generation are also calibrated for

maximum input. This calibration can only be done with the highly analyzed data of instantaneous solar irradiance which is recorded for each day and predicted for the next day by analyzing the previous data and by using weather data measuring instruments and more Sophisticated Data Acquisition Systems (SCADA). Energy generation of a solar PV system can be analyzed with help of some software which is based on location dependence (PVsyst, Ret Screen, and System Advisor Model/SAM). We need some smarter grid projects in India as the contribution of renewable energy sources in power supply contribute only to 57.28 GW of the total capacity (326.8 GW).

As the required rate in power generation is considerably bigger than our production rate, the gap between the demand and generation of power is increasing day by day. From the time of independence, we have improved a lot in the field of power generation. So, for sustainable development we need to improve in other areas too.

The means of achieving this aim with a balanced environment is to

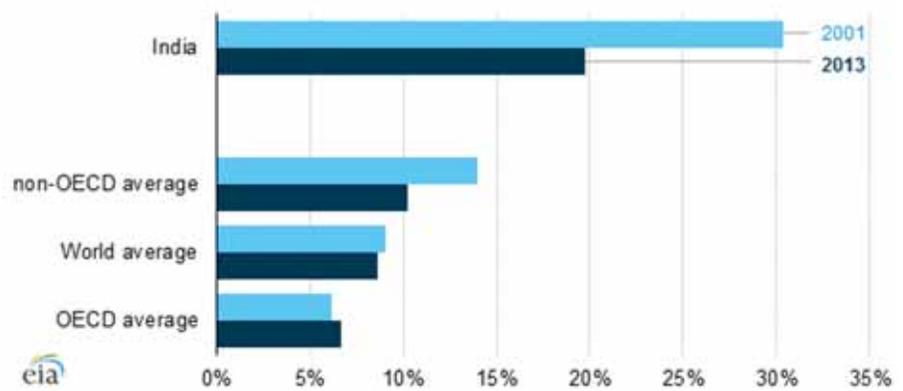


Figure 3: Electricity transmission and distribution (T&D) losses in India and other regions [3]

increase the use of smart ways for transmission, generation and consumption of electricity. Incorporating less polluting means in generation of electricity leads to less efficient production. Every day there are innovations to reduce load and maximize output but the rate of demand is increasing very vigorously. The next option is transmission which can be improved by making our grids smart. The process starts with making consumer smart by installing smart meters and smart meters at grid stations.

## Conclusion

For making electricity readily available in all parts of India, current means of production and transmission and distribution are not capable. We need smart grids to achieve this goal. Therefore, research and innovation in this area is a must for a cleaner and more advanced India. Our government is also supporting the smart grid models for new transmission grid layouts most of the pilot project are sanctioned by ministry of power. Let us think about the

implementation of smart grid that leads us to a better India and better World. 



**Dr. Anuradha Tomar**

Associate Professor and Head of Electrical & Electronics Engineering Department, HMR Institute of Technology & Management, New Delhi



**Anzar Hussain**

BE student, HMR Institute of Technology & Management Development New Delhi



**Karan Bhushan Sharma**

BTech Student, HMR Institute of Technology and Management New Delhi



Frontier Technologies Pvt Ltd  
Old Manesar Road  
PO Narsinghpur Factory Area  
Gurgaon Haryana 122002

**Heat Shrink Jointing Kits, End Terminations, and Tap-Off Connectors for UG and AB Cables**



# Frontec

**Frontec**

manufactures Heat Shrink items from the granules stage. Some of the products in our range are:

**MV TERMINATIONS**

MV STRAIGHT JOINTS

**MV TEE CONNECTORS**

HEAT SHRINK TUBING

**HEAT SHRINK COMPONENTS**

Frontec MVT Tap off Connector for Medium voltage is a product designed especially to facilitate loop-in / loop-out connections for MV ABC Lines.

Available in Porcelain and Silicon



Frontec manufactures end terminations for 11 KV and 33 KV cables in varying sizes from 35 Sq.MM till 630 Sq.MM. These are suitable for both AB as well as UG Cables

Available as Single Core and Three Core.





Tel: 0124-6513331
Email: mail@frontec.co.in
Web: www.frontec.co.in

# “UL India can help renewable energy sector adapt to the highest standards”



UL's services to the energy sector cater to low and medium voltage switchgear and control gear products as well as renewable energy products. UL has a world class testing center at its Bangalore lab that caters to this sector and over 100 dedicated professionals that serve over 500 manufacturers in India. UL's switchgear laboratory is one of India's largest third party testing lab that can conduct limited short-circuit testing of products as well as help manufacturers sell their products in the US, Europe, China and Latin American markets, apart from others. We need to explore other options to ensure that our dependence of coal and oil is reduced, informs **Suresh Sugavanam, Vice President and Managing Director, UL South Asia** in an interaction with **Electrical India...**

## **What are solutions offered by the company catering to energy sector?**

As solar and wind energy technologies become more prominent in the energy mix globally, UL has developed an advanced suite of end-to-end services to address the safety, quality and performance issues of these technologies. Our laboratory was the first private laboratory in India accredited to test MNRE requirements for PV components and systems. In the solar industry, we help manage risk by providing technical information and data for energy yield

assessments (EYAs), technical due diligence, and measurements and third party inspection.

We have an exciting array of services for the wind industry as well. We provide on-site technical support that deliver quick, reliable results and reduced time-to-market. UL offers safety, performance and function testing services for the assessment of wind turbines and wind turbine components. We ensure that these services comply with regional, national and international regulations and standards, and also meet the needs of insurers, developers and investors.

Our services cover many areas in project development for planning and engineering, construction and commissioning, and operations and maintenance.

Considering the challenges in evaluating operation efficiency in wind, we provide measurement services and instrumentation solutions to assess the quality characteristics and grid compliance of wind turbines and wind farms, the acoustic noise emission of wind turbines, and the performance and mechanical loads of wind turbines and wind turbine components.

In the renewable energy space, in particular, we work closely with the MNRE and allied bodies like the SECI and NIWE in lending our global experience to devise a robust country-specific

standards framework for India.

We work with some of the most significant players in the PV industry, including large players like ReNew Power, Suzlon Energy, Punj Llyod and Hero

Future Energies. UL India can hence help the Indian renewable energy sector adapt to the highest standards.

#### **What evolutions have you witnessed in Indian Power sector?**

In which ever manner we look at it, 2017 has been a landmark year for the Indian power sector. There has been a record increase in contribution of renewable energy to the country's energy capacity, a definite policy push in increasing access to electricity and the bold reforms to rejuvenate conventional and renewable power. The falling tariffs in both solar and wind are some of the lowest in the world, fostering keen domestic and global interest in the market. Recent data also suggests that private equity investment in renewables has increased by 46% in 2017, a healthy sign about the confidence in India's energy transformation. India is fast emerging as the new epicenter for renewable energy – the latest announcement by the IEA that India is expected to double its renewable capacity and overtake expansion of green energy by 2022, is a major boost to the sector. The government is looking at ways to achieve energy security and sustainability rather than mere capacity addition – and this is a welcome sign. What is remarkable in the present scenario is the consultative and forward thinking approach adopted by the government to address issues that are hampering

stable expansion of renewable energy, particularly, solar and wind power in India. For instance, there is now an increasing cognizance of the need to deploy a sound policy for energy storage systems to address the intermittent nature of renewable power. With the grid anticipated to grapple with the additional electricity generated through renewable energy, grid stabilization, optimization of transmission network for catering peak power demand and simultaneously controlling the vagaries of renewable power can all be achieved through energy storage.

Another noteworthy aspect that must be lauded in the government's establishment of standards for

**...2017 has been a landmark year for the Indian power sector. There has been a record increase in contribution of renewable energy to the country's energy capacity, a definite policy push in increasing access to electricity and the bold reforms to rejuvenate conventional and renewable power.**

solar equipment, enforceable from August 2018 that sets the right growth trajectory for the industry by ensuring a minimum quality level of products for installations across the country. Devised as per prevailing international norms, the new regulations provide a much needed respite to domestic module makers by ramping up their competitiveness and market value.

#### **What kind of role does UL play to bring efficiency in operations of renewable energy sector with the government's ambitious plans of producing 175 GW of renewable energy?**

Success of India's ambitious transition to clean power largely depends on the quality and bankability of the installations, which have direct impact on the operational efficiency of renewable projects. Even in the absence of regulatory control over these aspects, which was the case until the recent government order on standards for solar equipment, buyers and investors were keen to examine performance indicators of PV equipment when making purchasing decisions. To address these needs, manufacturers rely on non-partisan testing, inspection and certification services that help convince financial stakeholders of a product's bankability and investment worthiness, as well as assure buyers that products are durable and can perform at the intended yield levels over the project's planned operation time.

Considering our global leadership in meeting the testing, inspection and certification needs of the renewable energy sector, we are well armed to help Indian renewable energy sector with end-to-end professional services such as design evaluation, type testing and certification, wind measurements, energy yield assessment, technical due diligence, site classification and others.

As grid stability becomes a critical aspect with increasing capacity addition of renewable energy to the grid, UL's Low Voltage Ride Through (LVRT) testing services have emerged as an important aspect of our services. Unlike conventional those of conventional

**Even though India has become power surplus country and we have started exporting to other countries, we still have problems in terms of last mile connectivity and availability to homes and industries, mainly due to hurdles in the smooth functioning of the transmission and distribution network.**

energy, renewable energy projects are subject to voltage dips due to irregular wind flow or grid faults, thus impeding the power quality. These voltage dips in turn create transient voltage instability that eventually abates the overall stability of the wind turbine grid. LVRT describes the requirement that generating plants must continue to operate through short periods of low grid voltage and not disconnect from the grid.

UL conducts measurements and evaluations according to IEC 61400-21 for wind turbines and FGW TR3 for solar inverters/plants, to reveal the behavior of the generation unit during voltage dips and measure compliance with the corresponding grid codes such as CEA and BDEW guidelines. In light of the new regulations, UL's test facilities in Bangalore, India are accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) and are in the process of BIS accreditation. Engaging with UL can help companies identify applicable requirements and obtain pre-compliance testing during design and development.

**What opportunity does the company envisage in power sector with the Indian Government's emphasis to bring sustainability & efficiency through the launch of 100 smart cities?**

Adopting the clean technologies concept ensures optimal use of resources, promotes renewable energy

solutions and calls for lower use of natural resources.

As we face massive waves of urbanization around the world, UL has been working relentlessly to advance safety in tandem with innovation in areas critical to life in a modern city – energy, buildings, transportation, and healthcare and public facilities. We partner with national standards bodies of most developed and developing countries and our experts are members of leading standards development bodies. UL has pioneered an approach to address the risk that is inherent in the development of smart cities, and make new technologies functional, reliable, and safe.

Our variety of services are capable of serving smart cities in three broad areas—connectedness, safety, and The Concept of Green Cities.

In the 'Green Cities' criteria, we help in the sustainable deployment of renewable energy through certification of

components and systems, bankability and insurability services, site assessment & plant Inspection, R&D Support, and Advisory Services.

**How would you differentiate Indian energy markets as compared to global energy markets?**

Even though India has become power surplus country and we have started exporting to other countries, we still have problems in terms of last mile connectivity and availability to homes and industries, mainly due to hurdles in the smooth functioning of the transmission and distribution network. Our dependence on coal based power plants is still high. At 12-15 % of total energy generation, the shift toward renewables or gas based power plants – though laudable, is less than Europe, which runs on 40% or more of renewable energy. We need to explore other options to ensure that our dependence of coal and oil is reduced. That being said, there is serious effort on part of the government to rectify the problems. The Soubhagya scheme for instance, is expected to prove to be a real boon to address the access to electricity in the rural areas. Renewable power will also gain impetus with greater focus on reliability and sustainability. Additionally, it is also aiding in job creation and development of skilled manpower.

**What are your expansion plans in India with the government's 'Make in India' program?**

The changing regulatory scenario in India, the push

for 'Make in India' has created a rise in demand for our services. We are dedicated to expanding our manpower, training our safety experts and enhancing our laboratory capabilities with best in class equipment and services. As the current Indian Government ramps up safety and quality standards, our scope of work is slowly evolving from helping Indian companies attain greater global market access to also enable international players to enter the Indian market.

In the renewable space for instance, we are planning to double our capacity to support manufacturers in improving quality compliance. We are also working with our global market access team around the world to ensure that manufacturers in foreign markets understand the new regulation for solar equipment in India and comply with it.

**What is your outlook for 2017-18 fiscal for the power segment?**

The power sector in the next fiscal undoubtedly will be dominated by a major thrust on renewables, where India may add upto 8 – 12 GW of power generation in 2018-19. The UDAY scheme for debt restructuring for DISCOMS will start bearing fruit and in a better position financially, which will help them address distribution losses. The government is seriously looking at steps to increase the reliability of

renewable power. We can expect a lot of policy initiatives, regulatory reforms to improve reliability and bankability. As solar projects increasingly become grid-connected, reliability tests will ensure that these plants do not threaten to destabilize the grid.

We also see an expansion of electrical infrastructure for charging of vehicles to meet the aggressive push for electric vehicles. This will also provide impetus to the electric industry, which has been rather stagnant on innovation so far. Energy storage will also increasingly become a critical component in policy considerations for renewable energy. Over the past couple of months, the Indian Energy Storage Alliance (IESA) and UL are engaged in the development of India specific requirements for electrical energy storage systems, identifying ways in which various technologies can be integrated to the grid under Indian environmental conditions. Under the charge of the Central Electrical Authority, the Bureau of Indian Standards has recently initiated the process to create Indian standards for energy storage systems. UL is actively working with the BIS along with other public and private enterprises to share its expertise to build a robust standards regime to oversee safety, quality and performance aspects of energy storage systems in India. 



**Let people not Forget you Standout from the crowd...**

Attract More Business by advertising in

FOR DETAILS CALL :  
Ad Department (022-27777180)  
(022 2777 7184) & (+91 22 2777 7196)

**Electrical India**  
India's oldest magazine on power and electrical products industry

# Power Electronics for Energy Efficiency

Power electronics deals with the conversion and control of electrical energy with the help of power semiconductor devices that operate in a switching mode, and, therefore, efficiency of power electronic apparatus may approach as high as 98–99%. ...



**P**ower electronics is one of the contemporary subjects of electrical engineering, which has seen a lot of advancements in recent times and has impacted human life in almost every sphere. We use so many power electronic applications in our daily life without even realizing it. From laptop computer to kitchen appliances at

home, most of the electronic equipment that makes our lives so convenient today relies on gadgets called power electronics. This technology uses electronic components such as inverters and transformers to convert the electricity from wall outlet into the right voltage and current to power each of handy or handheld devices.

It is also used more widely to distribute electricity throughout the power grid to connect renewable energy systems, and to charge up electric vehicles. Electrical energy has already become our lifeline so we want to get a regulated form of this energy which in itself is not usable until it is converted into a tangible form of energy such as motion, light, sound, heat etc. In order to regulate these forms of energy, an effective way is to regulate the electrical energy itself and this forms the content of the subject power electronics. Power electronics is the study of switching electronic circuits in order to control the flow of electrical energy, its generation, transportation and applications. Power Electronics is the technology behind switching power supplies, power converters, power inverters, motor drives, and motor soft starters. Power electronics is an enabling technology, its development, together with internal developments, such as wide bandgap semiconductors, will be driven externally by applications in the future.

Power electronics deals with the conversion and control of electrical energy with the help of power semiconductor devices that operate in a switching mode, and, therefore, efficiency of power electronic apparatus may approach as high as 98–99%. Power electronics is very important in modern high-efficiency energy processing systems, such as HVDC, SVC, flexible ac transmission system (FACTS) for active and reactive power flow control, uninterruptible power supply (UPS), and industrial process control with variable-frequency drives for improving productivity

and quality of products in modern automated factories. Variable-frequency drives are now used extensively in pumps and compressor drives, paper and textile mill drives, subway and locomotive propulsion, electric and hybrid vehicles, elevators, metal rolling and textile mills, home appliances, machine tools, and robotics, variable-speed air conditioners, wind generation systems, ship propulsion. Power electronics plays a very important role in solving or mitigating our

**Technologies have specific life cycles that are driven by internal innovation, subsequently reaching maturity. Power electronics appears to be a much more complex case, functioning as an enabling technology spanning an enormous range of power levels, functions and applications.**

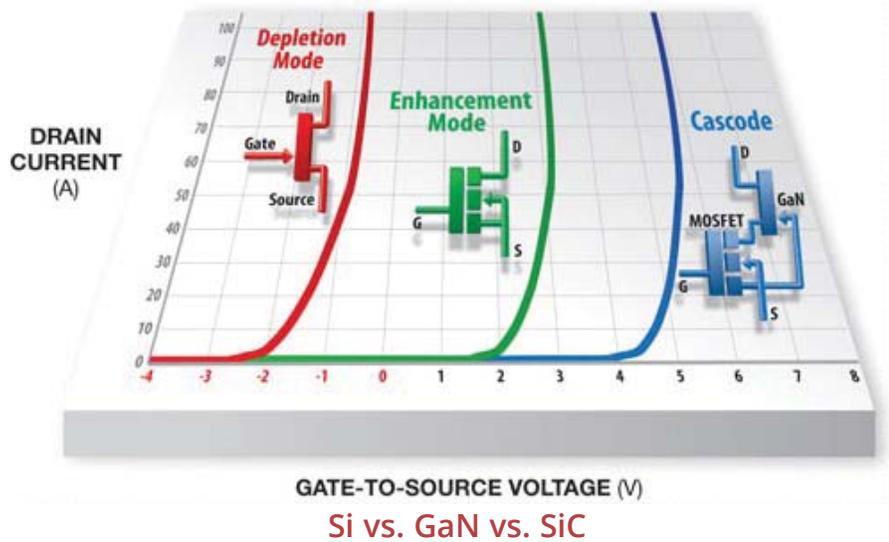
global warming problem, which is a very serious concern in our society.

### **Power Electronic Devices**

We can trace the overwhelming advancement in the subject back to the development of commercial thyristors or silicon controlled rectifiers (SCR). Before this the control of electrical energy was mainly done using thyratrons and mercury arc rectifiers which work on the principle of physical phenomena in gases and vapours. After SCR, a great many power electronic devices have emerged like GTO, IGBT, SIT, MCT, TRIAC, DIAC, IEGT, IGCT and so on. These devices are rated for several hundreds of volt and ampere unlike the signal level devices which work at few volts and mill amperes. In order to achieve the purpose of power electronics, the devices are made to work as nothing more than a switch. All the power electronic devices act as a switch and have two modes, i.e. ON and OFF. For example, a BJT

(Bipolar Junction Transistor) has three regions of operation in its output characteristics cut-off, active and saturation. In analogue electronics where the BJT is supposed to work as an amplifier, the circuit is so designed to bias it in active region of operation. However, in power electronics BJT will work in cutoff region when it is OFF and in saturation region when it is ON. Now that the devices are required to work as a switch, they must follow the basic characteristic of a switch, i.e. when the switch is

ON, it has zero voltage drop across it and carries full current through it, and when it is in OFF condition, it has full voltage drop across it and zero current flowing through it. The power electronic devices alone are not that useful in practical applications and hence require to be designed with a circuit along with other supporting components. These supporting components are like the decision making part which controls the power electronic switches in order to achieve the desired output. This includes the firing circuit and the feedback circuit. The Control Unit takes the output feedback from sensors and compares it with references and accordingly gives input to the firing circuit. Firing circuit is basically a pulse generating circuit which gives pulse output in a fashion so as to control the power electronic switches in the main circuit block. The net result is that the load receives the desired electrical



power and hence delivers the desired result. A typical example of the above system would be speed control of motors.

### Role of Materials

Power electronics plays an important role in our today society. It is present almost all power supplies, in servo systems and variable drives. The flexible energy conversion of power electronics is also present in energy saving applications and in almost all renewable energy applications, from small photovoltaic to large wind turbines. It is also penetrating our transport means, from railway to electrical bikes, ship propulsion to more performing and electric cars. Silicon (Si), gallium-nitride (GaN), and silicon-carbide (SiC) are the commonly used materials for power electronic devices with their specific advantages. SiC is also used to manufacture power transistors, but because SiC does not have an electron-gas structure, only vertical conduction devices are practical. With a vertical conduction device in GaN or SiC, 1- to 2-kV breakdown voltage levels are easier to reach than with Si. As silicon (Si), gallium-nitride (GaN),

and silicon-carbide (SiC) processes are maturing, so, too, are their suppliers' expertise and creativity towards power electronics. GaN and SiC are wide-bandgap (WBG) materials, which mean the energy required for an electron to jump from the top of the valence band to the bottom of the conduction band within the semiconductor is typically larger than one or two electron volts (eV). GaN transistors are extremely fast. As a result, the system is far more sensitive to the layout than it is with slower Si devices. In particular, stray inductance plays a larger role in the overall system efficiency. GaN needs no package—it is inert to its environment. This approach greatly reduces any resistive, inductive, and thermal problems.

Researchers have discovered that when two oxide compounds—strontium titanate (STO) and neodymium titanate (NTO)—are joined together, they make an extraordinary conductive material. The main application for a material with this level of conductivity would be in power transistors that regulate electrical current in electronic devices such as televisions and cellphones. The

researchers have shown that these two materials—which on their own operate as insulators—are up to five times more conductive than silicon. Currently, gallium nitride serves as the material used for transistors in power supplies. While gallium nitride is highly conductive as well, many believe that years of optimization have brought the material to its limits. This new STO/NTO material still has room for further optimization and improvement and eventually may serve as an attractive replacement for gallium nitride. These materials could be used in power transistors to enable much smaller devices, because the power supplies would be far more efficient. Take the external power supplies that come with our laptops and the big black box halfway down the electrical cord. By building far smaller power supplies inside the laptop, the need for these large external power supplies could be eliminated.

### Future Visions

Technologies have specific life cycles that are driven by internal innovation, subsequently reaching maturity. Power electronics appears to be a much more complex case, functioning as an enabling technology. Till now, the development of power electronics has been driven chiefly by internal semiconductor technology and converter circuit technology, approaching maturity in its internally set metrics, such as efficiency. Critically examination of the fundamental functions found in electronic energy processing, the constituent technologies comprising power electronics, and the power electronics technology space in light of the internal driving philosophy of

FROM PRINT WORLD TO THE E-WORLD

# ELECTRICAL INDIA ENHANCES LIFE WITH ENGINEERING EFFICIENCY

**BESIDES MONTHLY  
MAGAZINE, TAKE ADVANTAGE  
OF THE DIGITAL TECHNOLOGY  
& READ ELECTRICAL INDIA  
MAGAZINE ONLINE, AS WELL AS  
WEEKLY E-NEWSLETTER  
ON YOUR PC, TABLET OR LAPTOP.**

**FOR SUBSCRIPTION PLEASE  
CONTACT PRIYANKA ON  
022-27777182/8652142057 OR  
Email on [sub@charypublications.in](mailto:sub@charypublications.in)**

Please turn back for the subscription form.

**To Advertise, in Electrical India  
newsletter/magazine please  
contact YASMEEN on  
022 2777 7196 / 9867914216  
or email on  
[yasmeen@electricalindia.in](mailto:yasmeen@electricalindia.in)**

Since 1961

# Electrical India

India's oldest magazine on power and electrical products industry

# SUBSCRIBE

Since 1961  
**Electrical India**  
 India's oldest magazine on power and electrical products industry



## Subscription Offers

Sub. Period	No. of Issues	Subscription Type					
		Print		Digital		Print+Digital	
		Actual Rate	You Pay	Actual Rate	You Pay	Actual Rate	You Pay
1 Year	12	1200.00	1000.00	1200.00	1000.00	2400.00	1500.00
2 Years	24	2400.00	1750.00	2400.00	1750.00	4800.00	2625.00
3 Years	36	3600.00	2500.00	3600.00	2500.00	7200.00	3750.00
5 Years	60	6000.00	4000.00	6000.00	4000.00	12000.00	6000.00
<b>E-Newsletter</b>							
1 Year	52	N. A.		365.00		N.A	

PLEASE SELECT MODE OF DISPATCH FOR PRINT EDITION -  
 (1). By REGISTERED PARCEL - Rs. 435/- year (2). By COURIER - Rs. 600/- year  
**KINDLY ADD POSTAGE CHARGES IN SUBSCRIPTION AMOUNT.**

## Subscription / Renewal Form

To,  
 The Subscription in-charge  
 ELECTRICAL INDIA  
 Email: sub@charypublications.in

Are you a Subscriber,  
 Please submit your Subscription no:  
 \_\_\_\_\_

Yes, I would like to Subscribe/renew  Electrical India /  EI e-Newsletter for \_\_\_\_\_ years at ₹ \_\_\_\_\_.

### PAYMENT DETAILS :

Cheque / DD No. \_\_\_\_\_ Dated \_\_\_\_\_ Drawn on Bank \_\_\_\_\_  
 \_\_\_\_\_ Branch \_\_\_\_\_ in favour of Chary Publications Pvt. Ltd.

Bank details for NEFT / RTGS / IMPS : Account Name: Chary Publications Pvt. Ltd.

Bank Name: Bank of India      Branch: Chembur, Mumbai - 400 071      Account Type: Current Account  
 IFSC Code: BKID0000009      Bank A/C Number: 000920110000322      SWIFT CODE :BKIDINBBCHM

Name: \_\_\_\_\_

Company: \_\_\_\_\_ Designation: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_ City: \_\_\_\_\_ Pin: \_\_\_\_\_

Telephone: \_\_\_\_\_ Mobile: \_\_\_\_\_

Email: \_\_\_\_\_

Signature: \_\_\_\_\_

Stamp

 **Chary Publications Pvt. Ltd.**

905-906, The Corporate Park, Plot No. 14 & 15, Sector 18, Opp. Sanpada Railway Station, Vashi, Navi Mumbai - 400 703.  
 Phones: +91 22 27777 170 / 171 • Email: sub@charypublications.in • Contact : Priyanka Alugade • +91 22 27777182 / +91 8652142057

# Visit Largest China Sourcing B2B Show in India

1+1 makes 11 in Indo - China Business Relations

## 5th CHINA MACHINEX™ INDIA 2017

**1200+**  
EXHIBITORS

**25,000+**  
DISPLAY PRODUCTS

**750+**  
MANUFACTURERS

# Electrical, Power & Energy

<b>Cables &amp; wires</b>		<b>Controls + Switchgears</b>	
<b>Circuit breaker</b>		<b>Insulators</b>	
<b>Connectors</b>		<b>High Voltage Products</b>	
<b>Relays</b>		<b>Pneumatic Tools</b>	
<b>Switches</b>		<b>Smart LED Lighting</b>	
<b>Transformers</b>		<b>Capacitors</b>	
<b>Solar energy panels</b>		<b>Measuring Instruments</b>	

National Partner  
  
Confederation of Indian Industry

China - India Economic Forum  
on 5th December 2017

Download Full  Exhibitor Directory App



**5-6-7 December 2017 ★ 10am - 6pm**

Hall No. 5,6 and 7A, Bombay Exhibition Centre,  
W. E. Highway, Goregaon (E), Mumbai.



Register Now for  
**FREE Entry +**  
**Chance to WIN an iPhone**  
[in.chinahomelife247.com/expo](http://in.chinahomelife247.com/expo)

### Supporting Associations

Organised by  
  
International Exhibition  
米奥兰特国际会展

Exhibition Managed by  
**WINMARK**  
EXHIBITIONS



**Around The World**  
**- In 11 Countries**  
**Taking Place Every Year**



INDIA

POLAND

TURKEY

SOUTH AFRICA

JORDAN

BRAZIL

KAZAKHISTAN

EGYPT

UAE

IRAN

MEXICO

power electronics and its historical development is very important. Although with the approaching limits of its internal metrics indicates internal maturity, the external constituent technologies of packaging, manufacturing, electromagnetic and physical impact, and converter control technology still present opportunities for development.

The primary trends are: increased efficiency; higher power density; and cost reduction. With cost concerns, efficiency requirements and need of environmental friendly technology, power supply efficiency is a key selection criterion and is supported by legislation.

Independent of the environmental angle, OEMs are seeking to increase the performance of their end equipment and are consequently looking for power supplies that dissipate less heat and take up less space. There are several methods to improving efficiency and these include: developing new topologies; improved power devices, control of electronic and magnetic component designs entering the market; the availability of new materials; and the application of digital control loops. Depending on the type of power supply and its end use, some or all of these methods will be used. For lower power applications, it's all about high power density with more and more power being claimed on industry standard pc board sizes, such as 2 x 4in and 3 x 5in. For cost reasons, a flyback circuit is commonly used but this has its limitations in terms of achieving efficiency improvements. New chips are now available that enable efficiencies of up to 92%,

although one must appreciate that at an efficiency of 92%, a 200W power supply will still dissipate 27% more excess power than a previous generation 100W product at 88% efficiency. Indeed, many components will be larger for the 200W power supply so, if both are designed to be the same size, then the parts are packed much more tightly and significant thermal challenges arise.

Addressing the growing energy challenges faced by our society requires advances in how we create, manipulate, store, and utilize electrical energy. Energy-processing circuits – or power electronics – are a key element in each of these areas. Researchers are exploring how power electronics can be better designed and applied to meet the energy needs of our society. For example, ongoing research explores the design of power electronics to better extract energy from solar, mechanical, and thermal sources. Likewise, the development of power electronics to improve efficiency and energy utilization is being explored in applications ranging from lighting to computation to communications. To meet the needs of future systems, it is important to miniaturize and better integrate power electronic circuits. The size and cost of power conversion circuitry is a major factor preventing improved energy utilization and efficiency in many applications. Moreover, power electronics are not easily integrated with other electronic elements, and often limit the miniaturization of entire systems. Miniaturization and integration of power electronics are difficult because the necessary energy storage

components scale down poorly in size and are not well suited to the planar geometries of most integrated fabrication processes.

Researchers are working to develop power electronics providing miniaturization and integration. A key focus of this work is the development of system architectures and circuit topologies that permit greatly increased operating frequencies. Higher frequencies are desirable because they reduce energy storage requirements, thereby reducing size and enabling better component integration. However, higher frequencies have traditionally been associated with major practical obstacles, including low efficiency. New circuit designs under development will greatly reduce frequency-dependent losses by recovering energy that is traditionally lost in device switching and gating. These designs also seek to eliminate fixed loss components that reduce light load efficiency. Additional research focuses on design of semiconductor devices and passive components that are compatible with these circuits and that operate efficiently at very high frequencies. Together, these approaches enable up to two orders of magnitude increase in operating frequency, with commensurate improvements in energy storage. It is anticipated that such design approaches will enable small, highly integrated power controls that benefit size, efficiency and energy utilization in a tremendous range of future systems. 



**Dr S S Verma**

Department of  
Physics, S.L.I.E.T.,  
Longowal, Punjab

# chainflex<sup>®</sup> works ...

Servo cable

**26** million strokes tested  
Test 4404

Measuring system cable

**66** million strokes tested  
Test 3479



Moving energy made easy with the world's number 1 for moving cables:

- Largest selection, up to 7 price levels
- From stock, from 1 meter, without cutting fees
- Largest test lab in the industry
- Available as an assembled e-chainsystem<sup>®</sup>
- Calculate lifetime online

[www.igus.in/chainflectest](http://www.igus.in/chainflectest)



# igus<sup>®</sup>

plastics for longer life<sup>®</sup>

Free Samples: igus<sup>®</sup> (India) Pvt. Ltd.  
Phone +91-80-45127800 info@igus.in

**“We aim to maintain our leadership position in India”**



Fluke Corporation is the world leader in the manufacture, distribution and service of electronic test tools and software. Fluke has helped define and grow a unique technology market, providing testing and troubleshooting capabilities that have grown to mission critical status in manufacturing and service industries. From industrial electronic installation, maintenance and service, to precision measurement and quality control, Fluke tools help keep business and industry around the globe up and running. Indian electrical test and measurement market still remains price sensitive and price plays a major role, informs **Prasanta Das, Director-Marketing, Fluke Corporation** in an interaction with **Electrical India...**

### **Kindly take us through the journey of Fluke in India so far.**

Fluke is in India for more than five decades for now, being represented by different Indian corporates until its direct operation as a 100% subsidiary company of Fluke Corporation US in 2012. More than five decades, Fluke is a household name within the technology community in India, be it residential electrician till the research scientist in ISRO or defense organization. With its distinct identity as one of the most reliable testing tools, it has won the confidence of Indian user in no time and the legacy continues even after 50 years of existence. We remain as the first preferred Electrical, Electronics and Instrumentation tool suppliers in India. Our products are known as the most accurate, reliable and safe both for the user and for the device under test. We have expanded our operation to reach almost every corner of India through our direct and indirect sales network with technical support team regionally located to cater to customer's need. We have grown to become the biggest TnM Company in India in terms of revenue, reach and product solution offering.

### **What kind of transformations have you witnessed in Indian Electronic Testing & Measurement market in last decade?**

We are country of action only when the things break or reach the breaking point. This attributes hold good in operation and maintenance too. Different industries – starting from process or discrete, infrastructure – such as power, OnG or communication network, we act only when it fails. In other words, Indian OnM ecosystem predominantly believes in break down maintenance. Over last one and half decades, with new technologies gone into the systems and more intelligence build in within the maintenance community, major shift on maintenance can be noticed. Preventive and predictive maintenance are given more importance than the breakdown maintenance to ensure assets are maintained properly and timely for uninterrupted working,

**Over last one and half decades, with new technologies gone into the systems and more intelligence build in within the maintenance community, major shift on maintenance can be noticed. Preventive and predictive maintenance are given more importance than the breakdown maintenance to ensure assets are maintained properly and timely for uninterrupted working, that saves huge capex.**

that saves huge capex. Customers are well informed – thanks to the internet and other medium – they are sure about what instruments they want to buy, that would address their pain points. Entry of many top global companies build up the awareness of predictive and preventive maintenance, and best practices are adopted slowly but surely by most of these customers. Last decades see a huge transformation in TnM industry with customers wants to buy the best instruments to be used in their systems. The importance of preventive and predictive maintenance is hugely felt and customers are

ready to invest on best products that are available to take care of the assets on regular basis.

### **What are the products offered by the company and in particular catering to Indian Energy market? What are the growth drivers for your products? What are your major customers in India?**

Fluke is the pioneer in test and measurement tools that cater to different customer segments addressing exact application areas. All electrical, process and electronics, condition monitoring areas where the need of test tools are required for predictive, preventive and break down applications, Fluke provides solution. Products such as power quality analyzer, thermal imager, scope meter, battery tester, process calibrations tools, laser shaft alignment tools, vibration meters, digital multimeters, and clamp meters are highly popular within engineering community and considered as the first preferred tools for their everyday work.

We are pioneer in energy management tools with several offering in our Power Analyzer Basket. We held the highest market share amongst other players in power analyzer market in India with our patented energy loss algorithm that allows the user to pinpoint the exact origin

of energy waste within the system. We have complementary products such as thermal camera, insulation tester etc to create a complete package on energy management within the system.

**Indian electrical test and measurement market still remains price sensitive and price plays a major role. Electrical instruments with lots of safety standards and certifications are expensive and manufacturers like us face stiff competitions from the local manufactures or suppliers. Most of them are not complying the international certifications and standards – such as IEC, CE, UL, etc.**

Manufacturing, infrastructure remain our core area of operation with extensive product offering from our product basket. We maintain our leadership positions within these segments for many years and would continue to do so with our innovations and offering. Power, oil and gas, railways and education are some of our segment on focus with many new segment specific offering is on the course of introduction in India.

**What technological innovations would you incorporate in your products for making them more superior and efficient?**

We have introduced Fluke Connect™, widely known as FC, the world's largest system of wirelessly connected tools, enabling customers to see, save and share measurement data securely through the cloud. Customer can see, analyze and act based on these information remotely. FC enhances the capability of Operation and Maintenance to many folds and now being widely adopted by most of the engineers across the Globe. We have introduced non-contact type simultaneous voltage and current measurement with a Fork Clamp recently. An incredible technology that would change the entire measurement landscape in near future.

**How would you differentiate Indian electrical test equipment markets from the global markets particularly European and American markets while offering your services and products? Do you face any competition in Indian markets?**

Indian electrical test and measurement market still remains price sensitive and price plays a

major role. Electrical instruments with lots of safety standards and certifications are expensive and manufacturers like us face stiff competitions from the local manufactures or suppliers. Most of them are not complying the international certifications and standards – such as IEC, CE, UL, etc. Our products follows the stringent quality and certifications as per international standard, and it remain same irrespective of countries it is sold. We

remain with our customers who are well informed about these qualities and certifications and appreciate our product offerings irrespective of price.

**What are your expansion plans in India with the government's 'Make in India' program? What potential do you foresee for your company with the Indian Government's focus on development of infrastructure like smart cities, roll out of power projects, etc.?**

We are upbeat about the Government's push on 'Make in India' program which would help growing the manufacturing sector. As mentioned earlier, manufacturing is our core area of operation and growth in manufacturing sector would be a welcome sign for us. Our focus on infrastructure, power sector with many new products and solutions are growth areas that we are aiming for next few years. We are excited about the government's initiative on these areas that deem fits in our future plan.

**What is your outlook for 2017-18 fiscal for the segment?**

We would keep focusing on our core segments on expanding our footprints on areas that are uncovered and keep growing in these areas. Along with it, white spaces, new segments like infra, railways, construction, education are our radar with lots of new solutions and innovative products on its way for introduction in this market. We keep our momentum of growth and aim to grow further during 2018- 19 by maintaining our leadership position in TnM field in India.





Juno Series

India's Lighting Company



It's not just  
an Idea

It's  
Innovation



**K-LITE INDUSTRIES**

D-10, Ambattur Industrial Estate, Chennai-58.

Tel : 26257710, 48581950, Fax : 26257866

Cell : 95000 79797, 95000 85511

Email : info@klite.in

[www.klite.in](http://www.klite.in)



# Challenges for India's Solar Energy Growth

Development of off-grid systems that are 'Grid ready' for rural and remote areas, and making by-laws for new buildings for grid connected as 'Rooftop ready' should be the suggested goals for the future. If these initiative works are executed as envisaged, it is only a matter before India becomes one of the world leaders in Solar Energy...



## International Market Review

Total global solar PV installed capacity surpassed 300 GW by the end of 2016. 77 GW was added in 2016, a year-on-year growth rate of 34%. China led with 34.5 GW, followed by the USA (14.5 GW),

Japan (10.2 GW) and India (5 GW) in fourth place. In 2017, about 79 GW capacity is expected to be added globally, registering marginal growth over 2016. The stagnation is mainly due to policy pullbacks across major markets including China, Japan, the USA

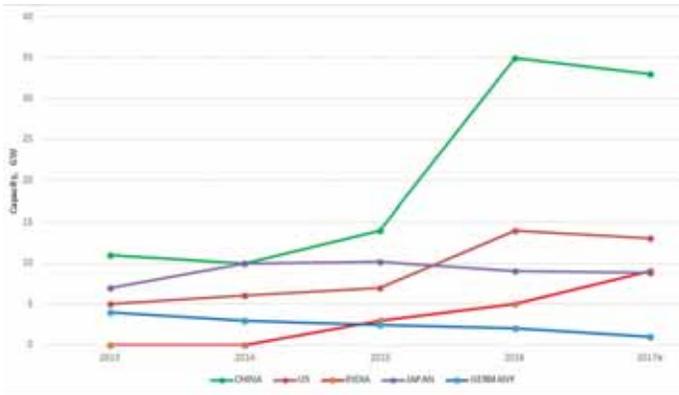


Figure 1: Capacity addition in leading international markets

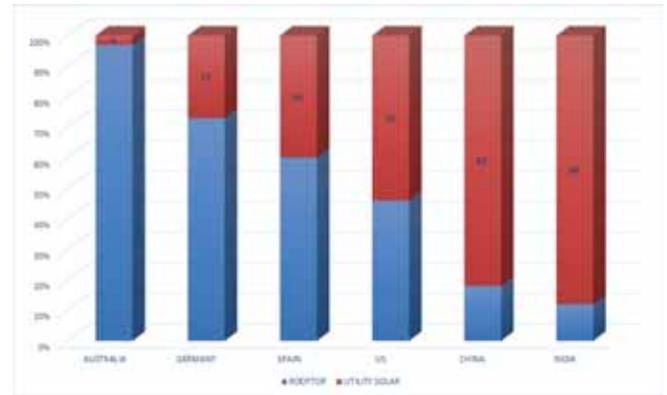


Figure 2: Share of utility scale vis-à-vis rooftop solar

and most parts of Europe.

Meanwhile, India is expected to continue its rapid growth. With 8.8 GW of projected capacity addition (growth of 76% over 2016), it is set to become the third largest PV market in 2017, overtaking Japan. India can take the lead in driving the energy transformation both regionally and globally with one of the largest, and most ambitious, renewable energy programmes anywhere in the world. India has set a target of 175 GW of installed renewable energy capacity by 2022, including 100 GW of solar, 60 GW of wind, 10 GW of biomass and 5 GW of small hydropower.

**Other key trends shaping the global solar industry include:**

- Asia continues to dominate the solar industry while Europe continues to fall in rankings.
- Auctions are gaining universal acceptance - number of countries using auctions to allocate solar capacity has increased from 14 in 2014 to 22 in 2016.
- Solar module prices continue to fall faster than most experts had anticipated. Prices in India fell to 32 ¢/Wp in Q1 2017 (- 29% over last year). Such a rapid fall has made solar PV the cheapest new source of power in most countries and provided demand boost in emerging economies.
- Developed countries are slowly shifting towards utility scale projects whereas in emerging markets, governments are trying to encourage more rooftop solar growth. In India, rooftop solar has maintained a 10-12% share of overall solar capacity. This is much lower than other key markets such as US, Germany, China, Spain and Australia.

**Indian Utility Scale Solar Market Capacity addition**

As of March 31, 2017, India had installed 12.2 GW of utility scale solar PV capacity.

**Project development landscape**

As the Indian solar market grows and project sizes increase, international developers and private equity funded IPPs are playing a greater role.

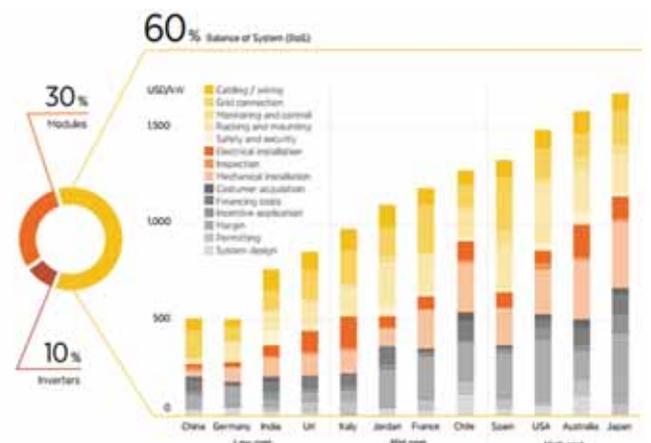
**Comparison of ‘Balance of System’ costs of utility scale solar in India with other countries**

As evident from the Illustration 1, India is competitively placed with regard to cost of BOS in comparison with several developed countries.

**Financial incentives**

The Government of India has been offering several financial incentives to promote the solar sector. But as cost of solar power is coming down, these benefits are being slowly phased out.

Illustration 1: Comparison of ‘Balance of System’ costs of utility scale solar in India with other countries



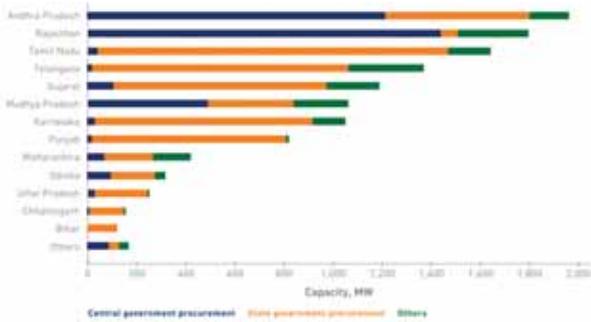


Figure 3: Commissioned capacity as of March 31, 2017

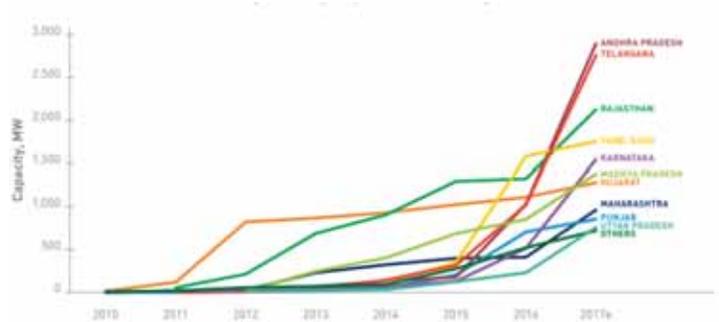


Figure 4: Capacity addition in leading states

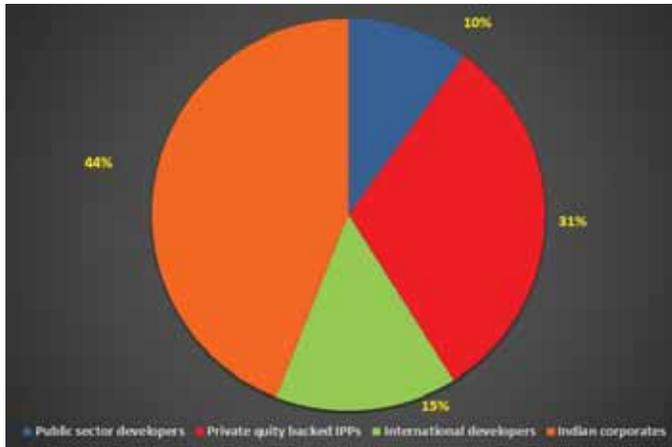


Figure 5: Commissioned capacity

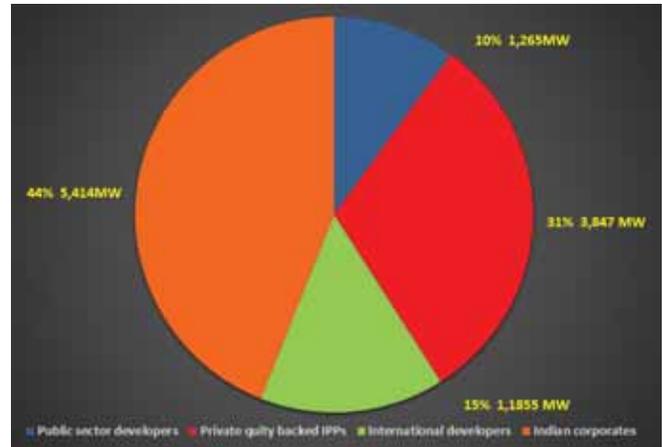


Figure 6: Capacity under development as of March 31, 2017 (12,381 MW)

**Viability gap funding (VGF):** Solar Energy Corporation of India (SECI) has allocated 4,835 MW of project capacity under the VGF route, whereby a capital subsidy is provided to project developers bidding for projects at a predetermined tariff. As of March 31, 2017, another 785 MW of tenders under SECI VGF scheme are under process.

**Accelerated depreciation:** All solar projects have been historically eligible to avail depreciation of 80%

of asset value but this rate has been reduced to 40% from April 2017 onwards.

**Ten-year corporate tax holiday:** A 10-year income tax holiday has been offered to solar projects so far, but this benefit has been withdrawn from April 2017 onwards.

**Development of solar parks**

The Government of India has sanctioned development of 40,000 MW of solar park infrastructure

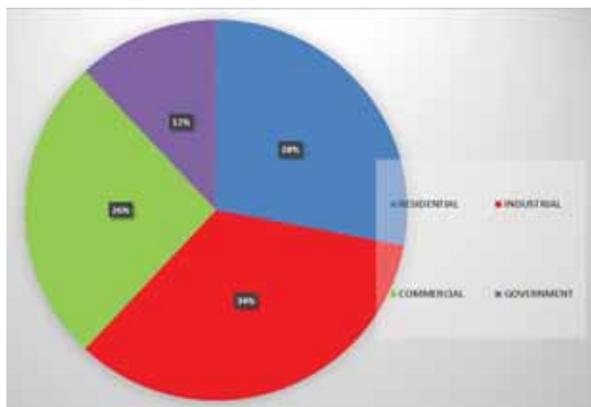


Figure 7: Rooftop solar annual capacity addition

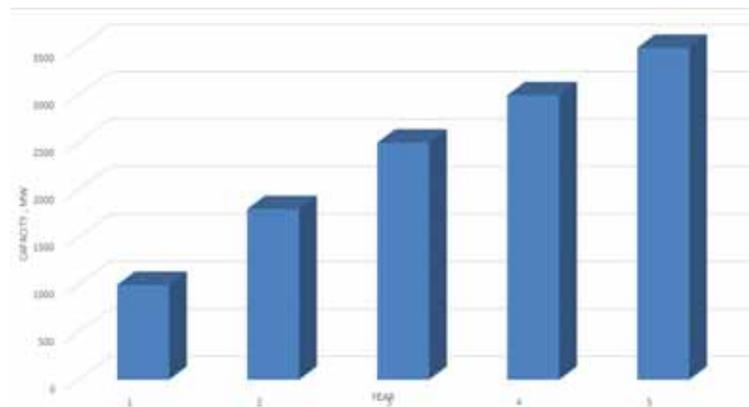


Figure 8: Rooftop solar capacity addition projections



Figure 9: India rooftop solar EPC price index

by the year 2020 with a financial support of M 81 billion (US \$ 1.2 billion). Solar projects with a total capacity of 8,900 MW have already been allocated in eight solar parks.

### Indian Rooftop solar market

#### Installation trends

India's total installed rooftop solar capacity is estimated at 1,247 MW as of December 31, 2016.

#### Projections

11.9 GW of new rooftop solar capacity addition is

expected in India between 2017 and 2021.

#### Policy update

**Net metering:** 29 states and 7 union territories have notified grid connectivity regulations with provision for net/gross metering but on-the-ground implementation remains patchy.

**Subsidy for residential, institutional and government consumers:** Ministry of New and Renewable Energy has sanctioned INR 50 billion (\$ 750 million) funding for 30% capital subsidy for rooftop solar for residential and institutional consumer segments. In addition, up to 30% subsidy is also available for government projects.

**Boost in government demand:** Government is expected to become a major demand source for rooftop solar in the coming years. All building facilities under different central government departments are being urged to adopt rooftop solar and a potential of 6 GW capacity has been identified so far. SECI has already announced 500 MW of tenders for such buildings.

**Concessional debt financing:** The Government of

### Solutions For A Wired World



Ring Main Unit

Bimetabolic terminals for connecting power cables with aluminium conductors to copper terminals and bus bars on equipments are made by STI. A bimetabolic terminal consists of copper palm integrated to an aluminium barrel by process of friction welding. Aluminium conductors of a power cable is connected to bimetabolic terminal inside the aluminium barrel and secured by compression (crimping) tools. Bimetabolic terminals eliminate burn out of copper terminals crimped to aluminium conductors. To bushing of Ring Main Units (RMUs) and to copper bus bars.

### Ask For **Calter Bimetals** & Compliment With Range Of **Calter Tools** For A **Secure Connection**



Recently completed project in South Gujarat

Successfully Supplying To Major Utilities **Without Any Failures** Across The Globe For The **Last 7 Years!!**

Find full range of products on : [www.calter.com](http://www.calter.com) or you can call us : 022 6153 2425



India, with assistance from multilateral financial institutions such as Asian Development Bank, The World Bank and New Development Bank has earmarked US \$ 1,470 million of concessional credit lines for the rooftop solar market.

**Building bye-laws:** The Government of India has recommended mandatory rooftop solar installations for buildings exceeding specified size and/or power consumption thresholds under the model Building Bye Laws. Four states and union territories - Uttar Pradesh, Haryana, Chandigarh and Chhattisgarh - have adopted these regulations so far.

### Market Growth Expectations

Solar PV has a capacity factor ranging from 16% to 19% and is estimated to produce around 350 TWh/yr of power, making up around 10% of India's power supply. So the impact of this addition on the grid will be limited

Rooftops in densely populated cities are an important element in the availability of space for solar PV and thermal systems. By 2030 around 40% of buildings would have either a solar thermal or solar PV system on their roofs. The estimate is based on the availability of rooftops in New Delhi: at present they amount to around 31 km<sup>2</sup>, which could take an estimated 2.5 GW of solar PV modules (Greenpeace, 2013). As Delhi makes up around 1% of India's total population, the total Indian rooftop potential may be around 250 GW. If it is assumed that there is around 50 GW of distributed rooftop solar PV (including solar home systems), around 20% of India's available

rooftop area would have a solar PV system in 2030. With around 150 million m<sup>2</sup> of solar thermal residential and commercial systems, an estimated 20% of buildings would have them.

Besides this very significant growth in solar PV, an addition of 10 GW is also expected from concentrated solar Power (CSP). Although a growth to 10 GW may seem modest compared to the increase in PV, it still implies building 20-50 large CSP plants within the next 15 years. Gujarat and Maharashtra in the west of India, Jammu and Kashmir, Himachal Pradesh and Uttarakhand in the north, and Karnataka, Andhra Pradesh and Tamil Nadu in the south, as well as Rajasthan, are favourable locations for CSP with high direct solar radiation.

### Solar capacity addition by March 2022

The industry is more optimistic than last year and expects India to add a total of 60 GW solar capacity by 2022 (+5% over last year) but still considerably below the government target of 100 GW.



### Rooftop solar capacity addition by March 2022

We see the same positive trend for rooftop solar capacity addition. Average of all the responses indicates estimated rooftop capacity of +14 GW by 2022. Rapidly falling costs and government efforts to boost demand in the public sector have improved growth prospects in this market.



### Challenges and Opportunities

SWOT analysis for the Indian Solar PV Industry.



Key challenges facing the growth and development of PV in India include:

- **Cost and T&D Losses:** Solar PV is some years away from true cost competitiveness and from being able to compete on the same scale as other energy generation technologies. Adding to the cost are T&D losses that at approximately 40 percent make generation through solar energy sources highly unfeasible. However, the government is supporting R&D activities by establishing research centres and funding such initiatives. The government has tied up with world-renowned universities to bring down the installation cost of solar power sources and is focusing on upgradation of substations and T&D lines to reduce T&D losses.
- **Land Scarcity:** Per capita land availability is very low in India, and land is a scarce resource.

Attracting Tomorrow

## TDK Technology Advancing power solutions.

**Rare earth magnets with high magnetic field strength** for wind power generators

**Aluminum electrolytic capacitors and film capacitors** for high ripple currents

**Surge arresters and varistors** with long-term reliability

**EMC and sine-wave filters** for currents up to 8 kA

<https://product.tdk.com>

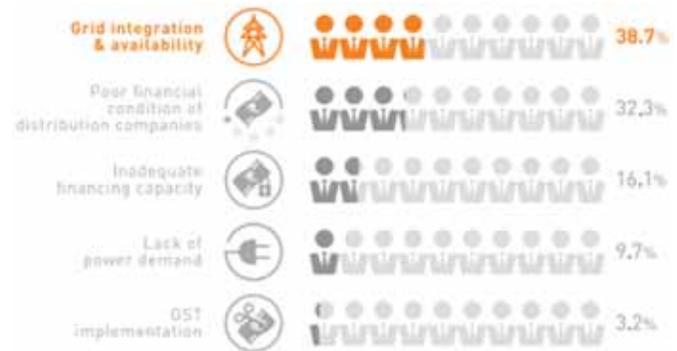
# Outlook

Dedication of land area near substations for exclusive installation of solar cells might have to compete with other necessities that require land.

- Funding of initiatives like National Solar Mission is a constraint given India's inadequate financing capabilities. The Finance Ministry has explicitly raised concerns about funding an ambitious scheme like NSM.
- Manufacturers are mostly focused on export markets that buy Solar PV cells and modules at higher prices thereby increasing their profits. Many new suppliers have tie-ups with foreign players in Europe and United States thereby prioritizing export demand. This could result in reduced supplies for the fast-growing local market.
- The lack of closer industry-government cooperation for the technology to achieve scale.
- The need for focused, collaborative and goals driven R&D to help India attain technology leadership in PV.
- The need for a better financing infrastructure, models and arrangements to spur the PV industry and consumption of PV products.
- Training and development of human resources to drive industry growth and PV adoption.
- The need for intra-industry cooperation in expanding the PV supply chain, in technical information sharing through conferences and workshops, in collaborating with BOS (balance of systems) manufacturers and in gathering and publishing accurate market data, trends and projections.
- The need to build consumer awareness about the technology, its economics and right usage.
- Complexity of subsidy structure & involvement of too many agencies like MNRE, IREDA, SNA, electricity board and electricity regulatory commission makes the development of solar PV projects difficult.
- Land allotment & PPA signing is a long procedure under the Generation Based Incentive scheme.

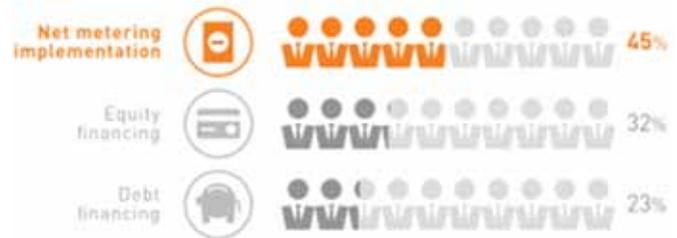
## Challenges in the utility scale solar market

The biggest concern for the sector is grid integration of growing renewable capacity followed by poor financial condition of Distribution Companies (DISCOMS).



## Challenges in the rooftop solar market

Net metering implementation as the most important challenge.



## Conclusion

Government of India is leading by example through installation of solar rooftops widely on government buildings, airports, railways network, educational



institutions, residential sector and commercial complexes. Though high growth is expected and cost wise, it can reach parity with coal based power generation very soon, it is to be noted that unlike thermal power plants, rooftop PV generation (RTPV) is consumers dominated and therefore, peoples' participation and acceptance are critical issues for its success. At the national level, manufacturing capacity, investment in R&D, investor friendly environment, skill development, low voltage grid connectivity of variable solar resource and regulatory decisions are major challenges to be resolved. As the penetration of RTPV has to increase, boost to manufacturing capabilities not only in solar modules but also in inverters and batteries is must. In skill development, providing skills for jobs of engineers, manufacturers, suppliers, repairs, maintenance, testing facilitators are some of the important challenges before the state agencies.

An outlook for linking of solar energy targets with the current missions on 'Make in India', 'Smart city mission' and 'Digital India' as a promise for developing

capabilities and transformation of entire power system in the country is recommended. Development of off-grid systems that are 'Grid ready' for rural and remote areas, and making by-laws for new buildings for grid connected as 'Rooftop ready' should be the suggested goals for the future. If these initiative works are executed as envisaged, it is only a matter before India becomes one of the world leaders in Solar Energy. BT



**Dr. Sarat Kumar Sahoo**  
Professor,  
School of Electrical Engineering,  
VIT University,  
Vellore, Tamilnadu.



**Manu Rajesh Menon**  
Student,  
School of Electrical Engineering,  
VIT University,  
Vellore, TamilNadu



Meet us at:  
 5 Tue - 7 Thus  
 December  
 2017  
**Hall : 1**  
**Stall : 1852**  
 Bombay Exhibition  
 Centre, Mumbai  
 INDIA

### Wire Management Solutions

## Wiring Ducts

PVC & Halogen Free



- Narrow Slot
- Wide Slot
- Un-slotted (Solid Wall)

Colors Available in PVC  
  
 Blue Grey White Black



## SIMPLY SOLUTIONS

### Halogen Free for Highest Safety

**HALOGEN FREE**  
WIRE MANAGEMENT

Maximum reliability for sensitive environment



**Trinity Touch Pvt. Ltd. [www.trinitytouch.com](http://www.trinitytouch.com)**

**Corporate Office**

**Delhi:** D-10, Defence Colony, New Delhi 110024 INDIA **Tel:** +91.11.30895900/+91.11.71200900 **Fax:** +91.11.30895998/+91.11.71200998

**E-mail:** [wiringduct@trinitytouch.com](mailto:wiringduct@trinitytouch.com), [ms@trinitytouch.com](mailto:ms@trinitytouch.com)



“A true three phase test system make power transformer testing significantly faster, easier and more accurate.”

# Diagnostic Testing On Transformers

Performing a range of standard electrical tests on a regular basis has proven to be an effective way of gaining reliable insight into the operating condition of transformers. But, this has been a time- and cost-intensive job in the past. A true three phase test system can really make a difference...

## True 3-Phase Testing Makes Difference in Power Transformer Diagnostics

Power transformers are critical components in an electrical power network. Testing, diagnostics and reliable condition assessment of

power transformers becomes increasingly relevant due to the aging of transformer fleets around the globe. Performing a range of standard electrical tests on a regular basis has proven to be an effective way of gaining reliable insight into the operating condition of transformers. But, this has been

a time- and cost-intensive job in the past. Different equipment needed to be used for each test, each phase had to be measured individually and the connections had to be changed between the tests. A true three phase test system can really make a difference.

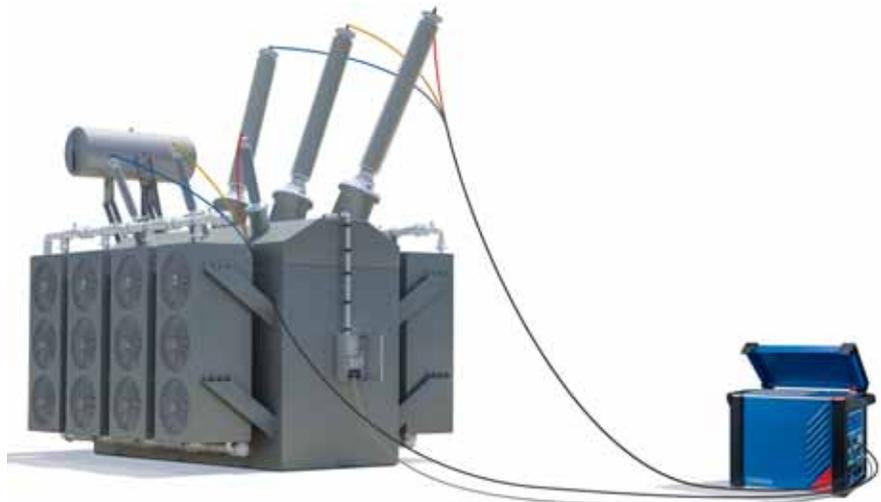
## One system – Multiple Tests

TESTRANO 600 is the only portable, three-phase test system which combines the most common electrical tests on power transformers for routine and diagnostic testing on site or during factory acceptance tests (FAT) in one system:

- 3-phase winding resistance with 33 A
- 3-phase transformer turns ratio with 400 V L-L
- 3-phase short-circuit impedance / leakage reactance
- Exciting current
- Frequency response of stray losses (FRSL) at 15 Hz – 400 Hz
- Dynamic resistance measurement
- Power / dissipation factor measurements at 15Hz – 400 Hz
- Fast demagnetization with up to 30 A

### DC Winding Resistance Measurement

DC winding resistance measurements are used to determine continuity problems in the winding connections and tap changer contacts. They are also used to check the on-load tap changer (OLTC) as they can indicate when to clean or replace OLTC contacts, or when to replace or refurbish the OLTC itself. Failures can be detected without opening the tap changer compartment. During the measurement the resistance of each subsequent tap position is investigated and compared with the reference measurement data of the manufacturer. Using TESTRANO 600 you can measure e.g. all three-phases of a wye-connected winding



“TESTRANO 600 makes power transformer testing three times faster than with conventional single phase test devices.”

simultaneously. This makes testing three times faster than single-phase testing and reduces your average measurement time.

During DC winding resistance measurements the core of the transformer may be magnetized. Therefore, it is recommended to demagnetize the core after performing this test.

### Transformer Turns Ratio (TTR) Measurement

Transformer turns ratio (TTR) measurements are performed to verify the fundamental operating principle of a power transformer. By measuring the ratio and phase angle from one winding to the other, open circuits and shorted turns can be detected. The turns ratio is determined during factory acceptance tests (FAT) and needs to be checked routinely once the transformer is in service. TTR measurements can also be triggered by a tripped relay and other diagnostic tests like dissolved gas analysis

(DGA) and dissipation factor/ power factor measurements. The

results of a TTR measurement are compared with nameplate values and across phases. When performing a TTR measurement with TESTRANO 600 a true 3 phase voltage signal with 120° phase shift of up to 400 V L-L is applied to the primary side of the transformer which is measured back on the secondary side. With this true three phase method the ratio and phase shift of any winding configuration can be verified. This comes in very handy, especially when measuring phase shifting or rectifier units with unconventional vector groups. Another advantage of this technique is that the connection for all vector groups is the same, making it very easy to perform the measurement and leaving almost no room for error.

A magnetized core or missing ground reference may influence the measurement and lead to incorrect results. Making sure the transformer core is demagnetized and proper grounds are established on each winding is therefore very important.



“No need for a laptop: TESTRANO TouchControl on the 10.6 multi-colour displays allows fast and easy on-site testing.”

### Short-Circuit Impedance / Leakage Reactance Measurement

Short-circuit impedance / leakage reactance measurements are sensitive methods for assessing the potential deformation or displacement of windings. Severe short-circuits or transportation of the power transformer may cause the windings to move or become deformed. In events like these, short-circuit impedance / leakage reactance tests are recommended. The tests are usually performed as a three-phase measurement which can be compared to the nameplate value established by the manufacturer during factory acceptance tests. As this value represents the average across all three phases, a per-phase measurement is also recommended for winding diagnosis.

With TESTRANO 600, you can test all three-phases in parallel. This saves time and reduces the number of trips up the ladder.

### Exciting Current Measurement

Exciting current measurements are performed to assess the turn-to-turn insulation of the windings, the magnetic circuit of a transformer as well as the tap changer. The most valued benefit of the test is to detect turn-to-turn short-circuits in a winding. Physical movement of the core laminations severe damage of the core can influence the reluctance and, thus, will result in a change in exciting current. Deviations may also indicate contact wear or improper wiring of the tap changer. The exciting currents of all three phases can be determined while measuring turns ratio with the TESTRANO 600. For an exciting current measurement at 10 kV, the TESTRANO 600 can be combined with the CP TD1.

### Frequency Response of Stray Losses (FRSL) Measurement

The frequency response of

stray losses (FRSL) test is a measurement of the resistive component of the short-circuit impedances at multiple frequencies. It is the only electrical method to identify short-circuits between parallel strands and local overheating due to excessive eddy current losses. Similar to the short-circuit and leakage reactance test, it is recommended to perform the FRSL measurement as a commissioning or acceptance test to establish benchmark results. Likewise FRSL tests are not routine diagnostic tests, but are recommended for advanced diagnostics.

With TESTRANO 600 the measurement can be done across a frequency range of 15 Hz to 400 Hz on all three phases at the same time without any reconnecting. This advanced diagnostic test and the short-circuit impedance / leakage reactance test can be done simultaneously, because the test setup is the same.

The analysis of FRSL results is largely visual and includes the comparison across phases and over time. An increase in impedance over the frequency range can be observed as the eddy losses become more pronounced at higher frequencies. This increase should be uniform across all three phases and problems are usually indicated by phase deviations at the upper end of the frequency spectrum.

### Dynamic Resistance Measurement (DRM)

DRM is used to check the on-load tap changer (OLTC) for poorly maintained and damaged OLTC contacts. It is performed as a

supplementary measurement in order to analyze the transient switching process of resistive type diverter switches. When switching the tap changer during winding resistance measurements, the DC current temporarily decreases due to the additional commutating resistors of the diverter switch. This current signature is recorded and can be analyzed to identify contact and timing problems of the tap changer.

A fast and comprehensive analysis of the switching process and the internal contacts of tap changers with resistive type diverter switches can be performed with TESTRANO 600. The measurement can be done in parallel to the DC winding resistance tests.

#### Power or Dissipation Factor (PF/DF) & Capacitance Measurement

PF/DF and capacitance measurements are performed in order to investigate the insulation condition of power transformers and bushings. Both insulation systems are essential for the reliable operation of the transformer. High oil conductivity, aging and an increase in the water content are symptoms of the degradation process in the insulation. These symptoms also result in an increase of losses, which can be quantified by measuring the power factor or dissipation factor. Changes in capacitance can indicate partial breakdown between the capacitive layers of bushings. By measuring the capacitance and losses, problems in the insulation can be detected before a failure occurs.



“One test-setup with 3 multi-plug cables can be used to perform multiple tests on power transformers.”

Standard PF/DF measurements at 50 Hz or 60 Hz can only detect the effects of moisture and aging at an advanced stage. Using frequencies other than line frequency increases the sensitivity of the measurement as some problems are more dominant at frequencies above or below line frequency. Combining the TESTRANO 600 with the CP TD1 accessory, allows you to measure PF/DF across a wide frequency range of 15 Hz to 400 Hz and detect defects at an earlier stage.

#### Active Discharge & Fast Demagnetization

The active discharge function (patent pending) of TESTRANO 600 automatically discharges the winding within a matter of seconds after resistance measurements have been performed. This guarantees a high level of safety during testing and reduces testing time. You can also demagnetize the transformer's core before and after performing a reliable test with

TESTRANO 600. This reduces the risk of high inrush currents and avoids the influence of a magnetized core on subsequent tests, such as excitation current tests or sweep frequency response analysis.

#### Three Wires Are All You Need

By using TESTRANO 600 you can perform various tests without rewiring.

Specially designed multi-purpose cables are used to connect TESTRANO 600 to the high-voltage and low-voltage side of the transformer. The cables, which support a 4-wire (Kelvin) connection, have to be connected to the transformer's terminals once. Afterwards, all test outputs and measurement inputs are automatically controlled by TESTRANO 600 without the need to change the connection again. An additional multi-plug cable can be connected to switch between different tap positions of an on-load tap changer (OLTC)

## Overview

automatically. This cable can also be used to record motor current and voltage of the OLTC.

The custom-designed connector plugs and labelled connection leads leave an extremely narrow margin for wiring errors. Thus, tangled cables become a thing of the past and it is easy for you to maintain an overview of the connections.

Additionally, there is no need for an additional external switchbox when testing with TESTRANO 600. Users of conventional single phase testing devices have to connect a switchbox to test all 3 phases in parallel and accept compromises in terms of usability. The unique approach of TESTRANO 600 with its three internal sources offer true three phase testing with just one portable unit.

### Rugged, Compact & Safe

Despite its extensive range of functions, the TESTRANO 600 weighs only 20 kg/44 lbs. The rugged design makes it ideal for on-site testing even in rough environments. When combined with the CP TD1 for power/dissipation factor measurement, both devices can be mounted on a trolley, which makes them easy to transport. In order to ensure safety during testing, TESTRANO 600 is

equipped with an emergency stop button as well as safety and warning lights.

TESTRANO can be operated it via the smart TESTRANO TouchControl on the integrated touch display or via the Primary Testing Manager™ (PTM) software on your laptop. This makes it ideal for routine and diagnostic testing on site or during factory acceptance tests (FAT).

### Touch-and-Test

TESTRANO TouchControl on the integrated touch display offers pre-configured wiring diagrams and convenient features for graphical comparisons and detailed analysis. You can prepare tests in advance and import the test files via the USB interface. In order to identify your asset and keep your test results organized, you can enter basic transformer nameplate information before starting your test.

The high contrast of the high-resolution, multi-touch 10.6" display ensures good visibility even in bright sunlight. This allows fast, flexible and easy testing on site – just touch & test.

### For More Guidance in Testing

Using TESTRANO 600 with the PTM software offers you full guidance while testing and easy

data management. It enables you to control and operate the connected test set directly from your laptop. Detailed wiring diagrams and asset-specific test plans based on international standards will support you in executing your tests. For a comprehensive analysis, PTM offers automatic result assessment and comparison as well as customized reporting.

Additionally, PTM provides a well-structured database for managing all related transformer data to get a comprehensive overview of your asset's condition. You can define and manage locations, assets, jobs and reports in an easy and fast way.

### A True Cost & Time Saver

At a time, when testing and condition assessment of power transformers becomes more relevant a true three phase test system can really make the difference. The cost and time savings achieved with a three phase test system are tremendous, especially when testing on-site. 



**Cornelius Plath**

Product Manager,  
OMICRON

Become the new face of  
growing Technology!

Print + Digital + eNewsletter

**Electrical India**  
India's oldest magazine on power and electrical products industry

FOR DETAILS CALL :  
Ad Department (022-2777180)  
(022 2777 7184) & (+91 22 2777 7196)

- # Technological updates
- # Trending news from the industries.
- # Versatile topics covered
- # Wide exposure
- # Eminent writers from the industries.

# HIGH QUALITY FOR YOUR MACHINERY



## MGM brake motor main features

- TEFC 3-ph asynchronous brake motor (0.09kW-130kW)
- AC 3-ph brake (no rectifier) or DC brake on request
- Oversized brake disc for higher brake torque, longer life and reduced maintenance
- Fine and easy brake torque adjustment (as standard)
- Very quick brake reaction time
- Frequent START/STOP cycle applications
- Manual brake release (as standard)
- Hexagonal hole on non drive end of the shaft for manual rotation
- Single speed or two speeds motors
- All motors designed for inverter duty



## VARVEL production lines

- RS-RT worm gearboxes: 28 to 150 mm centres.  
One stage worm, helical/worm and double worm.
- RD helical gearboxes: 50 to 2300 Nm. Two and three stages.
- RN parallel shaft gearboxes: 180 to 3300 Nm. Two and three stages.
- RO-RV bevel/helical gearboxes: 180 to 3300 Nm. Three stages.
- RG precision planetary gearboxes: 10 to 230 Nm.  
One and two stages.
- VR dry friction speed variators: IEC63 to IEC90  
1 to 5 stepless speed range, 300 to 1500 rpm.
- VS planetary speed variators: IEC71 to IEC112  
1 to 5 stepless speed range, 200 to 1000 rpm.



A new generation of electric motors and gearboxes for power transmission quality from the alliance of two dynamic italian companies.  
For those who want quality.

## MGM-VARVEL Power Transmission Pvt Ltd

Ware House No. G3 and G4 • Ground Floor • Indus Valley's Logistic Park • Unit 3 • Mel Ayanambakkam • Vellala Street  
Chennai - 600 095 • Tamil Nadu, INDIA • Phone: +91 44 64627008 • [info@mgmvarvelindia.com](mailto:info@mgmvarvelindia.com) • [www.mgmvarvelindia.com](http://www.mgmvarvelindia.com)

REGIONAL OFFICE: KOHLI TOWERS • 4<sup>th</sup> Floor, Dapodi • Near Bharat Petrol Pump • Pune - 411012



## “EESL seeks to be a \$1.5 bn company by 2020”



Energy efficiency is a key component in the government's bid to help India transform into a clean energy hub without significantly compromising upon its growth objectives. With implementation of various energy efficiency measures in various sectors such as agriculture, municipalities, buildings, domestic, industries a considerable quantum of electricity can be saved. EESL has already retrofitted over 35 lakh streetlights across 23 states and four Union Territories in the country, leading to an annual energy saving of 46.63 crore kWh to Urban Local Bodies (ULBs) while resulting in an avoidance of 117 MW peak demand as well as a reduction of 3.8 lakh tonnes of CO<sub>2</sub> annually, states **Saurabh Kumar, Managing Director, Energy Efficiency Services Ltd (EESL)** in an interaction with **Electrical India...**

### **How could energy efficiency help India meet growing power demand?**

A nation's per-capita electricity consumption is one of its biggest indicators of growth and development. The availability of reliable, uninterrupted, and affordable power can ensure holistic growth across various sectors of the economy. At present, India's installed capacity is around 319 GW. However, close to 700 million people across the country don't have access to adequate power supply. Faced with a pressing need

to provide uninterrupted energy solutions, the country needs to use its energy as judiciously as possible. Energy efficiency is a key component in the government's bid to help India transform into a clean energy hub without significantly compromising upon its growth objectives. With implementation of various energy efficiency measures in various sectors such as agriculture, municipalities, buildings, domestic, industries a considerable quantum of electricity can be saved.

Over 90% of our time is spent in buildings – home or workplace. Retrofitting buildings with energy-efficient appliances is one of the simplest ways to reduce power consumption. Measures like switching to LED bulbs and tubelights for lighting, using higher star rated air conditioners and fans is also the most cost-effective actions to reduce energy use. It can reduce the household lighting costs by half. Light Emitting Diode (LED) bulbs only use around 20% of the energy to produce the same amount of light as an incandescent light bulb and last much longer than sodium bulbs. Using LED lights in households, shops, supermarkets, and malls can reduce energy consumption by at least 75%, and last much longer than incandescent lighting. Using LED lights gives out more light, more savings, and a lower energy bill. The Government of India, through the UJALA scheme is distributing LED bulbs, tubelights and energy efficient fans in every DISCOM office of the state. The appliances, which are cheaper than the market price can help buildings easily switch to energy efficient buildings.

**According to you, what are the significant government policies that can help boost industry initiatives towards energy efficiency?**

The National Mission on Enhanced Energy Efficiency (NMEEE) of the Government of India is one of the eight missions under the National Action Plan for Climate Change to promote the market for energy efficiency by fostering innovative policies and effective market instruments. Its roots lie in the overall objective of the Energy Conservation Act of 2001. The Mission

**The challenge initially was to increase accessibility and affordability of energy efficient appliances to the common man. To overcome this, EESL facilitated bulk procurement of LED household lamps which subsequently lowered the cost of the product, making it affordable for consumers, keeping in mind the government’s vision of replacing 77 crore inefficient bulbs with LED bulbs in Indian households by 2019.**

document, which was approved in 2010, established the immense energy efficiency potential of India, which was about Rs 74,000 crore. The mission, upon its complete execution, envisages achieving total avoided capacity addition of 19,598 MW, fuel savings of around 23 million tonnes per year and greenhouse gas emissions reductions of 98.55 million tonnes per year. NMEEE consists of four initiatives to enhance

energy efficiency in energy intensive industries which is shown in chart 1.

**What is the status of National Streetlight Program? What is the success rate of this program? What percent of energy savings has the program achieved?**

On 5th January 2015, the Prime Minister launched a national program to replace the conventional streetlights with smart and energy efficient LED streetlights. With a target to retrofit 1.34 crore (13.4 million) LED streetlights across the country through the Street Lighting National Programme (SLNP), Energy Efficiency Services Limited (EESL) will reduce energy consumption in lighting for Municipal Corporations and help DISCOMs to manage peak demand. EESL has already retrofitted over 35 lakh streetlights across 23 states and four Union Territories in the country, leading to an annual energy saving of 46.63 crore kWh to Urban Local Bodies (ULBs) while resulting in an avoidance of 117 MW peak demand as well as a reduction of 3.8 lakh tonnes of CO<sub>2</sub> annually. EESL has also illuminated over 50,000 kilometer of Indian roads, which has made it the world’s largest streetlight management company. In each of the ULBs, the installed streetlights are leading to an estimated energy saving of 58%.

**EESL has reduced the costs of LED lights by as much as 85 per cent within three years, leading to the lowest prices for LEDs worldwide. What is your strategy to procure these lights?**

The challenge initially was to increase accessibility and affordability of energy efficient appliances to the

Chart 1

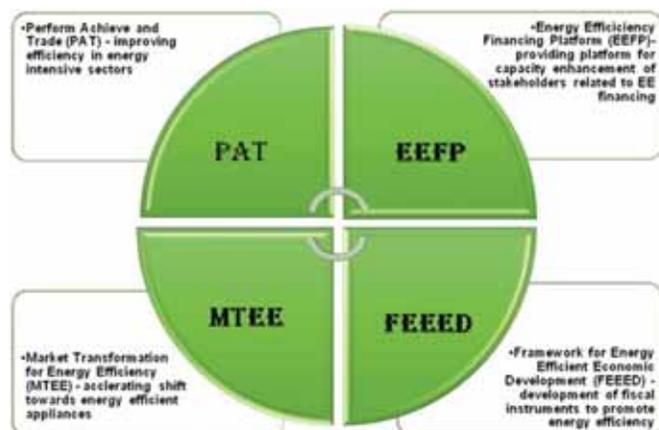
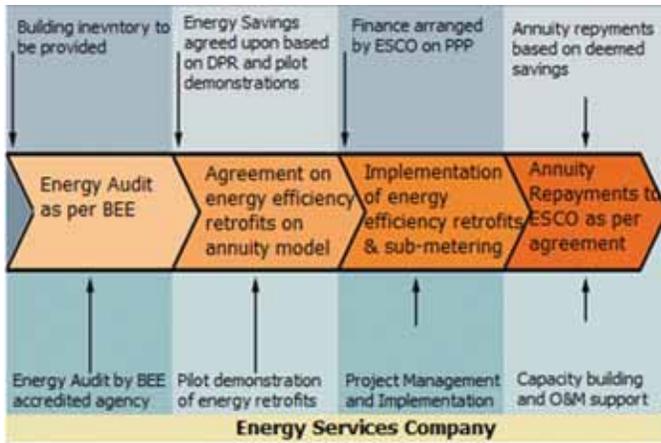


Chart 2



common man. To overcome this, EESL facilitated bulk procurement of LED household lamps which subsequently lowered the cost of the product, making it affordable for consumers, keeping in mind the government's vision of replacing 77 crore inefficient bulbs with LED bulbs in Indian households by 2019. With this, EESL became the first company in South Asia exclusively focused on energy efficiency implementation. Through the practice of bulk procurement, the procurement price of the 9-Watt LED bulbs under the UJALA programme has been

brought down by 88%. Due to this market intervention, EESL has been able to distribute LED bulbs under UJALA for ₹ 70/- (inclusive of GST) and has resulted in the drop of retail price of LED bulbs to approximately ₹ 150/- per unit. This has led to faster adoption of LED bulbs amongst the citizens of India, and we can see them installed even in the remotest of villages in the country today. In addition to LED bulbs, EESL has increased affordability of other energy efficient appliances such as

20-Watt LED tubelights as well as 50-Watt BEE 5-star energy efficient fans available under the UJALA scheme. Under the scheme, the 20-watt LED tubelight is priced at ₹ 220/- per unit, as against the retail price of ₹ 350-450, while the energy efficient fans are priced at ₹ 1,200/- per unit, as opposed to the market price of ₹ 1,500-2,500.

**Air-Conditioner is one of the major factors for inflated energy bills? Do you have plans to bring any energy efficiency program for ACs?**

India is part of the Global Cooling Challenge initiative that seeks to leapfrog to super energy efficient air conditioning technologies through a market transformation approach. To accelerate the introduction of super-efficient air conditioners and to meet the challenge of increasing electricity demand from ACs sustainably and reduce GHG emissions, 1 lakh ACs superior to the most efficient technology (>ISEER 5.0) available presently in Indian market have been procured by EESL through an open competitive bidding process earlier this year. Currently, the Super Energy Efficient ACs are being made available to institutional buyers. As part of the existing Buildings Energy Efficiency Programme (BEEP), EESL retrofits these super-efficient ACs in buildings.

**What is the execution strategy for creating an energy-efficiency market as well as meeting targets for national programs?**

EESL focuses on stimulating the demand for efficient and sustainable technology by bulk government procurement. As against subsidies, financing is done by monetizing the savings generated through efficient technology. On one hand where huge demand generated through this process creates incentives for the industry to invest in manufacturing, on the other hand transparent and highly competitive bidding ensures that the product prices are brought down to enhance consumer access.

Example in hand the market of energy efficient LED lighting till three years ago, these LED bulbs were not affordable, even for the middle-class consumers. But the government took it upon itself to procure high-quality LED bulbs through bulk procurement under the Unnat Jyoti by Affordable LEDs for all (UJALA) scheme. The country could not have depended on the industry alone to bring about this transformation. As a result, EESL, under the UJALA scheme has distributed 26.7 crore LED bulbs, while the industry has distributed



approximately 42 crore LED bulbs. Therefore, the UJALA scheme has not only driven the cost of the LED bulb by 88% in the last three years through bulk procurement impacting market prices, but also increased manufacturing. More than energy and cost savings, the LED bulb has transformed lives by better lighting and an improved living environment. It is an example of a self-sustaining government initiative that has not only surpassed traditional benefits, like energy savings and reduced carbon emissions, but has also triggered large scale investment in the manufacturing of LED bulbs, generated employment and other macro benefits.

**What innovative model does EESL follow for installing and maintaining street lamps as well as for retrofitting buildings?**

EESL employs the following business models for both streetlights and energy efficient buildings:

**a) Energy Services Company (ESCO) model:**

The upfront capital cost shall be borne by EESL and the resultant savings from projects used to repay for EESL investments on deemed basis. The ESCO agreements shall be finalized wherein modalities, if implemented, sharing of energy savings between, scope of services, etc., shall be worked out subsequent to results of the energy audits. The audit fee could be capitalized as part of the project capital cost. The complete investment for the project would be borne by EESL. The project financing would be done using debt and equity in the ratio of 80:20. This model is preferable generally for large investment projects/ Urban Local Bodies (ULBs) or cluster of buildings.

**b) Project Management Consultancy (PMC):**

The investment is borne by the organization directly and EESL provides technical advisory services, comprising of project designing, bid management, supervision of implementation, and impact assessment at a mutually agreed cost (roughly 14% of the capital investment).

**You have launched several new projects; please elaborate the details of some of them**

**Electric Vehicles**

EESL recently concluded bidding for 10,000 electric vehicles on behalf of the Government of India, wherein

Tata Motors and Mahindra & Mahindra will supply 500 vehicles in phase 1. The remaining 9,500 vehicles shall be procured in phase 2. This tender was the world's largest competitive bidding for electric vehicles. EESL is proud that the supply of electric vehicles is being led by Tata Motors and Mahindra & Mahindra. This certainly embodies the Government of India's Make in India philosophy, and the vision for 100% e-mobility in the country by 2030.

**Smart Meters**

The Central Government has framed a policy under UDAY (Ujwal DISCOM Assurance Yojana) where implementing smart meters is one of the operational performance parameters. The scheme is aimed at improving the billing efficiency and strengthening the distribution infrastructure. Therefore, smart meter programme has been designed and deployed to address these issues. In line with this, EESL has floated a tender for 50 lakh Smart GPRS meters in Uttar Pradesh and Haryana on 1st August 2017. EESL shall source these smart meters within a period of 3

**On one hand where huge demand generated through this process creates incentives for the industry to invest in manufacturing, on the other hand transparent and highly competitive bidding ensures that the product prices are brought down to enhance consumer access.**

years in a phased manner. The tender floated by EESL is the world's largest single Smart Meter procurement. The initial phase will see deployment of 40 lakh smart meters in Uttar Pradesh and 10 lakh in Haryana. Smart meters are a part of the overall Advanced Metering Infrastructure Solutions (AMI) aimed at better demand response designed to reduce energy consumption during peak hours. The overall AMI solution will also have a system integrator who will be responsible for meter installation, data storage on cloud, preparing dashboards, etc.

**Solar Rooftops**

EESL has signed a memorandum of understanding with the New Delhi Municipal Council to install 65,000 solar modules on all major buildings located in the areas under the civic body's jurisdiction. We are currently carrying out a field study to assess roof-top solar power generation potential of various institutions before beginning the work of installing the required infrastructure. Based on the findings, the owners of the buildings will be asked to choose between two

models. The capital expenditure model will involve the building owners putting in the money and EESL supplying, designing, installing and commissioning the solar set-up. Under the other model, the operational expenditure one, the entire burden, including financing, will be borne by EESL.

### **Municipal Energy Efficiency Programme (MEEP)**

EESL is currently under way to conduct Investment Grade Energy Audits (IGEA) in over 150 cities identified under the Atal Mission for Urban Rejuvenation and Transformation (AMRUT) and the target is to audit the functioning of existing municipal water pumps in all

**EESL, under the UJALA scheme has distributed 26.7 crore LED bulbs, while the industry has distributed approximately 42 crore LED bulbs. Therefore, the UJALA scheme has not only driven the cost of the LED bulb by 88% in the last three years through bulk procurement impacting market prices, but also increased manufacturing.**

500 AMRUT cities. Thereafter, based on the approval of the ULB/ State Government, the existing inefficient pumps will be replaced by energy efficient ones on the streetlight business model, i.e, the ESCO model.

### **International Operations**

EESL has set up office in UK and has started operations with the current turnover of £ 1 m. The EESL Board has approved a business plan of £ 150 m over the next two years and the turnover from UK operations next FY will be over £ 100 m. Further, a pipeline of 40 m LEDs has been identified in UK. The UJALA scheme was also launched in the state of Melaka in Malaysia on September 6, 2017. Orders of 2 crore LED bulbs have been received from Nepal and similar orders are being finalised in Thailand and Vietnam.

### **What kind of active role would you like to play in 100 smart cities Project?**

Smart Cities Mission is an urban renewal and retrofitting program by the Government of India with a mission to develop 100 cities all over the country making them citizen friendly and sustainable. The Municipal Energy Efficiency Programme being implemented by EESL, wherein inefficient water pumping shall be replaced by energy efficient pumps, as well as the CCMS technology in street lights, where lights are switched on/off automatically using sensors, are just some of the examples of EESL's progression towards enabling smart city-ready infrastructure.

Additionally, EESL already is either implementing or in the process of implementing a multitude of programmes that blend in with the essence of smart city, be it UJALA, Street lighting, retrofitting energy efficient appliances in existing buildings, electric vehicles and smart meters. All these elements fitted in together are a significant element of the smart cities mission.

### **What are some of the challenges you face in maintaining energy efficiency?**

The biggest challenge we face is that there is a lack of capacity and understanding about energy efficiency.

For the same, EESL develops products and business cases that are simple and easy to understand by the common man, an example of the case is UJALA, which means 'light' in Hindi. Another challenge we face is the issue of monitoring

and verification. This is addressed through demonstrated and deemed savings approach with stress on service delivery. The Street Lighting programme has components like the Centralised Control and Monitoring System (CCMS), regular maintenance, mobile vans, night patrols, and a guaranteed grievance redressal mechanism wherein citizens' complaints are addressed and solved within 48-72 hours. EESL has also developed various Mobile apps tailor-made for UJALA as well as the street lighting programme. As far as project structuring and financing is concerned, EESL undertakes risk mitigation by deemed savings, developing annuity model linked to Service Level Agreements (SLAs) and not energy savings, while also establishing Payment security measures in the form of letters of credit (LCs) and ESCROW. EESL also faces the issue of inadequate capacity of service providers and manufacturers, which is addressed through regular engagement with them with advance information of project requirements, as well as adequate and appropriate training and capacity building workshops.

### **What are your expansion plans for 2017-18?**

By 2020, EESL seeks to be a \$1.5 billion-dollar (~ 10,000 crore) company putting together all the programmes of EESL - UJALA, SLNP, Buildings, Solar rooftops, Mini solar plants in Maharashtra, Acquisitions in UK, Smart Metres and E-vehicles.

# Visit Largest China Sourcing B2B Show in India



Inauguration Picture of 2016 Edition

**5<sup>th</sup> CHINA MACHINEX INDIA 2017** and **CHINA HOMELIFE INDIA 2017** is the largest China Sourcing B2B Exhibition in India, which is a part of the global series of exhibitions taking place annually in 11 countries, viz, Poland, Egypt, Brazil, UAE (Dubai), South Africa, India, Kazakhstan, Turkey, Jordan, Iran and Mexico.

The 5<sup>th</sup> Edition of the China Homelife & Machinex India Exhibition is scheduled from 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> December, 2017 at Hall No 5,6 & 7A of Bombay Exhibition Centre, Mumbai.

The China Exhibition is being organized jointly by the State Government of Regions of Hangzhou, Ningbo, Shanghai and Wenzhou in China and being coordinated by Meorient International, Shanghai, while all the Ground Operations and Management is handled by Winmark Exhibitions, Mumbai and is being supported by Confederation of India Industry (CII) as our National Partner

along with 17 other top Indian Industry Associations.

## The India Exhibition will showcase

**China Machinex India 2017:** Electricity & new energy, packaging & printing machinery, plastic-machinery & moulds, construction machinery, food processing machinery, metal processing machinery, hardware & power tools, machinery equipment & parts, auto parts & accessories.

**China Homelife India 2017:** Textile & garments, home electronics, kitchen & bathroom products, lighting, furniture, household items, gift articles, shoes, luggage & bags.

We have around 200 exhibitors for electricity & new energy like cables & wire, circuit breaker, connectors, switches, transformers, controls + switch-gears, insulators, high voltage products, pneumatic, smart lighting and capacitors participating in our show.

## Engage in One-to-one Match Making Program By Pre-Registering Online

No need to walk full exhibition and hunt for your requirements. Just come to Match Making lounge & fill up our enquiry form, our trained products specialist will quickly identify the right suppliers for your need and bring them for one-to-one meeting.

## Benefits

- Free Chinese-English / Hindi translation service
- Free beverage and snacks onsite
- Pre-arranged meetings with leading suppliers
  1. All exhibitors are pre-approved to ensure they are reliable and products are of high quality.
  2. Deal direct with the manufacturer – you have the chance to avoid working with a Chinese trading agent.
  3. Chinese products are very suitable for the Indian market need.
  4. The variety of exhibits at the show gives you chance to source whatever hot products you want.
  5. Decision makers from exhibitor company are at the show, you can negotiate the best price and deal direct.
  6. Pre – register on [www.chl.mx.com](http://www.chl.mx.com) for fast track entry and pre-book your meeting with exhibitors.

# Wind Power Development in India

Government of India has set an ambitious target of reaching 175 GW of renewable power capacity in the country by 2022 of which 60 GW to come from wind. The country has further set a goal of having 40 percent of its installed electric capacity powered by non-fossil-fuel sources...



The wind power development in the country started in early 1990s and in 1994 100% Accelerated Depreciation benefit was introduced for wind turbines. Ministry issued guidelines for healthy and orderly growth of wind

power in the country. State also issued conducive policies for generation of power from wind energy. At the end of 9<sup>th</sup> Five Year Plan (FYP) the cumulative wind power installed capacity was only 1.7 GW, during 10<sup>th</sup> FYP 5.4 GW

capacity was added and during 11<sup>th</sup> FYP 10.3 GW capacity was added. More than 15 GW wind capacity added during 12<sup>th</sup> FYP. The present wind power installed capacity in the country is around 32.5 GW which is approximately 55% of the total renewable installed power generation capacity. Now, in terms of wind power installed capacity India is globally placed at 4<sup>th</sup> position after China, USA and Germany.

Government of India has set an ambitious target of reaching 175 GW of renewable power capacity in the country by 2022 of which 60 GW to come from wind. The country has further set a goal of having 40 percent of its installed electric capacity powered by non-fossil-fuel sources by 2030 and would reduce its “emissions intensity” by 33 percent to 35 percent below 2005 levels by 2030. Wind energy being clean energy has to play a major role in achieving these goals to meet the challenges of climate change.

In spite of the sharp increase in wind power capacity in the country, only a fraction of the country's wind potential has been tapped till date. As per recent assessment of National Institute of Wind Energy (NIWE) the potential for onshore wind at 100 meter above ground level is over 302 GW.

The vast untapped potential of wind power could be harnessed to meet India's policy goals, addressing energy security challenges and achieving low carbon growth, in a cost effective manner.

In this endeavour, the Ministry has adopted a multi-dimensional

**Table 1: State-wise Wind Power Potential**

States / UTs	Estimated potential (MW) @ 100 m
Andaman & Nicobar	8
Andhra Pradesh	44229
Chhattisgarh	77
Goa	1
Gujarat	84431
Karnataka	55857
Kerala	1700
Lakshadweep	8
Madhya Pradesh	10484
Maharashtra	45394
Odisha	3093
Pondicherry	153
Rajasthan	18770
Tamil Nadu	33800
Telangana	4244
Uttar Pradesh	1260
West Bengal	2
Total	302251

The online wind atlas is available on the NIWE website [www.niwe.res.in](http://www.niwe.res.in).

approach, which aims at large-scale commercialization of cost-effective generation of grid-quality wind power. The wind power programme includes comprehensive wind resource assessment programme, research and development; implementation of demonstration projects to create awareness; development of infrastructural capability; capacity to manufacture, installation, operation and maintenance of wind turbines and conducive policy formulation.

### Wind Potential

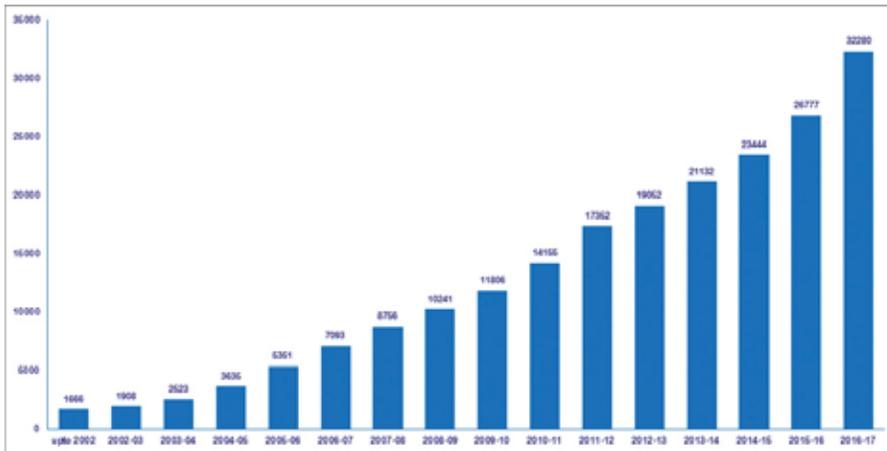
Wind Energy is intermittent and highly site-specific and, therefore, an extensive Wind Resource Assessment Programme is essential for selecting the potential sites. Therefore, Ministry placed emphasis on Wind Resource Assessment from the beginning and today India has abundant

data, collected from over 800 wind monitoring stations installed all over India.

The Wind Resource Assessment Programme is being implemented in the country through the National Institute of Wind Energy (NIWE), an autonomous institution of the Ministry.

As per recent assessment conducted by NIWE with actual land availability estimation using NRSC Land Use Land Cover (LULC) data, indicates a gross wind power potential of about 302 GW @ 100 m in the country. This potential assessment has been carried out at a very high spatial resolution of 500 m, using the advanced meso-micro coupled numerical wind flow model, and with the corroboration of almost 1300 actual measurements spread all over India, which can be stated as

**Figure 1: Year-wise cumulative wind power installed capacity in India (MW)**



Wind turbines and wind turbine components are exported to the US, Australia, Europe, Brazil and Asian countries. Around 70-80% indigenisation has been achieved with strong domestic manufacturing in the wind sector. The cost of Indian wind turbines is one of the lowest in the world.

**Deployment**

The annual growth picked up after enactment of Electricity Act, 2003. A total wind power capacity of around 32.3 GW was operational as on 31 March 2017. Year-wise cumulative wind power installed capacity is given in Figure 1. With an installed wind power capacity of over 7.86 GW, Tamil Nadu is top ranked in the country. During 2016-17, wind power capacity of 5,502 MW was added, which is the highest capacity addition ever achieved in a single year. The state-wise wind power capacity added during 2016-17 and cumulative wind power capacity as on 31 March 2017 is given in Table 2.

**Generation**

Central Electricity Authority

first of its kind. State-wise present wind power potential at 100 m height is given in Table 1.

**Commercial Development  
Technology Development and  
Manufacturing Base**

The Wind Electric Generator technology has evolved very rapidly in the country. State-of-the-art technologies are now available in the country for the manufacture of wind turbines. All the major global players in this field have their presence in the country. The

unit size of machines has gone up to 3.00 MW. Over 50 different models of wind turbines are being manufactured by more than 20 different companies in India, through (i) joint ventures under licensed production (ii) subsidiaries of foreign companies, and (iii) Indian companies with their own technology. The current annual production capacity of domestic wind turbines is about 10,000 MW. The focus is to promote a technology suitable for low wind regimes of India.

**Table 2: State wise wind power capacity**

S. No.	State	Wind Power Capacity addition during FY 2017 (MW)	Cumulative Wind Power Installed Capacity operational at the end of FY 2017 (MW)
1	Andhra Pradesh	2187.45	3618.85
2	Gujarat	1392.00	5340.62
3	Karnataka	882.30	3751.40
4	Kerala	8.00	51.50
5	Madhya Pradesh	356.70	2497.79
6	Maharashtra	117.55	4771.33
7	Rajasthan	287.70	4281.72
8	Tamil Nadu	247.57	7861.46
9	Telangana	23.10	100.80
10	Others	-	4.30
	<b>Total</b>	<b>5502.37</b>	<b>32279.77</b>

**Table 3**

Sl. No.	State	Wind Power Generation in MU		
		2014-15	2015-16	2016-17 (Tentative)
1	Andhra Pradesh	1675.82	2013.04	3187.85
2	Gujarat	5660.09	6446.58	7720.01
3	Karnataka	4658.1	4797.95	6058.65
4	Kerala	58.4	51.45	72.59
5	Madhya Pradesh	592.25	1558.43	3563.17
6	Maharashtra	6804.8	6121.34	7490.75
7	Rajasthan	4171.63	4767.36	5764.12
8	Tamil Nadu	10147.1	7273.23	11935.26
9	Telangana	0	0	211.93
	Total	33768.2	33029.4	46004.33

The contribution of wind energy in the total renewable generation during 2014-15, 2015-16 and 2016-17 was 55%, 50% and 56% respectively.

(CEA) started compiling the renewable energy generation data from 2014-15 onwards. The State-wise quantum of energy produced from wind energy during 2014-15, 2015-16 and 2016-17 is given in Table 3.

### Investment & Job Creation

An investment of around Rs 6 crore per MW is required for establishment of wind power project. Considering this normative figure, an investment of around Rs 33,000 crore was made in the wind energy sector in the country during 2016-17. For reaching a target of 60 GW by 2022, an additional investment of around Rs 1.8 lakh crore would be required in the sector over a period of next five years.

In wind energy sector for each MW capacity around 5 Full Time Equivalent (FTE) jobs are created during the first year for manufacturing, construction and installation and around 1.2 FTE jobs are created for 20 years for O&M activities.

### Guidelines for Setting up Projects

To bring about healthy and orderly growth of the wind energy sector and to achieve optimum generation of power in the most efficient and cost-effective manner, the Ministry had issued revised guidelines for wind power projects in 1996. These guidelines relate to preparation of Detailed Project Reports (DPR), micro-siting, selection of wind turbine equipment, operation & maintenance, performance evaluation, etc. These guidelines have created awareness in the State Electricity Boards, State

Nodal Agencies, manufacturers, developers and investors about planned development and implementation of wind power projects. However, with advancement in the wind turbine technology and requirement to comply various standards and regulations issued by CERC, CEA and other regulatory bodies, it was felt to issue comprehensive guidelines for development of onshore wind power projects in the country. Accordingly, new Guidelines for Development of Onshore Wind Power Projects have been issued on 22 October 2016 incorporating requirement of site feasibility, type and quality certified wind turbines, micro siting criteria, compliance of grid regulations, real time monitoring, online registry and performance reporting, health and safety provisions, decommissioning plan, etc.

### Promotional Policies

The Government promotes wind energy sector in the country through fiscal incentives such as accelerated depreciation, concessional custom duty on certain components of wind electric generators and loan from Indian Renewable Energy Development Agency (IREDA) & other financial institutions. In

**Table 4**

State	Wind Power Tariff in Rs. per kWh for 2016-17
Andhra Pradesh	4.84
Gujarat	4.19
Karnataka	4.50
Madhya Pradesh	4.78
Maharashtra	3.82-5.56
Rajasthan	5.76 & 6.04
Tamil Nadu	4.16

addition, 100 percent FDI through automatic route is allowed in the renewable energy sector including wind energy sector.

Till 2016-17 preferential tariff was being provided to increase wind energy generation in the potential states. Preferential tariffs in wind potential states during 2016-17 are given in Table 4.

### GBI Scheme

The Scheme of Generation Based Incentives (GBI) for grid interactive wind power was initially introduced in 11<sup>th</sup> Plan on 17.12.2009 with the approval of the Cabinet for taking up 4,000 MW in 11<sup>th</sup> Plan. Under the scheme a GBI of Rs. 0.50 per kWh with a ceiling of Rs. 0.62 crore per MW was provided to wind power project. The incentive was to be availed in not less than four years and in maximum of 10 years with an annual ceiling of Rs. 15.5 lakh per MW in first four years. Indian Renewable Energy Development Agency (IREDA) was designated as the implementing agency for the Scheme. The Scheme was later extended for 12<sup>th</sup> Plan period with increased ceiling of Rs 1.0 crore per MW. The Scheme was applicable for projects commissioned by 31.03.2017. Over 13,500 MW capacity wind power project registered under wind GBI Scheme and an amount of Rs 3020 crore has already been released to IREDA for disbursement of wind GBI claims.

### New Initiatives

#### Amendment in Tariff Policy

Renewable Purchase Obligation (RPO) was introduced through Electricity Act 2003 mandating the

obligated entities to procure a minimum percentage of their total energy procurement from renewables. The State regulators have declared the RPO level which ranges from 3% to 12% for the year 2016-17. The amended Tariff Policy notified in January 2016 provides for purchase of renewable energy by different states in more or less same proportion. The policy further provides for prescribing long term growth trajectory of RPO by Ministry of Power in consultation with MNRE. The MoP has issued RPO trajectory upto 2019 notifying uniform RPO across the country as under:

Year	Solar	Non-Solar	Total
2016-17	2.75%	8.75%	11.50%
2017-18	4.75%	9.50%	14.25%
2018-19	6.75%	10.25%	17.00%

As the wind power potential is concentrated in 7-8 windy states to facilitate the inter-state transmission of wind power from windy state to other states of the country, the Tariff Policy provides for waiving of the inter-state transmission charges and losses for inter-state sale of wind power. The Ministry of Power (MoP), on 30 September 2016 issued order for waiver of ISTS charges and losses for wind power with following conditions:

- i. The waiver is for projects commissioned till 31.03.2019 and for 25 years from the date of commissioning of the projects. Further, the waiver is available for projects having PPA with discoms for compliance of RPO.
- ii. The waiver is allowed only for projects awarded through competitive bidding process.

### Forecasting & Scheduling

Wind power is variable in nature and therefore, its large volumes possess challenges for grid security and stability. Many times, the wind power generators are backed down or put off the grid on this account. The issue could be addressed through proper forecasting and scheduling of wind power.

The CERC has already notified mechanism for scheduling and forecasting in case of inter-state transmission of solar and wind power. The states of Andhra Pradesh, Karnataka and Rajasthan have already finalized regulations for intra-state transmission of wind and solar power and the states of Gujarat, Madhya Pradesh and Tamil Nadu have notified draft regulations.

NIWE had undertaken forecasting and scheduling exercise in the state of Tamil Nadu in association with wind industry to provide forecast for the whole state. Proper forecasting by NIWE has resulted in better management of transmission system for evacuation of wind power in the state and during 2016-17 around 12 BU of wind power evacuated as compared to around 7 BU during previous year. Similar initiatives have been carried out by the states Rajasthan and Gujarat.

For proper forecasting and scheduling, it is necessary to put in place metering and communication infrastructure at all pooling stations for real time generation of data. PGCIL is working on establishment of Renewable Energy Management Centres (REMCs) initially in the renewable resource rich states.

THE IMPOSSIBLE IS OFTEN

THE TASKS UNTRIED



BESIDES BI-MONTHLY MAGAZINE TAKE ADVANTAGE OF THE DIGITAL TECHNOLOGY & READ **LIGHTING INDIA** MAGAZINE ONLINE, AS WELL AS FORTNIGHTLY E-NEWSLETTER ON YOUR PC, TABLET OR LAPTOP.

To **Subscribe** & Be Updated Please fill the form (P.T.O.)

PLEASE TURN BACK FOR THE SUBSCRIPTION FORM.

Come Join us in endeavour to bring the lighting industry to you, on the most read media platform of **LIGHTING INDIA**.

"WE TRAVEL AROUND THE WORLD TO GET NEWS, PRODUCTS & PROJECTS FOR YOU, SO THAT YOU CAN KEEP PACE WITH THE REST OF THE WORLD "



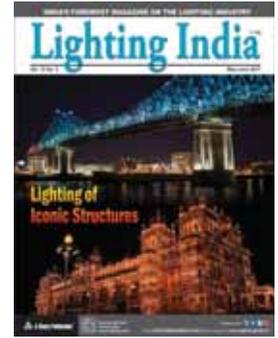
**CHARY PUBLICATIONS PVT LTD.**

905-906, THE CORPORATE PARK PLOT NO. 14 & 15, SECTOR - 18, OPP. SANPADA RAILWAY STATION, VASHI, NAVI MUMBAI - 400 703. FOR SUBSCRIPTION PLEASE CONTACT PRIYANKA ON 022-27777182/8652142057 OR EMAIL ON [sub@charypublications.in](mailto:sub@charypublications.in)

Read and advertise in India's foremost magazine on **LIGHTING INDUSTRY**.

# SUBSCRIBE

# Lighting India



## Subscription Offers

Sub. Period	No. of Issues	Subscription Type					
		Print		Digital		Print+Digital	
		Actual Rate	You Pay	Actual Rate	You Pay	Actual Rate	You Pay
1 Year	6	750.00		750.00		1500.00	1125.00
2 Years	12	1500.00	1350.00	1500.00	1350.00	3000.00	2025.00
3 Years	18	2250.00	2000.00	2250.00	2000.00	4500.00	3000.00
5 Years	30	3750.00	3000.00	3750.00	3000.00	7500.00	4500.00
<b>E-Newsletter</b>							
<b>1 Year</b>	<b>24</b>	<b>N. A.</b>		<b>365.00</b>		<b>N.A</b>	

MAGAZINE WILL BE SENT BY REGISTER PARCEL --Rs.220/YEAR

**KINDLY ADD POSTAGE CHARGES IN SUBSCRIPTION AMOUNT**

## Subscription / Renewal Form

To,  
The Subscription in-charge  
LIGHTING INDIA  
Email: sub@charypublications.in

Are you a Subscriber,  
Please submit your Subscription no:  
-----

Yes, I would like to Subscribe/renew  Lighting India /  LI e-Newsletter for \_\_\_\_\_ years at ₹ \_\_\_\_\_.

### PAYMENT DETAILS :

Cheque / DD No. \_\_\_\_\_ Dated \_\_\_\_\_ Drawn on Bank \_\_\_\_\_  
\_\_\_\_\_ Branch \_\_\_\_\_ in favour of Chary Publications Pvt. Ltd.

Bank details for NEFT / RTGS / IMPS : Account Name: Chary Publications Pvt. Ltd.

Bank Name: Bank of India      Branch: Chembur, Mumbai - 400 071      Account Type: Current Account

IFSC Code: BKID0000009      Bank A/C Number: 000920110000322      SWIFT CODE :BKIDINBBCHM

Name: \_\_\_\_\_

Company: \_\_\_\_\_ Designation: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_ City: \_\_\_\_\_ Pin: \_\_\_\_\_

Telephone: \_\_\_\_\_ Mobile: \_\_\_\_\_

Email: \_\_\_\_\_

Signature: \_\_\_\_\_

Stamp

 **Chary Publications Pvt. Ltd.**

905-906, The Corporate Park, Plot No. 14 & 15, Sector 18, Opp. Sanpada Railway Station, Vashi, Navi Mumbai - 400 703.

Phones: +91 22 27777 170 / 171 • Email: sub@charypublications.in • Contact : Priyanka Alugade • +91 22 27777182 / +91 8652142057

## Green Energy Corridors

Wind power potential is concentrated in 7-8 wind resource rich states. These windy states may not consume wind power beyond their RPO limit and therefore, wind power is to be evacuated from these resource rich states to the off-taker states. This requires strengthening of transmission intra-state as well as inter-state transmission infrastructure.

Green Energy Corridors Project that has identified transmission requirement for the renewable power capacity addition during the 12<sup>th</sup> Plan period is under implementation. Intra-state transmission infrastructure projects of total cost over ₹ 10,000 crore in eight states have already been approved and Central Government is providing 40% of the project cost as grant from National Clean Energy Fund and another 40% of the project cost is available as soft loan from German Bank KfW. The project is at different stages of implementation in states.

## Repowering Policy

Most of the wind-turbines installed up to the year 2000 are of capacity below 500 kW and are at sites having high wind energy potential. It is estimated that over 3,000 MW capacity installations are from wind turbines of 500 kW or below. In order to optimally utilise the wind energy resources, repowering is required.

Ministry issued repowering policy in August 2016. The main features of the repowering policy are:

- Wind turbine generators of capacity 1 MW and below would



be eligible for repowering under the policy.

- IREDA will provide an additional interest rate rebate of 0.25% for repowering projects.
- Benefits available to the new wind projects i.e. Accelerated Depreciation or GBI as per applicable conditions would also be available to the repowering project.
- In case augmentation of transmission system from pooling station onwards is required the same would be carried out by the respective State Transmission Utility.
- Additional generation would either be purchased by Discoms at Feed-in-Tariff applicable in the state at the time of commissioning of the repowering project or allowed for third party sale.
- State will facilitate acquiring additional footprint required for higher capacity turbines.

- For placing of wind turbines 7D x 5D criteria would be relaxed for micro siting.
- During the period of execution of repowering, projects would be exempted from not honouring the PPA.

## Draft Wind-Solar Hybrid Policy

Solar and wind power being infirm in nature impose certain challenges on grid security and stability. Studies have revealed that solar and winds are almost complementary to each other and hybridisation of two technologies would help in minimising the variability apart from optimally utilising the infrastructure, including land and transmission system.

Accordingly with the objective to provide a framework for promotion of large grid connected wind-solar PV system for optimal and efficient utilisation of transmission infrastructure and land, reducing the variability in

renewable power generation and thus achieving better grid stability Ministry issued draft wind-Solar Hybrid Policy.

The goal of the policy is to reach wind-solar hybrid capacity of 10 GW by 2022 and it policy aims to encourage new technologies, methods and way-outs involving combined operation of wind and solar PV plants. The Policy is under process of approval.

### Wind Bidding Scheme

To enable Discoms of the non-windy states to fulfil their non-solar RPO obligation, through purchase of wind power at a tariff determined by transparent bidding process, a Scheme for Setting-up of 1000 MW Inter-State Transmission System (ISTS) connected Wind Power Projects was sanctioned by MNRE on 14 June 2016.

PTC India Ltd was selected as trading company to sign Power Purchase Agreement (PPA) with successful bidders and to sign back-to-back Power Sale Agreement (PSA) with state utilities or bulk consumers under the scheme. Solar Energy Corporation of India (SECI), the implementing agency of the Scheme issued bid documents on 28.10.2016 and e-reverse auction was conducted on 23 February 2017.

The first wind bid was concluded at record low wind tariff of Rs 3.46 per kWh of wind energy. The SECI issued Letter of Award (LoA) to five selected bidders on 5 April 2017 and the projects under the scheme are likely to be commissioned by October 2018.

After success of first wind bid,

SECI has floated bids for another 1000 MW wind power projects and the bids were closed on 14 July 2017. In addition, states of Tamil Nadu and Gujarat have also started bidding process for procurement of 500 MW wind power each.

Wind bidding guidelines under Section 63 of Electricity Act, 2003 are likely to be issued by the Ministry of Power, which will enable the States to bid for wind power projects.

### Development of Offshore Wind Energy

India has vast coastline of 7,600 km considering the development of offshore wind energy in the Indian Exclusive Economic Zone (EEZ), the National Offshore wind energy policy was approved and notified in October 2015. The Ministry of New & Renewable Energy (MNRE) has been authorized as the Nodal Ministry for use of offshore areas within the Exclusive Economic Zone (EEZ) of the country and the National Institute of Wind Energy (NIWE) has been authorized as the Nodal Agency for development of offshore wind energy in the country and to carry out allocation of offshore wind energy blocks, coordination and allied functions with related ministries and agencies.

Initial studies carried out by National Institute of Wind Energy indicate offshore wind energy potential in the coasts Gujarat and Tamil Nadu. For assessment of offshore wind power potential NIWE is in the process of installing LiDAR (Light Detection and Ranging) at an identified offshore site near Gujarat.

### National Institute of Wind Energy

NIWE formerly known as Centre for Wind Energy Technology (C-WET), established at Chennai in 1998, is an autonomous institution under MNRE and serves as technical focal point for wind energy technologies. A Wind Turbine Test Station (WTTS) has also been established at Kayathar, Tamil Nadu, with the technical support and partial financial assistance from Danish International Development Agency (DANIDA), Denmark.

NIWE is providing its value added services including Wind Resource Assessment, Micro-siting, Due-Diligence Analysis of Wind Power Projects, Feasibility and Preparation of DPR, Wind Turbine Testing, Certification, Evaluation of Certificates, Research and Development with multi-institutional collaboration, preparation of standards, empanelment list of Small Wind Energy Systems (SWES) and their field performance testing, National and International training programmes. NIWE has been implementing on a mission mode Solar Radiation Resource Assessment (SRRA) all over the Country by having installed 119 real time networked SRRA monitoring stations.

NIWE has technical collaboration with international agencies. An MoU has been signed with Vortex, Spain for capacity building in wind power forecasting. Under this NIWE is successfully conducting forecasting and scheduling of wind generation in the State of Tamil Nadu. With GIZ, Germany

collaborating for data quality checking, data analysis and automation of report generation and involvement in the SolMAP (Solar Atlas) preparation for India. NIWE in collaborations with TUV-Rhineland has started activity of type certification of wind turbines.

### Small Wind Energy Systems

Small wind energy systems were being promoted by the Ministry through a scheme on "Small Wind Energy and Hybrid systems (SWES)", wherein hybrid system consisting of both aero-generator/ small wind turbine and solar photovoltaic technologies were being installed. So far, a total of around 3155 kW small wind energy systems have been installed in 23 states or UT. The scheme was operational till 31.03.2017. An evaluation of the scheme was undertaken and it is proposed to redesign the scheme to increase its coverage.

### Issues & Future Perspective

The Government has kept a target of reaching 60 GW by 2022. This means a capacity of around 27.7 GW is to be added in next five

years with annual capacity addition of 5.5 GW. Most of the wind power capacity will now be installed for inter-state transmission as the windy states have almost fulfilled their non-solar RPO obligation and will not absorb variable wind power beyond a certain limit. Government has already taken positive step by waiving interstate transmission charges and losses for interstate sale of wind power; this will facilitate non-windy states to fulfil their RPO requirement by buying wind power from windy states. To further accelerate the process, bidding has already been introduced to have a suitable price discovery mechanism for interstate sale of wind power. In order to provide long-term visibility the ISTS waiver, which is available for projects to be commissioned by March 2019, should be extended upto March 2022.

With successful auction of wind power all the wind capacity is likely to be added through bidding route only. For projects to be established through bidding process around 21 months' time is required (3 months for bidding process and 18 months for completion of projects). Bidding has started recently and

therefore, wind projects selected through bidding process would not be commissioned during 2017-18, this may affect achievement of targets during 2017-18 and also 2018-19.

Focus is required on Repowering and Wind-solar hybrid by formulating promotional programmes and schemes.

Wind power generators are facing certain challenges at State level that includes delay in payment, non-signing of PPAs, not-honouring 'Must-run' status and curtailment of wind-power, etc., and this is adversely impacting the wind sector.

For achieving target of 60 GW of wind power capacity by 2022 conducive policy framework and programmes for RPO, repowering, Inter-state sale and hybrid technologies are required to be put in place. 



**Jeevan Kumar Jethani**  
 Director/Scientist-E,  
 Ministry of New and  
 Renewable Energy,  
 Government of India,  
 New Delhi

# Let people not Forget you Standout from the crowd...

Attract More Business by advertising in

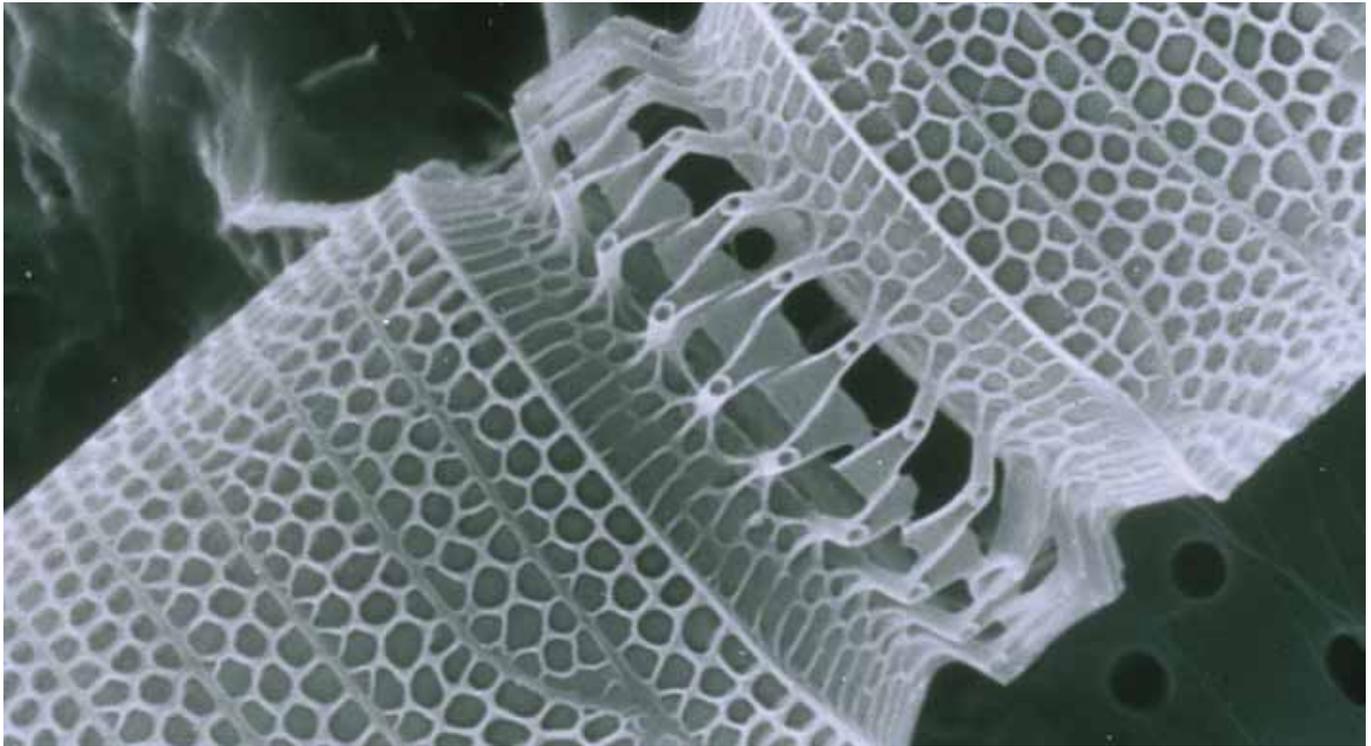
**FOR DETAILS CALL :**  
 Ad Department (022-27777180)  
 (022 2777 7184) & (+91 22 2777 7196)



India's oldest magazine on power and electrical products industry

# Technological Breakthrough for Insulators

Nano-science and nanotechnology will lead technological breakthroughs in the next few years for innovative solutions for the energy sector. Current concepts of nanotechnology for outdoor insulators, microstructure reinforcement of porcelain body by ceramic nanoparticles and nano-coating for self-cleaning characteristics, will continue under ...



High voltage insulators form an essential part of high voltage electric power transmission systems. Any failure in the satisfactory performance of high voltage insulators will result in considerable loss of capital, as there are numerous industries that depend upon the availability of an uninterrupted power supply. Most electric power transmission and distribution is done via overhead lines with insulators providing mechanical support and

electrical protection. The size and specific design of high voltage insulators will vary according to the line voltage, environmental conditions, material of construction and manufacturer. Insulator service life can be affected by electrical, mechanical and environmental factors. The principle dielectrics used for outdoor insulators are ceramics and polymers.

Decades of in-service performance have demonstrated that ceramic insulators made of porcelain and glass, show good performance and resist environmental aging. In addition to high mechanical strength, they provide excellent resistance to material degradation caused by electrical stress and discharge activities. However, they possess hydrophilic surface due to which water can easily form a continuous conductive film along the creepage path thus, allowing high surface leakage currents to flow on their wetted surfaces. Such currents cause dry bands at areas of high current density and lower wetting rates which eventually cause surface arcing and frequently complete flashover of the insulator shown in figure 1.

Contamination on outdoor insulators enhances the chances of flashover. Under dry conditions, contaminated surfaces are of little concern. However, under environmental conditions of light rain, fog or dew, surface contamination dissolves. This promotes a conducting layer on an insulator's surface which facilitates a leakage current. High current density near the electrodes results

in the heating and drying of the pollution layer.

An arc is initiated if the voltage stress across the insulator's dry band exceeds its withstand capability. Extension of the arc across the insulator ultimately results in flashover. The contamination severity determines the frequency and intensity of arcing and thus the probability of flashover.

### Consequences

As discussed above, surface flashover damages the whole insulator and ultimately results into a complete breakdown of the power system network. This in turn results into a great economic loss to the consumers as well to the owner of the power company. A 250 ms outage can shut down a paper machine, resulting in hours of down time, possible equipment damage and loss of millions of dollars. It is worth mentioning that the failure at any single point of the transmission network can bring down the entire system. Recent reports on grid disturbance in India indicate the loss of 5000 million rupees and 97% of interconnected generation on January 2, 2001. Similar disturbances of lesser magnitudes were also observed during the period of December 2002 and 2005, February and December



Figure 1: Flashover of the insulator

2006, January and February 2007, and March 2008. One of the major causes identified was the contamination-induced flashovers. These events have amply portrayed that the performance of overhead transmission insulators and that used in outdoor substations is a critical factor which governs the reliability of power delivery systems.

### Mitigations

It was understood that in order to prevent flashover, leakage current must be minimized. The practices used by utilities can be classified into the following groups.

- i. Remove accumulation of contamination on insulators by periodic cleaning
- ii. Minimize accumulation of contamination on the insulator surface with the use of aerodynamic profiles



Figure 2: Lotus Leaf effect

- iii. Increase the leakage distance by using additional bells or extra long leakage distance units on string insulation.
- iv. Keep large area of the insulator dry for a longer time during natural wetting either by the use of a resistive glaze or by use of fog bowl design which has a difficult to wet undershirt area.
- v. Prevent water filming on the insulator surface by coating insulators with water repellent materials (Hydrophobic).

## Concept of Hydrophobicity

The concept of hydrophobic surfaces is originally drawn from the inspiration of lotus leaves in nature. The very high water repellency and the self-cleaning properties exhibited by the lotus leaf have been referred to as "lotus effect", which has been attributed to a combined effect of the hydrophobicity induced by the epicuticular wax and the surface roughness resulted from the hierarchical structures on the leaf shown in figure 2.

## Conventional Coating

The fundamental reason that ceramic insulator wets is because they have high surface energy which means that moisture tends to spread forming a low resistance surface rather than bead up into small isolated droplets which results in a high surface resistance. If the tendency of spreading or wetting can be overcome by a

protective coating, then contaminated insulator surface would present a higher resistance thus, minimizing leakage current to levels obtained during dry conditions.

1. There are other compounds such as waxes, paints, lacquers and varnishes that have been tried as coatings on ceramic insulators. But the use of these is rather limited due to concerns on their long term performance. They are apparently easily weathered and subjected to loss in electrically high stress area by corona.
2. Grease coating is also a method to mitigate contamination problem. Grease coating was an effective practical counter measure for preventing contamination flashover on a large scale. However, the short intervals between re-greasing in highly contaminated areas and the associated high cost of re-greasing necessitated the



Fig. 3 Glass Insulator RTV Silicone Coating

development of longer term solutions to the insulator contamination problem.

3. The need for a longer lasting coating that has an increased resistance to UV and dry band arcing motivated the development of polymer hydrophobic coatings. Room temperature vulcanized (RTV) coating came out as a solution to this problem. The RTV coating can be applied to ceramic insulator by dipping, painting or spraying shown in figure 3.

The pollution deposit on the surface of the RTV coated insulator leads to surface erosion and the chemical composition of the surface changes and thus, the surface of the coating loses its electrical properties like surface resistance and hydrophobicity.

4. Another way of remediating pollution performance of insulators is to use polymeric insulators. Polymeric insulators offer numerous advantages over porcelain which includes light weight, better pollution performance, and safer flashover because of hollow core housing.

However, polymer insulators are also suffering from some drawbacks.

- a. Weathering degradation: Polymer materials have weaker bonds than porcelain which means they can be aged and changed by the multiple stresses encountered in service.
- b. High raw material costs
- c. Low mechanical strength: Polymer insulation is typically not rigid nor self-supporting.

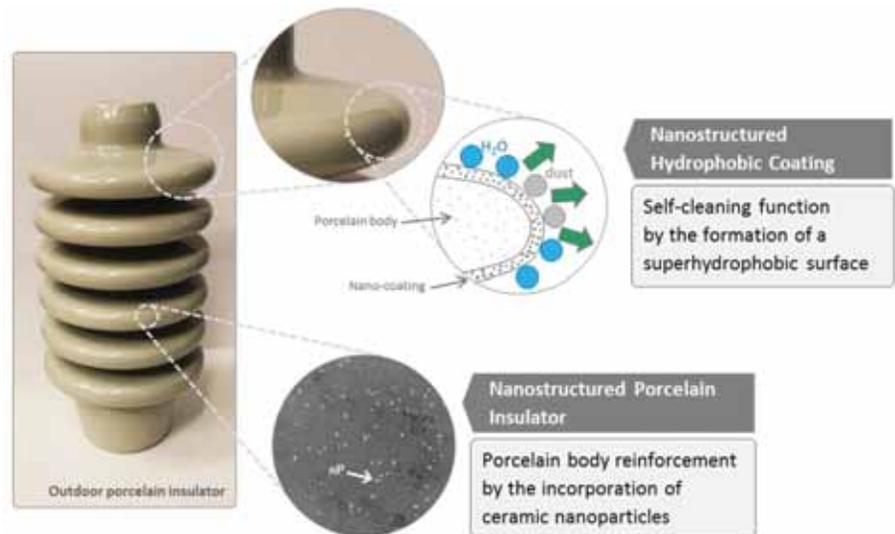


Figure 4: Nanoparticles alternatives for mechanical improvement of ceramic materials.

From the prior discussion, it is clear that each technique has some drawbacks. Hence, new effective method is required to mitigate the problem of contamination. A ray of hope arises with the advent of nanotechnology.

### Nanotechnology

Nanotechnology describe "creation, analysis and application of structure, molecular materials, inner interfaces and surfaces with at least one critical dimension or with manufacturing tolerances below 100 nanometers". The decisive factors is that new functionalities and properties resulting from the nanoscalability of system components are used for the improvement of existing products or the development of new products and application options. Such new effects and possibilities are predominantly based on the ratio of surface to volume atoms and on the quantum mechanical behavior of the elements of the material.

Nanotechnology is rapidly growing as a new technology alternative to create advance materials with unique characteristics and performance for different applications in several industrial sectors. In recent years, many nanotechnology-based products have appeared in our everyday life. On the other hand, industries have also considered nano-concepts to produce high-added value products with superior capacity, reliability and efficiency. Electric insulators are components with high importance in the electricity network system; reliability and high performance are essential characteristics demanded by actual markets. Recent studies have demonstrated the technical feasibility of innovative nano-concepts to improve the final properties of these electrical components.

Nanotechnology has been also considered as technological alternative to enhance the final properties of outdoor porcelain insulators, based on the

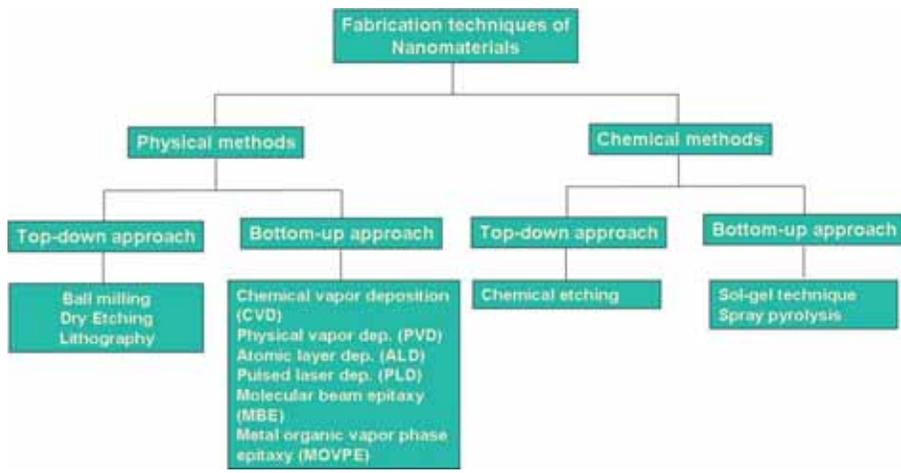


Figure 5: Synthesis/Fabrication techniques of nanomaterials

extraordinary and interesting results of investigations carried out in several ceramic materials (Figure. 4)

Some authors have reported that the nanotechnology can be successfully applied to electrical engineering applications. These include:

- Improvement in the conductivity of metals used as conductors.
- Improvement in the properties of insulators
- Miniaturizing of design and thus, reduction of used material.

## Material Selection for Coating

The protection of insulation by hydrophobic coating is one of the most important and versatile means of improving ceramic insulator performance. We have the following choice in this respect

- i. Metal
- ii. Semiconductor
- iii. Dielectric

The metal choice is rejected as it will aid in the process of flashover. The second choice of semiconductor is also rejected as due to thermal effect semiconductor will also become

conductor and thus aid in flashover. The last choice of dielectric is the most suitable for coating material

## Dielectric Materials

The dielectric material chosen should possess following properties.

- The Dielectric constant of the material should be high
- The Dielectric material should be thermodynamically stable in contact with ceramic materials
- The band gap should be large
- The refractive index should be fairly good

Presently, many researchers are searching for inorganic dielectric materials to replace RTV. Since a higher dielectric constant means we can grow thicker films to reduce leakage current. Many metal oxides and ferroelectric materials have been investigated as candidate materials, but most of them are not stable in contact with ceramic. Furthermore, the dielectric constant of materials generally tends to increase as the band gap decreases, making it difficult to select a material with a large band gap and dielectric constant. Transition metal oxides, their oxynitrides and their composites are attractive materials for industrial and engineering applications due to their remarkable physical, dielectric and mechanical properties including high hardness, high melting point, chemical inertness and good thermodynamic stability

## Synthesis Technique

The preparation of these hydrophobic dielectric coatings

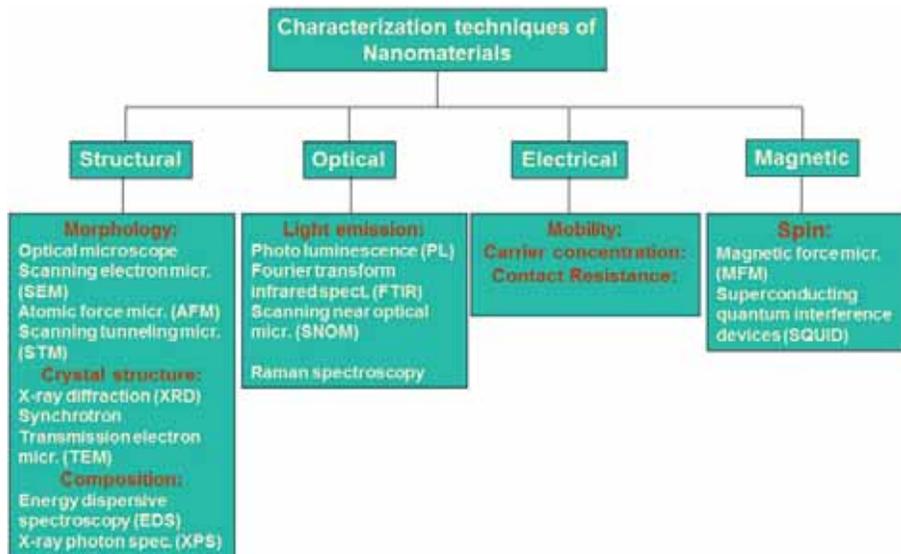


Figure 6: Characterization techniques of nanomaterials

will be carried out by two methods shown in figure 5 that is either by physical method or chemical method depending upon the application where they are used.

Deposition of thin films by Physical Vapor Deposition (PVD) techniques has found widespread use in many industrial sectors and there is an increasing demand for such coatings with enhanced properties. These coatings will be deposited on various substrates such as glass and quartz to study its influence on the structural evolution of coatings.

**Characterization**

The physical, electrical, optical etc. properties of the coating/film will be investigated using different equipment like X-ray Diffractometer, atomic force microscopy etc. Characterization techniques of nanomaterials are shown in figure 6.

**Conclusion and Future Trends**

Nano-science and nanotechnology will lead technological breakthroughs in the next few years for innovative

solutions for the energy sector. Current concepts of nanotechnology for outdoor insulators, (1) microstructure reinforcement of porcelain body by ceramic nanoparticles and (2) nano-coating for self-cleaning characteristics, will continue under investigation through new types, concentration, morphology and distribution of nanoparticles, alternative techniques to incorporate them into ceramic mixtures and new nano-films depositions techniques will be also included.

Authors suggest that nano-concepts, which have been already demonstrated in other ceramic materials, will be adapted to outdoor insulators, besides new research topics will appear. Future trends regarding nanotechnology applications for electric insulators will be focused on reducing the weight and size, increasing the insulation capacity, having a self-repair surface behavior, reducing the sintering temperatures, etc. On the other hand, there will be significant challenges to successfully adapt these nano-concepts into the conventional

industrial manufacturing processes. It will be essential to have a strong technological link between academic researchers and industrial research engineers to transfer the knowledge of new properties, performance and mechanisms of nanomaterials into industrial procedures to produce high-added value and innovative nanostructured outdoor insulators. E1



**Dr. Vikramaditya Dave**  
 Department of Electrical Engineering,  
 College of Technology and Engineering,  
 Maharana Pratap University of Agriculture & Technology, Udaipur



**Er. Sujit Kumar**  
 Department of Electrical Engineering,  
 College of Technology and Engineering,  
 Maharana Pratap University of Agriculture & Technology, Udaipur

**Let people not Forget you  
 Standout from the crowd...**

Attract More Business by advertising in

**FOR DETAILS CALL :**  
 Ad Department (022-27777180)  
 (022 2777 7184) & (+91 22 2777 7196)



**Electrical India**  
India's oldest magazine on power and electrical products industry

# Challenges Ahead

In the recent past battery and fuel cell technology are undergoing rapid advancements. The supercapacitor technology has to overcome these devices in economy, performance and utility to make itself a viable option. Thus the challenges faced by this technology are unique ...



Since the nineteenth century, chemists have studied the storage of electrical charge in the interface between an electrode and an electrolytic solution. But until General Electric patented electrolytic capacitor using porous carbon electrodes in 1957, it was not adopted for practical use. However, the supercapacitor market started picking up only in

the late eighties when the unique characteristics of these devices, like high power density and long cycle life coupled with reliable and safe operation at a wide range of temperatures started finding takers. As of 2016, there are around forty supercapacitor manufacturers globally.

Similar to the conventional capacitor, the supercapacitor

stores energy by charge separation. They are divided into various classes depending on the mechanism of charge storage. These are Electrical Double Layer Capacitor (EDLC), pseudocapacitor and hybrid capacitor. Of these the EDLC is the most common. Its construction is similar to a battery in that there are two electrodes immersed in an electrolyte, with an ion-permeable separator located between the electrodes to prevent electrical contact. In the charged state, the electrolyte anions and cations move toward the positive and negative electrodes, respectively, giving rise to two double layers, one at each electrode-electrolyte interface. Pseudocapacitors rely on highly reversible redox reactions on the electrode surfaces making them amenable to high energy densities. The trade-off is a lower cycle life. The hybrid capacitor combines the advantage of both these principles by having one electrode storing energy as a pseudocapacitor while the other stores energy similar to the electrical double layer capacitor.

The growth of the supercapacitor technology is slow as it faces challenges at various fronts. In the recent past battery and fuel cell technology are undergoing rapid advancements. The supercapacitor technology has to overcome these devices in economy, performance and utility to make itself a viable option. Thus, the challenges faced by this technology are unique and some of the issues that have been encountered are detailed in this article. It is imperative for someone in this field to understand the various issues that he might

<b>Research Challenges in Carbon for Supercapacitors</b>	Increase the Specific Surface Area
	Better Control on Pore Size during Activation
	Produce three-dimensionally interconnected pore networks during Activation
	Reduce the cost of production and improve yield in the case of CNTs
	Find a solution for stacking of layers in the case of graphene
	Improve the conductivity and electrochemical stability
	Improve the volumetric capacitance of carbon aerogels

encounter. This article tries to shine a light on these.

### Research Challenges

Even though the energy density of supercapacitors (less than 10 Wh/kg) is much higher than conventional dielectric capacitors, it is considerably lower than batteries and fuel cells. A lot of research is being done to increase the energy density of supercapacitors without surrendering its high power capability. This is being done by developing advanced materials and configurations for improving the energy density. Exploring cheaper preparation and processing of these materials and lowering of fabrication costs are also being looked into so as to reduce the cost and make the supercapacitor economically feasible for design engineers to incorporate it into their designs. The research into supercapacitors can be categorised depending on electrode materials, configurations and electrolytes used for supercapacitors.

The research trends and challenges in each of these are

characterized below.

#### a. Carbon

Due to its properties like good chemical stability, good electrical conductivity, availability, and moderate cost, carbon is one of the most favoured materials as far as supercapacitor electrodes are concerned. Activated carbons are the most preferred carbon by manufacturers as they are cheaper and have large surface. But since their pore system is highly randomized, ionic transport is poor which causes low conductivity. Considerable research is being done to control the pore sizes by controlling the activation process. The latest in this is the introduction of templated carbons. The carbon is produced by filling the pores of an inorganic sacrificial template (zeolites, silica or scaffolds) with a carbon precursor, followed by carbonization and subsequent removal of the template. This results in a well-defined pore diameter, high surface areas and three-dimensionally interconnected pore networks thereby, giving rise to very high specific capacitance. But as of now, the

**Table 1: Comparison of typical electrolyte properties**

Electrolyte	Voltage Window	Cost	Toxicity	Pseudocapacitance
Aqueous	< 1.6V	Less	Less	Yes
Organic	2.5-2.7V	Medium	Medium/High	No
Ionic Liquid	3-6V	High	Less	No

high cost of production and low yield of carbon has yet to make this technology viable. Graphene synthesized by chemical reduction of graphene oxide has recently demonstrated capacitances of 205 F/g. The performance of graphene is independent of the nature of porosity due to its 2D structure. But a major issue is the stacking of the various graphene layers. As of now, research needs to focus on new preparation, modification and assembling routes to avoid this graphene stacking while making the supercapacitor electrode. Another type of carbon that excited the research community was carbon nanotubes or CNTs which are the potential candidates for future supercapacitors. But their popularity seems to have decreased in the last couple of years due to stacking problems and higher cost of production. But

they are used as additives to improve the conductance and electrochemical stability. Again there is considerable scope of research to reduce the cost and improve the porosity. Another very important carbon is the carbon aerogel which is prepared by the poly-condensation reaction of resorcinol and formaldehyde. The pyrolysis in an inert atmosphere leads to the formation of a porous carbon aerogel with a controlled and uniform pore size between 2 and 50 nm, and high electrical conductivity. The capacitance values are in the range of 50–100 F/g, for organic and aqueous electrolytes, respectively. But due to the very low density of these materials, it has poor volumetric capacitance.

**b. Electrode materials other than Carbon**

The use of materials that display

pseudocapacitive characteristics is one of the most promising methods to improve the capacitance. In this phenomenon apart from electrostatic forces, quick faradaic reactions also take place. Transition metal oxides are the most common additive that displays pseudocapacitive properties. Ruthenium oxide has been found to display a capacitance of 900F/g. Since the cost is prohibitive, efforts are on to form composites with other oxides, conducting polymers or carbon based materials so that its content can be reduced without compromising the performance. A much cheaper and abundant option is manganese dioxide which exhibits capacitance in the range of 100-260F/gm. The main hindrance to manganese dioxide is its low conductivity. In spite of the awareness of pseudocapacitive behaviour for quite some time, the mechanisms of pseudocapacitance and electrochemical stability in non-aqueous electrolytes require further investigations. Finally, an immediate challenge is to optimize different redox reactions in both the positive and negative potential ranges for the usage of maximum potential pseudocapacitance by balancing the mass of the electrodes and/or the utilization of different optimized carbons in an asymmetric configuration.

Another innovation that has

<b>Research Challenges in Electrode Materials other than Carbon</b>	Find economical alternatives to Ruthenium oxide that show pseudocapacitive property
	Increase the conductivity of electrode material
	Better understand the pseudocapacitive behaviour and the electrochemical stability of materials which display pseudocapacitive behaviour
	Optimize the lithium ion supercapacitor and improve its cyclability and charge leakage
	Optimize different redox reactions in both the positive and negative potential ranges by balancing the mass of the electrodes and/or the utilization of different optimized carbons in an asymmetric configuration

Challenges in Manufacturing of Supercapacitors	Reduce the cost of production
	Produce electrode materials using simpler procedures without the need of expensive catalysts, templates or excessive temperatures.
	Simplify existing methods of production
	Find new methods of adhering the electrode material onto the current collector so that the internal resistance is as low as possible

garnered a lot interest is the lithium-ion supercapacitor because of the higher voltage per cell that it provides. The substrate is doped with various amounts of lithium and stores energy using both the conventional electrostatic method and the faradaic Lithium ion battery technology. But issues like poor cyclability and charge leakage need to be addressed.

### c. Electrolytes

Due to the squared dependence of energy density on the voltage window of the cell, a slight increase in the voltage window can increase the energy density drastically. Even though aqueous electrolytes are the most common they are inherently limited on account of gas evolution due to decomposition at high voltages. A comparison of the three types of electrolyte is given in the Table 1.

In spite of the high energy density possible with ionic liquids, the biggest drawback in its use is that most ionic liquids are stable only at high temperatures and room temperature ionic liquids are very costly. There is a lot of interest to come up with room temperature ionic liquids which are economically viable for this purpose.

Another important factor that needs optimization is the proper

pairing of electrolyte ions to the pore size of the electrode material. It has been found that capacitance increases when the electrolyte ion size is comparable to the pore size. The large pores need to be accessed quickly while the accessibility of smaller pores is more kinetically limited. Therefore, research needs to concentrate on this aspect of proper pairing of electrolyte and electrode.

## Manufacturing Challenges

The biggest detriment to the

wide scale acceptance of supercapacitor as an energy storage device is its cost. Electrode materials need to be produced using simpler procedures without the need of expensive catalysts, templates or excessive temperatures. Simplification of existing methods too need to be looked into. Another major challenge is the current collector and the method of adhesion of the electrode material to it. As of now, the slurry method has been used the most but this requires binders which tend to increase the internal resistance of the supercapacitor. Thus, there is an urgent requirement for low cost conductive binders suitable for this technology. Also, new methods of adhering the electrode material onto the current collector need to be found keeping the internal resistance of the supercapacitor as low as possible.

Challenges in Application of Supercapacitors	Costlier than batteries and lower energy density
	Reliability of the supercapacitor needs to be improved
	Maximum voltage of a supercapacitor is 2.5V which means a stack of supercapacitors need to be used for larger voltage
	Requirement of a reliable and efficient Power Electronic interface for proper charging and discharging. In some cases a DC /DC converter might be required
	Voltage balancing required for stack of supercapacitors
	Application engineers are still not aware of its special characteristics and are vary to use it in their designs
	A method of identifying applications that can be catered by the type of supercapacitor (this includes the type of material used, configuration, etc.) need to be standardized

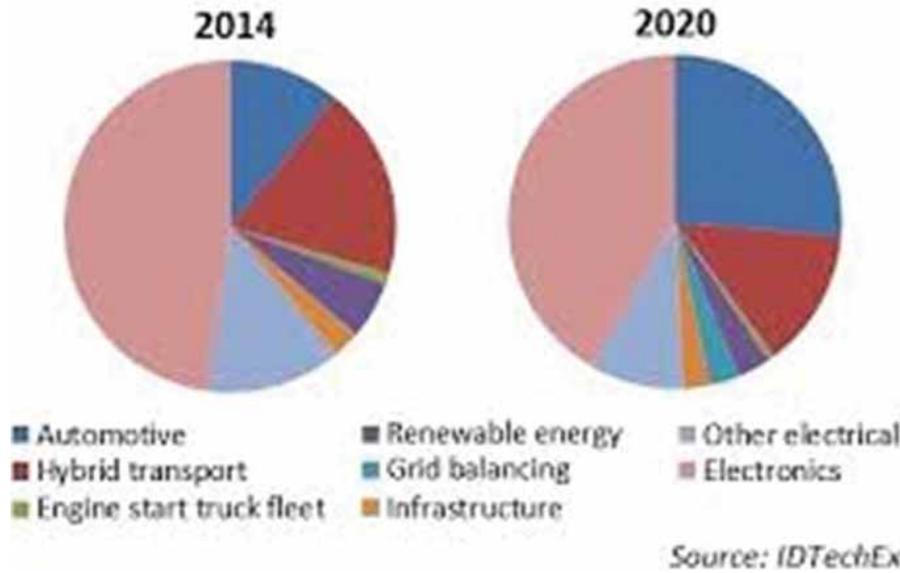


Figure 1: Supercapacitor Market Shares by Application as on 2014 and expected in 2020

## Application Challenges

The most sort after characteristics of the supercapacitor is that energy stored in it can be released within a very short timeframe (in the order of seconds), and can, be recharged in the same time. On the other hand, even the high power Lithium ion batteries, take several minutes or more to release all their energy, and several minutes to hours to be recharged. Moreover, due to its unique energy storage mechanism the supercapacitor can be discharged

completely without any issues to its life. In the case of batteries, the deep discharge can be detrimental due to the chemical changes that tend to take place. The other very important advantage the supercapacitor has is the issue of thermal runaway in batteries which can have catastrophic effects including catching fire. Supercapacitors tend to age gracefully and are not prone to thermal runaways. But the technology has not yet found widespread acceptance among design engineers. The largest

consumer of the supercapacitors is still the mobile phone industry as shown in the Table 2.

**Table 2: India Supercapacitor Market by Application 4th Quarter, 2013**

(Source 6W Research Quarterly)

Applications	Shipments
Mobile Phone	51.23%
LED Display	23.13%
Memory Backup	13.02%
Wind Turbine Controller	7.21%
Others (Renewable Energy, Automobile, sensors, etc.)	5.41%

As of now the supercapacitors are typically used in tandem with batteries in most energy storage applications. Applications that rely completely on supercapacitors for energy storage are still very low. One of the major reasons for this is the requirement of a reliable and efficient power electronics interface. Charging and discharging of the supercapacitor have very different challenges. It is normally expected that the supercapacitor charge quickly but discharge slowly. This means the time period of the charging circuit should be kept as low as possible which might require an additional charging circuit. Moreover, supercapacitors are required to deliver large currents at varying voltage. In the case of batteries, the range of voltage between discharged and fully charged is not very wide while for a supercapacitor the fully discharged voltage is zero. This means that supplying power at a constant voltage, which is normally the requirement for most applications, require DC/DC converters.

Another challenge to the design engineer is the non-uniformity of

Market Challenges of Supercapacitors	Design engineers are still reluctant to use this technology due to unfamiliarity and misconceptions
	Manufacturers with path breaking technology are small players and are not able to use existing channels of distribution and contact with customers
	Level of differentiation is very high. The same manufacturer cannot produce the various types of supercapacitors thereby reducing their market share

cell voltage in a stack of supercapacitors connected in series. Those cells that are under higher voltage stress tend to have lower life compared to those under less stress. To combat these issues a stack of supercapacitors requires active or passive cell balancing.

All these power components along with the supercapacitor, tend to make the supercapacitor based energy storage system costly and thus this technology is still not able to compete with other available storage approaches like batteries and fuel cells.

A very recent requirement is for flexible energy storage for wearable electronics. Though researchers are producing flexible supercapacitors it has not reached mass production stage. More niche applications for this technology need to be identified. A method of identifying applications that can be catered by the type of supercapacitor (this includes the type of material used, configuration, etc.) will also make it easier for a design engineer to utilize the supercapacitor in a particular system. More awareness among the end users about this technology will also create a larger market.

## Market Challenges

The global supercapacitor market as on October, 2016 is approximately \$400 million according to Paumanok Publications, Inc. who has monitored the global supercapacitor markets since 1993. It has bitten into the \$95 billion global battery market and the \$17 billion global capacitor market. The Indian supercapacitor market witnessed an increase in demand in the standalone and batteries combination devices. According to the market research firm 6Wresearch India, 1 Farad supercapacitors experienced more than 76% market share in the fourth quarter of 2013.

Some of the challenges of the supercapacitor market are unique. Even now there is a lot of reluctance in industry to embrace this technology. Even though the automobile industry is the largest perceived market and a few automobile manufacturers are claiming to use the supercapacitor in some of their models, we haven't yet seen them accept this technology in their entire range. Moreover, as most of the supercapacitor manufacturers in possession of path breaking technology are small players in the energy storage market, they are not able to use

existing channels of distribution and contact with customers. This keeps them from completely exploiting the energy needs of the consumer. In many countries, apart from manufacturing of this device, developing market for this is also a challenge. According to Dennis M Zogbi a market analyst in this niche area, "Even though early on the supercapacitor manufacturers were signing joint ventures and research and development deals with many end-users in multiple industries, only a few end-markets actually were cultivated into multi-million dollar channels of revenue." Thus, there is an urgent need to better access the vertical market.

Another major concern in the growth of this market is the level of differentiation of technologies within such a small market. The supercapacitor market itself is divided into (i) activated carbon based or EDLCs, (ii) Hybrid capacitor (iii) Lithium ion batteries. This means that the same manufacturer finds it difficult to manufacture all the three types and thereby, increase his market share and thereby, increase the supercapacitor market share. The figure 1 shows the supercapacitor market shares by application in 2014 and the expected share in 2020. As the world starts moving towards electric transportation the automotive market looks to make larger strides.

Thus to summarize, the challenges before the supercapacitor technology are many. These challenges need to be countered at different levels right from research, manufacturing and improving the market conditions. It is hoped that as the world moves towards greener technologies as epitomised by the Paris Agreement, this technology will grow by leaps and bounds. 



**Dr. P. B. Karandikar**

Associate Professor,  
Army Institute of Technology,  
Pune



**Seema Mathew**

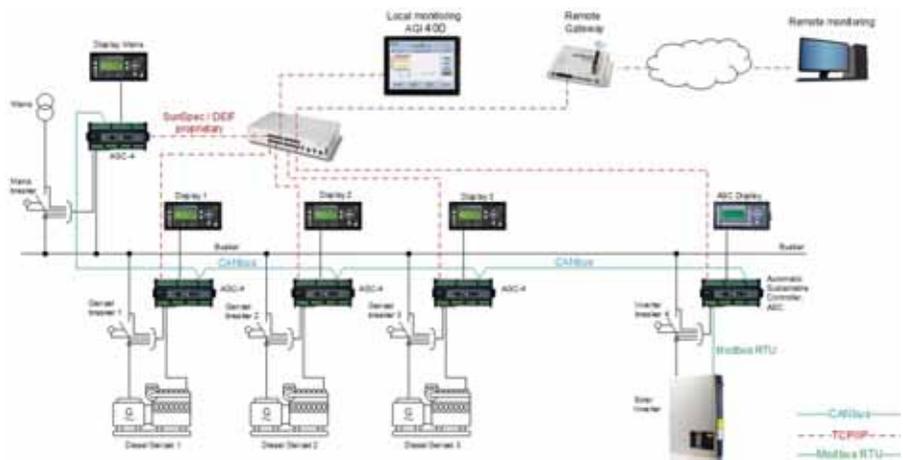
Assistant Professor,  
P.E.S's Modern College of Engineering,  
Pune

# DEIF Brings Revolutionary Solutions to Solar Sector

Known for commitment to provide green safe and reliable solution to customers, DEIF introduced the Automatic Sustainable Controller (ASC), a solution that provides integrated solution for systems with utility, diesel and solar power source. The system provides an interface between the diesel/gas genset and solar with or without the presence of utility power - a solution that enables you to share the load between solar PV cell and diesel or gas genset with maximum solar penetration, thus, resulting in maximised savings even during utility failure.

DEIF's solar solution is available for both - as power management for systems with multiple sustainable power sources, or as an add-on solution for retrofits or existing plants. The ASC supports interface with solar PV inverter from a number of leading manufacturers namely ABB, SMA, Schneider Electric, Gamesa Electric, Fronius, Sungrow, Delta, Huawei and many more.

Our collaboration with ABB has resulted in a "Declaration of Compatibility" certificate which states that the ASC is capable of



controlling and reading data from the ABB TRIO inverter series and that it can be applied without compromising inverter warranty. Similarly, other inverter manufacturers are in the process of issuing compatibility certificates for the ASC. Schneider Electric launched their Conext CL inverter series for the solar market, which includes an interface with the DEIF ASC controller. This solution works with the grid and a diesel genset to form a complete grid management solution. Conext CL inverters are designed to respond rapidly to power curtailment commands from controllers enabling integration of PV power in hybrid grids.

The ASC from DEIF controls

PV power from the Conext CL inverters to integrate seamlessly with diesel genset powered loads. We offer a customization option to add an Automatic Genset Controller AGC -4, to provide a complete plant management solution. Another inverter manufacturer - Fronius International GmbH, solar solution with DEIF's ASC is presented in their product catalogues. We are working more and more with all the different solar inverter companies to help the end customers enjoy a seamless integration of power. The future of the interface between Controller and Solar inverters will be Sun Spec and DEIF has already prepared its ASC to this protocol of the future. <sup>10</sup>

**Green, Safe and Reliable control – the promise from DEIF**

# HEY!

YOUR SEARCH  
| ENDS HERE



## WOULD YOU LIKE

**to know** more about the HVAC and R (heating, ventilation, air-conditioning and refrigeration) industry.

JUST FLIP OVER AND WE HAVE A  
**SUBSCRIPTION** FORM FOR YOU.

**B**ESIDES MONTHLY  
MAGAZINE TAKE  
ADVANTAGE OF THE  
DIGITAL TECHNOLOGY  
& READ COOLING INDIA  
MAGAZINE ONLINE, AS  
WELL AS FORTNIGHTLY  
E-NEWSLETTER ON YOUR  
PC, TABLET OR LAPTOP.



PRIYANKA

022-27777182 / 8652142057  
sub@charypublications.in



Chary Publications

# Cooling India

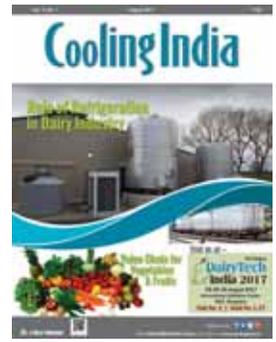
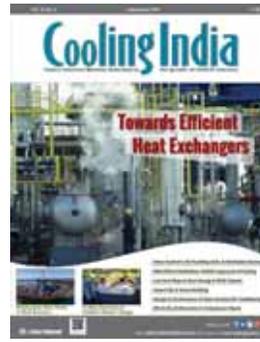
India's foremost Monthly dedicated to the growth of HVACR Industry

YOU CAN ALSO  
SUBSCRIBE **ONLINE**  
[www.coolingindia.in](http://www.coolingindia.in)

# SUBSCRIBE

# Cooling India

India's foremost Monthly dedicated to the growth of HVACR Industry



## Subscription Offers

Sub. Period	No. of Issues	Subscription Type					
		Print		Digital		Print+Digital	
		Actual Rate	You Pay	Actual Rate	You Pay	Actual Rate	You Pay
1 Year	12	1200.00	1000.00	1200.00	1000.00	2400.00	1500.00
2 Years	24	2400.00	1750.00	2400.00	1750.00	4800.00	2625.00
3 Years	36	3600.00	2500.00	3600.00	2500.00	7200.00	3750.00
5 Years	60	6000.00	4000.00	6000.00	4000.00	12000.00	6000.00
<b>E-Newsletter</b>							
<b>1 Year</b>	<b>24</b>	<b>N. A.</b>		<b>365.00</b>		<b>N.A</b>	

PLEASE SELECT MODE OF DISPATCH FOR PRINT EDITION -  
 (1). By REGISTERED PARCEL - Rs. 435/- year (2). By COURIER - Rs. 600/- year  
**KINDLY ADD POSTAGE CHARGES IN SUBSCRIPTION AMOUNT.**

## Subscription / Renewal Form

To,  
 The Subscription in-charge  
**COOLING INDIA**  
 Email: sub@charypublications.in

Are you a Subscriber,  
 Please submit your Subscription no:  
 \_\_\_\_\_

Yes, I would like to Subscribe/renew  Cooling India /  CI e-Newsletter for \_\_\_\_\_ years at ₹ \_\_\_\_\_.

### PAYMENT DETAILS :

Cheque / DD No. \_\_\_\_\_ Dated \_\_\_\_\_ Drawn on Bank \_\_\_\_\_  
 \_\_\_\_\_ Branch \_\_\_\_\_ in favour of Chary Publications Pvt. Ltd.

Bank details for NEFT / RTGS / IMPS : Account Name: Chary Publications Pvt. Ltd.

Bank Name: Bank of India      Branch: Chembur, Mumbai - 400 071      Account Type: Current Account  
 IFSC Code: BKID0000009      Bank A/C Number: 000920110000322      SWIFT CODE :BKIDINBBCHM

Name: \_\_\_\_\_  
 Company: \_\_\_\_\_ Designation: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 \_\_\_\_\_ City: \_\_\_\_\_ Pin: \_\_\_\_\_  
 Telephone: \_\_\_\_\_ Mobile: \_\_\_\_\_  
 Email: \_\_\_\_\_  
 Signature: \_\_\_\_\_

Stamp



905-906, The Corporate Park, Plot No. 14 & 15, Sector 18, Opp. Sanpada Railway Station, Vashi, Navi Mumbai - 400 703.  
 Phones: +91 22 27777 170 / 171 • Email: sub@charypublications.in • Contact : Priyanka Alugade • +91 22 27777182 / +91 8652142057

# THE WORLD OF ELECTRICITY IS CHANGING FAST!



Digital Transformation  
of Power Delivery



Energy Storage  
Systems & Solutions



IoT and AI  
in Electricity



E-Transportation

## ARE YOU ABLE TO KEEP UP?

### THE **FUTURE OF ELECTRICITY** IS UP FOR A SNEAK PREVIEW AT THE **E-TECHNXT PAVILION** AT **ELEC RAMA-2018**

In every few decades, one big game changer comes along the way making Irreversible changes that impact businesses, communities and the course of overall evolution. Since the discovery of electricity and its transmission over long distances, the first big disruption is here that is changing the rules of the game in a very big way.

Will this end up changing the rules of engagement for your business too?  
Visit E-TECHNXT Pavilion at ELEC RAMA-2018

#### NEW SEGMENTS. NEW EXPERIENCES. NEW OPPORTUNITIES



POWER ELECTRONICS



RENEWABLES



ELECTROMOBILITY



AUTOMATION



POWER STORAGE

#### SUITE OF TECHNOLOGY & BUSINESS EVENTS



\*These pavilions and concurrent events are subject to change or altered as per organisers discretion without advance notice.

organised by

**ieema**  
your link to electricity



[www.elecrama.com](http://www.elecrama.com)

# Diagnosing Health of Smart Meters

This article describes new in-meter health monitoring trends such as use of ADI's mSure technology. Such technologies address the challenges of the next-generation smart metering architecture to offer measurements with the highest accuracy and enable utilities to remotely access...



Over the past 15 years, the energy metering industry has been witnessing multiple waves of change, each with a scope and size not seen earlier for over a century. The transition from electromechanical to electronic meters was quickly followed by automatic meter reading (AMR) systems which in turn evolved into advanced metering infrastructure (AMI) systems associated with higher speed, two-way communication,



Figure 1: Smart Meter with Health Monitoring - Closed View



Figure 2: Smart Meter with Health Monitoring - Open View

industry along with increased regulations and a demand for customized services. All these are putting greater pressure on utilities to look beyond meters to cash and to manage assets cost-effectively, provide exceptional customer service and modernize their obsolete processes. This has given entry to the Internet of Things (IoT) that has promised amongst other things - translation of various sensor-based information into actions, new services, crew localization, part inventories, and control & maintenance of assets.

Despite the IoT promise, a chief engineer or a head of metering in an electrical utility is still left with unresolved inefficiencies around maintaining the health of millions of meters on a case-by-case basis, verifying accuracy using imperfect statistical methods, disrupting service for testing, replacing meters prematurely, or using age-based decision making. Most importantly, despite the advancements in IoT, the AMI network so far had been unable to do justice to its primary function,

and the ability to deliver large amounts of data to central databases for billing, troubleshooting, and analysis. Undeniably, these changes brought in business efficiencies ranging from drastic reduction in labour hours (for reading millions of meters), to improved access (from a utility key room), to worker safety (reduction in meter reader accidents - electrical shocks, dog

bites), to better measurement accuracies and lower losses, to reduction in down time, and to lower environmental impact. But, have these changes ensured accountability of the entire electricity consumption?

### Increasing Demands from AMI systems

There is rising competitiveness in the electricity distribution

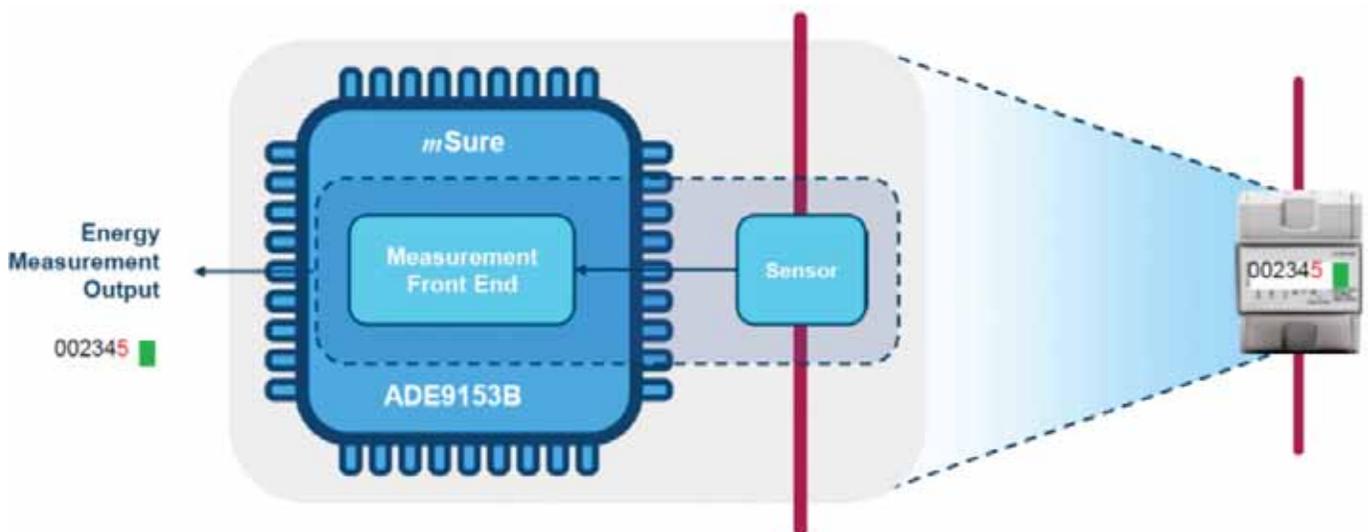


Figure 3: Self-Testing Capability of the Measurement Front End including the Sensor

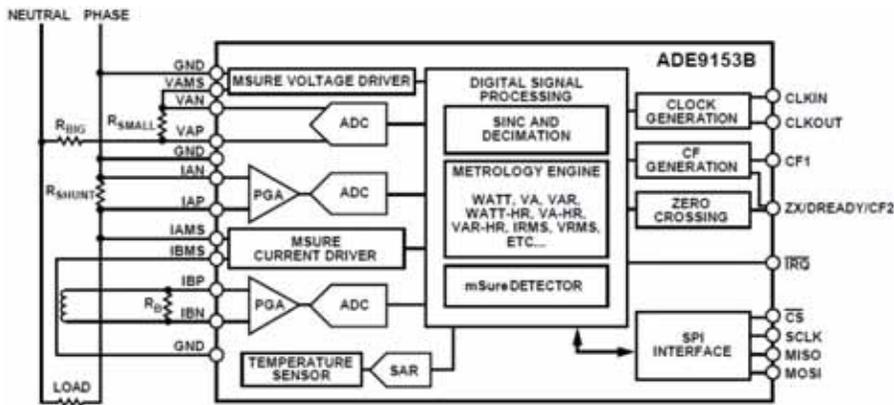


Figure 4: Block Diagram of the ADE9153B Chip

Once direct measurement of meter health is on your fingertips, it is easy to build intelligence around it. This will help make decisions quickly and with confidence by identifying out-of-specification meters, detecting meter malfunction, and confirming and quantifying more tamper events. Utility companies will then be able to more effectively dispatch field crews, optimize meter replacement, and reduce tamper investigation time.

The advantages of in-meter health monitoring are:

1. Always On: Detect problems quickly
2. Meter Specific: Locate drift or tampering
3. Direct Measurement: High confidence results
4. Non-invasive: No service interruption

## Metering IC with Sensor Monitoring

The recently launched chip ADE9153B from Analog Devices is an accurate, single-phase, energy metering IC with (a) sensor

namely to make sure all electricity consumption is measured and accounted for.

### How to get more value out of AMI systems

A quick market survey of all the metering systems available over the past few years, would lead us to believe that the measurement technology in electricity meters is commoditized. The specifications drafted by the different electrical utilities, too, have essentially remained the same over the past few years. The utility engineers have, therefore, been putting all their efforts into delivering value by analysing the available electricity data which they believe to be true and correct. However, when all electricity consumption is not being measured and accounted for, it makes little sense to pursue this approach.

What if we turn the tables and begin with an assumption that the electricity measurement data is suspect and incorrect. Is there a way to extract more value out of AMI systems and make the already smart meters even smarter? The answer is yes, and the way to achieve our goal is to upgrade the measurement with new

diagnostics. For this, the IoT revolution gives us the clue – to upgrade sensors!

### Intelligence based on Direct Measurements

Out-of-specification and faulty meters can be identified by an intelligent process working in real time called 'in-meter health monitoring'. This technology that can non-intrusively monitor the health of deployed meters, including the accuracy of the current and voltage sensors, and better detect meter tampering can save significant cost for electrical utilities.



Figure 5: Health Monitoring

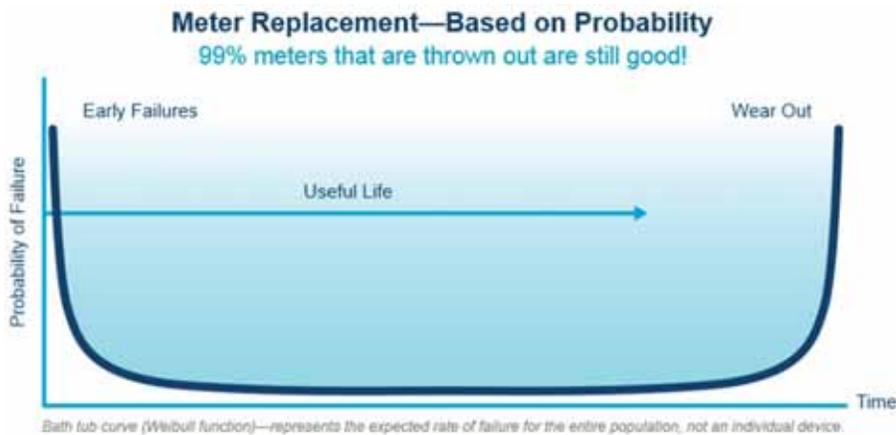


Figure 6: Bath tub Curve of Failures over time

monitoring and (b) autocalibration. Sensor monitoring is achieved with their patented mSure® technology that allows (i) meter health monitoring and (ii) advanced tamper detection.

As can be observed from Figure 3, the mSure technology resides in the energy measurement IC, and it provides accurate monitoring and self-testing capability for the entire system, including the sensor.

The monitoring feature allows the user to check the overall accuracy of the sensor and signal path to identify accuracy drifts that occur over time on the current and voltage channels, independently.

Similarly, mSure offers advanced tamper detection with the ability to detect unusual changes on the sensors. mSure runs in parallel to the metering measurements, allowing uninterrupted and unaffected metrology in the chip.

Autocalibration with mSure enables a meter to automatically calibrate the current and voltage channels without accurate reference meters or accurate sources when a shunt resistor is used as the current sensor. The

autocalibration feature supports Class 1 and Class 2 meters.

The ADE9153B chip includes three high performance analog-to-digital converters (ADCs) (see Figure 4), providing an 86 dB signal-to-noise ratio (SNR). It offers accurate measurement of line voltage and current, calculates active, fundamental reactive, and apparent energy, as well as rms. A wide range of power quality information is included, such as dip and swell detection. Current Channel A is ideal for shunts, with a flexible gain stage providing full-

scale input ranges from 62.5 mV peak down to 26.04 mV peak. Current Channel B has gain stages 1×, 2×, and 4× for use with current transformers (CTs). A high speed, 10 MHz, serial peripheral interface (SPI) port allows access to the chip's registers.

#### Standard Features

- For single phase energy meter: Real time meter health monitoring using mSure manager; Class 0.5 accuracy; Line and Neutral measurements;  $I_{max} = 60A$ ,  $I_{nominal} = 6A$ ; 110V-240V; 50/60Hz; LCD and CF outputs
- Voltage RMS, Current RMS, Active, Fundamental Reactive and Apparent Power and Energy measurements
- Power quality measurements: Dip, Swell; Frequency, Power Factor
- PC control using an isolated RS485 port; PC software for full control of the chip

#### Sensor Monitoring Features

- mSure sensor monitoring
  - Non-invasive, real-time, direct, precision

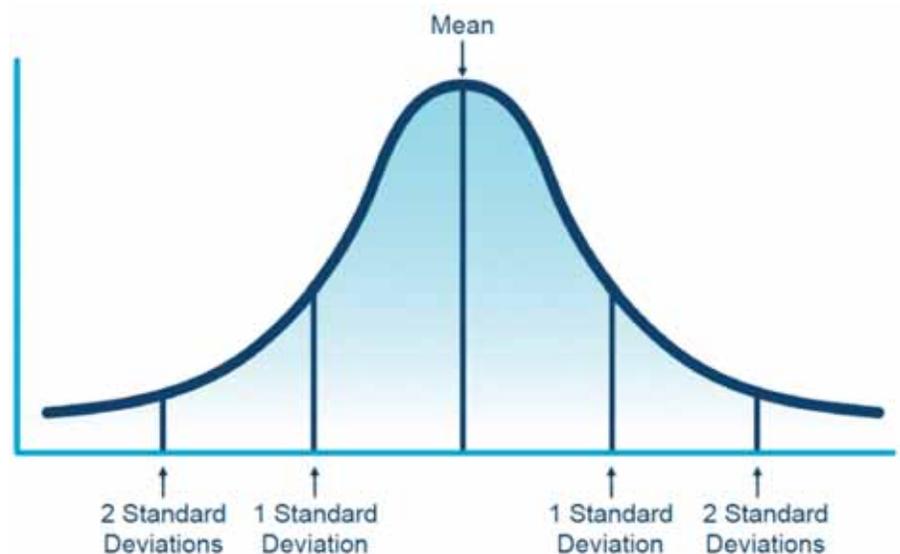


Figure 7. Mean and Standard Deviation of errors in a Meter Population

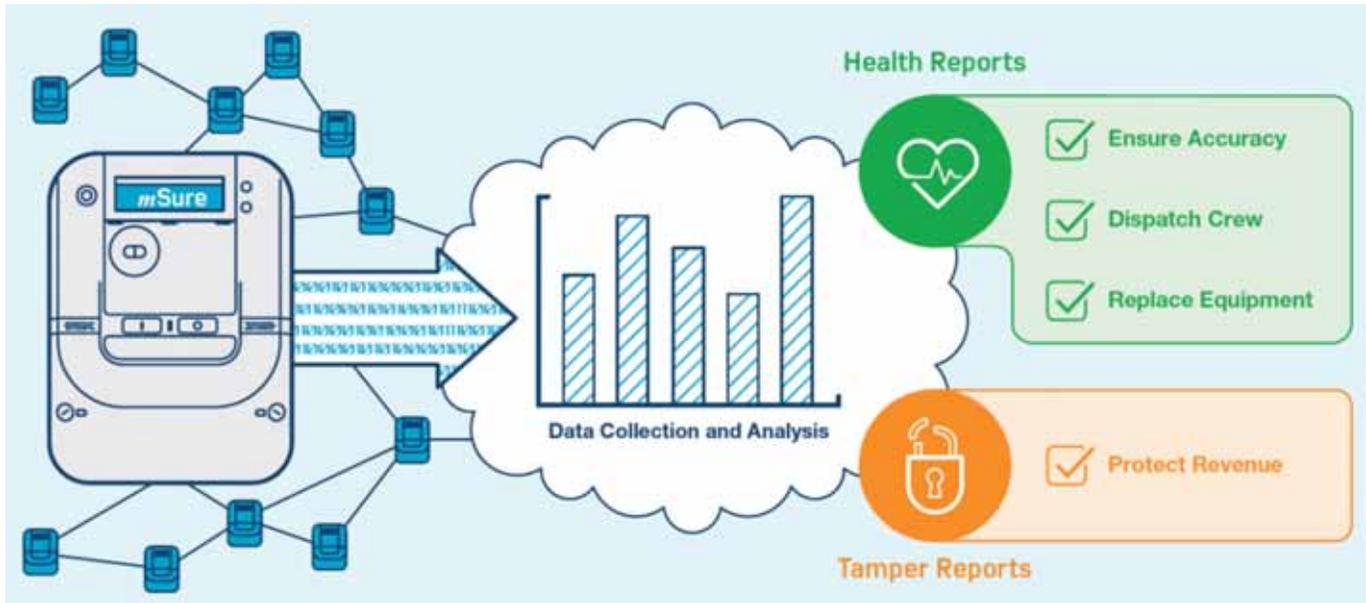


Figure 8: Need for a new approach to monitor Meter Health

- measurement of the input signal path
- Detects changes in meter accuracy and amount of drift over the life of the meter
- Identifies sensor malfunction
- Enables advanced tamper detection methods
- Companion MCU firmware to facilitate diagnostic data reporting
- Supported for shunts on the phase line and CTs on the neutral line
- mSure autocalibration
  - Automatic calibration based on a direct measurement of the full signal path
  - Calibration procedure not requiring a reference meter
- mSure Manager for analyzing and reporting mSure diagnostic and health data

## Monitoring Meter Health

It is estimated that there will be 780 million smart electricity meters worldwide by the year 2020. With such a large population of meters,

one of the bigger challenges is to overcome the limited visibility into the health of these meters. While smart meters and AMI remove the need for in-field meter readers, expensive crews still need to be scheduled to replace meters that are nearing the end of their useful lives.

### Estimating Meter Life

Historically, a lot of attention was devoted to reducing the impact of Early Life failures. This is accomplished by improving the

manufacturing process, environmental burn-in, and extensive testing. The Wear Out region of the curve, which typically has a Gaussian distribution, is avoided by using conservative (three or more standard deviations) statistical methods to minimize the possibility of an out-of-spec device remaining in service. Furthermore, sample testing is required in many global regions to spot check meter performance during deployment.

A technique usually adopted by



Figure 9: Tamper Detection without actionable intelligence

## New Advanced Tamper Detection with mSure®



Figure 10: Sensor based Advanced Tamper Detection

the electric utilities to verify the meter accuracy is to perform sample testing. Regulatory compliance requires checking the accuracy of up to 0.5% of all installed meters twice during a meter's lifetime. A utility with 10 million meters installed could easily incur a cost of ₹ 180 crores over the lifetime (15 years) of the population. A cost per customer of ₹ 900 assumes removing the meter under test, installing a new one, performing the test in a lab, and then installing the original meter for another customer. In-field accuracy verification can prove even costlier and inconvenience customers.

Current best practices require that utilities determine useful life of the meters based on statistical distribution of failures. Typically, this is done by reliability engineers using the Weibull function, otherwise known as the bath tub curve depicted in Figure 6. Reliability engineers use these techniques to ensure that a meter's measurement accuracy remains within class before it is replaced.

Based on the performance of the samples picked up at random from the field, a decision is taken,

either to replace the entire population or to continue with them for a pre-defined period. Such an approach gives rise to a possibility of leaving hundreds of bad meters in the field (see Figure 7).

If 1% of the meters are found to be defective during the sample testing, and based on it a decision is taken by the utility to replace the entire installed base, then too, the utility would be bearing avoidable expenses since 99% of the meters getting thrown out are still good and within its useful life.

Another common method for determining the time to replace meters is based on the length of service. Meters like other electronic devices follow a bath tub shaped failure curve (see Figure 6). For this method to be effective, the meter must be replaced before the first meter is expected to fail. Again, almost every meter that is thrown into the trash still functions.

However, the biggest drawback of all the above described methods is that often well over 99% of meters removed from operation still perform within specifications. There has never been a cost-effective way to verify the measurement accuracy of each

device.

Being able to precisely and cost effectively check meter accuracy helps enable utility companies to make better replacement decisions. If we assume a ₹ 5000 cost for the new meter and its installation, and by achieving a 2-year extension to a 15-year meter lifetime, over ₹ 500 can be saved per meter over its lifetime.

### Risk of Damage to Reputation

While slow running meters represent a loss to the utilities, meters running fast overcharge consumers and could result in an embarrassing situation for a utility. Many PR departments and meter managers have horror stories about overbilled customers who have turned to social media to express their dissatisfaction. The utility needs to subsequently check every meter in the batch and replace them at a high expense.

Clearly, we need a new approach to monitor meter health, collect data, analyse them and generate health reports. Any change in meter accuracy should get detected quickly and remedied before it becomes a larger problem. For this a meter should be in a position to perform

(a) Open Loop (existing meters)



(b) Servo Control Loop – Monitors and Reports Measurement Accuracy



Figure 11: Comparison of Errors in Meters with Open Loop vs. Control Loop

background accuracy check multiple times a day and send an alert as soon as it notices any abnormality or change in meter accuracy.

### An Edge-to-Cloud Utility Meter Analytics Solution

The mSure diagnostics technology enables direct and non-invasive monitoring of electric meter accuracy and faults in real-time. Such technology enabled meters, combined with an 'Edge-to-Cloud' analytics service, provide utility companies with real-time health data and actionable insights on meter accuracy over lifetime, meter malfunction, and advanced tamper detection.

Edge computing is a method of optimizing cloud computing systems by performing data processing at the edge of the network, near the source of the data. This reduces the communications bandwidth needed between sensors and the central data center by performing analytics and knowledge

generation at or near the sensor – the source of the data. This approach requires leveraging sensors that may not be continuously connected to a network. Analog Devices, has created an analytics solution featuring a real-time diagnostic technology—mSure®—residing in the individual utility meter that reports meter health data to an analytics service. The resulting actionable insights provide utilities with a direct ability to protect revenue better, manage field resources more effectively, reduce equipment costs, and improve customer service.

This non-invasive diagnostics technology monitors sensors for accuracy and faults. In utility meters, it is built into the new Analog Devices' energy measurement IC and it delivers meter health data. An mSure-enabled meter has the ability to check the accuracy of the metrology function directly and in real-time. The cloud based analytics service

combines various data sources and data history to provide actionable insights via advanced meter health and revenue protection modules. Such insights to detect tamper and out-of-spec meters help protect the utilities revenue and manage their equipment cost-effectively.

### Advanced Revenue Protection

Although often perceived as a developing nation issue, the problem of energy theft is widespread and impacting every geographical region, including India. It is estimated that electricity worth over \$96 billion per year is stolen worldwide. Creative thieves use a variety of methods to siphon energy including direct line tapping, magnetic interference, and bypassing the electricity meter. Given the size of the problem, a variety of methods have been developed to detect theft attempts and inform the energy supplier so that appropriate action can be taken. So far, results

**Table 1: Detection of Meters with Different Fault Types**

Identifier	Fault Type	Accuracy	Out of Spec	Tamper	Failure
Meter 1	Aging – Out of Spec.	1.87%	Alert	OK	OK
Meter 2	Sensor Fault – Damaged Meter	Open	Alert	OK	Alert
Meter 3	Senor Fault – Overcurrent Damage	-1.37%	Alert	OK	OK
Meter 4	Bypass Tamper	1.93%	Alert	OK	OK
...		...			
Meter X	No Fault (Accurate Meter)	-0.06%	OK	OK	OK

have been unsatisfactory and energy theft continues to rise. How can we reverse this trend?

### Existing Tamper Detection Methods

The root cause of the problem is that each tamper detection method has weaknesses. The insights and alerts generated are prone to error, leading to a lack of trust in the solution. They provide interesting views on the problem, but they don't provide real-time actionable intelligence.

Recent innovations have taken a more holistic, grid intelligence or network based approach. Energy consumption is measured at multiple points in the energy distribution chain, results are compared, and any differences are attributed to technical or non-technical (i.e. theft) losses. Such solutions show promise, but the granularity of the results is wide-ranging. It is simply not economical to measure consumption at all the network points needed to profile a theft to a specific end node.

The most pervasive method in use today is pattern-based analytics with machine learning to identify anomalies and profile tamper candidates. Meter-based historical and neighbour data are combined with other sources and mined for patterns that deviate

from an expected norm. Anomalies can be priority ranked, and in theory, offenders caught. In practice though, this method tends to deliver an amount of false positives, (i.e. results that are profiled as tampers but are actually not). For example, a homeowner goes on extended work assignment leaving the property unoccupied for a few months. Power consumption drops and a tamper candidate alert is triggered, leading the energy provider to initiate an erroneous investigation with a resulting waste of resources, frustrated homeowner, and damaged reputation. Another problem is that, by definition, the analysis relies on historical data and lags the actual theft (thief can't be caught red handed).

Another common method of tamper detection is meter-hardware protection. Basic meters contain built-in detectors that are tripped by certain kinds of tamper attempts and then alert the energy supplier. Anecdotal feedback from utilities deploying these detectors indicates that, generally, such systems are over-sensitive and also prone to the false positive problem. In short, the alerts cannot be acted upon because in a high number of cases the alerts are triggered innocently.

All existing methods also suffer from one core flaw. While they can, to a greater or lesser extent, point to a potential tamper, they cannot reliably indicate the amount of energy stolen.

### New Advanced Tamper Detection Method

A new approach is needed, that provides on-meter, continuous real-time monitoring with an associated analytics capability that can profile, quantify, and alert energy suppliers to tamper attempts. This approach must deliver consistent and reliable results that allow action to be taken with high confidence. That is where mSure® comes in. mSure is an agent that resides in the smart meter and monitors what happens at the sensor used to detect energy consumption. Any change to the characteristics of the sensor that would be induced by an attempt to bypass or saturate the meter can be immediately detected. That enables mSure to send the energy provider a tamper alert and/or to activate a visual flag at the meter, which can act as a deterrent to potential tampering. As the impact of various direct tamper methods on the sensor can be profiled, the type of tamper can be recognized with high confidence and the number of false positives significantly reduced. In addition,

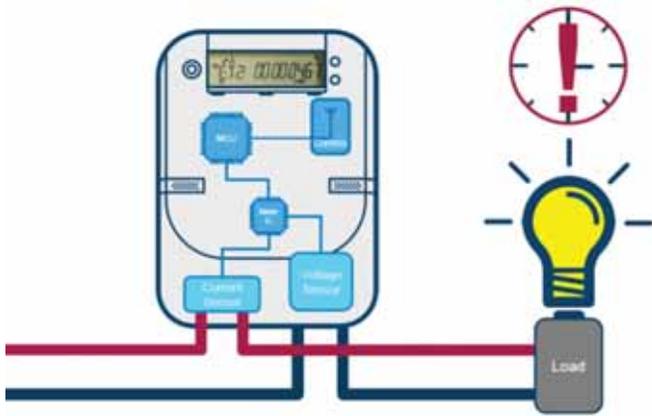


Figure 12: Aging - Out of Spec Meters

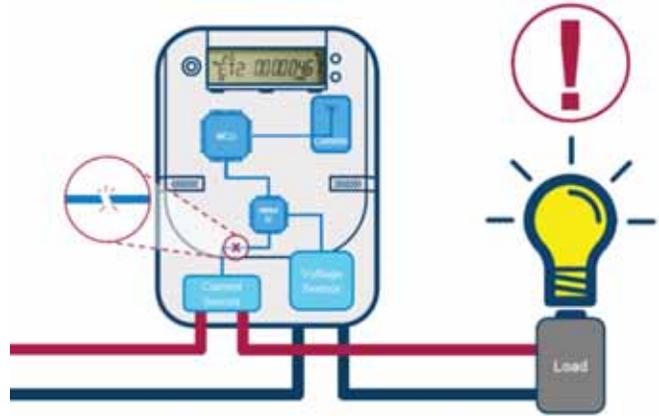


Figure 13: Sensor Fault - Damaged Meter

by understanding and analyzing the change in characteristics, an estimate can be made of the amount of energy stolen, not just that a tamper event has occurred.

Unlike other methods for tamper detection, the mSure technology is based on an always-on direct measurement of meter sensor functionality (see Figure 10) and not statistical or subjective factors, which enables it to:

- Deliver high confidence results with fewer false positives
- Detect new types of tampering never detected before
- Specify tampering to an individual meter
- Detect intermittent tampering (for example, during times

when meter crews are off duty)

- Estimate the amount of tampering, which helps prioritize tampering investigations

The financial benefits of mSure-enabled revenue protection will vary by utility, depending on the amount of tamper, the types of tamper, and the ability to pursue enforcement. For a 10 million meter utility with a 5% nontechnical revenue loss rate, tamper is a ` 900 Crores issue. Assuming a 15% improvement in recovery, an mSure-enabled meter can save a utility over is ` 1350 per meter over the meter's 15-year lifetime.

### Closed Loop Error Monitoring

Figure 11 describes the

disadvantage of the existing meters that have an open loop sensor measurement circuit. The total error is the product of the sensor error and the error of the measurement front end. The sensor is a major contributor to the error and open loop architecture cannot correct such an error over its lifetime.

On the other hand, a meter that incorporates sensor within its monitoring loop (closed loop) is able to detect such errors and re-calibrate or remove ones that can be corrected. mSure has the ability to inject signals into the sensor to detect and remove sensor errors.

Table 1 shows the fault

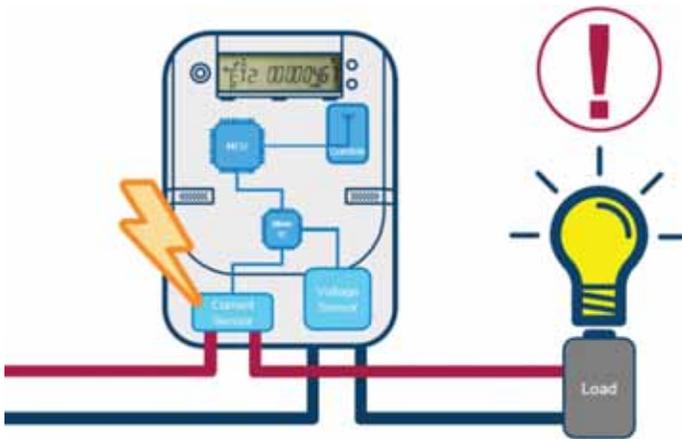


Figure 14: Sensor Fault - Overcurrent Damage

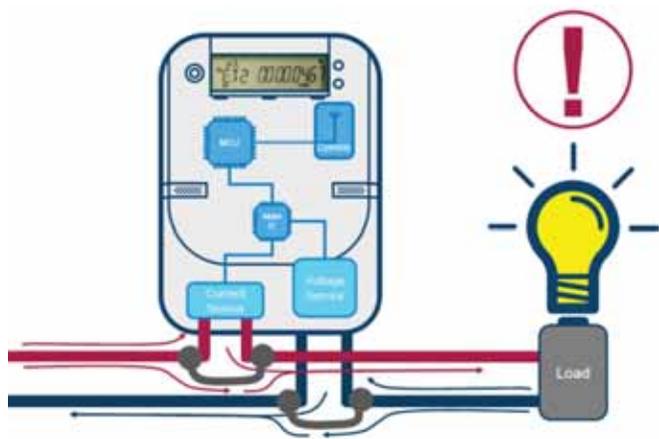


Figure 15: Bypass Tamper

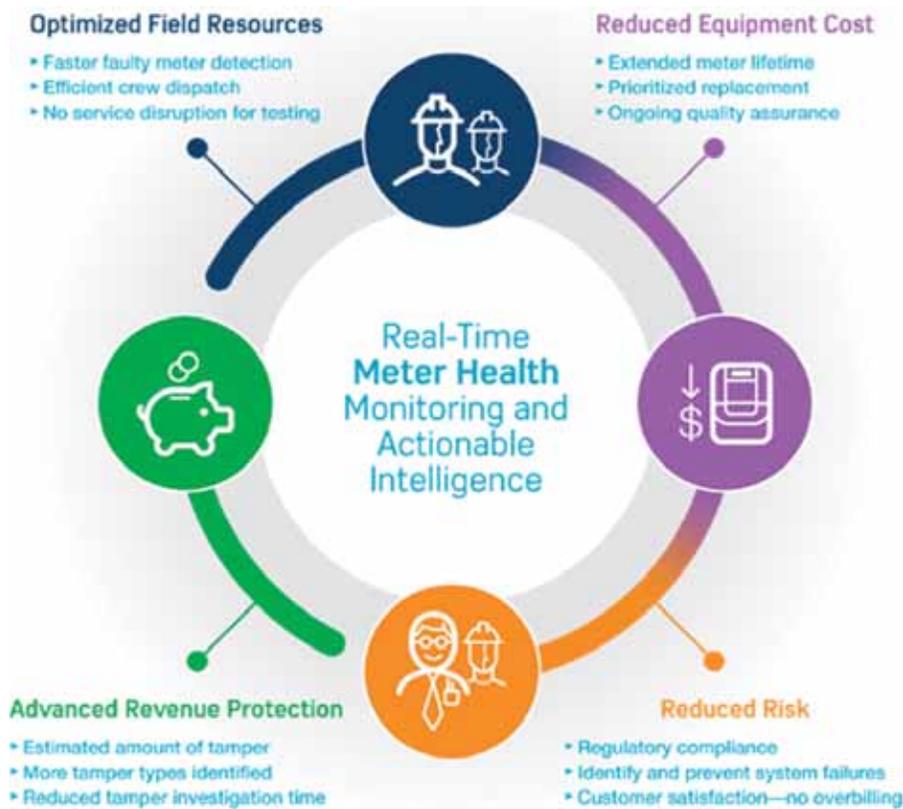


Figure 16: Health Monitoring and Actionable Intelligence

detection capability of a meter that incorporates a closed sensor loop as implemented by mSure. Meter 1 flags an 'Out of Specs' Alert since the accuracy has dropped due to aging.

Meter 2 indicates an error due to failure of Sensor (see Figure 12). This represents a damaged meter where there is no sensor output.

Meter 3 flags an error since the accuracy is outside limits due to a Sensor fault that is caused due to overcurrent damage (see Figure 14).

Meter 4 flags an error since the accuracy has fallen outside limits, but this time due to tamper of the sensor. In this tamper mode, the meter (sensor) is bypassed externally to slow down the meter (see Figure 15)

Thus, we have been able to demonstrate how energy theft can

be combatted with actionable intelligence.

As with all new technologies, phasing-in real-time accuracy monitoring technology is a prudent approach. Existing field sampling protocols can be used to confirm effectiveness of the solution and to train predictive analytics. After a couple of years of data correlation, field sampling can be reduced or eliminated, realizing additional cost savings (see Figure 16).

### Conclusion

Contrary to the belief of many that electricity metering has become 'commoditized', each wave of change that has hit this industry has caused significant improvements in operational efficiency and provided good return on investment. It is refreshing to note that in the

current wave, the last mission-critical parameter – 'energy measurement accuracy' has been effectively monitored.

With the deployment of non-invasive, real-time accuracy monitoring technologies, smart meters can deliver added value and increase a utility's return on investment. Smart meters with in-meter sensor based diagnostics coupled with analytics services enable multiple improvements, including eliminating meter accuracy verification, extending meter lifetime, reducing risk, and adding advanced revenue protection. With a meter's lifetime so extended that it be replaced only just before its decline in accuracy, utility companies need to seriously consider usage of such next-generation meters in their new deployments to boost their return on investment.

While a fool-proof revenue protection solution will likely embrace a combination of methods, the in-meter sensor based diagnostics coupled with analytics services provides the missing piece of the puzzle: a meter-level real-time tamper detection capability that can be acted on with confidence. In short, actionable intelligence. With this we are now getting close to achieving AMI network's primary function, namely to make the entire electricity consumption accountable! 



**Vithal Narasinha Kamat**

Managing Director,  
Baroda Electric  
Meters Ltd.

# Smart Switchgears for Smart Grid

Given their critical role in substation automation, the scope of switchgear is also expected to grow considerably in the near future. Given the government's reform initiatives, the switchgear market is likely to continue on its growth trajectory. ...



The power sector in India has been growing at a healthy pace supported by various policy initiatives by the government. Generation capacity has grown at a rate of over 10 per cent over the past five years, while the transmission and distribution network has witnessed a moderate growth of around 5 per cent. This has translated into a growing

demand for robust power system equipment such as switchgear in the country. Switchgear is a combination of components such as switches, fuses, and circuit breakers that are used to control, protect and isolate an electrical equipment to enable continuous and reliable supply of electricity. The use of switchgear helps in protecting against situations of

overload, short circuit, insulation failure etc. Power system protection is a bough of electrical power engineering and it is designed to continuously monitor the power system to ensure maximum continuity of electrical supply without damaging equipment. Since power system developments change its structure, the power system protection becomes very vital. The design of switchgear has to ensure that it will be able to detect abnormal or undesirable conditions and then trip the circuit to disconnect the affected area without affecting other undesired areas.

The different kinds of switchgears can be classified on the basis of their load bearing capacity (or voltage class), the medium used to interrupt the current, the interrupting rating (which is the maximum short circuit current that the device can safely interrupt), construction type, operating method and type of current. As per the construction type, switchgear is classified as indoor, outdoor, industrial, live-front, dead-front, open, metal-enclosed, metal-clad, arc resistant etc. With regard to the method of operation, switchgear is either manually operated or motor/stored energy operated, or solenoid operated. Meanwhile, depending on the type of current, it operates either on alternating current or direct current.

Switchgear is available in low, medium and high voltage levels. Low voltage switchgear is generally rated up to 1 kV and caters to buildings, the power distribution system and industries. This

segment includes circuit breakers, (moulded case circuit breakers and miniature circuit breakers), switches, high rupturing capacity fuses, residual current devices, contractors and relays. Medium voltage switchgear has ratings 1 kV to 75 kV and includes various types of circuit breakers such as air circuit breakers, minimum oil circuit breakers and vacuum circuit breakers. The high voltage switchgear has ratings above 75 kV and includes SF6 circuit breakers, gas-insulated switchgear, hybrid

switchgear, lighting arresters and composite insulators. In addition, based on the medium used to interrupt the current, switchgear is classified as either a simple open-air isolator switch or it may be insulated by some other material like oil and vacuum.

### Smart Grid Operation

In smart grid operation, automated switchgear operation is preferred over conventional operation. In conventional substations, all signals, controls and interlocks are hardwired and records are manually maintained in a logbook. Therefore, a lot of work and efforts is required to draw comparisons for analysis and trouble shooting. An automated substation, wherein all operations are automated, is more efficient and requires less manpower.

Traditionally, remote terminal units were used in substations as a link between the switchgear and the control centre. Some of these

remote terminal units had intelligence features such as interlocking features, but no substation or region-wide automation was available. However, now more and more remote terminal units are being replaced by or complemented with specialized intelligent electrical devices that are capable of multiple protections and measurements in smart grid operation. In addition, intelligent gateways and concentrators have been introduced in the substation. In

**...a lot of work and efforts is required to draw comparisons for analysis and trouble shooting. An automated substation, wherein all operations are automated, is more efficient and requires less manpower.**

smart grid operations, monitoring and signaling are becoming an integral, in addition to protection & control functions. Manufacturers are including intelligent built-in protection and control electronic devices in the switchgear to enhance grid efficiency and reliability.

### Classification

Historically, air-insulated switchgear has been the most commonly used switchgear in India due to the low price. However, gas-insulated switchgear is now gaining popularity and is emerging as the preferred technology in India, especially, in the transmission segment. Its compact and encapsulated structure makes it ideal for areas with space constraints. This kind of switchgear is also suitable for use in locations with severe weather conditions (high temperature and high altitudes) and in industrial environments.

New developments in the switchgear industry are vacuum switchgear, hybrid switchgear and intelligent switchgear. Vacuum switching through widely used in the medium voltage range, is also emerging as an alternative in HV applications. This trend is being driven by the fact that the vacuum switchgear is more environment friendly than SF6 switchgear. Hybrid switchgear is a combination of conventional air insulated switchgear and high voltage gas insulated switchgear. Some of the high voltage switchgears used in the power sector is as given below:

**New developments in the switchgear industry are vacuum switchgear, hybrid switchgear and intelligent switchgear. Vacuum switching through widely used in the medium voltage range, is also emerging as an alternative in HV applications. This trend is being driven by the fact that the vacuum switchgear is more environment friendly than SF6 switchgear.**

### Gas Insulated Switchgear

Current interruption in a high-voltage circuit breaker is obtained by separating two contacts in a medium such as sulfur hexafluoride (SF6), having excellent dielectric and arc-quenching properties. After contact separation, current is carried through an arc and is interrupted when this arc is cooled by a gas blast of sufficient intensity.

The sulfur hexafluoride gas (SF6) is an electronegative gas and has a strong tendency to absorb free electrons. The contacts of the breaker are opened in a high pressure flow of sulphur hexafluoride gas and an arc is struck between them. The gas captures the conducting free electrons in the arc to form relatively immobile negative ions. This loss of conducting electrons in the arc

quickly builds up enough insulation strength to extinguish the arc. Over time, gas insulated switchgear has gained popularity over regular air or oil insulated high voltage switchgear due its several advantages, including small size, high modularization, safety index, less maintenance, small land coverage, and ability to resist vibration and avoid electromagnetic pollution in the environment. These factors have increased the deployment of switchgear for extra high voltage projects.

Although the cost of a gas insulated switchgear is higher than

a regular switchgear, in a project, when the total cost includes land coverage and construction, the use of gas insulated switchgear proves to be more economical for high voltage and EHV applications. Moreover, with an increase in voltage, the ratio of the total investment required for gas insulated switchgear to that required for regular switchgear decreases. Continuous efforts are also being made to reduce the volume of SF6 gas used per module. Other gas mixtures are also being investigated as a substitute for SF6 gas.

### Vacuum Switchgear

A vacuum circuit breaker is the suitable for mainly medium voltage application circuit breaker where the arc quenching takes place in vacuum. Vacuum switchgear widely used in the medium voltage

range, is emerging as an alternative in high voltage applications as well. This is primarily due to its higher reliability, lower maintenance and faster interruption advantages. Given its higher dielectric strength, low open gap is a key characteristic of the vacuum switchgear. As such it is more compact requires lower mechanism energy and is thus considered more reliable.

This kind of switchgear uses vacuum as the arc quenching medium as vacuum has the highest insulating strength, vacuum switchgear has a much superior arc quenching property than any other medium. Hence, as soon the arc is produced in vacuum, it is extinguished pertaining to the fast recovery of dielectric strength in vacuum.

In recent time, as sensitivity towards environment degradation has increased, the drive towards a reduction in the use of SF6 gas due to its global warming potential has attracted renewed interest as far as the development of vacuum switchgear for transmission circuits (higher voltages) is concerned. Some of the key advantages that the vacuum switchgear offers at transmission voltages are its ability to withstand a much higher rate of rise of recovery voltage than SF6 due to its higher dielectric strength and a smaller contact stroke. Moreover, this type of switchgear has a longer moving mass, owing to which the mechanism energy is much lower in vacuum switchgear as compared to SF6 based switchgear. The lower mechanism energy makes it more reliable and less prone to damage. As such, it tends to have a longer life and requires less maintenance.

Given the various advantages and the fact that the use of vacuum does not have any adverse impact on the environment, the deployment of vacuum switchgear at higher voltages will be inevitable in times to come and further research is under way for its development. However, a few challenges pertaining to capacitor switching, continuous current performance, voltage sharing, voltage sharing during series connection, mechanical design, and testing related issues still need to be addressed before vacuum switchgear can be successfully deployed at higher voltages.

#### Intelligent Switchgear

The increased use of supervisory control and data acquisition has resulted in a growth in demand for intelligent switchgear. Switchgear manufacturers are now including built-in protection and control intelligent electronic devices in their switchgear solutions. These new intelligent electronic devices combined with the latest information and communication technologies from a base for enhance protection, control and monitoring. Intelligent switchgear will significantly enhance the efficiency and reliability of a grid and help utilities avoid blackouts and equipment failure. This switchgear overcomes the disadvantages of electric switchgear by utilizing internal computer technology. It can also perform functions like system diagnosis, electric power fire predictions and electric power demand predictions.

#### Hybrid Switchgear

Hybrid switchgear is a combination of conventional air

insulated switchgear and high voltage gas insulated switchgear, and is primarily used in the renovation and extension of substations along with AIS switchgear. The distinguishing feature of this type of switchgear is its compact and modular design, which allows for several functions in one module. The modular design allows for a large variety of different layout configurations. Modernization also helps in bringing about space, time and cost savings. Compact hybrid switchgear assemblies reduce space requirements by more than 50 percent as compared to the conventional open-type switchgear. Moreover, as compared to AIS and GIS, hybrid switchgear can be erected and installed faster. The use of standard components also decreases the chance of design faults.

Further, due to the use of SF6 gas for encapsulation, the maintenance of hybrid switchgear is simple and is not required to be undertaken very frequently. The use of SF6 gas also increases the operational reliability of this kind of switchgear and makes it safe to use even in very demanding environmental conditions like polluted environments and extreme climates.

#### Way Forward

Researchers are constantly trying to develop different kinds of switchgear suitable for smart grid operation and that is more compact, reliable, environment friendly and requires minimum installation and commissioning time. Moreover, as the pace of renewable energy integration increases and there is widespread

adoption of smart grid technologies, utilities would be required to increase the deployment of intelligent switchgear or to undertake modifications to transform the existing switchgear modules into smart switchgear as the availability of real-time data is critical. In times to come, space challenges are also bound to get more acute. Hence, going ahead, switchgear equipment manufacturers need to undertake innovations and more towards smaller but smarter switchgear.

#### Conclusion

With the arrival of smart grids, substation automation is expected to expand significantly, providing increased control of relays, capacitor banks, voltage regulators and feeders. Given their critical role in substation automation, the scope of switchgear is also expected to grow considerably in the near future. Given the government's reform initiatives, the switchgear market is likely to continue on its growth trajectory. The expansion of key industries and infrastructure sectors like telecom, railways, airports and ports, and the increases emphasis on the development of smart grids and grid automation are likely to support the switchgear market. 📧

(Source: IEEMA)



**Ashok Upadhyay**

Dy. Director  
(Generation)  
M.P. Electricity  
Regulatory  
Commission Bhopal (MP)

# Challenges for IoT-based Smart Grid

As a result of the smart grid evolution, some recent enabling technologies have emerged to reduce the number of communication protocols and handle big amounts of data. The Internet of Things (IoT) is one of the most recent enabler for the smart grid...



The smart grid is the integration of the 20<sup>th</sup> century traditional electrical power grid with the most recent 21<sup>st</sup> telecommunication and information technologies. Such integration enables efficient resource utilization to optimize energy consumption, install and manage distributed energy sources, as well as to exchange the generated power. In other words, the power flow and communications will be in two-ways. Many utility companies around the globe started to install renewable energy

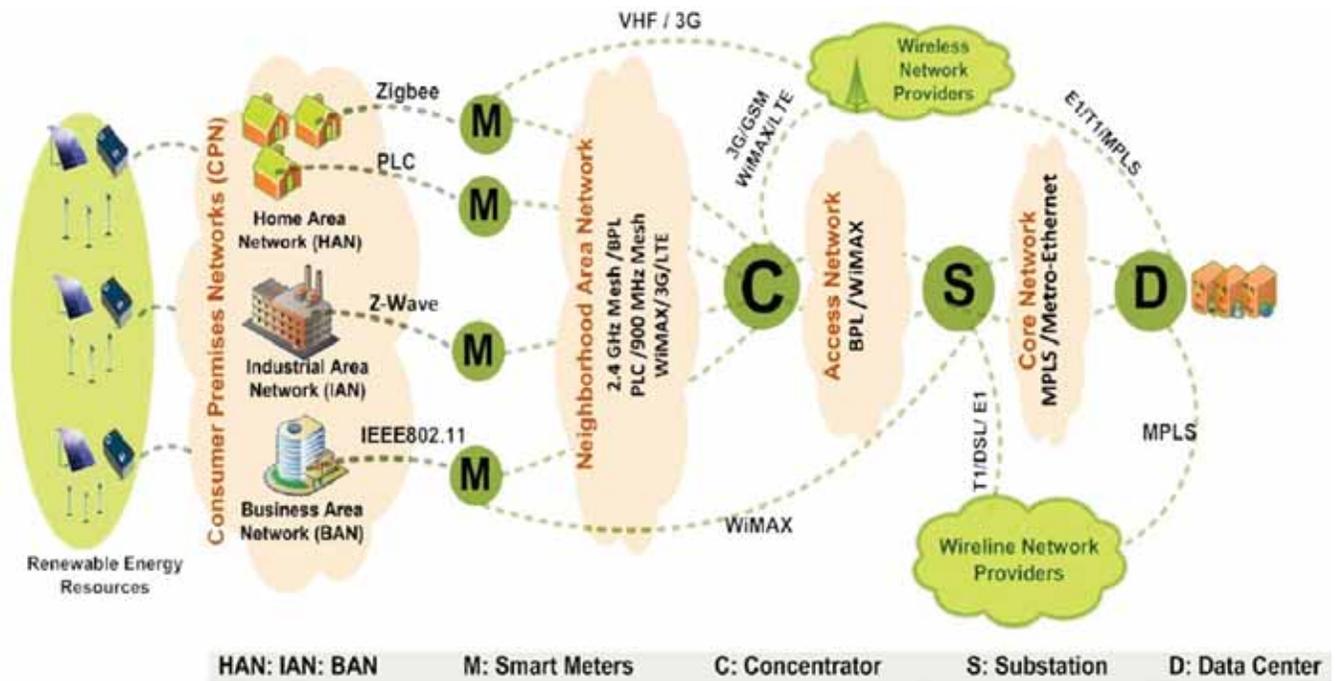


Figure 1: Smart grid communications protocols.

sources such as solar and wind energy nearby the consumption sites. Also, residential home owners started to install smart home appliances and renewable energy resources in their premises to generate and consume electrical power efficiently.

As the smart grid concepts emerged as a fast growing research and development topic in the last few years, the National Institute of Standards and Technology (NIST) developed a conceptual model for the smart grid to set the stage for a better understanding to the smart grid technology. The NIST conceptual model consists of seven domains, namely bulk generations, transmissions, distributions, consumers, markets, operations and service providers. Smart grid users communicate in two-way directions by utilizing several wireless and wired communication protocols such as Zigbee, WiFi, Homeplug, power line carrier, GPRS, WiMax, LET,

Lease line, and Fibers. Several software packages were updated and many are being developed to accommodate the new grid operation, maintenance and management such as, distribution management system (DMS), geographic information systems (GIS), outage management systems (OMS), customer information systems (CIS), and supervisory control and data acquisition system (SCADA).

As a result of the smart grid evolution, some recent enabling technologies have emerged to reduce the number of communication protocols and handle big amounts of data. The Internet of Things (IoT) is one the most recent enabler for the smart grid.

Internet of Things (IoT) is a recent new concept, on which Internet evolves from connecting machines and peoples towards connecting (smart) objects/things. Thus, we can say that IoT communications is the evolution

of M2M communications. According to Cisco, by 2020 there will be over 50 billion connected objects against a population of 7 billion. An object can be anything/device/entity equipped/embedded with computation, storage and communication capabilities with different capacities (sensor, actuator, mobile phone, desktop, laptop, printer, car, fridge, oven, etc). While smart objects are already connected through proprietary non-IP solutions in different applications (Zigbee, HART/ Wireless HART, Z-Wave, etc.) and at a small scale, IoT aims at connecting the objects at a large scale using IP-based solutions (IP, TCP/UDP, etc.), directly or through gateways if IP support is not possible, while allowing them to interact with any other communicating party on/over the Internet.

The Smart Grid (SG), the intelligent power grid, could be seen as the largest instantiation of

**Table 1: Smart grid applications bandwidth and latency requirements.**

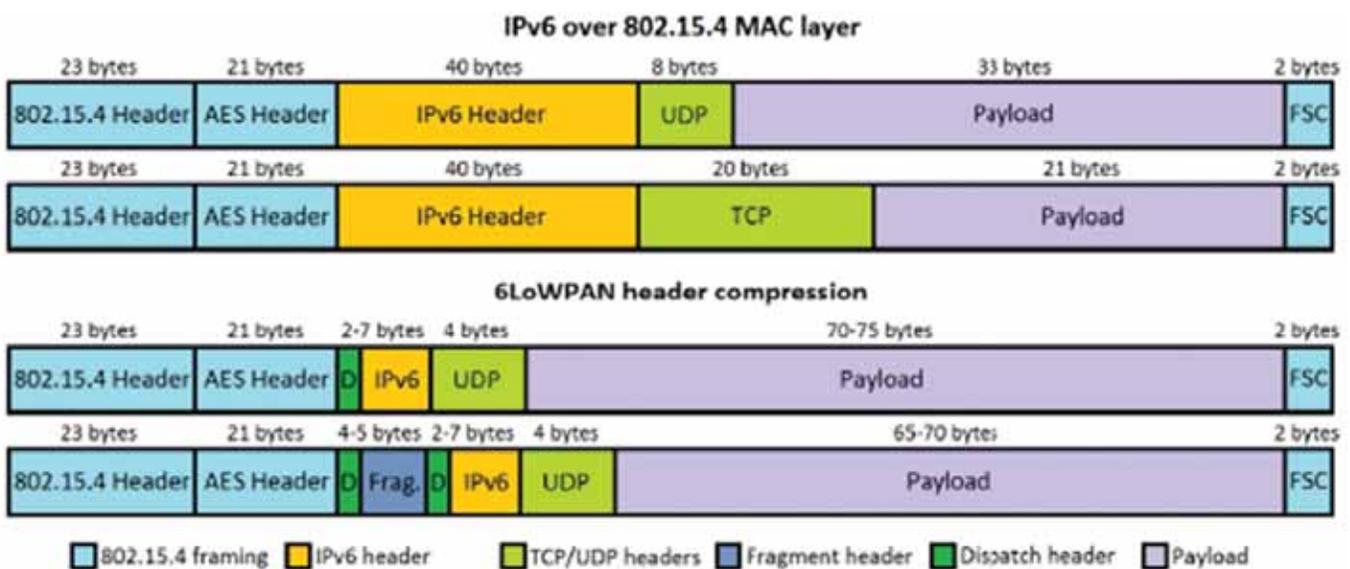
Smart Grid Application	Bandwidth	Latency
Substation Automation	9.6 – 56 kbps	12 - 200 ms
WASA	600 – 1500 kbps	15 – 200 ms
Outage Management	56 kbps	2000 ms
Distribution Automation	9.6 – 100 kbps	100 ms -2 sec
Distributed Energy Resources	9.6 – 56 kbps	100 ms -2 sec
Smart Meter Reading	10-100 kbps/meter 500 kbps/concentrator	2000 ms
Demand Response	14 – 100 kbps	500 ms-min
Demand Side Management	14 – 100 kbps	500 ms-min
Assets Management	56 kbps	2000 ms

the IoT network in the next future. The whole power grid chain, from the energy power plant generation to the final electricity consumers (houses, building, factories, public lightning, electric vehicles, smart appliances, etc.), including transmission and distribution power networks, will be filled with intelligence and two-way communication capabilities to monitor and control the power grid anywhere, at a fine granularity and a high accuracy. For instance, smart houses, will be equipped with smart meters and smart

appliances, whereas power generators and electric transmission and distribution networks will be equipped with various sensors and actuators. The aim of the SG is to keep a real-time balance between energy generation and consumption, by allowing a fine-grained monitoring and control over the power chain, thanks to the huge number of the two-way communicating smart objects (smart meters, smart appliances, sensors, actuators, etc.)

While the use of IoT is very

prominent in the context of the SG, it could also lead to disasters. Indeed, as a critical infrastructure, the SG will now be more attractive to cyber-attacks, since its monitoring and control could be done over standard internet-based protocols and solutions, and may rely on public communication infrastructure. As a consequence, an attacker could cause financial losses to the utility and make damage to the electric assets by breaking the real-time balance between energy consumption/production, through manipulating



**Figure 2: 6LoWPAN frame structure for smart grid applications.**

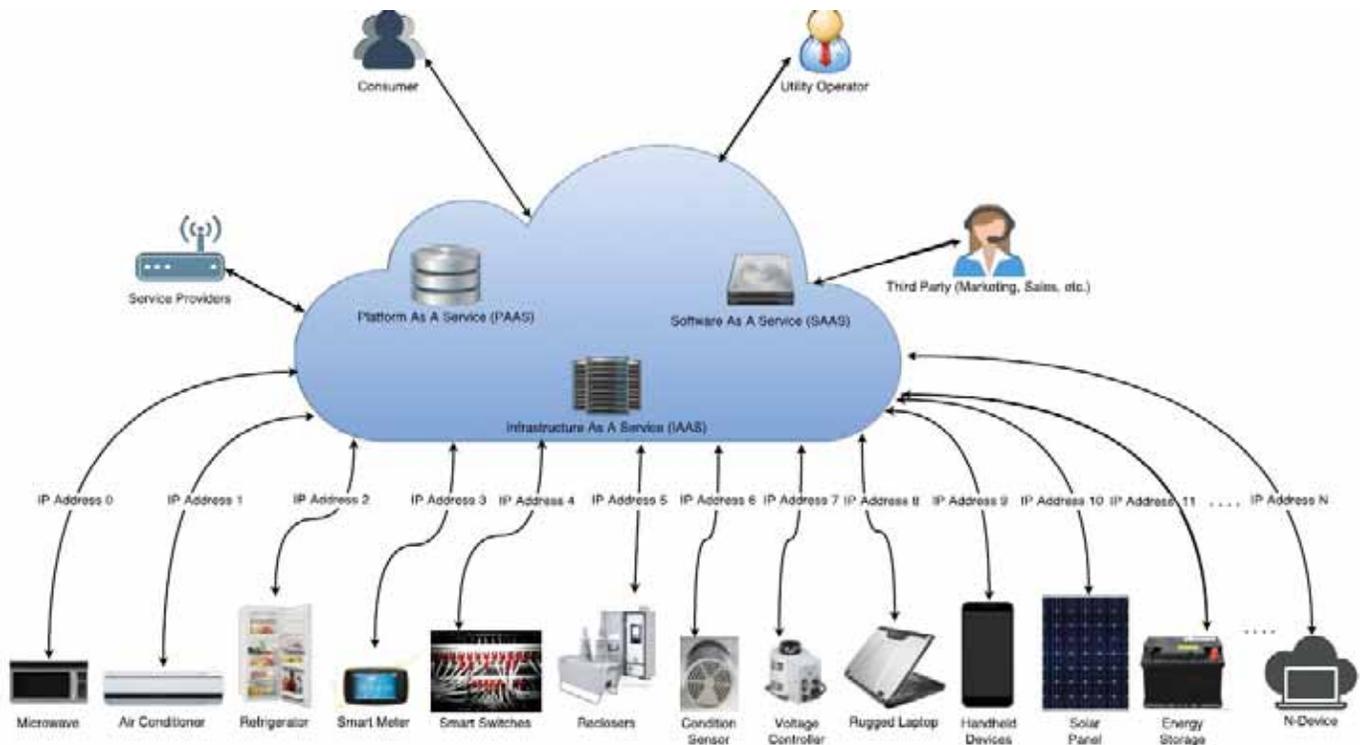


Figure 3: 6LoWPAN frame structure for smart grid applications

data generated by the smart objects or sent from the utility.

### Smart Grid Communication Protocols

Smart grid communications are based on wireless and wired networks technologies. Regardless of the technology, these networks can be classified based on their functionality within the smart grid. These classifications, as reported in the literature, are: home area network, neighborhood area network, access network, backhaul network, core and external networks. These networks connect many smart grid objects such as home appliances, smart meters, switches, reclosers, capacitors bank, integrated electronic devices (IEDs), transformer, relays, actuators, access points, concentrators, routers, computers, printers, scanners, cameras, field

testing devices, and other devices. All these appliances and devices are geographically distributed throughout the grid, starting from residential units to substations and up to utility data and command centers.

As mentioned in the introduction, each device can access and exchange data via different communication protocols. Figure 1 shows the smart grid communications protocols layers. The bandwidth and latency requirements for the smart grid appliances and devices vary from few msec to several minutes and from few kbps to few hundred kbps as shown in Table 1.

### IoT Smart Grid Conceptual Model

As mentioned in the previous sections, smart homes have several appliances and some form

of renewable energy resources. These appliances and resources can be considered as IoT technologies. Each can upload and download data and commands from utilities and home owners. In addition, the grid at large has many devices that can be considered as IoT objects such as reclosers, switches, capacitor banks, transformers, IEDs, smart sensors, and actuators in the substations. In general, smart grids for large cities or countries may have millions of home appliances and thousands of grid devices.

This research proposes that each one of the appliances and devices can have a unique IP address. For example, a dishwasher has a unique IP address a transformer's IP address. This requires the smart grid to have a large number of IP addresses. This is not an issue as the IPV4 is

extending from 32-bits to 128-bits address size IP addresses. The IPV4 can address up to 232 devices (4-billion unique addresses). Moreover, IPV6 can address up to 2128 (Trillions of unique addresses).

One outcome of such addressing schema is the 6Low PAN communication protocol. It embarks on top of IPV6 and is designed to be used over the IEEE 802.15.4 standard. The 6LowPAN frame sized is limited to 127 bytes including a payload of 21 bytes for TCP and 33 bytes for UDP. With some techniques, the payload may increase to 65 - 75 bytes. This is adequate for the smart grid appliances and devices monitoring and controlling applications. This protocol is the backbone of the IoT communication media.

To model the smart grid within the IoT context, smart home appliances, renewable energy resources, substation devices and workforce tools will be assigned IPV6 address as follows:

## 1. Smart home appliances:

Recent smart homes are equipped with smart appliances and each appliance is considered as a thing (object). These things can be an air-conditioner, water-heater, dishwasher, refrigerator, smart energy/gas/water meters, in-home-display, automated lights, solar energy cell, wind mill, electrical rechargeable vehicle, and storage battery [9]-[11]. In the proposed model a unique IP address is assigned to each appliance and device. Each appliance or device can be accessed through the internet by an authorized personnel such as a utility's operator or homeowner.

The appliance status can be transmitted (uploaded) or control command to be received (downloaded). The exchange data and control commands utilize the payload portion of the 6LowPAN frame as shown in Figure 2.

## 2. Substations devices:

The power substation has many devices (things) such as transformers, breakers, switches, reclosers, meters, relays, IEDs, capacitor banks, voltage regulators, cameras, and several other things. Similarly to smart homes, each device (thing) in the substation is considered as an object and is assigned a unique IP address. Each object (thing) can transmit its status and receive control commands from the utility authorized operator via the Internet. The payload is few bytes and can be accommodated using the 6LowPAN protocol as shown in Figure 3.

## 3. Distributed renewable energy resources:

The distributed renewable energy resources are one of the major smart grid enablers that can be installed around the residential neighborhoods, distributed transformers and substations. It supplements power sources that can be installed quickly to be used during the peak hours, as well as on other times of the day when is needed. Each one of these source can supply power to operate, monitor and control. An IP address can be assigned to each appliance and device. The payload size and other related 6LowPAN frames are shown in Figure 2.

## 4. Mobile workforce tools and devices:

To operate the grid efficiently, a mobile workforce should be on the

move 24 hours a day, 7 days a week to fix issues related to residential power outages, feeders, transformers, meters, power lines, and other related issues. The workforce operators are equipped with rugged laptop, smart meters, mobile phone, and cameras. Each of these devices is assigned an IP address and can be accessed as in the above mentioned devices and appliances in Sections 1 - 3.

## 5. Utility data and control center infrastructure:

This center has many applications and database services such as, distribution management system (DMS), geographic information systems (GIS), outage management systems (OMS), customer information systems (CIS), and supervisory control and data acquisition system (SCADA). Each service has its own IP address.

## 6. Echo systems:

The echo systems could be external power server providers, marketing and third parties power providers. Each of which should have point of access through an IP address.

Figure 3 depicts the above mentioned proposed conceptual model for the smart grid within the Internet of Things contexts. It mimics and integrates the about appliances and devices in model that is scalable. The proposed conceptual model introduces other challenges in security and handling big data that are beyond the scope of this paper. It is worth mentioning that cloud computing is a paradigm that enables a solution to the smart grid environment requirements related to computational power, storage, and high availability of resources.

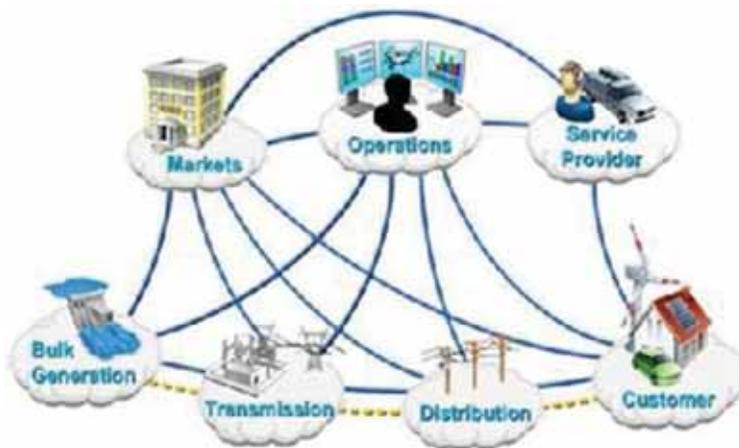


Figure 4: The Smart Grid Conceptual Model

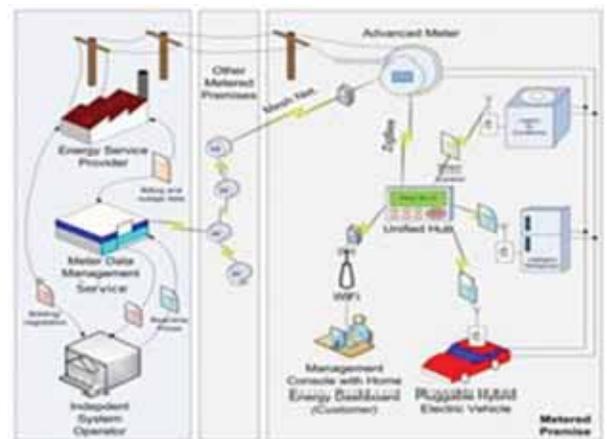


Figure 5: General View of the AMI

## Internet of Things And Smart Grid

### Internet of Things

The term IoT often makes reference to the integration of (resource-constrained) objects, such as sensors, actuators, RFID tags or any device involving a communicating interface and a computing capability, into the Internet. Objects of the physical world (fridge, window, heater, switch, washing-machine, etc.) could now be easily accessible, manageable and communicate through Internet using internet-based protocols (IPv6, UDP/TCP, HTTP, etc.). For the most resource-constrained devices, especially, those compliant with the IEEE 802.15.4 standard, the IETF (Internet Engineering Task Forces), proposed several protocols for their efficient integration and at different layer to the Internet:

- 6LoWPAN: IPv6 over Low Power Wireless Personal Area Networks, an adaptation layer to support the IPv6 protocol on IEEE 802.15.4 networks
- RPL Routing Protocol for Low-Power and Lossy Networks
- CoAP: Constrained Application

Protocol, is a specialized web transfer protocol for use with constrained nodes and constrained networks

Even for those objects that still couldn't support IP natively, or updated to support it (due to extremely resources constraint or other considerations like preserving legacy systems), integration to the global Internet network is still possible through gateways, where proprietary non-IP stack protocols (Zigbee v1, HART, Z-Wave, etc.), are translated to/from IP stack protocols, but at a highly cost and without achieving end-to-end communication.

### Smart Grid

The SG can be seen, in its simple form, as the classical power grid augmented with the massive use of ICT technologies (software, hardware, networks), in addition to the integration of distributed renewable energy generation and storage capacities. As seen in Figure 4, in the SG there are two flows:

- Electric flow (dashed line) from the plant generation to the end customer, which is the main flow of the classical power grid. However, in the vision of the

SG, the electric flow could be bidirectional, where the end-customer will buy and could also sell energy.

- Information flow (regular lines): A large-scale two-way communication flow between the different shareholder and components of the SG. Most of the communication flow is due to the massive use of sensors/actuators and other smart objects alongside the transmission and distribution areas, in addition to the use of smart meters and other smart objects (smart appliances, electric vehicles, etc.) at the end-customer side.

The SG involves, amongst others, two key elements, which are Smart Meters and Advanced Metering Infrastructure:

- Smart/Advanced meters (SMs), equip houses, factories, institutions, etc. (see Figure 5). They record energy consumption data and other information for billing or management purposes. They can report data periodically, upon request or in response to some events to the utility and also respond to requests from

the utility (e.g., software update, real-time pricing, load shedding, energy cut-off, etc.), thanks to their two-way communication capability. They may optionally play the role of local energy management system, by controlling or managing the energy consumption of the smart devices on the house (fridge, oven, air-conditioner, electric cars, etc.)

- **Advanced Metering Infrastructure (AMI)**, as shown in Figure 5, is responsible for collecting, analysing, storing and providing the metering data sent by the SMs to the appropriate authorized parties (e.g., energy provider, utility, SG's operator, Meter Data Management Service, etc), so they can proceed them (billing, outage management, demand forecasting, etc). The AMI is also responsible for transmitting requests, commands, pricing-information and software updates from the authorized parties to the SMs.

### IoT-based SG

Compared to classical power grid, the SG highly integrates ICT on the whole energy chain (from producers to end-consumers), through the large-scale deployment of different kind of sensing, actuating and other embedded devices, in addition to the use of smart meters, smart appliances and e-cars, all of them sharing the capacities of computing and communication.

What has made Internet universally popular is the use of standard communication protocols, mainly the TCP/IP stack. Any two computers situated anywhere in the world, could easily

have an end-to-end communication, regardless their access technology. IoT extends the reachability of Internet to reach, through standardized communication protocols (or a gateway in the extreme case), everything that could communicate and be individually addressed. This copes with the huge number of devices/objects deployed on the SG and the crucial need of near-real time communication with them through unified standard-based communication protocols (based on the TCP/IP stack), rather than proprietary solutions (Zigbee v1, (W)HART, Z-Wave, etc.).

Assuming that the SG of a country involves 20 million smart meters, in addition to 40 million sensors and actuators deployed to monitor the whole power grid infrastructure. For the SG's operator, it will be interesting to remotely manage and configure the smart meters and the sensors/actuators— regardless their manufacturer- in addition to get information on the last mile grid's status. For the energy providers, it will be interesting to get remotely energy consumption from SMs in-order to accurately bill the customers, in addition to detect attempts of tampering with the SMs (ex, energy theft). For the end-user, it will be also interesting to get up-to date prices (assuming dynamic pricing), to well manage its consumption, in addition to get early alerts about planned disconnection. Obviously, all these bidirectional end-to-end interactions and communications, will highly benefit from IP based communication protocols (unless it is impossible or not appropriate), and even public communication

infrastructures to make them easily scalable and to make induced costs lower.

## IoT-based Smart Grid's Security Issues and Challenges

The added ICT dimension to the classical power grid, introduced new security issues and challenges that were not (or rarely) present on the classical power grid. Those security issues and challenges could hamper the rapid deployment and adoption by end-users of the IoT-based SG. Hereafter, we briefly describe the most important security issues and challenges faced on the IoT-based SG.

### Security Issues

As a cyber-physical system, the IoT-based SG will face several security issues:

- **Impersonation/Identity Spoofing**

This attack aims at communicating on behalf of a legitimate thing in an unauthorized way, by making use of its identity. An attacker could spoof the identity of some one's smart meter, in order to make it paying for its energy consumption.

- **Eavesdropping**

Since objects/devices on the IoT-based SG communicate, often using public communication infrastructure, an attacker can easily have access to their exchanged data. An attacker can easily know the energy consumption of households

- **Data tampering**

An attacker can modify exchanged data, such as dynamic prices sent prior to peak periods, making them lowest prices. As a

consequence, this could make households increasing their consumption (charging e-cars, etc.) instead of reducing them, thus, resulting in overloaded power network.

- **Authorization and Control Access issues**

Since several devices could be monitored and configured remotely, such as smart meters, or field deployed sensors and actuators in distribution substations, an attacker or even an angry employee, could try to gain an unauthorized access rights, to manipulate them, thus damaging physical assets (ex, transformers) or leading to power outages.

- **Privacy issue**

Smart meters and smart appliances in residential houses,

could tell more than the energy consumption. Their generated fine-grained data could harm the privacy of the end-user, by divulging information about their habits (wake up, sleeping and dinner times, etc.), if they are in or away from house, if they are on vacation, etc.

- **Compromising and Malicious code**

Since objects of the SG are computation and communication enabled, they are target to compromising physically or remotely. Moreover, since they run different kind of software, they could be target of different kinds of software infection or malicious code infection in-order to control and manipulate them (ex, targeting smart meters, or smart appliances

in households). Moreover, massively deployed objects with constrained devices (sensors, etc.) are usually non-tamper-resistant devices, making physical compromising an easy task

- **Availability and DoS issues**

In the classical power grid, it was difficult, if not impossible, to target the availability of assets (electricity meters, substations, etc.), especially, at a large scale. In the SG, ICT will be integrated even in the vital assets of the power grid, thus making it possible to target them, making them partially or totally unavailable resulting on DoS attack. Moreover, assuming that most devices/things are IP-enabled and do not run proprietary protocols stacks, the task of a familiar Internet attacker

# INTELLIGENT GENERATOR CONTROL.

## DSE45XX MKII

Auto Start/Auto Mains (Utility) Failure Control Modules

- Comprehensive warning, electrical trip or shutdown protection upon fault condition
- Generator/load power monitoring (kW, kV A, kV Ar, pf)
- User-friendly set-up and button layout for ease of use
- Flexible Remote Communications
- Generator overload protection (kW)
- 3 engine maintenance alarms
- Comprehensive Event Logging (50)
- Advanced J1939 CAN



**Deep Sea Electronics India Pvt LTD**  
D-47, Udyog Vihar Phase V  
Gurgaon, 122016, India  
Ph - +91-124-4817080

[www.deepseapl.com](http://www.deepseapl.com)

will be easier.

- **Cyber-attack**

The SG could be seen as the largest Cyber-Physical-System (CPS)<sup>6</sup>, involving Physical systems representing the physical assets of the SG (transformers, circuit breakers, smart meters, cables, etc.) and ICT systems, where ICT elements control/manage physical entities. Now, a Cyber-attack could harm the physical assets - as was the case with the Stuxnet attack -, which was difficult in the classical power grid.

### Security Challenges

When dealing with security algorithms, protocols and policies for the IoT-based SG, several challenges need to be taken into consideration:

- **Scalability**

The SG could span over large areas (several cities or the entire country), and involves a large number of smart devices and objects. This will make it difficult to conceive scalable security solutions, such as key management and authentication<sup>5</sup>.

- **Mobility**

With mobile devices/objects, such as e-cars and on-the field technical agents, there will be a continuous need for authentication and secure communication with a changing surrounding (smart meters, electric charging stations, etc.).

- **Deployment**

Since the SG could span to the entire country, objects/devices are deployed at a large scale, work unattended, and could be placed on remote places with no physical perimeter protection, making them easily accessible. Security solutions should be able to detect

any attempt to tamper with them.

- **Legacy systems**

Already deployed systems and devices, could have a little or no support for security, since they were based mostly on proprietary solutions (hardware and software), deployed on isolated islands with no communication, or through private communication infrastructure. Integrating those legacy systems to the IoT-based SG is a real challenge, since in most cases there is no way to replace them with new systems, or update them so they can support the desired security solutions.

- **Constrained Resources**

Several devices/objects of the SG, especially, those massively deployed are resource constrained. Special care need to be taken when developing security solutions, to be sure that their limited resources could accommodate the solutions. This make applying classical security solutions, especially, those based on public-key cryptography or on PKI, a challenge.

- **Heterogeneity**

Due to the discrepancy on the resources of the devices/objects on the SG (memory, computation, bandwidth, energy autonomy, time-sensitivity, etc.), and their implemented protocols and communication stacks (for non IP-based devices) achieving secure end-to-end communications is a challenging task, requiring the most often adaptation of existing solutions or even using gateways.

- **Interoperability**

It could be seen as one of the consequences of protocols and communication stacks heterogeneity, between devices/objects in the SG. Legacy system

and devices/objects that couldn't support TCP/IP stack (ex, Zigbee v1, HART) couldn't communicate with IP-based systems and devices or objects, unless through gateways, making end-to-end secure communication impossible. Interoperability could also be seen between two devices implementing the same protocols and communication stacks, but different feature capabilities: one with fully support, the other with partial support (ex, DTLS with/without certificate support)

- **Bootstrapping**

How to efficiently bootstrap the millions of devices or objects of SG with the necessary initial keying materials (cryptographic keys, cryptographic functions/algorithms and parameters, etc.)?

- **Trust Management**

Objects/devices on the SG could be managed by different entities (end-users for smart appliances, SG's operator for smart meters and sensors, etc). Objects/devices couldn't communicate if a minimal trust level isn't established. While objects or devices owned or managed by the same entity could easily establish a trust relationship, building trust between objects or devices owned or managed by different entities is a challenge, especially in such large-scale network.

- **Latency or Time Constraint**

Some parts of the SG need to respond on a real-time basis to events and messages. For instance, electric SCADA (Supervisory Control and Data Acquisition) system, used on transmission and distribution sub-stations, must respond on a real-time basis to any variation on current, voltage

or frequency values of the electricity in addition to other meteorological parameters influencing equipment's functioning all provided by different kind of smart objects (sensors, actuators, etc. etc.), in order to keep the assets safe and prevent the propagation of anomalies (power overload or outage) to other parts of the power grid. This makes time-consuming operations (i.e. public-key operations) not suitable.

## Security Services for IoT-Based Smart Grid

Hereafter, we briefly list the major security services that should be considered for the IoT-based SG:

- **Authentication**

The capability to check/ensure the identity of any communicating device/object/ in the SG. For instance, the energy provider needs to authenticate each smart meter, in order to bill the corresponding user.

- **Data Integrity**

Ensures that (received) data were not modified in an unauthorized way. For instance, smart meters need to ensure the integrity of a software update, in addition, to source origin.

- **Confidentiality**

Ensures that data (stored or transmitted) is accessible only to the intended recipients. For instance, end-users' consumption need to be known by the SG's operator and the energy provider only.

- **User's Privacy**

Guarantees that any data related to the user (energy consumer end-user) – brut, inferred or computed data- could not be obtained without its explicit approval, and will be used only for the intended purposes. For instance, energy consumption data used for billing purpose couldn't be used for other purposes

- **Authorization and Control Access**

Guarantees that an authenticated object or person, is authorized to accomplish some tasks, or has been granted the necessary rights to access some resources. For Instance, an on-the field agent needs authorization and access control rights, to perform manual configuration on a smart meter.

Internet of Things, is the next step towards a globally and pervasive connection to any communication and computation enabled objects or devices, regardless their access technology, available resources and location. The Smart Grid can highly

benefits from the IoT vision, where smart objects/ devices are deployed alongside the energy path, from the generation plant to the end-customer. However, security is the main concern for the IoT, and the large-scale adoption and deployment of the SG.

In this paper, we briefly reviewed the main security issues and challenges for the SG, and dressed the major required security services. In the future, we will study on-depth the security of a key-element of the SG, which is the AMI, where we focus on how we can securely integrate energy aware smart home, equipped with smart meters and smart appliances, in the SG, so that end customer could actively and securely participate in the energy consumption or production equilibrium.



**Dr L Ashok Kumar**

Professor, Dept. of Electrical & Electronics Engineering  
PSG College of Technology, Coimbatore, Tamil Nadu

## A Solid Future Built On Our Strong Legacy



For a century, Hammond Power Solutions (HPS) has been an innovative leader in the magnetics industry.

HPS excels at designing and manufacturing a broad range of standard products and engineered-to-order solutions to meet many demanding applications.

Our extensive and durable line of Oil Filled, Cast Resin and VPI transformers and reactors provide a complete magnetic solution.

HPS has product designs that meet a wide range of global standards and regulatory compliance (IEC, BIS, CSA, UL, IEEE, GOST, DNV, RINA).

With multiple manufacturing facilities located throughout Asia, Europe, and North America, we are able to service your global needs.

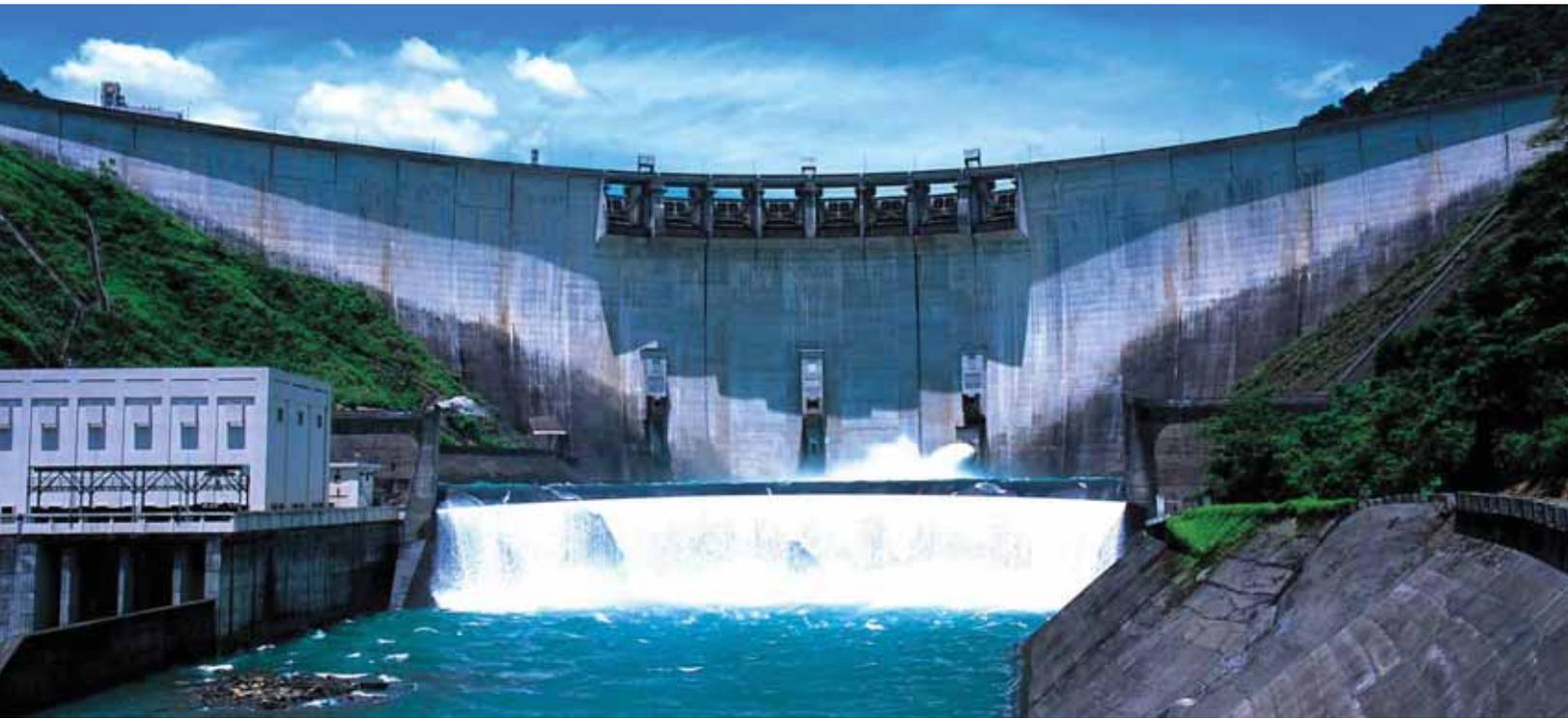


power to perform



# Vast Potential for Development

India has vast potential for hydro power development. A major part of the unexploited potential exists in Himalayan and North Eastern regions. The hydro sector inherently poses few challenges primarily on account of risk associated with implementation that can be mitigated...



www.electricalindia.in

India is the 7<sup>th</sup> largest producer of hydroelectric power in the world. As of 30 April 2017, India's installed utility-scale hydroelectric capacity was 44,594 MW, or 13.5% of its total utility power generation capacity.

Additional smaller hydroelectric power units with a total capacity of 4,380 MW (1.3% of its total utility power generation capacity) have been installed. India's hydroelectric power potential is estimated at 84,000 MW at 60% load factor. In

## Installed Power Station Capacity in India as of June 30, 2016

Sector	Thermal (MW)				Nuclear (MW)	Renewable (MW)			Total (MW)
	Coal	Gas	Diesel	Sub-Total Thermal		Hydro	Other Renewable	Sub-Total Renewable	
Central	54,335.00	7,490.83	0.00	61,825.83	6,780.00	11,651.42	0.00	11,651.42	80,257.25
State	64,685.50	7,257.95	363.93	72,307.38	0.00	29,683.00	1,976.90	31,659.90	103,967.28
Private	73,142.38	10,580.60	473.70	84,196.68	0.00	3,144.00	48,041.10	51,185.10	135,381.78
All India	192,168.88	25,329.38	837.63	218,329.88	6,780.00	44,478.42	50,018.00	94,496.42	319,606.30
Percentage	60.13	7.95	0.26	68.31	2.12	13.92	15.65	29.57	100

the fiscal year 2016-17, the total hydroelectric power generated in India was 122.31 TWh (excluding small hydro) with an average capacity factor of 33%.

The first Hydro Power Station (HPS) implemented in India was Sidrapong one in Darjeeling (West Bengal) completed in 1897 and is still in operation. Hydropower technology is well-proven with efficiency rates which could go up to 90% depending on the design power. The depreciated Hydro Power Stations i.e. Pong on Beas River and Bhakra on Satluj River are currently selling power @ 18 and 28 paise/unit respectively. However, the advantages of longevity and cost of generation doesn't reflect in trends in India's energy mix. Hydro, with an installed capacity of 44,478 MW, has a share of around 14% in 2016 coming down from 46% in 1966. This clearly indicates that there is an over-dependence on thermal plants vis-à-vis hydro assets.

### Hydroelectric Potential

The plummeting share of hydro in the overall power portfolio is primarily attributable to the consistent non-achievement of targets. Out of 10,897 MW of target capacity addition as per 12<sup>th</sup> Plan, only 3,811 MW has been achieved, which indicates that only one-third of the target was achieved during

the first two-thirds of the period. The same trend was observed in the previous 11<sup>th</sup> Plan wherein only 40% of the target was met.

### Challenges

As per the Central Electricity Authority Assessment (CEAA), the economically exploitable hydro power potential in terms of installed capacity as 148,701 MW, out of which 145,320 MW is from schemes having capacity above 25 MW. As on March 2016, the hydroelectric schemes in operation account for only 31% and thus, the bulk of the potential (69% including the projects that are under development) remains to be developed. Globally, countries like Canada and Brazil had harnessed around 48-69% of the economically feasible potential back in 2009.

The Government has taken many initiatives for sustainable hydro-power development. In 2008, the government came out with a hydro policy with an objective to achieve the implementation of these projects. The center and many states have initiated hydro projects through PPP to attract investors for the development of water resources in an environment-friendly manner and to generate revenue while ensuring project viability. Odisha adopted PPP policy in 2007, Arunachal Pradesh (2011), Uttarakhand (2012) and Andhra

Pradesh & Gujarat had framed PPP policy. Many projects had been allotted under PPP, however, some of these projects have struggled in the past due to several reasons such as R&R issues, land acquisition problems, clearance and approval procedures, capability of developers, etc. These issues resulted in a declining share of hydropower in India's power mix by almost 32% in the last 50 years. For example, in Arunachal Pradesh, out of 120 MoUs (~40 GW) signed in last decade, most of the projects are at a standstill. India added 1824 MW of large hydropower capacity in 2015, most of these projects have a troubled track record in one way or the other that include issues like land acquisition, R&R, and cost escalations.

Due to inherent risks associated with the sector, such as geological surprises, natural calamities, environmental & forest issues, and rehabilitation and resettlement issues apart from commercial risks and change of river basin during operation, many developers are averse to enter into the sector. The major deterrents for the private developers are high capital cost and long payback period due to high gestation period which may also create issues in financing.

### Policy Framework

Though, PPP is most suitable for hydro power projects as it



capacity in Hydro can be implemented within a significantly lower time vis-a-vis what is required for implementation of hydro power project. Further, solar and wind power projects today are comparatively lower capital intensive as compared to hydro. In view of this, until and unless the government promises effective intervention in laggard long-drawn clearance processes and takes responsibility in R&R, land acquisition, evacuation, law & order problems, and other disputes, the investor confidence which as of now has plummeted will not restore.

## Conclusion

India has vast potential for hydro power development. A major part of the unexploited potential exists in Himalayan and North Eastern regions. The hydro sector inherently poses few challenges primarily on account of risk associated with implementation that can be mitigated with timely involvement of government agencies to be made responsible for. The private developers will engage themselves only if they find compatible risk adjusted returns in the hydro sector. Thus, government has now two-fold work of removing the impediments and restoring the investor's interest in the sector and to create an enabling environment. <sup>15</sup>

solves budgetary constraints, ensures faster implementation of projects, and balances project risks, however, without monitoring of implementation, it may lead to disasters like one happened in Shree Maheshwar Hydel in Madhya Pradesh, which is still not operational though project implementation started in 1992. This calls for central government to setup a separate body in partnership with the state governments for active monitoring of the progress of hydro projects and resolve the impediments by directly overseeing issues such as land acquisition, rehabilitation & resettlement of affected people, expediting environment and forest clearances, interstate disputes and law & order issues arise due to these projects.

The other issue related to Hydropower projects is financing and evacuation. Hydro Power

projects are capital-intensive and financing them for long such as 20 years is really a challenge. Further, a number of hydropower projects are located in remote sites in states which do not have enough demand for electricity that presents geographical constraints in developing requisite transmission infrastructure for evacuation.

## Opportunities

Through the private route, only about 3100 MW has been commissioned contributing 7 percent of the total installed hydropower capacity signifying that there is minimal participation of the private sector. Private developers, today seek commensurate returns with respect to risks involved in the sector. The private developers today have avenues to invest in solar power and wind power where technology risk is minimal and these projects with the same



**Jay B Thakar**

(M.Tech in Power System), Business Development Manager, Zodiac Energy Limited

# Lighting Concepts at Lii2018

The Indian Society of Lighting Engineers has great pleasure in presenting the Light India International (Lii) 2018, at Bombay Exhibition Centre, Mumbai, India during 19-21 January 2018...



The Indian Society of Lighting Engineers has great pleasure in presenting the Light India International (Lii) 2018, at Bombay Exhibition Centre, Mumbai, India during 19-21 January 2018. The lighting industry in India is on a globalization drive and is now providing the Indian consumers a variety of lighting products sourced domestically as well as from overseas. In the context of the reduced import duty regime in India, the globalization drive is gaining momentum. The growing living standards in India are finding expressions in the lighting industry in many ways. The country is in the midst of an unprecedented growth especially, in infrastructure. The Light India International 2018 will publicise the developments taking place in the lighting industry and provide excellent marketing opportunities for all the products and services covered by the lighting industry.

## Why exhibit?

- Lii 2018 provides an excellent opportunity to meet target clients on a personal level for effective marketing.
- Lii 2018 is a platform to launch & showcase products to Government bodies, retailers, hoteliers,

architects, project managers, signage specialists, lighting industry professionals , etc.

- Lii 2018 gives the chance to promote brand to an international audience.
- Lii 2018 provides access to important decision makers from the industry and useful market insights found nowhere else. An effective ad campaign during and prior to the event will be run in different media. A well designed directory, comprising comprehensive information about all the participants will be distributed to industry delegations, government officials, OEMs and project officials. The directory would serve the purpose of a buyer's guide / resource directory.

## Who should participate?

- Manufacturers, importers, agents, dealers in lighting industry
- R&D institutions, Testing & Measuring instruments manufacturers
- Government departments, electric utilities, non-conventional energy, transport, housing, industrial development agency.
- NGOs engaged in energy development
- Publishers, Service providers, Lighting consultants & Lighting design software companies

## Opportunity

- Present products and services to potential buyers or dealers or customers.
- Introduce latest technical know-how in lighting industry, energy efficiency and renewable energy
- Launch new products in the midst of media, industry professionals
- Increase brand awareness
- Explore investment opportunities
- Locate partners for joint ventures and tie-ups

# Solar Energy Potential in Bihar

Bihar has about 280 - 300 sunny days in a year. There is negligible solar power development in the state at present. This article analyses the solar power potential in the state for the grid and off-grid projects...



www.electricalindia.in

The radiation emitted by the Sun and received on the Earth are:

1. 9% ultraviolet radiation
2. 41% visible radiation
3. 50% infrared radiation

Approximate wavelength ranges:

1. Ultraviolet : 0.20 - 0.39 microns

2. Visible : 0.39 - 0.78 microns

3. Near-Infrared : 0.78 - 4.00 microns

4. Infrared : 4.00 - 100.00 microns

The global solar radiation reaching the surface of the earth divided into two components: Direct solar radiation and diffuse solar radiation.



Figure 1: Map of Bihar

**Direct Solar Radiation:** The solar radiation that reaches the Earth's surface without being diffused is called direct or beam solar radiation. Atmospheric conditions can reduce direct beam radiation by 10% on clear, dry days and by 100% during thick, cloudy days. Direct solar radiation is measured by Pyrheliometer.

**Diffuse Solar Radiation:** As sunlight passes through the atmosphere, some of it is absorbed, scattered and reflected by the air molecules (Rayleigh scattering), water vapour (Mie Scattering), clouds, dust, pollutants, forest fires and volcanoes. The radiation received on the earth surface after being subjected to scattering in the atmosphere is called diffuse solar radiation. It is measured by shading pyranometer.

**Global Radiation:** The sum of the diffuse and beam radiation is called global solar radiation. The global solar radiation measured by pyranometer. The quantity of solar radiation reaching the Earth's surface at any location on any day is governed by:

1. The solar elevation (at noon).
2. The duration of day.
3. The turbidity of the air.
4. The total amount of water vapour in the air.
5. The type and amount of clouds.

Of all these factors, the first two are exactly calculable and are very important; (3) and (4) cause relatively small variations in the quantity of solar radiation. But by far the largest variations are caused by clouds, particularly, the low and dense clouds. Hence, locations with the lowest cloud cover around the year offer the highest annual potential for power

generation. The altitude of a place also exercises an influence on global, direct and diffuse solar radiation received at the ground.

## Current Status of Solar Projects

1. Current status of the off-grid systems in Bihar (As per world institute of sustainable energy, Pune):

S. No.	System	No.s
1	Solar Lantern	42975
2	Solar Home Lights	5471
3	Solar Street Lights	684
4	Solar Cookers	500

2. Current status of the grid connected power projects (As per world institute of sustainable energy, Pune):

As regards grid connected solar power projects, no solar power project is registered under Solar Mission phase I. The State Investment Promotion Board (SIPB), Bihar has approved 9 solar power projects of cumulative capacity 366 MW, comprising investment of ₹ 5562.72 crore.

## Assessment of Available Potential

### Solar radiation data from different sources

**MNRE:** The solar maps containing monthly and annual Direct Normal Irradiance (DNI) and Global Horizontal Irradiance (GHI) data have been developed from hourly satellite data spanning from January 2002 to December 2008. These maps cover the entire country at 10km x 10km spatial resolution. Solar resource maps and data were developed by the US National Renewable Energy Laboratory (NREL) in cooperation with India's Ministry of New and Renewable Energy, through funding from the US Department of Energy. The data were output as data in geographic information system (GIS) format and as static maps. Solar mapping of the entire country based on satellite imagery and duly validated by ground truth data will provide information of both Direct Normal Irradiance (DNI) and Global Horizontal Irradiance (GHI) on a continuum basis with an approximate accuracy of 15%.

**NASA:** NASA, through its Science Mission Directorate, has long supported satellite systems and research providing data important to the study of climate and climate processes. These data include long-term estimates of meteorological quantities and surface solar energy fluxes. To foster the commercial use of the global solar and meteorological data, NASA supported, and continues to support, the development

**Table 1: Average Annual Global Solar Radiation**

S. No.	Data Source	Global Solar Radiation kWh/m <sup>2</sup>	Direct Solar Radiation kWh/m <sup>2</sup>	Diffuse Solar Radiation kWh/m <sup>2</sup>
1.	MNRE	5.04-5.42	4.09-4.94	---
2.	NASA	4.88-5.27	5.17-6.18	1.59-1.77
3.	METEONORM	4.82-5.21	3.70-4.61	2.18-2.45
4.	IMD (Only 1 site)	4.79	5.19	2.09

of the Surface meteorology and Solar Energy (SSE) dataset that has been formulated specifically for photovoltaic and renewable energy system design needs. In general, meteorology and solar radiation for SSE Release 6.0 were obtained from the NASA Science Mission Directorate's satellite and reanalysis research programs. Parameters based upon the solar and/or meteorology data were derived and validated based on recommendations from partners in the energy industry.

However, the limitation of this data set is that it is only available for discrete locations and not for any specified location. Hence it can only be used for an approximate cross validation of data available from other sources.

**METEONORM:** METEONORM is a software program developed by METEOTEST for the calculation of solar radiation on arbitrarily orientated surfaces at any desired location. The method is based on databases and algorithms coupled according to a predetermined scheme. It commences with the user specifying a particular location for which meteorological data are required, and terminates with the delivery of data of the desired structure and in the required format. Version 6.1 is used to compute solar radiation data for different locations. METEONORM allows a user to create typical year data for any place on Earth. It provides a quick and relatively accurate overlook of weather information. However, the error in interpolating the monthly radiation values was 9%, and for temperature 1.5°C when subjected to extensive tests.

At present there are 45 radiation observatories recording various radiation parameters. At all these stations, measurement of global solar radiation is being carried out while at a few selected stations other parameters like diffuse, direct, net, net-terrestrial, reflected radiation and atmospheric turbidity are also measured. The primary objective of the observational programme is to have an

understanding of basic physical processes involved in the conversion of the Sun's radiant energy into atmospheric motions as also into chemical and biochemical energy. The observations made at national network of radiation stations are useful in the assessment of solar energy potential in different parts of the country. Data available for global and diffuse radiation is from year 1957 to 2003 and for direct radiation from 1985 to 2001. However, this data set is primarily collected for other purposes related to meteorological forecasting, agriculture, irrigation, shipping, aviation, offshore oil explorations etc and may not be adequate for basing decisions related to solar power generation. In the state of Bihar there is only one weather station at Patna for monitoring solar radiation along with other weather related physical parameters.

### Radiation Analysis

Different data sources given different range of solar radiation. Annual average solar radiation in Bihar state is given in table 1 (As per world institute of sustainable energy, Pune)

From the Table 1, we can conclude that, average annual global solar radiation comes in the range of 4.79 – 5.42 kWh/sq.m. Direct and diffuse solar radiation obtained in the range of 3.70 – 6.18 kWh/sq.m and 1.59-2.44 kWh/sq.m respectively. The MNRE solar map also shows that Bihar state, unlike North-Western parts of the country, falls in moderate solar radiation zone of India.

The availability of average annual global radiation in the state is sufficient for development of Solar PV power projects. E



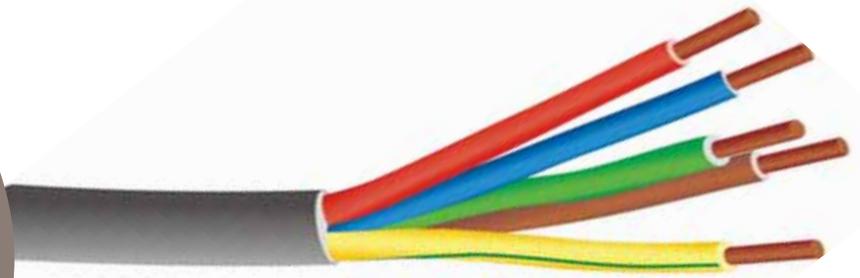
**Saurabh Mishra**

Assistant Professor  
Electrical Engineering Department  
Delhi Technological University

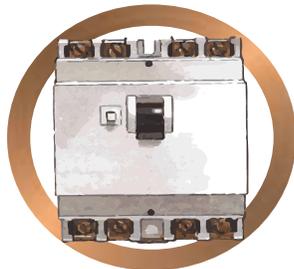
# COPPER IS ESSENTIAL FOR ELECTRICAL INSTALLATIONS



Its unique properties make the most secure, efficient and durable installations.



Copper wires and cables are capable of significantly reducing energy losses, thus contributing to low CO2 emissions.



Electrical conductors are manufactured with high-purity electrolytic copper (99.99%), which ensures major conductivity.

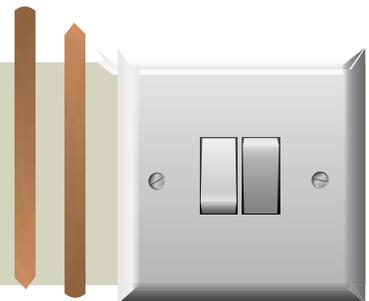
Copper is able to transmit quality energy at low loss rate.



Copper is highly resistant to deformation and corrosion, by prolonging both the useful life and safety of products used in electrical installations.



Currently copper is present in many devices such as circuit breakers, fuses, grounding rods, rails, switches and sockets.



## COPPER. MAKES THE WORLD WORK BETTER



International Copper  
Association India  
Copper Alliance

# Power Scenario in Haryana

Haryana power establishments have been a forerunner in terms of growth in comparison to national capacity creation. On the one hand, state boasts to have surplus electricity which is distributed by two state-owned power utilities...



Haryana is the 20<sup>th</sup> largest state with an area 44,212 km<sup>2</sup> and the 17<sup>th</sup> largest by population (as per census 2011) with total population of 25,351,462 (13,494,734 male and 11,856,728 female). It is bordered by Punjab and Himachal Pradesh to its north

and by Rajasthan to the west and south. It also borders with country's capital Delhi on three sides north, west & south.

Haryana power establishments have been a forerunner in terms of growth in comparison to national capacity creation. On the one

**Table 1: Installed Generation Capacity, Power Availability, Power Sold in the State**

Year	Installed Generation Capacity* (MW)	Total Installed Capacity (MW)	Power Available (lakh KWH)	Power Sold (lakh KWH)
1970-71	29	486	12460	9030.00
1980-81	1074	1174	41480	33910.00
1990-91	1757	2229.50	90250	66410.00
2000-01	1780	3124.50	166017	154231.00
2010-11	4106	5997.83	296623	240125.00
2014-15	4060	11102.32	438956	319972.00
2015-16	3611.37	11053.30	445111	322370.61

Source: HVPN Ltd.

hand, state boasts to have surplus electricity which is distributed by two state-owned power utilities i.e. Uttar Haryana Bijli Vitran Nigam (UHBVN) and Dakshin Haryana Bijli Vitran Nigam (DHBVN). On the other hand, it suffers from inability to sell power at compensatory rates in the market. Haryana stands at 10<sup>th</sup> position with approximately 3.53% of the total installed capacity in the country.

Haryana has shown 0% peak shortage and less

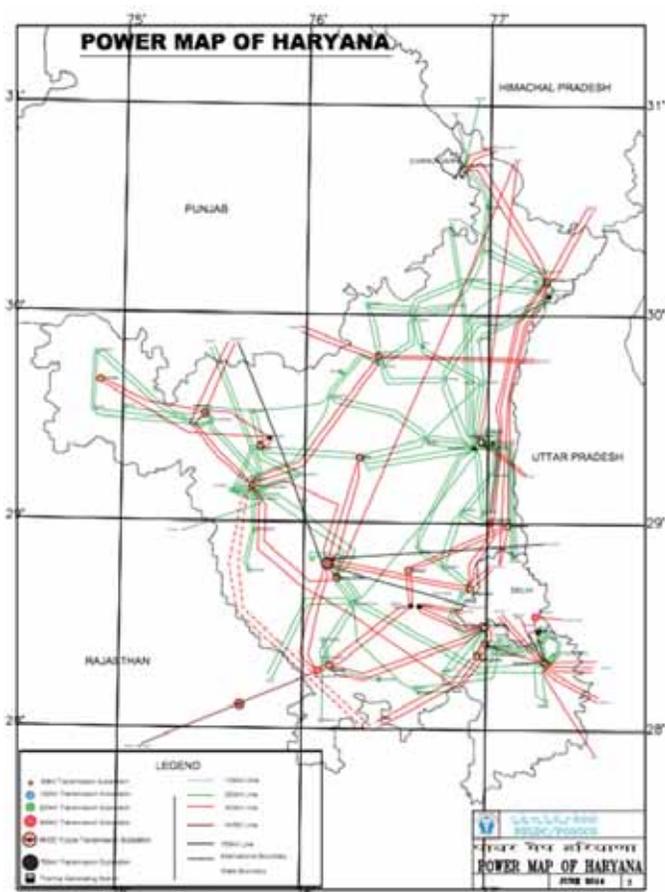
than 1% energy shortage during last two years. The state has achieved 100% electrification, but there are still 2.85 lakhs rural un-electrified households in the state, which are proposed to be electrified by FY 2018-19 in phased manner.

The per capita consumption of power in Haryana has been 1909 units which is much higher than national average of 1010 during FY 2014-15. The total installed capacity available to the state at present is 11,053.30 MW. It includes 2,782.4 MW from state's own stations, 828.97 MW from jointly owned projects (BBMB) and the balance as share in central projects and Independent Private Power Projects. The power availability from these sources was 4,45,111 lakh KWH during the year 2015-16. The power sold during the year 2015-16 was 3,22,370 lakh KWH. The year-wise detail of installed generation capacity, power availability and power sold are given in Table 1.

The total number of electricity consumers in the state has been increased from 35,44,380 in 2001-02 to 57,52,170 in 2015-16. The category-wise number of electricity consumers as given in Table 2.

The per capita consumption of electricity increased from 57 units in 1967-68 to 1,628 units in 2015-16. The consumption of electricity in the state during 2015-16 was 32,237.06 million units (MUs). The consumption of electricity by the industrial sector was maximum i.e. 10,142.35 MUs followed by agriculture sector i.e. 9,176.50 MUs. For agriculture sector subsidy amounting to 6,434.67 crore was given by state government in 2015-16. The sector-wise electricity consumed is given in Table 3.

The state government unbundled the erstwhile Haryana State Electricity Board (HSEB) in August 1998



**Table 2: Number of Electricity Consumers in the State**

Year	Domestic	Non- Domestic	Industrial	Tube-wells	Others	Total
2001-02	2759547	347437	66247	361932	9217	3544380
2005-06	3119788	387520	70181	411769	11402	4000660
2010-11	3684410	462520	85705	520391	34896	4787922
2014-15	4266675	547395	96887	603797	47265	5562919
2015-16	4419364	573848	99195	613973	45790	5752170

Source: HVPN Ltd.

**Table 3: Sector-wise Electricity Consumed in the State**

Sector	2015-16 (MUs)
Industrial	10142.35
Domestic	6987.30
Agriculture	9176.50
Commercial	3542.42
Public Services (Public Lighting & Public Water Works)	584.25
Railways	321.95
Miscellaneous	1482.30
Total	32237.06

into separate functional entities as below:

- Haryana Power Generation Corporation Limited (HPGCL)
- Haryana Vidyut Prasaran Nigam Limited (HVPNL)
- Uttar Haryana Bijli Vitran Nigam Limited (UHBVNL)
- Dakshin Haryana Bijli Vitran Nigam Limited (DHBVNL)

### Haryana Power Generation Corporation

On March 17, 1997 Haryana Power Generation Corporation came into existence. It was assigned the responsibility of working projects run by the state, maintaining them and also setting up new power generation projects. Thus, activities related to generation of power were shifted from Haryana State Electricity Board (HSEB) to Haryana Power Generation Corporation Limited (HPGCL) on August 14, 1998 with the aim of excellence in power generation, the state's own generating stations Haryana Power Generation Corporation Limited (HPGCL) came into existence.

The following thermal units are engaged in the generation of power in the state:

- Panipat Thermal Power Station, Panipat

- Deen Bandhu Chhotu Ram Thermal Power Project, Yamuna Nagar
- Rajiv Gandhi Thermal Power Project, Khedar, Hisar  
**Haryana Vidyut Prasaran Nigam Limited**

On August 19, 1997, Haryana Vidyut Prasaran Nigam Limited (HVPNL) was built-in as a company under the Companies Act. It initiated its functioning on September 18, 1997 and the functioning of HSEB was shifted to HVPNL on August 14, 1998 for distribution and transmission of power in the state. HVPNL was assigned accountability of transmission and distribution of electricity through relocate scheme notified by the Government and Haryana Electricity Regulatory Commission and was accorded license for transmission and bulk supply of electricity.

### Uttar Haryana Bijli Vitran Nigam Limited

Uttar Haryana Bijli Vitran Nigam Limited (UHBVNL) distributes retail power supply in the northern region of Haryana. Haryana Power Purchase Center (HPPC), has been assigned the power of retail supply which is a joint forum of UHBVN and DHBVN.

### Dakshin Haryana Bijli Vitaran Nigam Limited

Dakshin Haryana Bijli Vitaran Nigam Limited (DHBVNL) is also a government undertaking which look at the retail electricity supply in the southern region of Haryana. It also started its operations in July, 1999. Safe and sound power supply was the main aim of this Nigam. Through this it tried to encourage development in the region by reducing line losses. It tried to become modern through e-billing, e-tendering, network mapping, data logging, remote meter reading and electricity distribution automation etc. 



**Sahil Bansal**

Perusing M Tech,  
Delhi Technological University,  
New Delhi

# UNI★STAR®

Leading India to  
the World...



...in Extra High Voltage  
(EHV) Cables upto  
**400kV** Class

1<sup>st</sup> company in India to successfully  
Type Test 400 kV XLPE cable

Cable System Type Tested at  
IPH- Berlin (CESI) as per IEC: 62067

Manufactured using VCV technology

All variants of Metallic Sheath - Extruded  
Aluminium, Lead Sheath and Poly Al Sheath

Only company in India to manufacture  
Extra High Voltage cables with Continuous  
Seamless Extruded Aluminium Sheath

ISO 9001: 2000



## Universal Cables Limited

Regd. Office & Works:  
P. O. Birla Vikas, Satna – 485 005 (M.P.)  
Tel.: (07672) 257121-27, 414000  
Fax: (07672) 257129  
E-mail: sales@unistar.co.in

## MARKETING OFFICES

Mumbai – (022) 44422200 • Fax: 22027854  
Allahabad – (0532) 2423646 • Fax: 2423132  
Bangalore – (080) 23612484 • Fax: 23619981  
Baroda – (0265) 2791794 • Fax: 2793128  
Chennai – (044) 23746623-24 • Fax: 23746625

Kolkata – (033) 22805043-44 • Fax: 22805046  
New Delhi – (011) 45538800 • Fax: (011) 26779031  
Hyderabad – (040) 23550183 / 23608218 • Fax: 23553272  
Goa – (0832) 2782829 / 2782613 • Fax: 2782614

[www.unistar.co.in](http://www.unistar.co.in)

# Power Scenario in Tamil Nadu

Tamil Nadu is one of the early achievers of 100% village electrification and has the largest wind and solar power generation capacity across the country. The state has been maintaining almost 24 hours power supply to all consumers...



**2**<sup>4x7</sup> Power for All is a joint initiative of Government of India and State Government with an objective to strengthen the power supply infrastructure and make 24X7 reliable and quality power available to all households, industry, commercial businesses,

public needs, agriculture and any other electricity consuming entity. Tamil Nadu is already a pioneer state in implementing 24X7 power to all sectors.

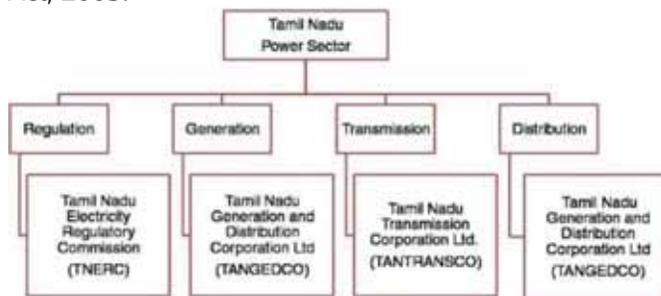
Tamil Nadu is situated in the southern peninsula of Indian subcontinent and is surrounded

on the north by Andhra Pradesh and Karnataka, on the west by Kerala, on the east by the Bay of Bengal and on the south by the Indian Ocean. With a population of over seven crore and an area of 130,058 sq.km, it is the seventh largest in terms of population and 11th largest state in India in terms of area.

Urbanization in Tamil Nadu is highest in the country with urban areas accounting for as high as 48.4% of state's population as against national average of 31.2%. The state provides free electricity to agricultural consumers to boost the primary sector output of the state. Tamil Nadu is one of the early achievers of 100% village electrification and has the largest wind and solar power generation capacity across the country. The state has been maintaining almost 24 hours power supply to all categories of consumers.

### Tamil Nadu Power Sector at a Glance

Formed in 1957, Tamil Nadu Electricity Board was constituted as a vertically integrated entity responsible for power generation, transmission and distribution. In line with the requirement of Electricity Act 2003, the entity was restructured into one holding and two subsidiary companies with TNEB Ltd as holding company. The subsidiary TANTRANSCO Ltd was created to undertake transmission in the state, while the generation and distribution was vested into TANGEDCO Ltd. The State Regulator Tamil Nadu Electricity Regulatory Commission (TNERC) was established and became operational from July 2, 1998. TNERC carries out its function and roles in accordance with applicable provisions of the Electricity Act, 2003.



### Generation Plan

The state has an installed capacity of 24,433 MW as on 31.03.2016. Tamil Nadu has one state owned generation company – TANGEDCO. In addition, there are various central and private generating companies. By FY17 the installed capacity is expected to increase by about 2,509 MW from thermal sources including

165 MW from cogeneration sources and another 5,100 MW from renewable energy sources (Wind, Solar and other Sources). The expected capacity additions are in line with the anticipated peak demand projections. The state is expecting capacity additions of about 2,509 MW from thermal sources including cogeneration plants and Central sector's plants such as NTPC, NLC and NPCIL.

The company operates four large thermal power stations:

- Ennore Thermal Power Station (ETPS) - 450 MW (2x60, 3x110 MW)
- Mettur Thermal Power Station (MTPS) - 1440 MW (4x210, 1x600 MW)
- North Chennai Thermal Power Station (NCTPS) 1830 MW (3x210 MW, 2x600 MW)
- Tuticorin Thermal Power Station (TTPS) - 1050 MW (5x210 MW)

TANGEDCO is undertaking construction of following four new upcoming Thermal Power Projects,

- 660 MW ETPS Expansion project,
- 1,320 MW Ennore SEZ project,
- 800 NCTPP Stage III and
- 1,600 MW Uppur Thermal power project

TANGEDCO is undertaking R&M of TTPS, MTPS, and NCTPS thermal power stations. The company has availed funds from PFC and REC for implementing the R&M projects in the state. The State Generation Company TANGEDCO has tied up funds for new and R&M projects in the state.

### Transmission Plan

The planning and development of intra-state transmission system in the state is undertaken by Tamil Nadu Transmission Corporation (TANTRANSCO). The existing transmission system is adequate for evacuation and transmission of power and the transmission plan is at ensuring adequacy of transmission infrastructure for evacuation of such power from the inter-state boundary and proposed generating plants within the state to the end consumers located across various geographies of the state. The intra-state system is maintained and operated by TANTRANSCO, which is a subsidiary of TNEB Limited. As on 31.03.2016, the existing intra state transmission network comprises of 908 EHV grid substations with 59,953 MVA capacities along with 30,331.6 ckt km associated transmission lines. The

interstate transmission system operated and maintained by PGCIL consists of 8,127 ckt km of lines and 9,300 MVA of transformation capacity. By FY19 the intra-state transformation capacity is proposed to be enhanced to 94,217 MVA (which includes additional 8,640 MVA for Renewable Corridor) and 33,768 ckm of intra-state transmission lines.

The state transmission utility TANTRANSCO has proposed investments for meeting its anticipated demand as well as providing connectivity to the upcoming renewable energy corridors. TANTRANSCO is focusing on efficient operation and maintenance practices to provide stable and quality power with maximum transmission system availability and minimum transmission system losses.

### Distribution Plan

Distribution of electricity in the state is managed by the state distribution utility – TANGEDCO. It is the sole distribution licensee in the state. The company was formed in 2010 when the erstwhile TNEB limited was restructured into corporate entities.

During the period FY16 to FY19 the peak demand (including wheeling demand) and energy requirement (including wheeling sales) is expected to increase from 14,533 MW and 1,00,319 MU in FY16 to 17,651 MW and 1,17,487 MU in FY19. This is due to increase in natural demand from the present consumer base and more importantly because of the initiatives proposed under this.

The distribution network of TANGEDCO comprises of 66 kV, 33 kV, 22 kV and 11 kV sub-transmission systems. This forms the distribution backbone at the district level and LT distribution systems and delivers electricity to majority of the end consumers. TANGEDCO has 31.97 lakhs unmetered consumers as on March 2016. TANGEDCO is monitoring SAIFI and SAIDI values of the R APDRP towns in the state.

The state distribution utility TANGEDCO is in advanced stages of completing the RGGVY (Rajiv Gandhi Grameen Vidyutikaran Yojana) scheme. Further, the utility has already started implementing R-APDRP schemes across the state. In addition to these centrally sponsored schemes, the utility is also adding network under ADB funded schemes. For meeting the network requirement of existing consumers and extending the distribution network to the newly constructed HHs, the utility has proposed enhancement of network by means

of addition in HT network, LT network and additional power and distribution transformers and various other improvement works. This plan will increase the number of DTs from 2,64,029 in FY16 to 3,20,681 in FY19, similarly the LT network will increase from 6,09,544 kms in FY16 to 644,603 kms in FY19. These network additions are proposed with an investment of ₹ 9,348 crore. The IT initiatives proposed by TANGEDCO are mostly covered under the R-APDRP Part A schemes. TANGEDCO has proposed construction of a Data Centre (DC) at Chennai and Disaster Recovery Centre (DRC) at Madurai. Data Centre (DC) has been commissioned at Chennai. DRC Works are under progress in Madurai. Around 100 towns have been made 'Go-Live' and are connected to DC over MPLS-VPN.

### Renewable Energy & Energy Efficiency

The state of Tamil Nadu is blessed with various forms of renewable energy sources viz., Wind, Solar Biomass, Biogas, Small Hydro etc. The state has emerged as a major hub for development of renewable energy in the last few years and presently approximately 40% of the total installed capacity in the state is from RE sources. The Govt of Tamil Nadu set up the Tamil Nadu Energy Development Agency (TEDA) in 1985 to promote the use of new and renewable energy sources and promote energy conservation activities in the state

The state has RE installed capacity of 9,687 MW (as of September 2016). The RE installed capacity is mostly contributed by wind (7,642 MW) followed by solar (1,155.4 MW). The state has planned off-grid renewable solutions to cater to the growth in demand in far-flung areas with poor accessibility.

This includes 5,787 standalone solar solutions. Future plans for renewable capacity addition includes addition of 5,265 MW of renewable energy through investments by private sector.

### Energy Efficiency Plan

TANGEDCO has been selected under BEE's Capacity building of DISCOMs program to establish the energy saving potential in various sectors by conducting load research across the state. The selection of consultant for conducting the load research has been completed. The Load Survey in all consumer categories including domestic, commercial, industrial, educational institutions etc. has been completed.

Distribution of 1 crore LEDs comprising of 2 LEDs per household at a subsidized rate of ₹ 10/- per LED to all metered domestic services (consuming less than 500 units bimonthly) in five cities viz Chennai, Coimbatore Madurai, Trichy and Tirunelveli is under consideration.

### Other Initiatives

For the training needs of the employees Tamil Nadu power sector has four training institutes which cater to hydro, thermal, transmission and distribution, management and safety training needs to its employees. Ten Centers were established to cater the needs of staff in distribution areas. One Cable Jointing Training and development Centre has also been created to impart both the officers & work force of TANGEDCO & TANTRANSO (formerly TNEB) in the field of UG power cables & jointing techniques and in both theory and practical.

### Future Energy Scenario

Future Energy Scenario Energy projections for

Tamil Nadu based on the 18th Draft Electric Power Survey with respect to future energy requirements suggest an increase in annual energy requirement:

- 80.69 billion units (BU) present
- 110.25 BU by 2016-17
- 154.59 BU by 2021-22 The corresponding increase in peak load is expected to grow to
- 11,971 MW 2011-12 (past number) to
- 18,994 MW by 2016-17
- 26,330 MW by 2021-22

The Vision Tamil Nadu 2023 document released by the state chief minister on 22 March 2012, envisages a massive investment of ₹ 4,50,000 crore (₹ 4500 billion) in the state energy sector



**Manisha Singh**

Assistant Professor, Division of Instrumentation and Control Engineering, at Netaji Subhas Institute of Technology, Dwarka, New Delhi

**Let the Market Leader in Clamp Meters Make Your Life Easier.**

- 1000A AC & 600V AC/DC Auto Ranging
- 0.01A Resolution
- Non Contact Voltage Function
- Carry Case Standard

Ø33
••••
Ω
DATA HOLD
AUTO POWER SAVE

IEC 61010-1  
CATIV/300V

TRUE  
RMS

NEW

KEW 2117R

Special Introductory Price :  
With Carry Case.

MRP ₹ 4500/-

(till stocks last)

Clamp Meters

AC Analog Clamp Meter <span style="color: red; font-weight: bold;">Ø 33 100A</span>	Digital AC Clamp Meter (Flex) <span style="color: red; font-weight: bold;">upto Ø150mm upto 3000A</span>	Digital AC/DC mA Clamp Meter <span style="color: red; font-weight: bold;">upto 20A OUTPUT</span>	Digital AC/DC mA Clamp Meter <span style="color: red; font-weight: bold;">upto 20A OUTPUT</span>
Digital AC Clamp Meters <span style="color: red; font-weight: bold;">upto Ø55mm upto 2000A</span>	Digital DC mA Clamp Meter <span style="color: red; font-weight: bold;">upto 120mA OUTPUT</span>	Digital AC/DC Clamp Meters <span style="color: red; font-weight: bold;">upto Ø 55mm upto 2000A</span>	Digital AC/DC Clamp Meters <span style="color: red; font-weight: bold;">upto Ø 55mm upto 2000A</span>

For detailed specification please refer to products Data Sheet.

Earth Testers | Insulation Testers | Clamp Meters | Loop/PSC/RCD Testers  
| Power Quality Analyser | Phase Rotation Testers

**ELEC RAMA**  
we are all about electricity

10th - 14th March 2018,  
Hall No. 3 | Stall No. H3D9

Japan

QUALITY

Quality and reliability is our tradition

KYORITSU

Kyoritsu KEW India Instruments Pvt. Ltd.  
#4, S P Nagar, Navrangpura, Ahmedabad-380006. India.  
T: +91 98246 80404, E: info.ei@kew-india.co.in

India Service Centre  
write to: service@kew-india.co.in

# Renewable Power Scenario in Jammu & Kashmir

Jammu and Kashmir is a region with immense potential for renewable energy projects. Considering the region's vast potential to harness renewable resources and to promote clean energy, investment in this sector promises high returns...



Jammu and Kashmir is blessed with sizeable natural resources like sunshine, wind, vegetation, water flow, biomass and other biological wastes are abundantly available in the state yet are not being potentially harnessed which, if suitable harnessed on priority,

could transform its economy and bring socio-economic development not only in the state but in the whole region. It has led in forcing peoples to use wood resulting to deforestation. The fossil fuels, which pollute the environment, are extensively utilised even though



they are not sustainable. Among the major natural resources, water as a resource forms the base for its hydroelectric power and has strong potential to generate as a critical input not only for its economic activities but also as a large source of state revenue. The cost of providing kerosene, LPG or even firewood is very high due to higher transportation cost (i.e. 20-25% more than Jammu region). It has added advantage of widespread use, non-polluting nature and inexhaustible supply over other fuels. In the case of diesel sets, the fuel has to be transported from the plains. Due to the region's remoteness, the cost of transportation maintenance as well as the cost of generation per unit is very high. Development and properly implementing renewable energy technologies in this state can provide secure energy supply for rapid domestic and industrial development which will attract new investments, thereby, creates additional employment. It shall also generate additional state income by allowing the state to sell renewable energy trading certificates to other states.

Energy is a vital component for sustained economic growth and the energy mix is an indication sustainable development of a state and the country. Energy, as an input available adequately has multiplier and trickledown effect, thereby, would give flip to the other sectors of the economy in the state. Since, the other sectors of the economy like agriculture are not strong enough to provide large revenue to the state, therefore, it becomes imperative for the state to look at this sector as a vital source for further economic growth and development. The other promising sector

of the state i.e, tourism, is highly dependent upon the overall circumstances. There is an urgent need to shift from utilization based on fossil fuels, which not only are carbon intensive but also are not sustained.

Jammu and Kashmir has a huge quantity of biomass by-products, which can be utilized for electricity generation by the use of solar energy, bio gas, gasification technologies, etc. The Ladakh region gets approximately 320 days of sunshine for a year and is one of the best places in the world for solar cooking. The Ladakh Renewable Energy Development Agency (LREDA), the nodal agency of the MNRE is currently implementing renewable energy technologies across the region. To date, more than 30 companies from across India have put forward proposal for the execution of solar thermal and solar photovoltaic works, e.g. TATA BP Solar and Reliance.

Jammu and Kashmir is fairly untapped in the field of the wind energy. However, there is a significant scope of harnessing wind energy in different districts. Table 1: Wind energy potential in different districts of Jammu and Kashmir.

S. No.	District	Wind energy potential(kwh)
1	Leh	7000
2	Udhampur	5000
3	Anantnag	5000
4	Baramulla	5000
5	Kupwara	5000

The state is currently focused on generation through big hydro power projects. Potential of micro hydro power and solar are increasingly being tapped. Grid electricity penetration in remote hilly areas of Jammu and Kashmir is techno-economically unviable by virtue of geographical disadvantages and scattered household pattern. Moreover, the power sector of the state is already facing difficulties like slow rate of capacity addition, poor power evacuation facility, high AT&C losses and mismatch in load profile. Power utilization mix is not commensurate with the state's climatic conditions. Promotion and utilization of renewable energy is the most feasible solution.

The state largely depends on the power generation from hydropower projects and thermal power plants besides supplements from DG set. Jammu & Kashmir has a total generation capacity of 20,000 MW under central and state sector. The state is heavily relying on power purchase from the NEWNE grid and thermal



power generation units and gas and diesel based power units during winters when its own hydro power generation reduces and power demand rises. The state is facing power crisis due to untapped renewable energy, high rate of AT&C losses including pilferage.

The major reason behind the existence of various dams that exist in the state of J&K is the generation of power are Salal project of Jammu and Kashmir having capacity of 690MW, Baglihar Dam having capacity of 900MW, Uri hydroelectric dam having generation capacity of 480MW, etc. The primary sources of cooking fuel in rural areas are firewood and chips followed by LPG. Urban cooking fuel demand is mainly met through LPG. The scenario is same in the rural areas too. At least 349 villages in Kashmir are without electricity despite the state having potential of 20,000 MW of power, an official survey has revealed. People in these villages still continue to live in 'Dark Age' at a time when rest of the world has progressed exponentially in terms of technological advancements. As per survey the district-wise number of villages without electricity as Kupwara (118), Budgam (88), Anantnag (67), Bandipora (39), Baramuul (17), Pulwama (13), Ganderbal (3), Srinagar (2).

### Conclusion

Jammu and Kashmir is a region with immense

potential for renewable energy projects. Considering the region's vast potential to harness renewable resources and to promote clean energy, investment in this sector promises high returns, there is an essential need for encouraging corporate sector to increase their investments in renewable energy by providing higher returns on their investments. Engineers or scientists, developmental agencies of government, and NGOs should work on this aspect of non-traditional energy resources for the development of eco-friendly, farmer-friendly power generation system. The micro hydel projects having short gestation period will prove to be economical, beneficial and most environmental-friendly in the long run. These projects can bring sustained energy to the state. It is urged that cooperative and constructive efforts are required for efficient harnessing of renewable energy. <sup>15</sup>



**Munazama Ali**

Assistant Professor in Islamic university of Science & Technology, Kashmir

# Displaying All Current Trends from Dec 5-7

Intersolar India displays all current trends from December 5-7 from around 260 exhibitors to more than 12,000 international solar and energy storage experts at Bombay Exhibition Centre, Mumbai...



Solar is set to remain in the limelight in 2017 as the entire industry returns strong growth. India is expected to increase installed solar capacity to more than 17 GW by the end of 2017. Intersolar India displays all current trends from December 5-7 from around 260 exhibitors to more than 12,000 international solar and energy storage experts.

According to Mercom Capital Group about 10 GW of solar will be installed in calendar year 2017 in India and roughly 8 GW more will be installed in 2018. The solar project pipeline in India is now approximately 13 GW. Currently, about 6 GW of tendered projects are awaiting auction. Battery energy storage systems turn out to be the most preferred among the storage systems. India's ambitious strategy to accelerate the adoption of electric vehicles requires a concerted and coordinated effort that brings together the best of the private and public sectors in transport, infrastructure and energy. Electric mobility solutions and energy storage systems have additionally the potential to actively shape India's future energy system.

## Special Exhibitions & Pavilions

In this context, Intersolar India 2017 will be hosting and highlighting three special exhibitions: Sees India as the major platform for storage technologies reshaping India's energy sector and enhancing grid reliability, Power2Drive India that showcases electric mobility solutions and technologies and Energy Decentral India, the international exhibition for innovative energy supply. This year Intersolar India has also been certified by the US Commercial Service for the second time and will present an US Pavilion. Germany will have a big footprint on the show floor as well. The Federal Ministry for Economic Affairs and Energy (BMWi) will again organize the official German Pavilion with 10 exhibitors from Germany in Mumbai. In total, exhibitors from more than 12 countries will join Intersolar India 2017.

## Special Activities

Intersolar India will be powered by the tremendous energy generated by special activities. Two unique forums will be part of the event. One is the Buyer Seller Forum. The other is the round table on financing solar projects in India for US companies, which was designed to discuss how US Government agencies and commercial banks assist US companies financing solar projects in India. More than 100 internationally renowned speakers will share their insights from the global solar and energy storage industries at the Intersolar India Conference. Whether it is the latest market insides, brand new technology up-dates, financing options and operating models or customized networking opportunities, conference attendees will find everything they need at one spot. Special forums and technical workshops will complete an extensive program. 

“Targets have given a direction, but there is still a long way to go”



India garnered an investment of \$10.2 billion from across the globe ranking fifth in the world. This is the result of a stable government policy and commitment to renewable energy. China might be the manufacturing hub for solar PV, but India is certainly one of the biggest markets for both solar and wind, informs **Aruna Kumarankandath, Programme Manager, Renewable Energy Programme, Centre for Science and Environment** in an interaction with **Electrical India...**

**According to you, what kind of opportunities will generate for Indian renewable energy sector with the government's intention of producing 175 gigawatts of clean energy?**

More than anything than these ambitious targets have accomplished, they have given immense confidence in the Indian renewable energy sector. It has proven that the current Indian government is dedicated to pushing renewable energy and has made it a prime focus. Investors now have a policy certainty that has not always been there for this sector with changing patterns of subsidies and ad-hoc policy intervention.

Given the government push, renewable energy sector has made strides in achievement. However, it is really hard to imagine that the sector can achieve its 175 GW

target by 2022. The economies of scale had made solar tariff and wind tariffs to be competitive with any thermal power plant, but going from a small base to the heights that have been set, would be difficult for the country.

The potential of the country is immense and the target is only miniscule compared to this potential. There is opportunity of job creations but most of the jobs are temporary and usually gets over after the construction of the plant is finished. These renewable energy projects do not create many permanent jobs. Also, the space for small and medium entrepreneurs is also very limited in large scale installations because bidding is so competitive that they do not have financial advantage over much larger firms.

The benefit that Indian renewable energy sector has

gained from the massive ambition is opportunity to diversify the electricity mix in the country and taking away share from fossil fuel especially coal. However, it is important that we assess the share of electricity through generation and not just installed capacity. So, targets have given a direction, but there is still a long way to go.

**What are the initiatives taken by the government for generating the momentum in the sector?**

There are many initiatives that have contributed to the surge of renewable energy in the country. The National Solar Mission did more for the solar sector than any other push. What made the giant leap possible was reverse bidding for solar installation under the central government. The tariff has been reduced from over ₹17 per unit to ₹2.44 per unit in the last bids that happened this year. Reverse bidding has also been responsible reducing tariff of wind power to its lowest this year ₹2.64 per unit just last month. It is historical that competitive reserve bidding has pushed the tariffs at levels where coal looks more expensive compared to renewable energy.

The solar parks initiative, under the solar mission, has also contributed to this reduction in tariffs. In the last year itself, thanks to the solar park, the installation has jumped to 13 GW of solar capacity from a sheer 2 MW in 2010. This initiative has reduced the developer's task of acquiring land and also reduced the costs to some extent. The solar park bidding showed government trying to remove all uncertainties for a solar developer including guaranteed purchase of power. Many solar and wind developers were being asked to shut down the supply of electricity when there was excess power in the grid, thereby, reducing the revenue that a developer can make. The 'must run' status that has been accorded to the renewable energy project is a step to remove this uncertainty.

For ease of development and learning from the wind sector, the government established the Wind Resource Assessment Programme through the National Institute of Wind Energy (NIWE). They were also responsible for setting up network of solar radiation resource assessment stations all over the country to provide investors with ground measured solar radiation data essential for implementation of solar power projects. Ministry of New and Renewable Energy has been responsible for spreading awareness regarding development of the sector and ensuring that this sector develops, in some sense it has succeeded. Today any major development about renewable energy sector is front page news in most of the newspapers.

**Do you think that India can become a renewable energy hub with these government steps?**

These initiatives have already made India a renewable energy hub. In any given bidding for solar and wind, investors from all over the world participate and win projects. India garnered an investment of \$10.2 billion from across the globe ranking fifth in the world. This is the result of a stable government policy and commitment to renewable energy. China might be the manufacturing hub for solar PV, but India is certainly one of the biggest markets for both solar and wind.

**What challenges does the Indian Renewable Energy need to overcome for achieving this target?**

The roadblock in achievement of this sector would not be why we could not reach the target; it would be by when we can reach it. India is capable of installing 175 GW, we might not be able to achieve it by 2022, may be in another 10 years from that, but we can certainly achieve it. What is more important is that we make sure that the rapid development that is happening in this sector is not at the cost of our environment. There are

**There are many initiatives that have contributed to the surge of renewable energy in the country. The National Solar Mission did more for the solar sector than any other push. What made the giant leap possible was reverse bidding for solar installation under the central government.**

constraints about availability of land and regarding agricultural and forest land being diverted for these power plants.

Another developmental fear is of skewed progress where one segment is being scaled up at an enormous rate; the focus has been on large scale solar and wind projects. Decentralised or distributed generation is not being promoted – energy access has become about grid extension and not about decentralised mini-grids. Rooftop solar targets are being curtailed because of the slow progress. LPG is being pushed for cooking energy, another foreign produced fossil fuel.

The western world looks at renewable energy as consumption at source of generation. Individuals producing and consuming electricity at the same place with highly efficient products that causes little damage to the environment. But, the conversation of renewable energy has become large giga-watt scale projects only. Electricity is being fed into the same leaking grid and we are losing electricity in transmission and distribution. We are not taking advantage of the modular nature of solar for instance.

The solutions are complicated and I guess the government after making claims about 175 GW sees

that there is need for much more work in decentralised solutions. Decentralised solutions would require more policy focus, right now there is no central level policy for either rooftop solar or energy access through renewable energy. MNRE produces benchmarks and gives subsidies to these segments, but there is no coordinated target or any policy to promote such efforts. Both these causes have been left to state government and some states have shown initiatives, but they require more effort to spread awareness in the first place. For rooftop segment, there is certainly a lot of policies promoting installation, but there is very little monitoring of this happening, its lack of mandate and enforcement, where there are any. People who can afford to have home solar systems have not installed it because they do not know the benefits or are still dependent on diesel generators and grid for electricity, both of which is expensive compared to solar in many states.

Energy access is a convoluted problem that the government is trying to address. Grid expansion has been the answer for electricity access and LPG is a solution promoted after years of previous government focusing on cleaner use of biomass. Renewable energy is not what the government is focusing on for energy access. Given the modular nature of solar, electricity from renewable energy makes perfect sense for issues of both electricity access and clean cooking energy. MNRE has not done anything for development of mini-grid since the draft was announced in June 2016. No steps have been taken to ensure that the people with less means do not pay highest prices, which currently many people who do not have access to electricity are paying to DG sets operators or solar projects that are not under any regulatory framework. This needs to change.

### **What is the position of India on the global map in terms of generation of renewable energy?**

Contribution of renewable energy in the electricity generation has been only seven per cent in the financial year 2016-17. In comparison, in 2015-16, the share was a little higher – 8.36 per cent. Some estimates show that even 175 GW of renewable energy would only translate to 32 per cent of the total installed capacity and 17 per cent of electricity generation in the country. If we include large hydro as well, 2016-17 share does up to 17.61 per cent.

Many other countries across the globe have more or less all their power coming from renewable energy primarily because countries like Norway, Iceland and Costa Rica have used largely hydropower to meet its electricity needs. But most countries in the world have announced some targets for renewable energy under

the Paris Accord and have targets less than 50 per cent and countries like United States have no national targets. Currently, Germany produces around 30 per cent and France produces almost 20 per cent of its electricity from renewable energy. China on the other hand, barring large hydro, renewable energy forms five per cent of its electricity generation.

### **How can India rapidly scale up renewables without any wastage or curtailment like other countries?**

India can learn a lot from other countries regarding increasing its share of renewable energy. For instance, focus of renewable energy in Germany was the decentralised model for solar. Everyone in Germany was encouraged to install solar rooftop system and that forms the largest set of owners of solar plants in the country. This reduces transmission and distribution losses in the system. India loses around 22 per cent of its electricity during transmission and distribution.

Countries in Europe also have an advantage of connected grid, because this helps them manage the supply with least amount of wastages. Like when wind power in Germany produces excess power than anticipated, it sells the power to its neighbouring countries to manage the grid. This is also what happens in Scandinavian countries.

Countries that have high amount of hydropower plants, have also invested in pumped storage, for instance China. Energy storage is also something that India should invest in as this would help integrate the renewable energy better in the longer run for the country. Investments should also be made in upgrading the grid and investing in more green corridors and smart grid because this would be the next step for the government to intervene and integrate the large amount of renewable power that is being curtailed.

### **What is your outlook for the renewable energy sector for 2017-18 fiscal?**

Renewable energy sector in 2017-18 would be functioning in the same way. There are almost 15 GW of solar projects in pipeline and very little wind projects. The most interesting development would be how the lowering in tariffs of both solar and wind power would impact the already tendered projects. We have seen states like Andhra Pradesh, Karnataka, Telangana and Uttar Pradesh have projects that have tariffs much higher than the recent bids for both solar and wind projects. CRISIL has reported that `48,000 crore worth of 7 GW capacity is in question.

According to MNRE, none of the renewable energy segment has even met the half of the targets in the six months of FY 2017-18, so it seems achieving the yearly target would be very difficult. 

# Forthcoming Events At A Glance

## National

### Intersolar India 2017

**Venue:** Bombay Exhibition Centre, Mumbai

**Date:** 05-07 December 2017

**Website:** [www.intersolar.in](http://www.intersolar.in)

### ELECRAMA

**Venue:** India Expo Mart, Greater Noida, NCR, India

**Date:** 10-14 March 2018

**Website:** <http://ieema.org/events/>

### China Machinex India

**Venue:** Bombay Convention & Exhibition Centre, Mumbai

**Date:** 05-07 December 2017

**Website:** [www.chinamachinex.in](http://www.chinamachinex.in)

### Solar Today Expo

**Venue:** BIEC Bengaluru

**Date:** 10-12 April 2018

**Website:** [www.solartodayexpo.com](http://www.solartodayexpo.com)

## International

### Solar Power New York

**Venue:** New York Marriott at The Brooklyn Bridge, New York, NY

**Date:** 11-12 December 2017

**Website:** <http://events.solar/newyork/>

### Middle East Electricity 2018

**Venue:** Dubai World Trade Center

**Date:** 06-08 March 2018

**Website:** [www.middleeastelectricity.com](http://www.middleeastelectricity.com)

### Kenya Power & Energy Expo 2018

**Venue:** KICC Nairobi Kenya Expo Group, Dubai, UAE

**Date:** 29-31 May 2018

**Website:** [www.expogr.com/kenyaenergy](http://www.expogr.com/kenyaenergy)

### POWER-GEN & DistribuTECH Africa

**Venue:** Sandton Convention Centre, Johannesburg, South Africa

**Date:** 19-20 July 2018

**Website:** <http://www.wire-southeastasia.com/>

**SHIRKE**  
ELECTRO PVT. LTD.

CE

**Instrument Selector Switches**

**Phase Selector Switches**

**Rotary Auxiliary Knife Switches**

**Rotary Cam Breaker Control Switches**

**DC Isolator Switch**

**ELECRAMA**  
we are all about electricity  
HALL NO. 3  
STALL NO. K 1

**PRODUCT RANGE :**  
440V AC / 250V DC, 6-43A

1. TNC SWITCH
2. L/R SWITCH
3. ON/OFF SWITCH
4. AUTO MANUAL SWITCH
5. AUXILIARY SWITCH
6. ASS & VSS
7. LIMIT SWITCH

**CORPORATE OFFICE :**  
W-72/L-25, MIDC, Ambad,  
Nashik 422010, Maharashtra, India.  
PH: +91 253 6619372  
Email : [sales@shirkeswitch.net](mailto:sales@shirkeswitch.net)  
Website : [www.shirkeswitch.net](http://www.shirkeswitch.net)

# Thermography that is Smart & Networked!

Testo thermal imager 872 can also be connected to the testo Thermography App The App, available for iOS and Android, turns the user's smartphone into a second display...



In contracting as well as in the industrial sector, you profit considerably from the use of a thermal imager:

- You carry out status-oriented servicing work and prevent expensive system downtimes.
- You overcome the limitations of a pyrometer by measuring not just individual points but whole surfaces.
- You deal with jobs such as preventive maintenance

of high voltage systems, circuit breakers or mechanical components on plants more quickly than before, thus, saving time and money.

- You always provide best quality and ensure the satisfaction of your management or your customers – for example by testing and impressively presenting the faultless fitting or the functionality of system.

## Convincing Features for Efficient Thermography

- High resolution and image quality  
Up to 320 x 240 pixels – with Testo SuperResolution, even up to 640 x 480 pixels. Image quality and resolution are ideal for all applications in both contracting and industry.
- Connection to App and other Testo measuring instruments.

Create and send compact reports on site with the testo Thermography App. Transfer the measurement values of the testo 605i hygrometer and the clamp meter testo 770 wirelessly to the imagers, in order to identify mould/humidity related danger or to complement thermal images with current/voltage values. For example – in solar panels.

**The clamp meter testo 770.**

- Easy to operate thanks to the fully retractable pincer arm
- Auto AC/DC and large two-line display
- Improved TRMS method

**The thermohygrometer testo 605i**

- Compact professional measuring instrument from the Testo Smart Probes series
- Measures air temperature and relative humidity
- Space-saving and easy to transport

**The thermal imager testo 872**



- **Automatic setting of emissivity**  
The testo  $\epsilon$ -Assist function automatically sets the emissivity and temperature of the measurement object, thus, facilitating precise thermography.
- **Objectively comparable images**  
Testo ScaleAssist adapts the thermal image scale to the inner and outer temperatures of the measurement object, and the difference between them. This ensures comparable and error-free thermal images of the thermal insulation behaviour of a building.

### Work Smart & Networked

Testo thermal imager 872 can also be connected to the testo Thermography App. The App, available for iOS and Android, turns the user's smartphone into a second display and a remote control for the thermal imager, and serves to create compact reports quickly on site, to save them online and send them by e-mail. Apart from this, the App offers useful tools for fast analysis on site – for example for inserting additional

measurement points, determining the temperature development via a line or adding comments to a thermal image. Also very useful: With the App you can transmit thermal images live to your smartphone/tablet, and can use it as a second display.

### Connectivity with Testo Hygrometer and Testo Clamp Meter

Testo 872 thermal imager can be additionally connected wirelessly with the thermohygrometer testo 605i and the clamp meter testo 770-3. The measurement values of both compact measuring instruments are transmitted to the imagers by bluetooth. This allows fast and clear identification of where exactly the thermography is to be done in any given climatic condition or at what load a switching cabinet is running.

### Entry into Thermography Made Easy and Economical

Testo has launched a limited period offer of a free testo thermohygrometer 605i and the clamp meter testo 770-3 along with testo thermal imager 872. That too is priced very attractively. But this is limited time period offer in a wake to promote use of thermography with wireless connectivity across industry and contracting business.

**testo Thermography App** for testo 868/871/872  
Download now for iOS or Android free of charge:



For more info, email at: [info@testo.in](mailto:info@testo.in)

# Smart Technologies for a Better Tomorrow

Along with its primary product - the GRP Cable Trays - SUMIP has pioneered first-of-its-kind fiberglass multi-utility poles, enclosures and ladders in India

---

For over three decades, SUMIP Composites Pvt Ltd, has been quietly and brilliantly, causing a positive ripple in the industrial electrical segment. Replacing conventional structural materials in electrical instrumentation with composites, today, SUMIP has set a standard for itself in the marketplace, earning the trust and respect of its clients and competitors for its innovative and eco-friendly solutions.

Born out of its previous identity Shrenik and Company, SUMIP was established in 1980 by its Founder Lt. Shri Narendra Shah, with a vision to provide the industrial electrical segment with smart and environment-friendly solutions. Understanding the benefits of composites, including its minimal impact on the environment, SUMIP broke the mould by bringing products that were both innovative and sustainable in the long run.

Along with its primary product - the GRP Cable Trays - SUMIP has pioneered first-of-its-kind fiberglass multi-utility poles, enclosures and ladders in India, which have found a place in the minds of its most distinguished clients, who champion the brand for its

quality and performance. SUMIP's fiberglass poles are used for various applications including street lighting, highway lighting, offshore platforms etc., whereas its fiberglass ladders are used across multiple industrial applications.

As a company, SUMIP is engaged in continuous research and development in the field of composites, which has enabled the company to offer an extensive range of products that have found use in a wide range of applications. With a production facility in Changodar spread across 275000 sq ft, SUMIP is well-equipped to deliver a range of solutions in fiberglass industrial and electrical instrumentation.

Driven by the passion to excel, SUMIP envisions to grow into a brand that is the first choice of its customers across the globe, SUMIP is committed to upholding its promise of leaving a better world, for the times to come, by bringing more sustainable technologies in the world of industrial electrical instrumentation.

Simply put, we are slowly but surely, replacing metal with composites. 



# BHEL Wins Largest Value EPC Order for 765 kV Substation

In the face of stiff competition, Bharat Heavy Electricals Limited (BHEL) has bagged a major order for setting up two 765 kV substations on EPC (Engineering, Procurement & Construction) basis, in West Bengal. Significantly, valued at over Rs 350 crore, this is the largest value 765kV substation project order for BHEL so far. With this, the company has maintained its undisputed leadership in the 765 kV Power Transmission segment. The order has been placed on BHEL by Powergrid Medinipur-Jeerat Transmission

Limited (PMJTL), a 100% wholly owned subsidiary of POWERGRID. BHEL's scope of work in the contract envisages constructing two large sized greenfield 3,000 MVA, 765/400 kV substations, at Medinipur and Jeerat (near Kolkata). These EHV substations will play a key role in strengthening the 765 kV system in the Eastern region (ERSS-XVIII), for delivering power to important load centres in the state of West Bengal.

The substations are slated to be commissioned within a schedule of 30 months. The project shall be

engineered and delivered by BHEL on total turnkey basis. BHEL has been contributing significantly in making the 765 kV Ultra High Capacity inter-state transmission network a reality by undertaking the commissioning of 765 kV greenfield substations across the nation on turnkey basis.

These include substations at Raichur (3,000 MVA) in Karnataka, Fatehabad in Uttar Pradesh (3,000 MVA), Banaskantha (3,000 MVA) and Bhuj (4,000 MVA) in Gujarat and Ariyalur in Tamil Nadu (3,000 MVA). 

|| SHRI LAXMI NARSINVAH PRASANNA ||



Electrical Engineers and Contractors,  
Manufacturers of Distribution &  
Power Transformer  
Specialist in repairs of  
all Kind Distribution Transformer

**M/S. N DATTA ELECTRICALS**

Fact : F-25, M.I.D.C Area, LATUR - 413 531. (M.S)  
Ph. (02382) 220031. Mobile : 9421913833  
Email ID : ndelltr@gmail.com

## Voltage wise ckm & MVA Declared under Commercial Operation till 30.04.16 in Different Regions of POWERGRID

Voltage level	NR-I	NR-II	ER-I	ER-II	WR-I	WR-II	SR-I	SR-II	NER	Total	No. of lines
765 kV	2563.42	868.84	985.85	546.92	7097.26	5198.96	1761.19	0.00	0.00	19022.43	77
765 kV (charged at 400 kV)	422.83	562.50	0.00	0.00	0.00	0.00	0.00	379.60	0.00	1364.92	8
800 kV (HVDC)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3507.12	3507.12	2
500 kV (HVDC)	3209.57	0.00	0.00	0.00	0.00	0.00	2737.54	0.00	0.00	5947.11	6
400 kV	15979.64	8025.45	9964.24	7175.83	10428.30	14273.83	9643.24	9217.13	3312.84	88020.49	703
220 kV	3021.33	1447.68	497.46	1173.04	204.56	1076.82	0.00	811.47	647.48	8879.84	172
132 kV	58.00	262.33	95.40	336.00	0.00	0.00	0.00	0.00	1876.67	2628.40	67
66 kV	0.00	0.00	0.00	37.00	0.00	0.00	0.00	0.00	0.00	37.00	2
<b>Total CKm</b>	<b>25254.78</b>	<b>11166.81</b>	<b>11542.94</b>	<b>9268.79</b>	<b>17730.12</b>	<b>20549.61</b>	<b>14141.97</b>	<b>10408.21</b>	<b>9344.10</b>	<b>129407.32</b>	<b>1037</b>
No. of S/S	41	24	16	22	21	20	14	30	19	207	
MVA Capacity	61580.6	27320	19604	22747	50368	29580	17911.2	21667	4570	255347.8	
No. of transformer	125	65	45	57	63	48	38	55	27	523	
No. of bays	648	432	251	298	389	419	154	353	205	3149	

## Voltage wise ckm & MVA Declared under Commercial Operation till 31.03.16 in Different Regions of POWERGRID

Voltage level	NR-I	NR-II	ER-I	ER-II	WR-I	WR-II	SR-I	SR-II	NER	Total	No. of lines
765 kV	2563.42	868.84	712.67	546.92	7097.26	5198.96	1761.19	0.00	0.00	18749.25	76
765 kV (charged at 400 kV)	422.83	562.50	0.00	0.00	0.00	0.00	0.00	379.60	0.00	1364.92	8
800 kV (HVDC)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3507.12	3507.12	2
500 kV (HVDC)	3209.57	0.00	0.00	0.00	0.00	0.00	2737.54	0.00	0.00	5947.11	6
400 kV	15979.64	8025.45	9964.24	7175.83	10407.30	14273.83	9633.74	9217.13	3312.84	87989.99	698
220 kV	3021.33	1447.68	497.46	1173.04	204.56	1076.82	0.00	811.47	647.48	8879.84	172
132 kV	58.00	262.33	95.40	336.00	0.00	0.00	0.00	0.00	1876.67	2628.40	67
66 kV	0.00	0.00	0.00	37.00	0.00	0.00	0.00	0.00	0.00	37.00	2
<b>Total CKm</b>	<b>25254.78</b>	<b>11166.81</b>	<b>11269.76</b>	<b>9268.79</b>	<b>17709.12</b>	<b>20549.61</b>	<b>14132.47</b>	<b>10408.21</b>	<b>9344.10</b>	<b>129103.64</b>	<b>1031</b>
No. of S/S	41	24	16	22	21	20	14	30	19	207	
MVA Capacity	61580.6	27320	19604	22747	50368	29580	17911.2	21667	4570	255347.8	
No. of transformer	125	65	45	57	63	48	38	55	27	523	
No. of bays	648	432	251	298	389	419	154	353	205	3149	

**Note :**

1. Talcher - Kolar Complete Line Length Shown in SR-I
2. New Siliguri - Bongaigaon Complete Line Length Shown in ER-II
3. Kankroli - Zerda Complete Line Length Shown in NR-I
4. DOCO of LILO for ROJA power w.e.f. 01.04.12 received through letter dated 13.06.12
5. Information on DOCO w.e.f.01.07.12 of part of 132 kV Silchar - Hailakandi received from Region on 17.07.12
6. Change in Ckm due to CERC vide order dated 09.05.13 notified DOCO of Nalagarh - Koldam w.e.f 01.04.10

# Construction Of Photovoltaic Plant in Annapolis

**B**uilding Energy SpA, operating as a global integrated IPP in renewable energy industry, announces the beginning of construction of the Annapolis Solar Park, an 18 MW photovoltaic system stretching over an 80-acre area occupied by a landfill in the City of Annapolis, in Anne Arundel County, Maryland. The start of construction has been celebrated on the occasion of an inauguration event in the presence of Annapolis Mayor Michael Pantelides, County Executive Steve Schuh, Annapolis City Alderpersons and Building Energy Managing Director North America Andrea Braccialarghe.

This solar park, that will use over 50,000 panels to convert sunlight into electricity, will be the largest solar project exclusively installed on a closed landfill in the United States, according to the Environmental Protection Agency. Building Energy entirely owns the

power plant and will operate the facility, the construction of which is expected to be completed in the spring of 2018.

The City of Annapolis, Anne Arundel County and Anne Arundel County Board of Education signed a power purchase agreements for the energy produced by the facility, which will be used to power city, county and school buildings and operations. Of the plant's total production capacity, Anne Arundel County is purchasing 50%, the City of Annapolis 33%, while the Anne Arundel County Board of Education the remaining 17%. Several subcontracts have been awarded to local firms for the construction and operation of the plant, creating more than 100 green jobs. The project will also bring financial benefits to the City of Annapolis over the next 20 years, ensuring real energy cost savings. 



## One stop solution for Electrical Switchgear Manufacturers





Visit us at:  
HALL NO - 2  
STALL H2F24

### POWERINST ELECTROMAGNETS PVT. LTD.

- Closing / Tripping Coil Assemblies
- Solenoid Coil Assemblies
- Resin Cast/ Tape Wound Current Transformers
- Fault Passage Indicator
- Remote Switching Device
- Voltage Presence Indicator with Change Over Contacts
- Flag Indicators
- Electromagnetic / Magnetolectric
- Sub Assemblies










21 / 1, MIDC Satpur, Nashik, Maharashtra, India, 422007 Ph: +91-253-2351352, 0253-2351353  
Email: support@powerinst.co.in, ajitkulkarni@powerinst.co.in [www.powerinst.in](http://www.powerinst.in)

PART OF THE INTERSOLAR GLOBAL EXHIBITION SERIES

# inter solar

connecting solar business | INDIA

India's Largest Exhibition and Conference for the Solar Industry  
Bombay Exhibition Centre, Hall 1, Mumbai

# SAVE THE DATES

DEC  
05-07  
2017  
[www.intersolar.in](http://www.intersolar.in)



with special exhibitions



HUSUM  
Wind India



Join us!

- > RELAY TEST SETS
- > TRANSFORMER TEST SETS
- > CIRCUIT BREAKER ANALYZERS
- > PRIMARY AND SECONDARY INJECTION TEST SETS
- > BATTERY TEST SETS
- > ON LINE MONITORING SYSTEMS

## TDX 5000

TDX 5000 is developed as a compact solution for high voltage Capacitance and Tan Delta (Dissipation Factor) measurements. Using the reactor option, TDX 5000 can also perform tests on rotating machines.

- > Fully automatic
- > Variable output frequency: 15 - 500 Hz
- > Output voltage up to 12 kV
- > Tan Delta, capacitance, dissipation factor measurements and exciting current test
- > PADS - Power Apparatus Diagnostic Software for automatic testing, assessment and report
- > USB interface and Ethernet interface for PC connection  
Patented technology for capacitance and Tan Delta measurement
- > Light and compact



### REGIONAL OFFICE - SOUTH ASIA

C-33, Ground Floor, Sector-2, NOIDA-201301, Uttar Pradesh, INDIA  
T +91 120 4543853 / 54 / 4222712 | F +91 120 4574772 | Email [info.asia@isatest.com](mailto:info.asia@isatest.com)

## Film Capacitors: Motor Run Capacitors for 100°C

**T**DK Corporation presents the new B32355C\* series of EPCOS MotorCap™ motor run capacitors, which are designed for a high continuous operating temperature of 100 °C. They are based on a metalized polypropylene film, feature self-healing properties, and conform to the highest Safety Class S3 as specified in IEC60252-1. These robust capacitors have a rated voltage of 400 V AC at 50/60 Hz. The series consists of six different types with capacitance values ranging from 1.5 µF to 5 µF. The components have been approved by the VDE and their design is IEC 60335-1 compatible (safety of household and similar electrical appliances).

A special design feature of the B32355C\* series are the compact dimensions: the capacitors have a diameter of 25 mm and a height of 51 mm to 75 mm, depending on the capacitance. The capacitor

can is made of flame-retardant plastic and filled with a dry resin. The terminals consist of two 100 mm cables. At maximum operating voltage the capacitors offer a life expectancy of at least 10,000 h is achieved. Due to its high temperature resistance, this capacitor is particularly suitable for the motors of heating system pumps as well as other AC applications.

**Main applications**

- Motors of heating system pumps
- AC applications

**Main features and benefits**

- High permissible continuous operating temperature of 100 °C
- Safety Class S3 according to IEC 60252-1
- Compact design

**For further information:** [www.epcos.com/motorrun](http://www.epcos.com/motorrun)

## QuickChain.100: Configure e-chain & Cables Online

**I**gus offers comprehensive online configurators and expert systems on the internet to ensure that energy chain system design and calculation is not a time-consuming process. On the igus website, the customer can not only choose the right cable for their moving application with the chainflex product finder, but also immediately configure their individual energy chain system using the online e-chain expert, QuickChain.100. This ensures reliable data on the durability of the e-chain and the cables, thus making the selection of the most cost-effective system even easier.

With the motion plastics specialist igus, the customer has now the opportunity to find the best energy chain system for a travel of up to 100 metres more easily and quickly: Visit the igus website, open the e-chain expert QuickChain.100 (QC.100), choose unharnessed or harnessed cables, enter the application and environmental parameters and finally select and configure the appropriate energy chain. Within the QuickChain.100 expert, the user can choose from more than 1,200 highly flexible chainflex cables tested by igus as well as over 4,000 'readycable' drive cables. On the basis of the specified cables and application data, space



The igus online QuickChain.100 tool allows a simple and quick assembly of an energy chain system, even with harnessed cables, including service life calculation and CAD data. (Source: igus GmbH)

constraints, dynamics and energy chain environment, the customer can easily choose from a range of 90,000 e-chains parts, which are tested in the in-house laboratory spread over 2,750 square metres. The integrated service life calculation for the energy chain and cables allows the customer to quickly

and easily choose the most cost-effective system that safely meets their requirements.

For customers trained by igus sales staff, a "power mode" is also available, which allows interior separations deviating from the standard recommendations for example the stacking of up to three cables one above the other. This allows the customer to choose a smaller e-chain width. Once the configuration has been completed, this is checked again and approved by igus. The free e-chain expert QC.100 can be used both online and offline, alone and by a team. For example, several team members from different departments can design energy chain systems online at any time and at any place, process the CAD data and order them directly.

**For further information:** [www.igus.eu/qc100](http://www.igus.eu/qc100)

# The one stop solution for all your business needs.

We care about your businesses. Hence, provide solutions for all your fibreglass requirements at one place.



CABLE TRAYS



LADDERS



HAND RAILS



ENCLOSURES



POLES



GRATINGS

## ADVANTAGES



HIGH IMPACT STRENGTH



CORROSION RESISTANCE



NON-CONDUCTIVE



LIGHT WEIGHT



CHEMICAL RESISTANCE



LOW MAINTENANCE

Follow us on  



**Sumip Composites Pvt. Ltd.**  
Ahmedabad - 382213 Gujarat (India).  
Ph: +91 9925003594  
E-mail: [marketing@sumip.com](mailto:marketing@sumip.com)  
Web: [www.sumip.com](http://www.sumip.com)

  
TRUSTED BRAND SINCE 1988

### Kyoritsu RCD Testers

**A** frontline global presence in electrical test & measurement equipment since 1940, with specialized expertise in low voltage test & measurement.

In India, the company has been present for many decades already, offering world class products optimized for Indian needs at 'just right prices'. Many of these products have for long been the choice equipment of every Indian electrical installation professional.

Kyoritsu RCD testers measure trip time and trip out current at different ranges. Constant current source circuitry ensures that a fluctuating mains voltage does not affect the accuracy of readings.

Kyristou's 5410 is high quality RCD conducting testing of rated residual non operating currents at x ½ range, measuring RCD trip time at x1 and x5 ranges .

**5410's key features are:**

- Auto ramp test
- Carrying out constant measurement of voltage in stand by mode at each range.

- Remote test
- 0 and 180 degree phase angle switch permits quick tests and consistent readings.
- Dust and water proof construction.



**Other features of 5410 are:**

- Trip current settings 15mA TO 500 mA.
- Self powered by battery.
- Testing time 200ms to 2000ms.
- Withstand voltage AC 3700V/1 Min (Between electrical circuit and enclosure)
- Safety standards IEC 61010-1 Pollution degree 2 CAT III300V/ CAT II400V.

Kyoritsu Products are readily available in India & have complete Service & Calibration Support Setup too.

**For further information:** [www.kew-ltd.co.in](http://www.kew-ltd.co.in)

### FLIR DM166 - Imaging TRMS Multimeter

**T**he FLIR DM166 is the most affordable multimeter with built-in thermal imaging - a must-have tool for commercial electricians, automation, electronics, and HVAC technicians. Featuring Infrared Guided Measurement (IGM™) powered by an 80 x 60 FLIR thermal imager, the DM166 visually guides you to the precise location of temperature anomalies and potential problems faster, more safely, and efficiently.



issues in both high-voltage and low-voltage applications. It includes the essential measurement features you demand from a multimeter including True RMS AC/DC voltage and current, non-contact voltage detection, VFD mode, and more. Thermal imaging - IR Resolution 60 x 80 pixels with temperature range of -10 to 150 deg C and fixed focus. The DM166 is the most affordable multimeter with built-in thermal imaging to date.

The feature-packed multimeter is an ideal tool for troubleshooting and diagnosing complex

**For further information, email :** [flirindia@flir.com](mailto:flirindia@flir.com). hkt

### "KUSAM-MECO" Volt / mA Calibrator Source & Measures

**K**usam - Mecco Model KM - 700, Volt /mA Precision Hand Held Calibrator, Source and Measure is Power and Current Calibrator introduced by "Kusam - Mecco", an ISO 9001-2008 Certified Company. This Unique Volt /mA Calibrator Source & Measuring Device has a DC Voltage Input and Output Voltage of 0 to 100.00mV/20.000V with an accuracy of +/- (0.02% +3).



For DC Current Input & Output of 24.000mA the Accuracy is +/- 0.015%+3. For a Loop Output of 24V with Accuracy 10%, it has an

Input Impedance of 2 Meg ohm. It has an Over Voltage Protection of 30V, Voltage Driver capability of 1mA.

It has a 5 digit LCD Display. It has a 125mA/250V Fast Acting Fuse with an External Power Option. It has a LCD Display size of 64\*42mm & the dimension of this device is 205\*97\*45\*mm. The Accessories include DC 1.5V (AAA) battery\*6, a Protective Bag, High Quality Double Insulation Test Lead, a Crocodile Jack & a User Manual.

**For further information:** [www.kusam-meco.co.in](http://www.kusam-meco.co.in)

## Electrical Test & Measuring Solutions



Contact Resistance Meter 200A



Turns Ratio Meter



Winding Resistance Meter



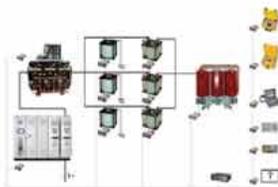
Digital Micro Ohm Meter



M/s Raytech GmbH, Switzerland



Current Transformer Tester



Automatic Transformer Test System



M/s Epro Gallspach GmbH, Austria



ETL Prüftechnik, Germany



75 KV AC High Voltage Test Set



Cast Resin Standard PT



Standard CT



Battery Analyzer



Automatic Portable HV Tester

### OUR PRODUCT RANGE

Winding Resistance Meter  
Turns Ratio Meter  
Digital Microhm Meter  
Contact Resistance Meter  
Current Transformer Tester

Standard Current Transformer  
Standard Voltage Transformer  
Transformer Loss Measuring System  
Automatic Transformer Test System  
Online DGA

Static Frequency Converter (EPS)  
Mobile EPS  
High Voltage PD Filters  
Coupling Capacitor/ HV Dividers  
Online PD Test System

Oil BDV Test Set  
AC HV Test Set  
AC / DC HV Test Set  
Battery Analyzer

Branch Office: 35-B, Ashiana Duplex, Tandalja, Vadodara – 390012 , Gujarat

Ph : +91 9979888269, +91 9374904404, +91 9811004404 Email : info@ngepl.com

Regd. Office : 279-D, Defence Colony, Jajmau, Kanpur -208010, U.P.

Website: www.ngepl.com

## Index to Advertisers

Company Name	Page No.	Company Name	Page No.
ABB India Ltd.	11	International Copper Association India	183
Accent Industries Ltd.	81	ISA Advance Instruments (I) Pvt. Ltd	207
Allied Power Solutions	213	K-Lite Industries	105
Anchor Electricals Pvt. Ltd.	23	Kusam Electricals Pvt. Ltd.	85
Apar Industries Ltd.	61	Kyoritsu Kew India Instruments Pvt. Ltd.	191
Calter Ltd_STI Industries	109	Larsen & Toubro Ltd.	IFC
Central Power Research Institute	83	Leoni Cable Solutions (India) Pvt. Ltd.	67
China Machinex India 2017	99	M&I Material India Pvt. Ltd.	41
Citizen Metalloys Ltd.	57	M/s. N Datta Electricals	203
Crompton Greaves Ltd.	25	M/s. Ramakrishna Electrical Winding Works	214
Deepsea Electronics	173	MGM Varvel Power Transmission Pvt. Ltd.	119
Deif India Pvt. Ltd.	19	Nextgen Equipment Pvt. Ltd.	211
Delta Power Solutions India Pvt. Ltd.	Front Cover	Omicron Energy Solutions Pvt. Ltd.	55
Dilo Armaturen Und Anlagen Gmbh	21	PCI Ltd.	17
Dynamic Cables Pvt. Ltd.	77	Pepperl + Fuchs ( India) Pvt. Ltd.	33
Elecrama 2018	151	Powerinst Electromagnets Pvt. Ltd.	205
Electracon Paradise Ltd.	IFC	Riello Power India Pvt. Ltd.	13
Epcos AG	111	Rishabh Instruments Pvt. Ltd.	51
Epcos India Pvt. Ltd.	47	Schweitzer Engineering Laboratories Pvt. Ltd.	IBC
Flir Systems India Pvt. Ltd.	39	Scope T&M Pvt. Ltd.	7
Fluke Technologies Pvt. Ltd.	Back Cover	Shirke Electro Pvt. Ltd.	199
Frontier Technologies Pvt. Ltd.	89	Sterlite Power	5
Greatwhite Global Pvt. Ltd.	15	Sumip Composites Pvt. Ltd.	209
Hammond Power Solutions	175	Suresh Enterprises	79
Havells India Ltd.	27, 29, 31	Tekmeasure Technologies Pvt. Ltd.	9
Hindustan Petroleum Corporation Ltd.	37	Testo India Pvt. Ltd.	45
Honeywell Automation	35	Transtron Electricals Pvt. Ltd.	53
HPL Electric & Power Ltd.	65	Trinity Touch Pvt. Ltd.	113
Igus India Pvt. Ltd.	101	Universal Cables Ltd.	187
Inter Solar 2017	206	Vishay Components India Pvt. Ltd.	73



# Surge Protection for PV Systems



**HAKEL Ltd.**  
Bharti Stefanu 980  
500 03 Hradec Kralove  
Czech Republic  
t: + 420 494 942 300  
e: info@hakel.cz  
www.hakel.com



**ALLIED POWER SOLUTIONS**  
T - 4, 5 & 6, Third Floor  
Pankaj Plaza - 3, I.P. Extn.  
Patparganj, Delhi - 110 092  
t: +91 11 2224 7322  
e: info@alliedpowersolutions.com  
www.alliedpowersolutions.org  
**Bengaluru:** +91 98869 63195, 98860 08218  
**Kolkata:** +91 83348 95599

**\*\* DEALERS ENQUIRY SOLICITED \*\***



# Ramakrishna Electrical Winding Works

Opp. Boat Club, Pithapuram Road, Kakinada - 533003. (A.P)

Tel: 0884 - 2374185, 2352103, 2373795 Fax: 0884-2348022

Email: rkelecworks2003@yahoo.co.in Visit us : www.rkeww.com



- ❖ Complete Rewinding of 375 MVA, 17 KV, 3000 RPM Water Cooled Stator, Hydrogen cooled Generator with Hallow Conductors, trasposed coils (Robal bars) at Al-Zour South Power Generation & Water Distillation Plant, Kuwait.

An ISO 9001:2008 certified company

## Field of activities

- ❖ Repair, Rewinding, Overhauling & testing of rotating electrical machines (Steam/Gas/Hydro) Generators of lower, higher voltages & power ratings more than 250 MW & Power Transformers (220 KV)
- ❖ Manufacturing of Transposition coils and remaking the same.
- ❖ Commissioning of all electrical equipments.
- ❖ Dynamic balancing of Rotors, Fans & Impellers.
- ❖ Generators Redesigning & uprating of capacity of existing machines without disturbing the rotor winding.
- ❖ Redesigning of cooling systems like air cooled to water cooled and vice versa.
- ❖ Redesigning with change in voltage like 415V to 660 volts or 3.3KV to 6.6KV or 11KV to 15KV & vice versa.

## Profile

- ❖ RKEW is one of the premier and experienced service outfit in the field of electrical motors, generators and transformer repair in India.
- ❖ RKEW an exclusive expertise in executing Repair/Rewinding & Refurbishment of worst damaged industrial steam generators, motors & power transformers. It extends expert service to various locations of its large industrial clients spread across the globe.
- ❖ RKEW team that includes management, technical & skilled man power understands the urgent need of its clients and is well prepared to deliver faster services (with no limitations on size of the machine) to client's satisfaction.

Authorised Service Centre for



The 5-inch diagonal color display with a resolution of 800 × 480 pixels offers direct navigation via a capacitive touchscreen.



Folders and applications provide quick access to bay screens, metering and monitoring data, reports, settings, and more.

The home pushbutton allows users to easily return to the default home screen.

# Visualize What You're Protecting

## Introducing the New Touchscreen for the SEL-751 Feeder Protection Relay

The SEL-751 just got a whole lot easier to use. The 5-inch, full-color touchscreen displays your power system in one intuitive interface. Your settings, bay screens, and other data are just a few touches away from the home screen, and the full keyboard makes it easy to adjust settings and enter passwords. And with an IP54 rating and extensive validation testing, you can be confident the touchscreen will hold up in its surroundings.

To find out more about how the SEL-751 touchscreen makes it faster, easier, and simpler to visualize what you're protecting, visit [selinc.com/India751](http://selinc.com/India751).



# ~~You can't~~ measure voltage without test leads



## The NEW Fluke T6-1000 Electrical Tester

Now measure voltage the same way you measure current, without test lead contact to live voltage. FieldSense technology lets you slide the open fork over a conductor and see the voltage level.<sup>1</sup>

**BE SAFER** Measure voltage to 1000 V ac through the open fork, without test leads.

**BE FASTER** No need to open covers or remove wire nuts.

**BE MORE EFFICIENT** Simultaneously measure voltage and current.

**BE EVERYWHERE** 17.8 mm open fork is widest in the industry; measure up to 200 A on 4/0 wires (120 mm<sup>2</sup>).

<sup>1</sup> Requires capacitive path to ground, provided through user in most applications. Ground connection via test lead may be required in some situations.



SMS "FLUKE<space>ELT6" to 56767 to know more

### New from Fluke



Ti450 SF6



729



64 Max



438-II



368 FC



1630-II

Visit us at **ELECRAMA 2018**, Stall no. H3G20 from 10<sup>th</sup> to 14<sup>th</sup> Mar, 2018 at India Expo Mart, Greater Noida, NCR.

Visit our website [www.fluke.com/india](http://www.fluke.com/india) to have comprehensive T&M solutions from Fluke

Toll Free : 1800 419 3001 | Email : [info.india@fluke.com](mailto:info.india@fluke.com)  
Website : [www.fluke.com/india](http://www.fluke.com/india) | [www.facebook.com/flukeindia](https://www.facebook.com/flukeindia)

# FLUKE®

Fluke. Keeping your world up and running.®