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From the Publisher's Desk

I Welcome 2022 with a Confident Note

Although we are stepping into 2022 with several uncertainties, but if we look at our achievements in the pandemic-affected days, we see that the Indian electrical power industry has undergone several note-worthy and unprecedented improvements. As the old saying goes – every challenge is an opportunity in disguise, exactly the same thing has happened here.

I do not hold any pessimistic view, still it goes without saying that during COP 26, we have realised that we are far behind to be able to control global temperature rise below 1.5 degrees centigrade. In global context, following the Paris agreement, the progress is not at all commendable. Abruptly changing the traditional ways of power generation, transmission and distribution is not possible, thus, it is high time to focus on deriving benefits from small or incremental developments – and I'm happy to note that our country is following that path.

Recently, Deepesh Nanda, the Chief Executive Officer of GE Gas Power South Asia, has stated that India's strategy to move towards using low to zero-carbon fuels for electricity generation is bringing a paradigm shift in the energy space in the region as well as globally. Yes, indeed it is. As on November 2021, India's renewable energy capacity has been 150.54 GW, which was just 76.37 GW in March 2014.

In the transmission segment also, our country has started adopting new technologies. The practice of inspection of high and remote power transmission lines using drones has already started. The state of Maharashtra pioneered the technique in 2020, recently Telangana government also has successfully completed its pilot project with drones.

Thus, I hold quite positive opinion about our industry's future and I welcome 2022 with a note of confidence.

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RECPDCL HANDS OVER THE 'KALLAM TRANSMISSION LIMITED' PROJECT SPV

REC Power Development and Consultancy Limited (RECPDCL), a wholly owned subsidiary of REC Limited, the NBFC Navaratna CPSU under the aegis of Ministry of Power, handed over the project specific SPV (Special Purpose Vehicle) formed for construction of Transmission Project viz., 'Transmission system for evacuation of power from RE projects in Osmanabad area (1 GW) in Maharashtra' to Consortium of IndiGrid 1 Limited and IndiGrid 2 Limited on 28th December, 2021.

Kallam Transmission Limited is a project specific SPV, incorporated on May, 28, 2020 at New Delhi as wholly owned subsidiary of REC Transmission Projects Company Limited. Consortium of IndiGrid 1 Limited and IndiGrid 2 Limited has been the successful bidder



A view of the ceremony of handing over the project...

of the Inter - State Transmission Project of Ministry of Power, GoI and RECPDCL as the Bid Process Coordinator.

The SPV has been handed over by R. Lakshmanan, CEO, RECPDCL and T S C Bosh, Jt. CEO, RECPDCL to Bigyan Parija from IndiGrid 1 Limited and Aditya Kislay from IndiGrid 2 Limited in the presence of other senior officials of RECPDCL, IndiGrid 1 Limited and IndiGrid 2 Limited.

The selection of successful bidder was carried out through Tariff

Based Competitive Bidding (TBCB) process for selection of Transmission Developers in line with the Standard Bidding Documents and Guidelines thereof as notified by Ministry of Power, Government of India. The work involves establishment of 400/220 kV Sub-station at Kallam and LILO of 400 kV double circuit Parli-Pune transmission line. The project is targeted for completion in 18 months. **BI**

BEE ORGANISED WEBINAR AIMING TO PROMOTE AWARENESS AMONGST ITS PERSONNEL, CIVIL SOCIETY

PAT is the flagship schemes under the National Mission on Enhanced Energy Efficiency under the National Action Plan for Climate Change...

The Bureau of Energy Efficiency (BEE) organised a webinar for Designated Consumers under the PAT scheme during the ongoing 'National Energy Conservation Week: 8th-14th December 2021', under 'Azadi ka Amrit Mahotsav'. The Designated Consumers belonged to energy intensive sectors such as Cement, Iron & Steel, Textile, Pulp & Paper, Refinery, Fertilizer, Chlor-Alkali, Thermal Power Plants, and Aluminium.

On this occasion, while delivering the keynote, the Director General, BEE congratulated the Designated Consumers for celebrating the spirit of Azadi and Amrit Utsav by organizing various activities involving awareness, outreach and commitments towards inculcating values of energy conservation and engaging in energy efficiency activities.

The webinar was conducted to interact with DCs

so as to share experiences of the celebration of the week and to highlight their broad course of action plan to contribute to the recent announcements by the Hon'ble Prime Minister at COP 26, Glasgow, UK.

During the webinar, the DCs under the leadership of the Plant Head or Energy Managers highlighted the activities performed during National Energy Conservation Week. The celebration of National Energy Conservation Week included the following main activities: Painting Competition/Essay Writing, Quiz/Competition/Debates, Vriksha Ropan (Tree Plantations), Road Shows on energy conservation in the nearby areas. The DCs of all nine sectors conducted many activities for the employees and other staff to empower them, such as energy walks, online training, tree plantations, and many more where they used social media platforms. **BI**

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INTELLISMART, IIT DELHI COLLABORATE TO DEVELOP NEXT GENERATION SMART GRID TECHNOLOGY SOLUTIONS

In its efforts to advance digitalisation in the power distribution systems, IntelliSmart Infrastructure Private Limited (IntelliSmart), a joint venture of National Investment & Infrastructure Fund (NIIF) and Energy Efficiency Services Ltd (EESL) and India's leading smart metering and digital solutions company, has signed a Memorandum of Understanding with the IIT Delhi's industry interface arm Foundation for Innovation and Technology Transfer (FITT) to collaborate on defining next-generation smart-grid functions, advanced research to drive the development of real-time smart grid solutions with potential to achieve improved revenue management, increased billing efficiency & control, consumer satisfaction and opening up the smart grid data for many newer applications and monetization.

The collaboration aims to evolve new age real-time communication capabilities of Advanced Metering



A view of the occasion of signing the MoU...

Infrastructure (AMI) functional specifications, which will be supported by the enhanced capabilities of next generation equipment/solutions to be developed by the country's leading research institute IIT Delhi (with its industry collaborators) utilizing its advance research outcome in the field of energy efficiency, learning based smart IOT System, smart sensing, data analytics, IOT security, advanced communication technology frameworks of 5G NR/NB-IOT and MEC framework.

The product or solutions will include centralized infrastructure that interconnects with DISCOMs, Power Quality and health monitoring real-time systems of power distribution network & the next-generation smart-meters capable for online connectivity.

Research collaboration will also seek to create sustainable solutions for identified operational problems in the areas of system architecture and design features.

ET

INDIA'S FIRST 3-PHASE AC MAINLINE EMU TRAIN SUCCESSFULLY RUNS FROM KAPURTHALA TO ASANSOL

BHEL has set up an ecosystem for indigenisation of transportation technology thereby strengthening the vision of 'Make in India' and 'Atmanirbhar Bharat'...

Recently, the first 3-phase Ethernet-based AC Mainline Electric Multiple Unit (MEMU), equipped with BHEL manufactured electrics, has rolled out from RCF Kapurthala to Asansol MEMU shed, Eastern Railways. The development has signalled a new era in the urban transportation segment. The 12 coach MEMU train is equipped with 3-phase IGBT-based converter and inverter designed and developed by BHEL.

Significantly, the state-of-the-art Ethernet-based Train Control Management System, which provides advanced control features, has been developed in-house in collaboration with a global OEM. With a focus on passenger comfort and safety, this AC MEMU train is designed for speeds of up to 110 kmph that will make travel faster and comfortable for passengers.

The MEMU train is equipped with the latest GPS-based public address and passenger information system in each coach to facilitate passengers with respect to railway stations enroute. A touchscreen-based user-friendly driver display unit is also installed for easy monitoring and control of the MEMU Train. An air-conditioned driving cab with an ergonomically designed driver desk provides a comfortable driving environment to the driver. Energy efficient LED lights have been provided with 50% emergency lights in each coach.

Notably, the MEMU also features a technologically advanced regenerative braking system, which feeds braking energy back to the overhead supply line, which can be utilised within the system by other trains in the same feeding zone.

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RENEW POWER'S CAPACITY ADDITION WILL HELP AVOIDING HUGE AMOUNT OF CARBON EMISSIONS

ReNew Power, India's leading renewable energy company, has commissioned the 300 MW SECI-6 solar project, pushing the company's total operating capacity to its highest level ever of 7.4 GW. Driving this growth is a record installation of 1.5 GW of renewable energy projects this fiscal year (FY22 YTD), despite challenges related to COVID-19 and supply chain disruptions. ReNew is on track to meet its goal of 8.2 GW of operating capacity by the end of FY22. In FY21, ReNew finished the year with an operating capacity of 5.6 GW.

The bulk of ReNew's organic capacity addition that led it to surge past the 7 GW landmark is located in the states of Rajasthan and Gujarat. The 1.5 GW capacity addition in the current fiscal year comprises



*Sumant Sinha, Chairman and CEO
of ReNew Power*

more than 1.3 GW of utility scale solar projects. These include 1.2 GW in Rajasthan, 105 MW in Gujarat, and 20 MW in Maharashtra. In wind projects, over 150 MW has been installed, including 136 MW in Karnataka and 22 MW in Gujarat.

Speaking about the capacity addition, Chairman and CEO of ReNew, Sumant Sinha, said, "ReNew continues to be at the heart of India's transformation as a clean energy leader. The major organic addition of 1.5 GW of renewable energy projects this fiscal year and the fact that we have crossed

7 GW of commissioned capacity shows we are well on track to achieve our aspirational goal of 18 GW by FY25."

BI

KPTL RECEIVES NEW ORDERS WORTH RS.1,560 CRORES

With over 3,250 highly efficient work force, KPTL delivers compelling advantage, combining in-house research, engineering, project management, construction and manufacturing...

Kalpataru Power Transmission Limited (KPTL), a leading global EPC player in the power and infrastructure contracting sector, has secured new orders and/or notifications of award of Rs. 1,560 crores. The orders include: orders from India, Africa, CIS and South America in the power transmission business and KPTL's international subsidiary has secured new power transmission projects in Europe.

Commenting on the new order announcements, Manish Mohnot, Managing Director & CEO, KPTL, said, "We are delighted with the new order wins, especially that all these orders are in our core power T&D business. These orders in the T&D business reaffirms our confidence in the strong growth of this business going forward. With reduced volatility

and good visibility across all our businesses, we are confident to reach our targeted margin and build a strong order book."

KPTL is part of the Kalpataru Group established in 1969. It is a diversified conglomerate with interest in Real Estate, Power Generation, Agri Logistics and EPC in major infrastructure segments. KPTL is one of the largest specialized EPC companies engaged in power transmission & distribution, oil & gas pipeline, railways and civil infrastructure business. The company is currently executing projects in over 40 countries and has global footprints in 62 countries. It has maintained leadership position in all its major business backed by strong organisational capabilities, superior technical knowhow, and adherence to top-class sustainability standards.

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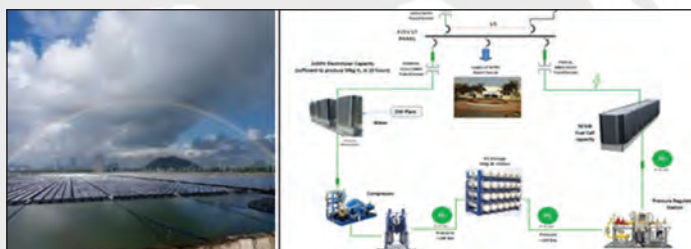
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NTPC AWARDS INDIA'S FIRST GREEN HYDROGEN MICROGRID PROJECT

NTPC Ltd., has awarded the project of 'Standalone Fuel-Cell-based Micro-grid with hydrogen production using electrolyser' at NTPC Simhadri (Andhra Pradesh). This will be India's first Green Hydrogen-based Energy Storage Project and one of the world's largest. It would be a precursor to large scale hydrogen energy storage projects and would be useful for studying and deploying multiple microgrids in various off-grid and strategic locations of the country.

The hydrogen would be produced using the advanced 240 kW Solid Oxide Electrolyser by taking input power from the nearby Floating Solar project. The hydrogen produced during sunshine hours would be stored at high pressure and would be electrified using a 50 kW Solid Oxide Fuel Cell. The system would work in



It will be one of world's largest Green Hydrogen Microgrid Project...

a standalone mode from 5 PM to 7 AM.

This project configuration is designed in-house by NTPC. This unique project for India would open doors for decarbonising the far-off regions of the country like Ladakh, Jammu & Kashmir (J&K) etc.,

hitherto dependent on diesel generators. The project is in-line with the vision of India's Hon'ble Prime Minister for becoming carbon neutral by 2070 and making Ladakh a carbon-neutral territory.

NTPC's current installed capacity is 67,907.5 MW including 13,425 MW through JVs/Subsidiaries. It comprises 47 NTPC stations (23 coal-based stations, 7 gas-based stations, 1 hydro station, 1 small hydro, 14 solar PV and 1 wind-based station) and 26 joint venture stations (9 coal-based, 4 gas-based, 8 hydro, 1 small hydro 2 wind and 2 solar PV).

ET

AMP CAPITAL, STERLITE POWER JOIN HANDS TO UPGRADE INDIAN POWER TRANSMISSION SEGMENT

The partners may in the future contribute further capital for new inter-state transmission projects that are expected to be tendered by the government of India...

Global investment manager AMP Capital has established a 50/50 partnership with Sterlite Power Transmission Limited (Sterlite Power) for the development of energy transmission projects in India. This marks the first investment in India for AMP Capital's global infrastructure equity strategy.

The companies will each invest an initial amount of approximately USD 150 million in the development of four transmission projects, and have put in place debt financing, which represents a total capital outlay of around USD 1 billion. These projects have a circuit length of nearly 1800 kilometres of transmission lines across the Western, Southern and North Eastern regions of India. They will provide the critical infrastructure required for evacuating power from multiple renewable energy generation projects

and will strengthen the power delivery infrastructure in the country.

Transmission infrastructure has underpinned the rapid growth seen in the generation capacity of India over the last decade. This growth has been led by renewable energy, where India is rapidly becoming recognised as a global leader, having surpassed its ambitious Paris Agreement targets with 38% of generation capacity currently from clean energy. The Indian power market still has huge potential for expansion, with low relative per capita power consumption in the country. Due to years of underinvestment in transmission capacity, there is significant demand for investment, now the Indian government has been actively promoting the participation of the private sector in transmission line development through supportive regulatory reforms. ET

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REDFLOW COMMISSIONS TWO MWH ENERGY STORAGE SYSTEM FOR ANAERGIA IN CALIFORNIA

Redflow has completed the 2 MWh energy storage system for Anaergia in California. The 2 MWh sale was announced on March 9, 2021. This represents Redflow's largest single sale of batteries to date. The energy storage system, comprising 192 zinc-bromine flow batteries, has been designed for Anaergia's Rialto Bioenergy



Redflow Energy Pods deployed at Anaergia's Rialto Bioenergy Facility in California...

Facility as part of the Facility's microgrid. The project was funded in part by a grant from the California Energy Commission and consists of the batteries, a biogas conditioning system to support a 2.0MW biogas-fuelled cogeneration unit, and a microgrid control system. The battery system is consisted of 12 x 160 kWh Redflow Energy Pods that are clustered into four

strings tied to four 125 kW Dynapower inverters.

Each of the four battery strings has now been successfully charged and discharged and has passed critical acceptance testing criteria. The final test of the entire system will be executed in January – when Siemens integrate the battery into the microgrid controller and the facility can absorb the entire 2 MWh load of the energy storage system. Anaergia has

given Redflow approval for full invoicing of the project.

Commenting on the installation, Andrew Dale, the Lead Project Manager for Anaergia, said, "Redflow has completed the deployment of the 2 MWh energy storage system, a major milestone for us both, and we look forward to working with them on future energy storage projects."

BI

GE TO SUPPLY WORLD'S FIRST G3-CIRCUIT-BREAKER TO SP ENERGY NETWORKS

The GL312g live tank circuit-breakers will use GE's g³ (pronounced 'g'-cubed) gas insulating and switching technology, which is an alternative to SF₆...

GE Renewable Energy's Grid Solutions has been awarded a three-year framework contract with SP Energy Networks (SPN) in the UK for the supply of 145 kV Sulphur Hexafluoride (SF₆)-free live tank circuit-breakers utilizing GE's g³ gas as the insulating and switching dielectric medium.

Commenting on their attachment, Graham Campbell, Director of Processes and Technology for SPN, said, "We're continuously evolving our operations and looking for ways to make our network more environmentally sustainable. This work with GE over the next three years will allow us to take another step forward in our push towards achieving net zero emissions in the future."

Following a tough tender qualification process, GE

has secured 80% of the forecasted volume of 145 kV SF₆-free live tank circuit-breakers to be supplied to SPN under the three-year 'High Voltage (HV) Main Plant' framework agreement, which will run until June 2024. The agreement will cover the majority of SPN's 145 kV SF₆-free live tank circuit-breaker requirements over the UK's RIIIO-T2 regulatory period. SPN is also planning to take other high voltage equipment from GE, such as disconnectors at different voltage levels to cater to the needs of the SP Transmission (SPT) and SP Manweb (SPM) networks in the UK.

Today, 28 leading electrical utilities have already adopted GE's g³ products for their high voltage networks, avoiding the addition of more than a million tons of CO₂ equivalent to the grid.

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SE LAUNCHES 'GRIDS OF THE FUTURE LIFECYCLE MANAGEMENT' AT ENLIT EUROPE

At Enlit Europe, Schneider Electric has announced its powerful new capabilities that will help grid operators minimize the risk of outages, manage supply and demand flexibility, and improve operational and energy efficiency.

As the frequency of climate-linked severe weather events intensify, Schneider Electric delivers innovative, new software solutions designed to enable greater grid flexibility from distributed clean renewable energy (Electricity 4.0), maximize reliability and resilience, and improve operational efficiency of grid management. Decentralized generation is the future, with a joint Schneider Electric -Bloomberg New Energy Finance (BNEF) assessment indicating that solar is a major under tapped opportunity, with the potential of 167 million households and 23 million businesses worldwide hosting their own clean power



Enlit Europe is the new unifying brand for European Utility Week & POWERGEN Europe. A platform where the community connects 365 days a year...

generation by 2050. These deployments will unlock major decarbonization benefits, but policy and tariff design will be critical to enable them.

All roads to decarbonization rely on distribution utilities (DSOs) that manage the essential infrastructure for the energy transition. Only a data-driven grid overhaul allows the 'prosumer revolution' – the ability of consumers and businesses to generate their

own renewable energy through solar and microgrids and sell excess back to the grid – that we are all counting on to decarbonize the biggest CO₂ emitters, including buildings, homes and personal transportation. With EcoStruxure Grid software and services, Schneider aims to equip distribution utilities with data gathering, data management and advanced analytics solutions that let digital speed up the hard work of decarbonization. **EI**

HILO OFFERS THE FIRST-EVER SMART SOLUTION FOR ELECTRIC WATER HEATERS

Hydro-Québec launched its Hilo subsidiary two years ago, primarily to manage winter peaks when demand on the grid is at its highest...

The Hilo smart home ecosystem now boasts a new service. Beginning in March 2022, the Hilo smart solution for electric water heaters and a compatible HydroSolution water heater will be available to consumers.

During winter, smart water heaters can be shut off remotely for Hilo customers (Montréal) who have authorized this measure. The large quantity of water in the water heaters will remain hot for several hours, which means comfort will not be sacrificed.

A limited quantity of the beta version of the solution will be offered at a cost of \$0 in winter 2022. Customers who have water heaters installed in the coming months will be able to participate in Hilo challenges as of winter 2022-2023 and accumulate rewards.

As is true for all Hilo devices, this is a turnkey option. The new water heater will be installed by a certified installer at no charge and the old water heater—whether rented or owned—will be recycled. The Hilo offer consists of a load controller, a probe and a plumbing kit, which will be provided upon purchase of a 60-gallon, bottom-entry water heater from HydroSolution.

This is the only smart solution for electric water heaters allowing the appliances to be shut off remotely and safely that meets Québec's public health requirements. Hydro-Québec's research institute has developed the technology that reduces the risk of legionellosis infection to a minimum. **EI**



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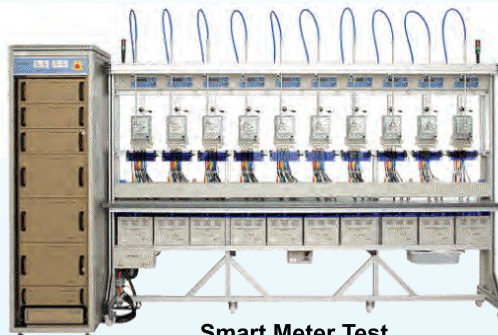
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R. NAGPAL ASSUMES CHARGE OF EXECUTIVE DIRECTOR, NORTHERN REGION-III, POWERGRID



He started his career from NTPC in 1985 as Engineer...

R. Nagpal has taken over the charge of Executive Director of Northern Region-III of Power Grid Corporation of India Limited (POWERGRID). POWERGRID is a Schedule 'A', 'Maharatna' Public Sector Enterprise of Govt. of India, which was incorporated on 23rd October, 1989 – under the Company Act, 1956. Prior to this, he held the responsibility of CGM (Projects) of Northern Region-I of POWERGRID.

Nagpal did his Electrical Engineering from Punjab Engineering College, Chandigarh in the year 1984. He is MBA (Finance) and possesses a Master's Degree in Computer Science. He has served more than 37 years in the Indian Power Sector. He joined POWERGRID in 1991. During his service in various Regions and Corporate Centre, Nagpal played a vital role in the Construction and Operation of various important Power Projects and Transmission Systems. **ET**

A. KRISHNAMURTHI JOINS AXISCADES TECHNOLOGIES LTD. AS MD & CEO



He brings with him two and a half decades of pedigree global technology experience...

AXISCADES Technologies Ltd., a leading end to end engineering and technology solutions catering to the aerospace, defence, heavy engineering, automotive, energy, medical & healthcare sectors, has appointed Arun Krishnamurthi as the Managing Director (MD) and Chief Executive Officer (CEO) effective from 22nd November 2021. Arun has joined AXISCADES from Tata Technologies (TTL), London, where he was the President for the Europe region and responsible for sales of the Europe

business besides sitting on the Board of TTL UK, Romania and Sweden.

Welcoming Arun on board, David Bradley, Chairman, Board of Directors, AXISCADES, said, "We are glad to have Arun on board who joins us at this crucial juncture of taking the organisation to the next level. His rich experience will augur well with the goal of consolidating our presence and market share in important sectors such as Aerospace, Heavy Engineering, Energy, Auto, and Medical Devices." **ET**

R. R. JHA TAKES CHARGE AS DIRECTOR (PROJECTS) OF POWER FINANCE CORPORATION (PFC)



He was earlier working as Executive Director (Projects) in PFC...

PFC has promoted Rajiv Ranjan Jha as Director (Projects) of the company. Jha holds a Bachelor Degree in Science (Mechanical Engineering) from NIT Jamshedpur of Ranchi University and an advanced Diploma in Management from IGNOU.

Before joining PFC, he had worked with Visakhapatnam Steel Plant (Rashtriya Ispat Nigam Ltd.) for more than eight years and dealt with Operation and Maintenance of their coal-based Captive Power Plant.

He was earlier responsible for the entire loan portfolio of Private Sector Projects under Consortium Lending with PFC as lead Financial Institution. He had also handled the Renewable Energy loan portfolio and has worked extensively in the area of Project Appraisal (especially for Independent Private Power Projects). He was also associated with development & award of UMPPs for which PFC is the nodal agency. Jha has been instrumental in resolving some of the large scale stressed assets of PFC. **ET**



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P. C. MCCULLOUGH TO JOIN THE BOARD OF DIRECTORS OF SUNWORKS



As a seasoned Executive, he brings more than 20 years of experience with Fortune 500 companies...

Sunworks, Inc., a provider of solar power and battery storage solutions for residential, agriculture, commercial, industrial, and public works markets, has recently appointed Patrick C. McCullough to its Board of Directors. McCullough brings more than 24 years of C-level experience with startup and mature public companies, including Fortune 500 companies, and relevant expertise in retail energy, renewables, oil & gas, industrial equipment, building products and automotive industries.

McCullough most recently served as Chief Executive Officer, having been promoted from Chief Financial Officer, of Just Energy Group, Inc. (JE), a publicly traded energy management solutions provider with revenues of approximately \$3 billion (CAD). Just Energy sold residential rooftop solar solutions among other energy management offerings. In this role, he led the transformation of the company from a commoditized, push marketing business model to a customer-centric, differentiated value selling solutions provider. **ET**

S. A. GREENSTEIN JOINS THE BOARD OF DIRECTORS OF BORGWARNER



From 2018-2021, she served on the Board of Directors of Briggs & Stratton Corporation...

According to the information available from BorgWarner, Sara A. Greenstein has been named to its Board of Directors. Greenstein holds a Bachelor of Science in Business Administration. Later she earned her MBA from the University of Michigan Stephen M. Ross School of Business.

Commenting on her appointment, Alexis P. Michas, Non-Executive Chairman of the board of BorgWarner, said, “We are pleased to welcome Sara to BorgWarner’s Board of Directors. Sara’s breadth of leadership experience in the production

and manufacturing space makes her a strong complement to our board.”

Greenstein was the President, Chief Executive Officer and Board Member of Lydall, Inc., a leading global manufacturer of value-added engineered materials and specialty filtration solutions serving the industrial, automotive, agribusiness, and medical markets. Prior to joining Lydall, Inc., she served as Senior Vice President of United States Steel Corporation, where she managed the company’s \$4 billion Consumer Solutions business unit. **ET**

R. SALAH ELDEEN MOHAMED TO BECOME THE MD OF ALSTOM EGYPT



He brings 20 years’ experience in sales, management and engineering...

Alstom has recently informed that Ramy Salah Eldeen Mohamed will take over the role of Managing Director of Egypt from Mohamed Khalil – who will relocate to Saudi Arabia and lead Alstom’s business in the Kingdom. Ramy has been the Customer Director for Egypt since 2012, managing Alstom’s business development efforts, tenders and projects in Egypt.

Commenting on this appointment, Andrew DeLeone, AMECA President, said, “Ramy’s intimate customer knowledge

will help us build on our momentum in Egypt and ensure we remain engaged and attentive to our customers’ needs. We are honoured to be part of the transformation of the public transport system of the country. The investment in transportation is commendable and will bring numerous benefits to Egyptians and improve their everyday life. We remain committed to supporting the country’s efforts and will continue to develop strong local capability to support this growth.” **ET**

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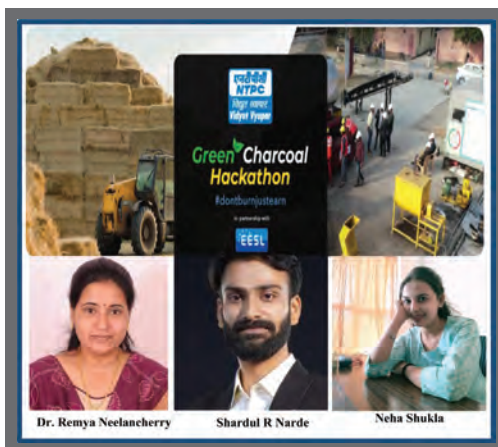
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IIT BHUBANESWAR TEAM WINS INNOVATION AWARD

GREEN CHARCOAL

IT Bhubaneswar team led by Dr. Remya Neelanchery, Assistant Professor, SIF has bagged the Innovation award and cash prize at the prestigious Green Charcoal Hackathon, a technology challenge organized by National Thermal Power Plant (NTPC) and Energy Efficiency Services Limited (EESL). The event was organized with a motto to fast track the development of technology to convert agro residue to charcoal in the pursuit of reducing carbon foot print. The purpose of the event was to bridge the technology gap with the prime objective to clean the air by eliminating farm fire, to produce renewable energy from agro residues, to promote local entrepreneurship, and to increase the income of the farmers.

The award winning team, Dr. Remya Neelancherry,



Shardul Narde (MTech student) and Neha Shukla (research scholar) designed a microwave torrier and pelletizer plant to produce 100 kg/d of charcoal from rice straw, one of the agricultural residues. The team presented the complete process and instrumentation of microwave torrier, torrefaction operation details and business model canvas. The designed technology is capable of converting agro residue

to charcoal at a faster rate compared to conventional method. In addition, the charcoal pellets obtained from the process showed heating value comparable to that of coal. Along with this stunning achievement, the team will also receive financial assistance from NTPC for the development of machine prototype on the basis of mutually accepted terms and conditions. **ET**

BALCO'S POWER PLANTS HONOURED WITH CII ENCON AWARDS 2021

ENERGY CONSERVATION

Bharat Aluminium Company Limited (BALCO) has been conferred with two CII Energy Conservation (ENCON) Awards 2021 for best energy management at its Power Plants. BALCO's 1,200 MW power plant has been declared as State Winner Chhattisgarh with 4.75 Star rated certificate and the 540 MW Power Plant has also been procured with 4.25 Star rated certificate in a large scale category. These achievements stand testimony to BALCO's endeavours in operational excellence.

Congratulating BALCO, Sanjeev Duggal, Managing Director of NTPC GE Power Services Ltd., has said, "We are proud to be associated with BALCO and work in partnership to achieve business goals, keeping in mind the principle of zero harm, zero waste and zero discharge. Together we will strive for sustainable operations through effective



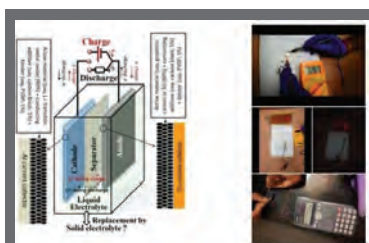
practices of energy management, safety and productivity."

Commenting on the achievement, Abhijit Pati, CEO and Director, BALCO, informed, "At BALCO, we are committed to maximizing our efforts of energy conservation. With such efforts, we aim to achieve the larger goal of creating a sustainable future for the generations to come and contributing to the expeditious development of the nation. BALCO has been an early adopter of smart technologies for heightened operational efficiencies,

which further bolsters energy optimization, safety and productivity that we have meticulously fostered across the organization. We are dedicatedly driving the Environment, Social and Governance (ESG) dimensions of sustainability for building a greater tomorrow and, therefore, are actively exploring innovations that can help reduce carbon footprint as early as possible in the creation process." **ET**

PROF. A. MUKHOPADHYAY RECEIVES THE SWARNAJAYANTI FELLOWSHIP FOR 2021

Prof Amartya Mukhopadhyay from the Department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay (IIT Bombay), Mumbai, has received the prestigious fellowship for the year 2021, for his contribution to the field of Engineering Science. The Swarnajayanti fellowship comes with Rs. 25,000/- monthly stipend along with a research grant for five years. He is also the recipient of several other awards and recognitions, notably, recognised by the Royal Society of Chemistry (United Kingdom) journals as one of the ‘2019 Emerging Investigators’ and conferred with the Young Engineer Award from the Indian National Academy of Engineering (INAE). Also, he has co-authored a textbook - Interdisciplinary Engineering Sciences: Concepts and Applications to Materials Science.



Overview of the research work...



Prof. Amartya Mukhopadhyay

Prof Mukhopadhyay heads the High Temperature and Energy Materials Laboratory at IIT Bombay. He has been instrumental in the pioneering research in finding new reactive alloys for designing anodes for Lithium-ion and Sodium-ion batteries. He says, “We aim to build better, robust, long-lasting rechargeable batteries for advanced applications, such as batteries for electric vehicles and for storage of energy harvested from renewable sources.”

Prof Mukhopadhyay’s group is actively researching novel solutions, one of them being focusing on designing new alloy materials that will reduce lithium-plating and ‘dendrite’ formation in the lithium-ion battery systems, thus improving the battery’s safety aspects. In addition, they endeavour to improve the battery’s energy storage capacity, the possibility of rapidly charging the battery (in a few minutes) and battery longevity.

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VISHAY INTERTECHNOLOGY’S ENERGY STORAGE COMPONENT RECEIVES RECOGNITION

The 235 EDLC-HVR ENYCAP capacitor series manufactured by Vishay Intertechnology, Inc., has received a 2021 AspenCore World Electronics Achievement Award in the High Performance Passive/Discrete Devices category. The devices are the industry’s first ruggedized ENYCAP electrical double-layer energy storage capacitors to offer useful life of 2,000 hours at +85 °C while meeting the highest class of moisture resistance: the biased 85/85 1,500-hour test.

Presented by AspenCore, the world’s largest media group within the technical electronics sector, the World Electronics Achievement Awards (WEAA) program honours companies and individuals who have made outstanding contributions to innovations and development in the electronics industry worldwide. Product award winners are selected by a judging panel comprising AspenCore editors, as well as through



online voting by engineers around the globe. In 2021, Vishay’s 235 EDLC-HVR series has received the most votes in the High Performance Passive/Discrete Devices category.

The long useful life of 235 EDLC-HVR series devices is double that of standard electrical double-layer capacitors, enabling maintenance-free operation and greater design flexibility for energy harvesting and power backup applications in harsh, high humidity environments. Uses include a wide range of industrial, renewable energy, and automotive applications. Among them are smart meters, handheld electronics, robotics, solar panels, e-latch door systems, transmission gearboxes, auxiliary power backup for navigation systems, emergency lighting, and more. AEC-Q200 qualified and UL-810 recognized, the capacitors meet the highest quality standards.

14

Increased Investment to Boost the Global Power Sector

TBRC's latest report predicts good growth of the Power Generation, Transmission, and Distribution Market...



According to the latest report by the TBRC Business Research, titled “Electric Power Generation, Transmission, And Distribution Global Market Report 2022 – Market Size, Trends, And Global Forecast,” the power generation industry is expected to see increased investment activity. Investments in microgrid technology, renewables and other advanced technologies are expected to drive the market.

According to the Global Innovation Report, the total capacity of microgrid is expected to reach 1.2 GW by 2024 in North America with an annual revenue of \$4.2 billion. The United States Senate enacted a \$1.2 trillion infrastructure bill in August 2021, which includes financing to accelerate clean energy initiatives. The growing investment in the power generation will drive the growth of electric power generation, transmission, and distribution market.

According to the TBRC researchers, electric power generation companies are increasingly using batteries to store solar energy during daylight hours. These energy-storage sites consist of large lithium-ion batteries. These batteries store enough energy to serve as a back-up in case of fuel shortages. They are designed to absorb solar power and feed it back to the grid. These systems

minimize the need for capital intensive power generation plants, thereby enhancing transmission and distribution efficiencies and thus reduce operational costs. For instance, by 2025, the World Bank Group aims to fund 17.5 Gigawatt hours (GWh) of battery storage, more than tripling the current 4-5 GWh installed across all developing nations.

They feel that the global electric power generation, transmission, and distribution market size is expected to grow from \$4.09 trillion in 2021 to \$4.43 trillion in 2022 at a Compound Annual Growth Rate (CAGR) of 8.3%. The growth in the electric power generation, transmission, and distribution market is mainly due to the companies rearranging their operations and recovering from the COVID-19 impact, which had earlier led to restrictive containment measures involving social distancing, remote working, and the closure of commercial activities that resulted in operational challenges. The electric power generation, transmission, and distribution market growth is expected to reach \$5.93 trillion in 2026 at a CAGR of 7.6%.

They find that the Asia Pacific was the largest region in the electric power generation, transmission, and distribution market in 2021. Western Europe was the second largest region in the electric power generation, transmission, and distribution market. 51

For further information: <https://www.thebusinessresearchcompany.com/report/electric-power-generation,-transmission,-and-distribution-global-market-report>

Researchers Expect Growth in Switchgear Market

SDKI has recently published a research report, which finds a \$ 155 billion worth market for switchgears by 2025...



Global switchgear market is expected to grow from around \$ 100 billion in 2019 to \$ 155 billion by 2025. Switchgears are switching devices designed to protect, regulate & control power generation, transmission & distribution equipment and electric motor control systems. They are located on both the low voltage and high voltage side of large power transformers in substations. A switchgear includes circuit breakers, fuses, and isolators. Besides stopping flow of current in a circuit manually, switchgear automatically do the thing whenever there is an over current in the circuit or any other abnormal situation arises, thereby protecting valuable equipment.

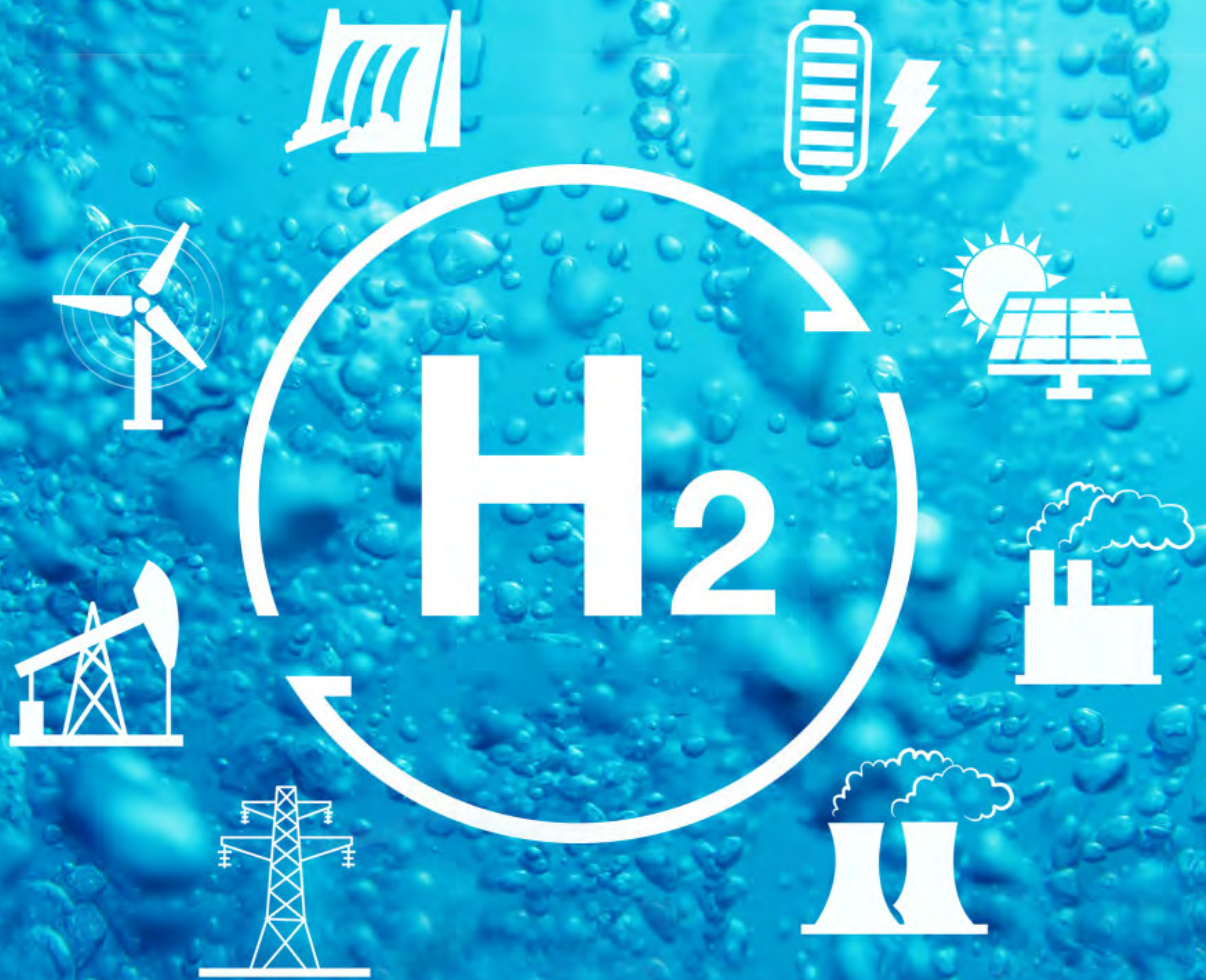
Growing investments in renewable forms of energy and surging demand for safe and secure control distribution systems and advanced monitoring units is increasing the demand for switchgear. Additionally, the replacement and modernization of aging electrical networks is further contributing to the growth of global switchgear market. Innovations in smart grid technologies and growing focus towards environmental protection would further boost the demand for switchgear, globally.

The global switchgear market is segmented based on insulation, installation, voltage, product, end user, region and company. Based on insulation, the market can be segmented into air insulated, gas insulated and others. The gas insulated segment is expected to hold the largest market share during the forecast period on account of its use in various industries for fulfilling the high demand for energy. Based on installation, the market can

be bifurcated into indoor and outdoor. The outdoor segment is expected to grow at a fast pace during the forecast period owing to the widespread application in transmission and sub transmission sectors. Based on voltage, the market can be categorized into low, medium and high. The low voltage segment is expected to dominate the market and hold the highest share of the market during the forecast period. Based on end user, the market can be fragmented into Transmission & Distribution Utilities, Industrial, Commercial, Residential and Others. The Transmission & Distribution utilities segment is anticipated to register high CAGR during the forecast period, as the segment is responsible for the generation, transmission, and distribution of electricity.

The Asia-Pacific region is expected to dominate the overall switchgear market followed by Europe, North America, Middle East & Africa and South America. The major players operating in the global switchgear market are Bharat Heavy Electricals Ltd., Mitsubishi Electric Corporation, CG Power and Industrial Solutions Limited, Siemens Aktiengesellschaft, General Electric Company, Eaton Corporation plc, ABB Ltd., Alstom SA, Schneider Electric SE, Havells India Limited and others. 

For further information: <https://www.sdki.jp/sample-request-77439>



HYDROGEN THE NEXT HOPE

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As a fuel, hydrogen has a critical role to play in driving the paradigm shift towards a green and sustainable economy. Up to the end of October 2020, there were about 161 operating fuel cells at 108 facilities in the United States with a total of about 250 MW of electricity generation capacity – including the largest one at the Red Lion Energy Center in Delaware with about 25 MW electricity generation capacity. Use of hydrogen-based clean power generation will increase further in the post-COVID era. It is also expected that the cost of production of hydrogen will be much lower than it is today...

- P. K. Chatterjee (PK)

Although, as far as the development of new sources of energy is concerned, of late solar energy has been gaining ubiquitous support and prominence, almost parallelly the hydrogen technology is being developed at a rapid pace. In the coming days, at many applications (especially in power sector) these two technologies will function as complementary to each other.

As per International Energy Agency, (IEA), “Hydrogen and energy have a long shared history – powering the first internal combustion engines over 200 years ago to becoming an integral part of the modern refining industry. It is light, storable, energy-dense, and produces no direct emissions of pollutants or greenhouse gases. But for hydrogen to make a significant contribution to clean energy transitions, it needs to be adopted in sectors where it is almost completely absent, such as transport, buildings and power generation.”

The development

Almost two years back, IEA found that supplying hydrogen to industrial users was becoming a major business around the world. That time the demand for hydrogen had grown more than three-fold since 1975. However, almost the entire production of hydrogen was dependent on fossil fuel. Naturally, the production of hydrogen was responsible for CO₂ emissions of around 830 million tonnes of carbon dioxide per year, equivalent to the CO₂ emissions of the United Kingdom and Indonesia together.

Since then the scenario has changed a lot. As per IEA's latest report (2021), “The time is ripe to tap into hydrogen's potential contribution to a sustainable energy system. In 2019, at the time of the release of the IEA's landmark report ‘The Future of Hydrogen’ for the G20, only France, Japan and Korea had strategies for the use of hydrogen. Today, 17 governments have released hydrogen strategies, more than 20 governments have publicly announced that they are working to develop strategies, and numerous companies are seeking to tap into hydrogen business opportunities. Such efforts are timely: hydrogen will be needed for an energy system with net zero emissions.”

IEA's ‘Net Zero by 2050: A Roadmap for the Global Energy Sector’, states that the use of hydrogen will extend to several parts of the energy sector and grow six-

fold from today's levels to meet 10% of total final energy consumption by 2050. This will all be supplied from low-carbon sources.

Present status

According to IEA's ‘Global Hydrogen Review 2021,’ currently, global production of low-carbon hydrogen is minimal, its cost is not yet competitive, and its use in promising sectors such as industry and transport remains limited – but there are encouraging signs that it is on the cusp of significant cost declines and widespread global growth.

A few pilot projects are underway to produce steel and chemicals with low-carbon hydrogen, with other industrial uses under development. The costs of fuel cells that run on hydrogen are continuously falling, and sales of fuel-cell vehicles are growing.

Obstacles on the way

Although, use of hydrogen as a fuel is advantageous in several respects, its cost of production is still very high that needs to be lowered. That's why IEA points out, “Investments and focused policies are needed to close the price gap between low-carbon hydrogen and emissions-intensive hydrogen produced from fossil fuels. Depending on the prices of natural gas and renewable electricity, producing hydrogen from renewables can cost between 2 and 7 times as much as producing it from natural gas without carbon capture. But with technological advances and economies of scale, the cost of making hydrogen with solar PV electricity can become competitive with hydrogen made with natural gas.”

Capacity of electrolyzers

Global capacity of electrolyzers, which produce hydrogen from water using electricity, doubled over the last five years, with about 350 projects currently under development and another 40 projects in early stages of development. Should all these projects be realised, global hydrogen supply from electrolyzers – which creates zero emissions provided the electricity used is clean – would reach eight million tonnes by 2030. This is a huge increase from today's level of less than 50 000 tonnes – but remains well below the 80 million tonnes required in 2030 in the IEA pathway to net zero emissions by 2050.

As per IEA, practically all hydrogen use in 2020 was for refining and industrial applications. However, hydrogen can be used in many more applications than those are common today. The gas has important potential uses in sectors where emissions are particularly challenging to reduce, such as chemicals, steel, long-haul trucking, shipping and aviation.

The challenge at present

The broader issue is that policy action so far focuses on the production of low-carbon hydrogen, while the necessary corresponding steps that are required to build demand in new applications are limited. Enabling greater use of hydrogen in industry and transport will require much stronger policy measures to foster the construction of the necessary storage, transmission and charging facilities.

As IEA points out, countries with hydrogen strategies have committed at least USD 37 billion to the development and deployment of hydrogen technologies, and the private sector has announced additional investment of USD 300 billion. But putting the hydrogen sector on path consistent with global net zero emissions by 2050 requires USD 1 200 billion of investment between now and 2030.

What needs to be done?

The governments could stimulate demand and reduce price differences through carbon pricing, mandates, quotas and hydrogen requirements in public procurement. In addition, international cooperation is needed to establish standards and regulations, and to create global hydrogen markets that could spur demand in countries with limited potential to produce low-carbon hydrogen and create export opportunities for countries with large renewable energy supplies or large CO₂ storage potential – suggests IEA.

The Indian scenario

India is the country naturally blessed with the scope of producing huge amount of green hydrogen. As promised in the Union Budget for 2021-22, on India's 75th independence day i.e., 15th August, 2022, Prime Minister Narendra Modi had announced a Hydrogen Mission.

Our prudent government is already active in scaling up the gas pipeline infrastructure across the length and breadth of the country. It has also taken steps to reform our complete power grid that includes smart grids. All these

will lead to the effective integration of renewable energy in the current energy mix.

Indigenous scientific development: Indian researchers have come up with an innovative hydrogen manufacture route that increases its production three times and lowers the energy required that could pave the path towards environment-friendly hydrogen fuel at a lower cost.

In addition to having about three-fold higher calorific value compared to non-renewable energy sources such as coal and gasoline, the combustion of hydrogen to release energy and produces water – thus it is completely non-polluting. Due to the extremely low abundance of molecular hydrogen in the earth's atmosphere (350 ppbv), electric-field driven breakdown of water is an attractive route for production of hydrogen. However, such electrolysis requires high energy input and is associated with slow rate of hydrogen production. The use of expensive platinum-iridium-based catalysts also discourages it for wide-spread commercialization. Therefore, the transition to 'green-hydrogen-economy' demands approaches that lower the energy cost and material cost and simultaneously improve the hydrogen production rate.

A remarkable development: A team of researchers from IIT Bombay led by Prof. C. Subramaniam have come out with an innovative route that provides viable solutions to all these challenges. It involves electrolysis of water in the presence of an external magnetic field. In this method, the same system that produces one ml of hydrogen gas required 19% lower energy to produce three ml of hydrogen in the same time. This is achieved by synergistically coupling the electric and magnetic fields at the catalytic site.

The simple approach also provides the capability to retrofit any existing electrolyser (that uses electricity to break water into hydrogen and oxygen) with external magnets without drastic change in the design, leading to increased energy efficiency of H₂ production.

Our pioneering project: NTPC has already awarded a project of 'Standalone Fuel-Cell based Micro-grid with hydrogen production using electrolyser in NTPC Guest House at Simhadri (near Visakhapatnam)'. It is India's first Green Hydrogen-based Energy Storage Project. It would be a precursor to large scale hydrogen energy storage projects and would be useful for studying and deploying multiple microgrids in various off grid and strategic locations of the country.



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CHALLENGES & THEIR MITIGATION PART 1

NETC's 400kV Palatana-Silchar-Bongaigaon double circuit corridor in North Eastern part of India is a very important transmission line. This article describes how the line is maintained to ensure 100% availability...

In India power utilities are under tremendous pressure to meet the growing demand for power as the country is on a firm footing on the development trajectory to become one of the largest economies of the world. To meet the increasing energy demand coupled with the fact that the load centers being far away from generating stations, transmission lines are to be constructed and maintained in all types of terrain. The task of maintaining these transmission lines becomes very arduous and difficult, if the terrain is hilly with steep gradients covered by dense tropical rainforest bordering river valleys. Such type of terrain poses many threats to the security of the Transmission system, which entails various cost-effective and innovative techniques of maintenance protocol.

North East Transmission Company (NETC) is entrusted with maintenance of its 662.8 Km, 400 kV Double Circuit transmission corridor through similar difficult hilly & dense forest terrain of the States of Tripura, Meghalaya and Assam in the North Eastern Region (NER) of India. Some of the forest terrains are also inhabited by wild animals mainly Elephants

& Leopards. The transmission line crosses two major rivers namely Brahmaputra and Barak. The mighty Brahmaputra river with its source in Tibet, flows down through the steep Southern Himalayas with great speed and flows with huge discharge & speed during monsoon season from its numerous tributaries causing erosion, flash floods and siltation leading to frequent changes of its course. Similarly, the Barak river also causes flood and erosion. The terrain consists of various types of soil viz., laterite, alluvial, loamy etc., and is prone to sinking and landslides due to steep gradient and soil characteristics. The transmission lines traverses through terrain with the high rainfall, wind zones of V & VI and high Isokeraunic level. Increasing threat from insurgency adds up to the multiplicity of problems.

This article strives to describe in detail various types of challenges being faced and their mitigation measures adopted by NETC.

NETC's transmission line corridor

NETC's transmission line corridor is evacuating almost one third of the power demand of the North Eastern Region of India along with exporting power to a neighboring country. A map showing transmission line corridor in NER [Reference 1] is exhibited in Fig-1.

This 400 kV transmission line corridor has been envisaged to evacuate power from ONGC Tripura Power Company's (OTPC) Palatana Gas Based Combined Cycle Power Project of 2x 363.3 MW in

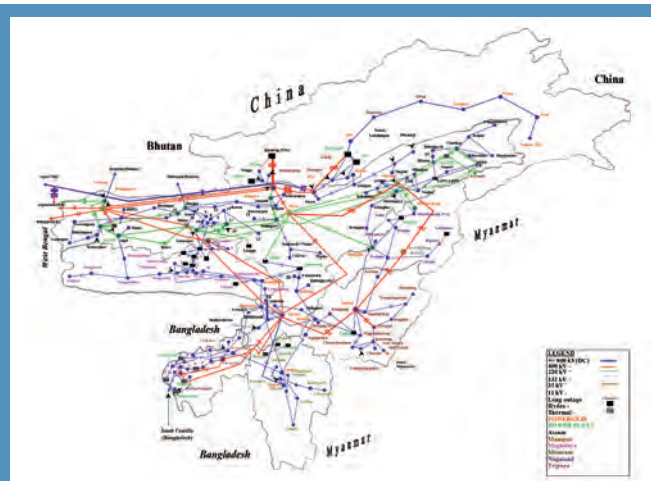


Fig-1: Transmission Line Corridor in NER...

Tripura state. NETC has constructed 662.8 km of 400 kV Palatana- Silchar- Bongaigaon Double circuit line as detailed below

- 400 kV Palatana- Silchar D/c line (247.39 km)
- 400 kV (First circuit of D/C) Silchar- Byrnihat line (214.41 km)
- 400 kV (Second circuit of D/C) Silchar- Azara line (256.41 km)
- 400 kV (First circuit of D/C) Azara - Bongaigaon line (159 km)
- 400 kV (Second circuit of D/C) Byrnihat-Bongaigaon line (201 km)

Challenges

The task of maintaining the transmission line corridor with 100% availability is a prime concern. NETC is facing the following major challenges:

- Vulnerability of line due to exposure of tower foundations because of land slide & rains. The transmission line is traversing through Assam and Meghalaya having highest rainfall to the tune of about 3 to 5 times the average rainfall in India. The average annual rainfall in India is 300- 650 millimetres.
- Submergence of towers in low lying areas
- Tower endangerment during high wind & cyclones and changing course of rivers
- Outages due to severe lightning in hilly terrains with high soil resistivity
- Transient fault & safety threat due to fast growth of vegetation and bamboo trees on hillsides due to the climatic condition of NER, and local tradition of subsequent burning of these under transmission lines

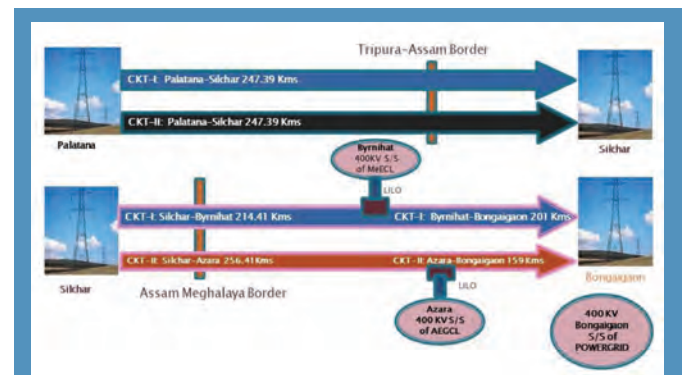


Fig-2: NETC's transmission line corridor...

Table -1: Average Annual Rainfall of the NER States...
Source: www.rainwaterharvesting.org

Sl. No	State	Meteorological Divisions	Average
1.	Arunachal Pradesh	Arunachal Pradesh	2,782
2.	Assam	Assam and Meghalaya	2,818
3.	Meghalaya	Assam and Meghalaya	2,818
4.	Nagaland	Nagaland, Manipur, Mizoram and Tripura	1,881
5.	Manipur	Nagaland, Manipur, Mizoram and Tripura	1,881
6.	Mizoram	Nagaland, Manipur, Mizoram and Tripura	1,881
7.	Tripura	Nagaland, Manipur, Mizoram and Tripura	1,881

NETC
LINE
REGION

- Impact on the life of transmission line and outages due to rapid industrial pollution.

In addition to the above mentioned environmental & climatic challenges, there are many local & social challenges related to insurgency, theft, Right of Way etc.

Measures adopted to mitigate these challenges

Temporary and permanent wall protection

In the year 2018, the State of Tripura experienced unprecedented heavy monsoon with incessant rains in the month of June. The intensity of rain was so severe that within a time span of 7 – 10 days the free flowing rain water caused very heavy landslides in the entire hilly stretch of Tripura State resulting in number of road blockades in the Inter-State National Highway including some arterial roads.

Due to the above landslide, 15 tower locations were badly affected and 8 tower locations became vulnerable. This line being the only high-capacity line for evacuation of power from a 726.6 MW Generation Plant, any break



Fig: 3B - Temporary protection locations...



Fig: 3C - Permanent protection with RRM wall in location...

Fig: 3A to C: The severity of landslides, temporary and permanent arrangement adopted in few locations...



Fig: 3A - Land slide locations...

down like tower collapse etc., would have caused outage of the plant resulting in severe power crisis in the North Eastern Region. This emphasized immediate temporary measure to protect these vulnerable towers by providing bamboo palisade in multi steps along with empty cement bags filled with earth were taken in all these locations for providing minimum protection. Sufficient plantation was also done in the eroded sides of the locations to retain the soil.

However, as the measures taken were temporary in nature during that difficult time, Random Rubble Masonry (RRM) walls were subsequently constructed in 8 badly affected towers' locations before the onset of next monsoon to provide permanent protection. More plantation work is also being continued in these locations to increase the stability of the soil and to reduce erosion.

Stub encasement & additional anti rust painting of tower legs in water logged areas

Some sections of the transmission lines (i.e. around 300 towers) remain submerged up to 7 months in a year in the low lying area in the State of Assam causing corrosion and rusting in the stub. For permanent eradication of this problem, the stubs of these towers were encased by raising the chimney heights by providing RCC up to various heights (max. up to 1.5 metres) depending upon the submergence water level of the towers. Further after encasement, in the towers where submergence level was beyond 1.5 metres, tower legs were painted up to the height of 3.0 metres with silverish coating fortified with Zinc & other metallic powder (MOSIL ZS – 44 & MOSIL RCH – 100) for prevention of rust and corrosion.

Adoption of pile foundations for towers under threat due to river changing its course

The Byrnihat / Azara – Bongaigaon section of the line is crossing the Brahmaputra River in the state of Assam. The crossing involves 2 nos. well foundation locations as exhibited in Figure 4A, 1 no. pile foundation location and 2 nos. anchor tower locations on open cast foundation having depth of 3 metres with total crossing distance of 2.564 km. The Brahmaputra River is the largest river in the Indian sub-continent with very high velocity and

the 10th largest in the world in terms of discharge and known for its character of shifting its course.

One of the anchor tower locations on the right bank of the river was 137 metres away from the river bank edge during construction in 2010. Subsequently, because of continuous erosion of the bank the distance reduced to 10 metres in the year 2016, which was 137 metres during 2010 as exhibited in Figure 4B. During the year 2016, this Anchor Tower location also got submerged under the river water. Considering the fact that any further shifting of bank line or formation of any whirlpool in this area may cause a problem to the stability of the Anchor Tower

Table 2 : Pile foundation details...
Source: NETC Inhouse Data

Type of Pile	R.C. Bored
Method of Piling	Hydraulic Rig
Concrete Grade	M25
Total Nos. of Pile	24 nos.
Nos. of Pile on Each Leg	6 nos.
Liner Depths of a Pile from test level (m)	10.00 m
Pile Diameter	1200 mm
Pile depths from test level	49.90 m
Pile Cap	7.5 m x 4.5 m x 1.2 m
Chimney	Dia. = 1 m, Vertical Height = 2.52 m

foundation, this location was shifted to a safer location with pile foundation as per details indicated below in Table 2. Prior to shifting, to protect this location from the continuous river bank erosion, Bamboo Palisading work had to be provided at the river bank face as a temporary protection measure as exhibited in Figure 4C.



Fig: 4A: Two nos. well foundation locations...



Fig: 4B: Anchor Tower in old location...

Transmission Tower

For smooth and accident-free work of pile foundation, one of the circuits that was directly above the new pile foundation under construction had to be shifted by



Fig: 4C: Temporary protection in old location...



Fig 4D: Use of Emergency Restoration System (ERS)...

using an Emergency Restoration System (ERS) tower as exhibited in Figure 4D. Subsequently, on completion of the pile foundation the entire work of tower erection and final stringing was carried out by keeping one of the circuits continuously charged as per requirement – so as to keep the power flow through this line intact. All tower foundations have been designed with adequate factor of safety.

Adoption of chemical earthing along with provision of Transmission Line Arrestors (TLA) in high isokeraunic level coupled with high soil resistivity

The Silchar- Byrnihat section in the state of Meghalaya, encounters severe lightning in the hilly terrain having high soil resistivity [Reference 3]. Due to which number of outages were experienced in this section during monsoon period in spite of regular maintenance of the section. The main cause of tripping was attributed to the lightning during and on set of monsoons. On measurement of Tower Footing Resistance (TFR) of the section, value of TFR was found high in 129 tower locations.

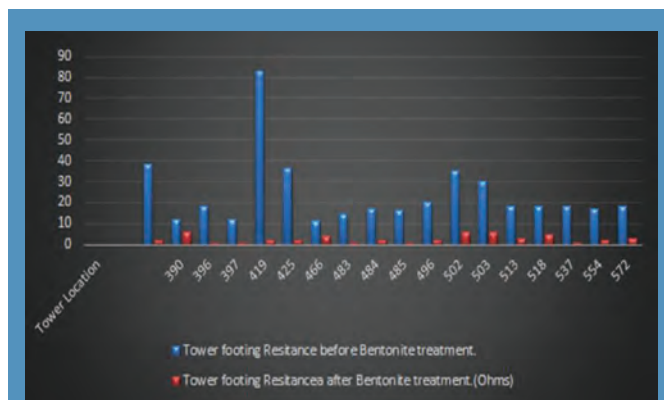


Fig-5: TFR results before and after using marconite...

To minimize the TFR value, sodium bentonite having high moisture characteristics & swelling properties was used as Ground Enhancement Materials. The TFR results improved significantly as exhibited in Figure 5. The existing counterpoise earthing trenches were excavated, a layer of about 4 cm of sodium bentonite slurry [Reference 4] applied to the existing counterpoise trenches & the trenches refilled with excavated soil.

As the life of marconite, another Ground Enhancement Material is comparatively higher, NETC is in process to use it on experimental basis. Further, based on experience gained from successful operation of the Transmission Line Arrestors (TLAs) in lightning prone areas for 220kV & 132 kV system in India, use of 400 kV TLAs is considered to be the best option to eliminate the issue of outages permanently. NETC is exploring adoption of 400kV Transmission Line Arrestors (TLA) in near future though these are costlier and its successful operational experience are yet to be established in Indian grid.

Clearance of vegetation at frequent intervals and developing environmental awareness among local people

The entire North Eastern part of India falls under tropical rain forest zone and the trees and plants grow very fast in these areas. The quickest such growth is observed with Bamboo, which covers the entire region. Therefore, along with a schedule of ground patrolling with three cycles in a year i.e., pre-monsoon, post-monsoon and before high-wind season being followed for clearing the vegetation, the line sections traversing through the forest areas are being patrolled regularly. Such practices have minimized the outage of Transmission Lines due to vegetation faults.



Fig-6: Jhum burning for cultivation purpose...

In NER, the tribal forest dwellers follow the age-old practice of burning the forest cover for cultivation purpose known as Jhum Cultivation as exhibited in Figure 6. On many occasions, outage of transmission lines had been observed due to such burning. Therefore, to stop such practices the forest dwellers have been educated in collaboration with the local administration, to develop environmental awareness among them. This has considerably reduced the outage of transmission line to a great extent.

Replacement of disc insulators with polymer insulators and painting of towers with zinc rich anti-corrosive paint in polluted area.

Some towers in Silchar- Byrnihat section are located in the industrial zone of Byrnihat town in Meghalaya, causing flash over due to deposition of industrial dust and subsequent outage of the line. The pollution combined with humidity reduces the surface resistance of porcelain disc insulators, which lead to flow of leakage current on the surface. Leakage current with large magnitude flowing on the surface for long period causes degradation of the insulator performance leading to flashovers ultimately thereby effecting the reliability of power supply system.

NETC replaced all porcelain disc insulator strings with polymer insulators due to the fact that hydrophobicity properties of polymer insulators are best suited in polluted environment.

Due to such heavy pollution in the area, the tower members including the leg members also get severely rusted and corroded causing concern for structure

strength. Therefore, Zinc rich paint and anti-pollution paint with necessary primer coat have been provided as preventative measures.

Asset monitoring

In addition to regular on-line update on weather condition, physical patrolling of the line to clear any bamboos & vegetation, three cycles of patrolling are done in a year i.e., pre & post monsoon and before high wind season [Reference 5]. Due to climatic and geographical condition of the area and data analysis done so far, NETC has its priorities on the asset, as per following:

- Foundations- In lands slide area, river bank foundations, low lying areas
- Towers - In theft prone area
- Insulators - In lightning prone area / polluted / industrial / mining area
- Hardwares - In lightning prone area/ high wind / normal
- Conductors - In river crossings spans/ other areas
- Earthwire - In river crossings/ lightning prone areas/ high
- Earthing of towers- In lightning prone areas

Due to above, NETC has strengthened the foundations, provided missing members in towers, replaced porcelain disc & composite insulators with polymer insulators, replaced damaged clamps & jumpers, replaced broken strand conductors & earth wire and strengthened earthing conductors. For condition monitoring of insulators, hardware, jumper connection etc., Punctured Insulator Detection (PID), thermo vision scanning and night patrolling is also taken up. To identify & rectify the fault as per indication of fault locators, tower top emergency patrolling is done on regular basis. The identified vulnerable location, leaning trees on uphill side, land slide areas, mining & blasting prone areas are monitored through monthly inspection. For on line monitoring, data analysis and inspection, NETC is exploring use of drone in near future.

...To be continued 



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Role of AI and ML in Power Measurement

Enough research has been done in academia and the AI firms for Industry 4.0 applications. The early adopters are going to enjoy unprecedented advantages...

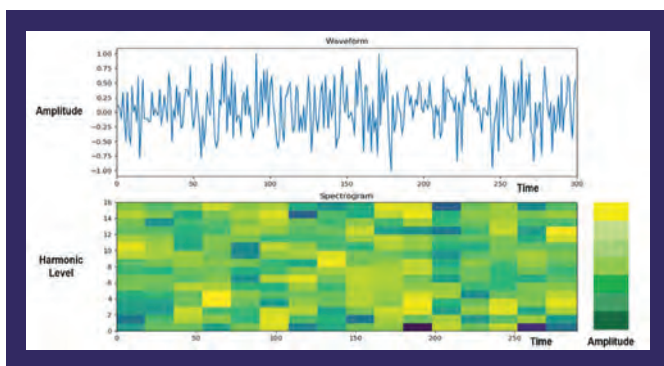
Big Data techniques have taken all aspects of life by storm in the last few years. Be it the medical profession, stock markets, oil exploration or anything, these techniques are providing incredible insights by catching ‘signals’ embedded in ‘noise.’ However, many of these methods have not penetrated into Industry 4.0 – primarily because of the conservative nature of this business. Now, enough research has been done in academia and the AI firms for Industry 4.0 applications that the early adopters are going to enjoy unprecedented advantage, maybe even overturning the established players. Just a few years down the line motors and machine tools industry will look very different -both in terms of players and the tools they deploy to give themselves an ‘unfair advantage’.

The pump and motors typically face issues like electrical unbalance due to uneven air gap from badly

worn sleeve bearing. Then there are problems due to misalignment that cause noise and lead to unbalance in the power circuit. Also, there could be electrical unbalance due to uneven magnetic attraction between stator and rotor, which causes the shaft to deflect and results into mechanical unbalance. All these events cause a faint harmonic signal on the electrical source. The AI Engine can be trained to recognize these signals using the supervised learning techniques. Traditional AI methods like Logistic Regression can be enhanced with other suitable techniques like Convolutional Neural Net or ensemble methods like Random Forest. The picture before shows how to pre-process the current amplitude data and apply STFT-based approach for recognizing a slight imbalance in a rotor shaft. The spectrograms can be fed into the same image recognition algorithms that can figure out, for instance, whether you are happy or sad.

Just being able to monitor harmonic distortion is an advantage in itself. For instance, in case of air compressors higher THD (Total Harmonic Distortion) content can indicate efficiency decrease due to the heat loss. While THD itself can serve as a metric, some of the unsupervised learning techniques can predict how much time it would take to reach that metric if the measurement is being done on a 24x7 basis.

This type of methodology when applied at a plant level is even more important and shows the overall health



of the factory at a coarse level such as maintaining the Power Factor of plant by understanding the load patterns and prompt user to take an anticipatory action or monitoring the Maximum Demand continuously and prompt user to change the load patterns that reduce the penalty in billing.

For a Big Data based system, there are two key aspects that often get overlooked. One is that of interaction with the system. That allows one to get you an actionable inference without having to be a Math PhD and a Senior Software engineer. This can be achieved by using a Natural Language Processing (NLP) based interface into the monitoring system.

The second important aspect is a standard API interface to get the data into an excel sheet or using Python or any other language of choice. Most power monitoring lock you into their interface and do not provide a standard API to get to your own data without having knowledge of SQL.

Summary

Big Data and Machine Learning are set to revolutionize Industry 4.0. However, there are some caveats. There needs to be emphasis on Edge Based AI to manage the

cost and security of 'Data in Flight'. The data going into the AI Algorithms needs to be carefully curated since like all computer programs 'Garbage In- Garbage Out' holds for it as well.

Lastly, AI is not meant to replace the experts and engineers in the field, but rather to give them tools and insights so that they can make better decisions to reduce the cost of the operation, increase the uptime and generally maintain a more efficient operation. There is no substitute for intuition. In games like Go and Chess, AI can routinely beat the world champions but a human and AI together is unbeatable. AI can draw upon the knowledge of the human experts and that is what some of the techniques of unsupervised learning bring to the table that can bring huge benefits in the power management. 18

Lokesh Johri has past experience of working in the Software and Semiconductor Industries. He is currently leading an AI-IOT start-up based in Silicon Valley.

Vinod Joshi has past experience in Instrumentation Product development and its marketing. He is currently a Marketing Director of an AI-IOT Start-up. www.Tantiv4.com

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The Odyssey of ELECTRICITY

Part 2

Here is a brief history of development of electric power generation. The authors have very creatively sailed from the beginning to today's status quo – and highlighted the present-day challenges and hinted towards some possible solutions...

The expediency of providing free electricity to woo voters also creates further complications. One of the steps taken by the government is the introduction of mechanisms enabling a degree of open market for trade of electricity through market determined prices in its Electricity act of 2003. This has enabled the setup of power exchanges such as IEX (Indian energy exchange). Currently, 10-12% of the total electricity produced is sold through this exchange mechanism. It is expected that the policymakers may allow the margin to reach higher levels of around 20%. This move is anticipated to help system operators schedule dispatches on the basis of all India level merit order of energy prices and Market

Clearing Price (MCP) is expected to stimulate efficient plants and penalise the inefficient ones. India is trading electricity through its grid connection with Bhutan, Nepal and Bangladesh. As of now, India is the world's third largest power consumer country.

Electricity boon or bane

Since the 1960s, the berserk use of natural resources started receiving special attention as the potential environmental hazards, which were being ignored started showing up. In addition to ash contamination of river water, heating of water bodies, suspended particulate matter etc., which were somewhat redeemed by Ash utilisation in manufacturing cement and other purposes, by use of cooling towers and by going for Electro Static Precipitators or emission of SO_x and NO_x , which are currently addressed through Flue Gas Desulphurisation and Low NO_x burners, phenomena of global warming due to the entrapment of low frequency radiation by the Green House Gases from constant combustion and

emission of Carbon dioxide. The ice sheet in the poles began reducing leading to sea level rise. There has been a rise in the global temperature of the atmosphere and the sea, causing a climate change, which poses a massive risk towards life on this planet.

To mitigate these problems, the governments were forced to sit together and formulate certain laws, which would be governing industrial operations and standardise consumer goods that pose a risk of GHG emissions. The Kyoto protocol, which extended the 1992 United Nations Framework Convention on Climate Change was signed by some of countries in 1997 to tackle the problems of climate change through reduction of GHG emission. Countries (41 developed countries listed in Annex I) were legally bound to reduce man-made GHG emissions by approximately 5.2%. Major economies like USA, Canada, Russia refused to agree. Thus, at Paris it was agreed that every country would set a target for itself and meet it.



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Electricity in view of the net zero perspective

Although India is ranked 5th in total GHG emissions, its emission per capita remains low and is thus not bound to reduce its GHG emission, India is committed to make some bold and impressive commitments to cut down its net GHG emissions to zero by 2070. The route to this feat is through extensive foray into renewable sources of energy, storage of energy, cutting down dependency on thermal power generation and carbon sequestration projects. As discussed, there are various sources of generating power such as solar power, hydroelectricity, nuclear power, biomass, biofuel etc.

As of 2021, 38% of India's power installation capacity is based on nuclear, hydro and renewable energy. The cost of solar power is significantly decreasing, thus rendering it a massive potential to be a major alternative for fossil fuels. The installed solar energy capacity has increased by over 15 times and stands at 41.09 GW. India has a large untapped resource of hydropower. Its share of total installed capacity stands at 12%. It is important to appreciate that dams often result in inundation of adjoining areas and pose a grave risk, besides the risk of earthquake in the sensitive seismic zone of North India. Rehabilitation of the displaced people, maintenance of aquatic life and proper care of geological factors are often neglected that often results in tempestuous floods. A lot of such incidents have been reported since the first projects and they continue to come.

Thus, the emergence of green hydropower projects with proper monitoring by central and state environmental board is the way towards a sustainable production process of power. Innovations, such as cascading style of water holding by dams in the downstream, could become one of the ways of pursuing hydro projects in an ecologically sensitive country like India. Nuclear power is also an area of exploration and expansion.

India has found one of the largest reserves of uranium in Tummalapalle uranium mine and it can ensure a large amount of clean energy. Although nuclear power accidents have unleashed a lot of public resentment toward it, a properly monitored, regulated and transparent management of nuclear projects can be one of the ultimate solutions for clean power in the future.

Recently, hydrogen has been harnessed and being used as a fuel for vehicles and producing power. Currently, almost all of the hydrogen is amassed from fossil fuels. There are efforts for combining hydrogen with fossil fuels

to make the combustion cleaner and efficient. Indian oil is planning to generate hydrogen from electrolysis powered by wind turbines. It is the cleanest alternative and has a high yield of energy. However, the process of extracting hydrogen is expensive although the cost could come down with economies of scale. Germany has provided 700 million euros to firms working on green hydrogen projects alone. Biomass is another alternative source of fuel for combustion. Tidal and geothermal power are also avenues that needs to be properly explored for power generation.

Epilogue

India has a lot of complexities that must be dealt with carefully for its progress into sustainable power generation. The concept of carbon crediting, joint implementation, Clean Development Mechanism (CDM) and emission trading must be adopted and enforced properly.

Super critical technology, renovation and modernisation, fuel switch and combined cycle gas plants are some of the domains of carbon credits India is concerned about for availing CDM.

The biggest challenge that India is facing is redeeming electricity through its carbon footprint. Electricity brought in a lot of developments in mechanisation and in the creation of technology. It has provided the fuel to drive the wheels of the Indian economy and of human welfare development directly and indirectly. India has a long way still to fare and it must invest heavily in human capital as well for bringing in skilled and knowledgeable human resources in the energy sector – who would usher in new developments in the financial and technological arenas and ultimately result in the growth of economy and welfare of present and future generations.

...concluded 



Rwitorshi Probho Roy is an under graduate student in Economics in Calcutta University, he has wide interest in Socio-Economic issues.



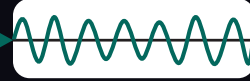
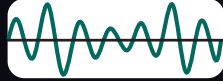
Dr. Bibhu Prasad Rath a graduate in Mechanical Engineering with Intermediate course work from ICWA and M.Tech from IIT Delhi. He has also done PhD (in Business Administration) from Aligarh Muslim University. He is currently holding the post of Additional General Manager in Engineering Division of NTPC Ltd.



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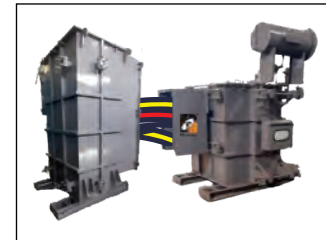
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3150 kVA Transformer with OLTC 33 KV/0-433 KV



Isolation Transformer



Rectifier oil cooled



IGBT Based Rectifier



Electrical Control Panel



Dry Type Transformer 11 KV/0.433 KV

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Climate change is one of the most burning issues of our time. Based on many studies backed up by historically recorded data indicate that human activities are changing the Earth's climate drastically.

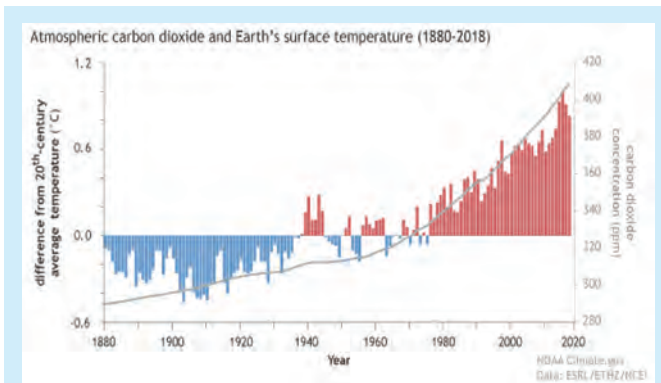
The extensive use of fossil fuel is increasingly warming the Earth causing the melting of arctic sea ice, leading to rising sea levels, as well as causing many other climate-related changes, the impacts of which are increasingly more apparent on people and nature. Unprecedented flooding, changing temperatures and precipitation patterns, heat waves, and wildfires are more frequent. Habitats are undergoing rapid shifts in response to these changes...

MITIGATING CLIMATE CHANGE



Is Climate Change Real? The regular answer what we hear is a big “Yes” [but alternatively there is another answer which is “No” - see the alternative view at the end of this article]. The statistical data confirms that the average surface air temperature of Earth has increased by about 1°C (1.8°F) since 1900, and over half of this increase occurred since the mid-1970s. A wide range of other observations (such as reduced Arctic sea ice extent and increased ocean heat content) as well as the indications from the natural world, such as poleward shifts of temperature-sensitive species of fish, mammals, insects, etc., when combined provide incontrovertible evidence of planetary-scale warming.

The clearest evidence for surface warming comes from widespread temperature records that, in some places, extend back to the late 19th century. Today, temperatures are being monitored at many thousands of locations across the globe, over both the land and ocean surface. Indirect estimates of temperature change from tree rings and ice cores also help in placing recent temperature changes in the context of the past. In terms of the average surface temperature of the Earth, these indirect estimates show that 1989 to 2019 was very likely the warmest 30-year period in more than 800 years while the most recent decade, 2010-2019, is the warmest decade in the instrumental record so far (since 1850).



Annual Global Surface Temperature (1880~20209) with Rise of CO₂ PPM

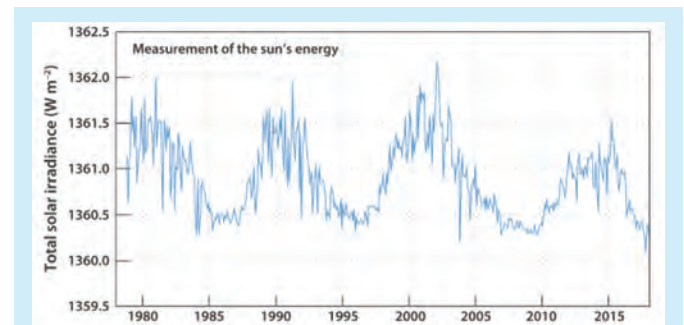
A wide range of other observations provides a more comprehensive picture of warming throughout the climate system. For example, the lower atmosphere and the upper layers of the ocean have also warmed, snow and ice cover are decreasing in the Northern Hemisphere, the Greenland ice sheet is shrinking, and the sea level is rising. These measurements are

made with a variety of land, ocean, and space-based monitoring systems, which give added confidence in the reality of global-scale warming of Earth's climate.

Scientists have been knowing this fact since 1800 that CO₂ is one of the main greenhouse gases and maintains the Earth's energy balance. While the measurement of this CO₂ in the atmosphere and air trapped in ice confirmed that atmospheric CO₂ had increased by more than 40% from 1800 to 2019, the measurements of different forms of carbon reveal that this increase happened mainly due to human activities. Humans also artificially created other greenhouse gases like methane, nitrous oxide & refrigeration gases for their comfort. Various studies have confirmed that the natural causes alone cannot explain these recorded changes in the climate. These natural causes include variations in the Sun's output and Earth's orbit around the Sun, volcanic eruptions, and internal fluctuations in the climate system (such as El Niño and La Niña).

Human activities have significantly disturbed nature's carbon cycle as more & more fossil fuel is being extracted and is being burned to meet the ever-increasing hunger for energy for human industrialization & comfort. Such large-scale burning of fossil fuel is releasing a large quantity of CO₂ into the atmosphere that cannot be recycled by nature. The data confirm that the CO₂ level in 2019 was more than 40% higher than it was in the 19th century. CO₂ levels today are higher than at any point in at least the past 800,000 years - most of this CO₂ increase has taken place since 1970, about the time when global energy consumption accelerated.

Since the Sun provides the primary source of energy, driving the Earth's climate system, yet its 11 years cycle of hot spots during which its energy output varies by roughly 0.1%, affecting ozone concentrations,



Total Solar Irradiance Falling On Earth (Average W/m²)

temperatures, and winds in the stratosphere has played very little role in the climate changes. In fact, direct satellite measurements since the late 1970s clearly show no net increase in the Sun's energy output, but at the same time average global surface temperature has been increasing continuously. Available evidences also do not indicate any long-term changes in the Sun's output over the past century, a period when human induced increase in CO₂ concentrations have been the dominant influence on the long-term global surface temperature increase. Further evidence that current warming is not a result of solar changes can be found in the temperature trends at different altitudes in the atmosphere.

Solar Roofs & Climate Change

The exponentially increasing global hunger of energy have been causing massive burning of fossil fuel at a much higher rate than what nature can replenish by its control mechanism leading to large accumulation of CO₂ and other greenhouse gases in the earth's atmosphere in the past few decades converting the previously thought threat of climate change, a reality.

While fighting the climate change may seem like an overwhelming task, yet it can be fought both individually and collectively. A fight in which solar energy plays a huge role in creating a cleaner and safer environment. Solar energy is a renewable energy that is available in all regions of planet and more so in India. By going solar, even individuals can contribute on their parts in fighting the climate change. In other words, each energy choice people make certainly plays an important role in the impact of climate change and just by changing everyday behaviour people can

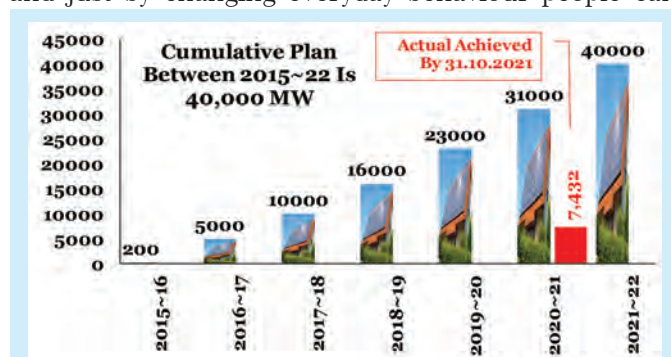
contribute to the larger cause in reducing a bit of global warming.

A building roof with a solar photovoltaic (PV) system mounted on top of it is known as Solar Roof and is a mini power plant, converting solar energy directly into electricity either to meet the building's power requirements or feed into the grid. Although anyone can install a solar rooftop system, the size of the installation varies significantly depending on availability of space, amount of electricity consumed by the building, and the ability or willingness of the owner to invest the capital required. These solar roofs form an important and critical part of Government of India's 100 GW target by 2022 out of which 40 GW is to be achieved through Rooftop Solar (RTS) power plants as per the clean climate commitments. Realizing the immense potential of RTS Power Plants, Ministry of New & Renewable Energy (MNRE), GoI, had launched Grid Connected Rooftop and Small Solar Power Plant Programme with increased budget of Rs. 5,000 Crore (Rs. 50 billion) for RTS Power Plant projects.

However, the recent data of GoI indicate that India is lagging much behind from the aggressive target of 40 GW by the end of 2021~22 and has attained only 24% of the target as on 31.10.2021. The analysis indicated that there were many initial challenges including public's perception about high initial cost of installing RTS Power Plants. Whereas the financial assistance is one of the factors that has provided the momentum to RTS Power plants. Also, to keep the solar panels efficient a lot of water is required and in contrast areas with high solar energy density like Rajasthan, Gujarat. Andhra Pradesh, Chhattisgarh. Orissa, Western Uttar Pradesh have scarcity of water. These issues as well other local issues need to be resolved on a broader & larger scale to make RTS Power Plants more popular.

The Program of MNRE looks into these issues and provides the support for them. It also clearly defines the following objectives for the Program for pushing the RTS Power Plants:

- Promote the grid-connected RTS Power Plants amongst the residential, community, institutional, industrial & commercial establishments.
- Mitigate the dependence on fossil fuel-based electricity generation.
- Create enabling environment for investment in



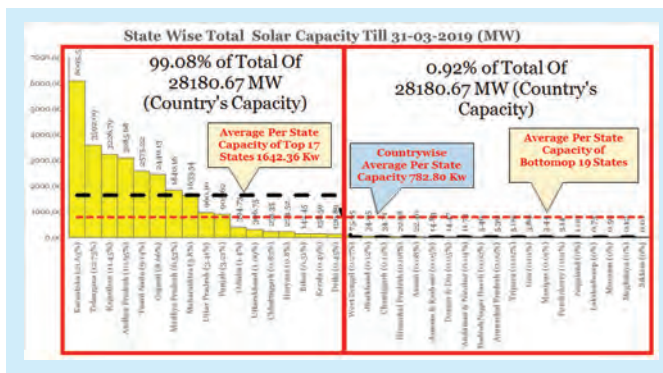
Year Wise Targets of GoI, For Setting up RTS Power Plants (MW)

Ref: Page 15, National Solar Mission: Grid Connected Solar Rooftop Programme In India.pdf
<https://mnre.gov.in/the-ministry/physical-progress>

the solar energy sector by private sectors, state government & the individual.

- Create enabling environment for the supply of solar power from RTS Power plants to the grid.
- Encourage innovation in addressing market needs and promoting sustainable business models and ensure employment opportunities.
- Provide support to change partners and potential beneficiaries within the framework of boundary conditions and in a flexible demand-driven mode.
- Create a paradigm shift needed to the commoditization of grid-connected RTS Power Plants.
- Encourage replacement of diesel/ fossil fuel, wherever possible.

With large areas of the region endowed with bountiful solar radiation, many countries in the region have the ideal conditions for utilizing solar energy. The RTS Power Plants generate power during the day while feeding surplus power back into the power grid. Residences can be sufficiently supplied with small systems of usually up to 20 kilowatts (kW), while larger public, commercial, and industrial buildings may have systems with a capacity as large as 1 MW. Although much smaller in capacity than regular power plants, rooftop solar systems have many benefits in helping us change how we produce energy and make our world a better place to live.



A statement of the state-wise overall solar power generation capacities (including solar farm, RTS Power Plants etc.) has been given below. It shows that while many States have leapfrogged in overall solar power generation, many of the States need to catch up even the national average. However, we cannot ignore the physical location of some of these states, which may not have advantages of land available as well as fall of solar radiation. Still, the states that are lagging need to come

up with innovative ideas – to generate more solar power using RTS power Plants for meeting the overall target of the country for 2022.

Solar Energy to Reduce Greenhouse Gases and CO₂ Emissions

Solar powered electricity is considered to be one of the most promising technologies to help slow and halt the progress of climate change because they generate 'renewable' electricity from sunlight. This electricity for homes and businesses is therefore produced without burning the fossil fuels that release greenhouse gases into the atmosphere including carbon dioxide and methane. Solar PV panels are currently a great choice to produce renewable energy thanks to recent improvements the technology, fast-reducing costs and how easy they are to install - taking 2 days for a typical domestic property - and the International Renewable Energy Agency (IRENA) expects they could supply 25–49% of global electricity needs by 2050.

A modest-sized solar system can reduce energy usage by approximately 80%, with others approaching 100%. This reduction clearly indicates the significant environmental impact of solar energy. With this type of clean energy production, solar can offset the CO₂ emissions and the greenhouse gases to create a cleaner environment. RTS Power Plants installed at homes, commercial or industrial buildings, are the key to generating electricity without worsening the climate crisis.

Benefits of Roof Top Solar (RTS) Power Plants

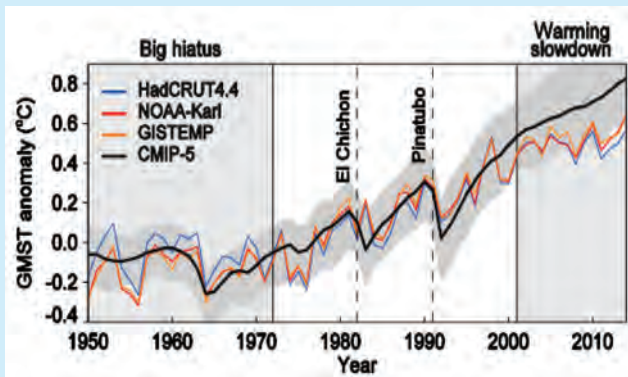
Some of the tangible & non –tangible benefits associated with RTS Power Plants have been summarized below.

- **Peak Load Management (of DISCOMs):** The RTS Power Plants play a very important role in helping the distribution companies (DISCOMs) to reduce their peak demand and simultaneously decrease transmission and distribution losses associated with power consumption at the point of generation.
- **Revenue Generation:** Some states in India are offering Net-metering schemes on RTS Power Plants wherein the consumer has the option to sell the excess energy to the grid and get paid for the same.
- **Cost Savings:** Being standalone & modular in nature system, which can be installed at the point of consumption with any additional investment

Solar Roof

for power line & associated system, the RTS Power Plants prove to be highly cost-effective when compared with grid electricity or any other kind of captive generation.

- **Rise of ESCO Model:** Adopting the ESCO (Energy Service Company) model, allows consumers to avail lower tariffs, compared with grid tariff rates without investing on capital cost. The ESCO model has been successfully implemented in many high & low-rise buildings and at individual houses across India.
- **Easy Installation in Remote Areas:** In remote areas where power grid is not available, RTS Power Plants serve as the most affordable and reliable source of electricity.
- **Better Space Utilization:** The RTS Power Plants can be installed on existing roof of any building or industrial sheds, where apart from generating power they also provide secondary protection to the roof.
- **Low Maintenance:** The RTS Power Plants require very low maintenance (except frequent cleaning of PV panels & replacement of batteries every 3-5 years in the case of off-grid systems).



Annual-Mean and Global-Mean Surface Temperature Anomaly with Periodic Drops of Average Temperature

- **Green Source of Energy:** With no emission & noise, the RTS Power Plants are environment friendly compared to conventional energy sources.

Over the last two years, there has been a tremendous thrust from the central as well as state governments, in the form of policies, regulations, guidelines and even promotional subsidies at various levels, to promote RTS Power Plants for reducing the region's reliance on fossil fuel & is a welcome step toward enhancing future energy security and mitigating climate change.

Epilogue & Alternative View on Global Warming

Despite all these hyper worries and threat of Global Warming, which everyone has been hearing for many decades, the world saw a slower rate of warming between 2000~2010, a period which also saw increase in Antarctic sea ice cover.

With this background comes an alternative view, which also has a strong holding but has never been discussed on broader scale. This alternative view looks at planet earth as a well-designed eco system acting as a gyroscope, which self-manages the issue of global warming as if mother nature has built its own control mechanism. This concept relies on three factors associated with earth's unique design/ characteristics, which are i) its water-ice cycle, ii) its axial rotation and iii) its rotation around the Sun. While it is well known that the Earth with its large water content (which incidentally gets accumulated at equator and acts as major mass of gyroscope storing most of earth's rotational energy. Whenever the quantity of water in sea increases (due to melting of polar ice), the rotational speed of earth increases causing its orbit to elongate (scientific law) and pushes the earth, farther from sun, leading to less exposure to the heat/ radiation of Sun. Once this happens, the sea receives lesser heat from sun, the sea water starts cooling down & becomes heavier, forms ice and with time travels back to poles to add to the polar ice formation. Once the sea water level/ quantity reduces, and polar ice caps become bigger the rotational speed of the earth reduces (<https://www.discovermagazine.com/planet-earth/the-earths-rotation-is-gradually-slowing-down>) and earth comes back to its lower radius orbit to get exposed to higher solar heat/ radiation. The cycle repeats over many millennium and maintains the heat balance earth.

BI



Prabhat Khare possesses a BE (Electrical) degree from IIT Roorkee (Gold Medalist). Now, he is the Director of KK Consultants. He is also a BEE Certified Energy Manager and a Lead Assessor for ISO 9K, 14K, 45K & 50K.

Electricity from Raindrops

While the entire world is worried about managing the battery wastes that will create a big challenge by 2050, Indian researchers have created an excellent device that will literally use water to generate electricity to support small electronic devices...

Researchers from IIT Delhi have designed and fabricated a device that can generate electricity from water drops, raindrops, water streams, and even from ocean waves using ‘Triboelectric Effect’ and ‘Electrostatic Induction’. The device is called ‘Liquid-solid Interface Triboelectric Nanogenerator’. The generated electricity can be stored in batteries for further use.

The device has a very simple structure consisting of specially designed nanocomposite polymers and contact electrodes and can generate a few Milliwatt (mW) power, which is sufficient to power small electronic devices like watches, digital thermometers, radio frequency transmitters, healthcare sensors, pedometers. When compared to conventional methods, such as the use of the piezoelectric effect, the present device can generate significantly more electricity.

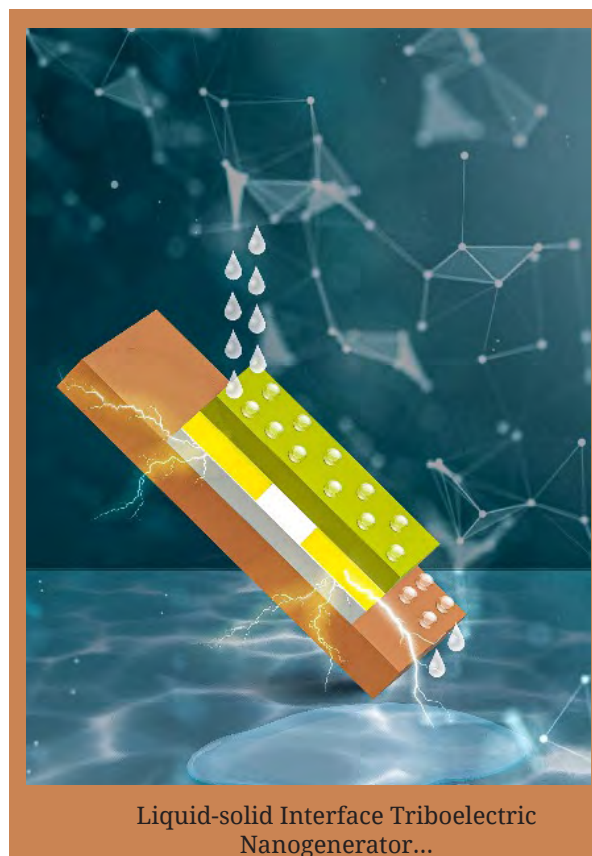
Construction of the device

The researchers have successfully incorporated nanostructures into a polymer matrix, which has enhanced the film’s surface roughness, polarizability, and hydrophobicity, among other characteristics, as a result. Due to the enhancement in the above property, the flexible film is used to fabricate the device where raindrops have just to slide down and can generate electricity. The artificially created rough surface allows to generate more charge and superhydrophobic properties of the solid surface help to roll the water drop without getting stick to the surface.

The IIT Delhi research team also explored the underlying mechanism of the electricity generated when the water drop comes in contact with the solid surface and it is shown that saline water drops generate more electricity.

Background of the development

Prof. Neeraj Khare from the Department of Physics and his group at the Nanoscale Research Facility (NRF), IIT Delhi, have been working on harvesting electrical energy from to-be-wasted mechanical vibrations using the triboelectric effect. The group has filed an Indian patent on the various aspects of the use of ferroelectric polymer for harvesting mechanical energy including the present device.



Liquid-solid Interface Triboelectric Nanogenerator...

Commenting on the high-potential development, Prof. Khare said, “Triboelectric effect is a known phenomenon for a long time, and in this effect, charges are generated when two surfaces are in friction. The best example we see are sparkling lights when we move the blankets/jackets. It is only lately that it has been extensively investigated as a practical alternative for energy harvesting.”

Supporting organisations

The Ministry of Electronics and Information Technology (MeitY) and the Department of Science and Technology (DST), Government of India, have supported the research work under NNetRA project.





'Rising data centers for OTT, E-commerce boosts demand for Cable'

Polycab is a leading Indian manufacturer of cables, wires and allied products such as uPVC conduits and lugs and glands. The company has a range of cables and wires for practically every application. More recently, it has also launched a wide range of consumer electrical products like Fans, Switches, Switchgears, LED lights & Luminaires, Solar Inverters and Pumps. In an exclusive e-interview with P. K. Chatterjee (PK), Polycab's Executive President and CBO, Shashi Amin has revealed some valuable insights about his company's capability and deliverables. Excerpts...

How is the Indian market changing as far as the demand for electrical cables (LV, MV, and HV) are concerned?

At Polycab, we maintain strong oversight over economic and industry developments and megatrends that shape our opportunity landscape. With the increase in development and growth of the country, we are experiencing a new demand for cables from different key sectors.



Cables manufactured by Polycab...

In 2021, the total installed capacity for data centres in India is estimated to be 450 MW and with an increasing thirst for content delivery platforms for entertainment, ecommerce, education, and push for digital India, demand for data centres is increasing in the country. Hence, we saw a sharp incline in the demand for cables from data centres.

The second sector that is driving the demand for cables is the Indian renewable energy sector. With the largest expansion plan, it is the fourth most attractive renewable energy market in the world. Currently, India has a capacity of installed renewable energy production of over 150 GW, and investments in 2022 is likely to cross 1125 billion INR, making capacity to reach the goal of 175 GW. Up to 100%, FDI is allowed under the automatic route for renewable energy generation and distribution projects, triggering the demand for cables in the segment.

Also, with the increase in infrastructure development, the right of way comes into play. In populated areas, we are witnessing a growing need to replace the overhead transmission and distribution lines with underground cables to ensure safety. Private transmission & distribution utilities aren't rigid with old standards and looking to adapt underground cabling with keener intent. This results in increasing demand for the cables segment.

What kind of safety features are finding growing demand in this market?

A cables' performance can make a huge difference between a small accident and a dangerous mishap. Price used to be the most important factor that drives a purchase decision, but we are witnessing a change in customers' buying behaviour in key sectors like metro rail and real estate.

In metros, fire safety is a huge concern. Cables with lower safety standards can contribute significantly to the spread of fire and heat emission, increased emission of toxic gases, and increased smoke emission. These factors make it difficult for safe evacuation and are the reason for most of the fatalities in such events.

To cater to this growing need, we came up with Polycab Fire Survival cables and the focus on quality, safety, and energy-saving features have worked well for the brand. Polycab fire survival cables are designed to withstand temperatures as high as 950-degree C. They can also maintain circuit integrity for a period of three hours for emergency safety circuits, water sprinkler systems, fire

alarm systems, and emergency lighting circuits. They have a low toxicity index (5%) and high visibility index (95%). Polycab FS Cables are LPCB Certified, which is one of the most recognized certifications and is owned by only a handful of brands in the country.

To meet the latest demands of environmentally friendly cables with increased safety in the event of a fire, Polycab also offers a high range of product that provides Halogen-free environment which contributes to less corrosive gases and prevents the damage of human beings.

What's your observation on the common factors that influence the purchase decisions - price or quality?

In the cables and wires segment, we deal with both the contractors and the end consumers, and the factors that influence the buying decisions are quite different for them. For our customers like contractors and consultants, the price of the product plays an important role. A majority of the requirement for our cables are given by the contractors who are mostly concerned by the L1 prices. Since the price at which these customers get the product makes a huge impact on their margins, other factors like technological advancement and life expectancy take the back seat.



Glimpses of Polycab's manufacturing facility...



A view of Polycab's production line...

When it comes to an end consumer, this game changes and we have observed that some of these customers provide due weightage to the quality of the product for making a purchase decision. Though factors like delivery time, MOQ still affect the decisions of these customers, customers be educated about the importance of using high-quality electrical products which will lower their operating cost and reduce downtime. Quality in terms of fire-related events, life expectancy, curing techniques, etc should be properly evaluated and cables with the best price to quality ratio should be used for greater satisfaction.

What is the USP (Unique Selling Proposition) for Polycab cables?

Polycab India Limited has a legacy of over 50 exceptional years marked by customer satisfaction and enabled by our focus on Quality, Service, and Timely deliveries. We make best-in-class wires and cables using cutting-edge technologies such as CCV, electron beam, etc and have the advanced Quality Assurance and Development laboratory to monitor in-process products and to develop new products. We are the only player in India with a private power cable test Laboratory, having the scope of 4,113 tests complying with all national as well as international standards.

Our leadership position in the industry is well augmented by our state-of-the-art manufacturing units having the capacity to produce 42 lacs km of wires and cables annually. We also maintain sufficient stock of our ready-to-stock SKUs, so that even in times of uncertainty we can serve the demand of the market

within the desired time, making us the most reliable partner in the industry.

In FY21, we introduced 7 Polycab Experience Centres named “Polycab Galleria” to engage with diverse customer groups and enhance their shopping experience with audio-visual facilities. We stay focused on innovating to deliver better products and bring greater value to our customers, amplifying our value proposition year on year, helping us grow into the nation's most preferred end-to-end electrical solutions brand.

What kind of priority do you attach on research & development to develop and launch new products?

R&D remains one of the key strengths of the Company which enables it to achieve product differentiation and offer a unique value proposition to its consumers, distribution, dealers as well as institutional customers. At Polycab, we undertake agile product and process innovations to stay on top of shifting market demands and aspirations of the customer. This necessitates continued investments in research facilities, processes, and talent, and enabled our leap onto new growth horizons.

Our state-of-the-art, in-house R&D centre is certified by the Department of Science and Industrial Research, Government of India. The R&D centre functions in tandem with the sales and market demand to support aspects of the research process and offer expertise in design, performance and project management.

During 2020-2021 alone, we spent 208 million INR on research and development, catering to the evolving market requirements like fire survival, fire- retardant, Low smoke and multi-chemical resistant compounds from sectors like real-estate, nuclear and industrial etc.

What are your actions to prevent climate deterioration?

Our products reflect a genuine sense of eco-consciousness and are produced using the most environment-friendly materials and processes, with the highest efforts to conserve energy and other key resources. We work to minimise resource wastage and maintain ecological balance. These efforts also extend to reusing and recycling the resources to the extent possible.

We have a focussed drive to efficiently manage water with prompt recycling for the purposes of gardening and sanitation. Our units are equipped with Sewage Treatment Plant to promote recovery, reuse and recycle water.

Polycab, as an ecologically responsible player, also utilise renewable sources of energy for daily operations. Presently, we are fulfilling over 10% of our total energy needs by renewable energy. We are continuously putting efforts to fulfill our maximums of energy needs from renewable sources only.

We have also taken on a robust waste management project in western India. This project involves a door-to-door collection of solid waste, transporting it to the nominated site, and recycling the same to produce products, which are marketed by the Gram Panchayat.

What would you like to communicate to your prospective buyers?

Polycab is a strong brand name in the Indian electrical space. We worked on developing new ranges of consumer-centric products, based on our deep understanding of the market and launched new products across categories.

We partner with the dealers and distributors to offer a wide gamut of products at affordable prices

which cater to rising consumers' aspirations. We manufacture a world-class range of wires and cables from House wires, industrial flexible wires, green wires to EHV Cables, Fire Survival Cables, Power and Control Cables, Instrumentation Cables, and Rubber cables. We cater to evolving market trends with our FMEG offerings from Fans and Lightning to IoT based automation offering- Hohm. Our strong backward integrated processes ensure a consistent supply of quality raw materials while in-house research and development capabilities help us earn national and international certifications

We would like to get more involved with our customers and end consumer hence we are coming up with more engagement programs this year. Our strategic decisions will be driven by customer-centricity, digital transformation, and a sharp focus on Environment, Sustainability, and Governance (ESG). Let us together make a difference and scale new heights of progress in the coming years. 

Social Media keeps Changing, but Networking is Constant





Paid Services: Coverage on our Electrical India digital profiles and print magazine
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TOWARDS MAKING RESILIENT GRID

GE Research has been working closely with the Prolec GE team to develop the flexible transformer technology and has partnered with Cooperative Energy on the field demonstration...



GE Research and Prolec GE have teamed with Cooperative Energy to develop and install the world's first flexible large power transformer at the utility's major substation in Columbia, Mississippi. This substation is part of a service network that delivers power to nearly a half million homes and businesses across Mississippi.

Speciality of this transformer

The transformer, rated at 165kV, 60/80/100 MVA and developed as part of an ongoing project funded through the U.S. Department of Energy's (DOE's) Office of Electricity, has begun six months of field validation in October 2021 – to assess its performance and understand how this new technology could transform grid management in the future.

Transformers are part of the backbone of electricity grids, regulating the flow of power from generation plants, where electricity is produced, through transmission and distribution power lines to be delivered

to people's homes and businesses. Historically, the existing infrastructure has performed reliably well. But as higher percentages of renewables like wind and solar power come online, new transformers, with much greater flexibility in impedance, will be required to support the grid in voltage regulation, stability, fault management, and transmission lines restoration and resiliency. This new large flexible transformer technology is poised to help meet this need.

Commenting on the project, US Secretary of Energy Jennifer M. Granholm, said, "The Department of Energy's \$2.4 million investment to develop this first-of-its-kind flexible transformer will help make the grid more resilient to severe weather events, more secure from cyberattacks, and handle more clean energy sources to power the places we live and work. It's yet another example of the innovation that's possible when the public and private sectors collaborate to build new technologies here at home that improve the well-being of the American people."



Transformers are part of the backbone of electricity grids...
Image by pixabay.com



The world's first large flexible transformer ...
Photo credit: Cooperative Energy

Focusing on the utility of the transformer, Ibrahima Ndiaye, Technology Manager at GE Research Center and project leader, said, “Strengthening our grid and facilitating the transition to a more renewable-intensive energy portfolio will require a more flexible infrastructure, including transformers, to manage the

wider range of voltage and frequency oscillation that utility operators will see. Our flexible large power transformer, a world- first, will deliver unprecedented flexibility to not only manage more dynamic grids, but do so in a way that could revolutionize the resiliency of the grid in fault management, spare coverage and adaptability for grid restoration.”

Highlighting the need for mitigating emerging challenges in the power grid industry, Jeff C. Bowman, President and CEO of Cooperative Energy, said, “Cooperative Energy, as a member-focused electric cooperative, is continually working to update and maintain our transmission system, thus ensuring its resilience and reliability. Advanced hardware and grid components such as the flexible large power transformer will help us meet many of the challenges our industry faces, now and in the future, and ensure reliable service. It is an exciting opportunity for Cooperative Energy to aid in advancing the modernization of the nation’s electric grid.”

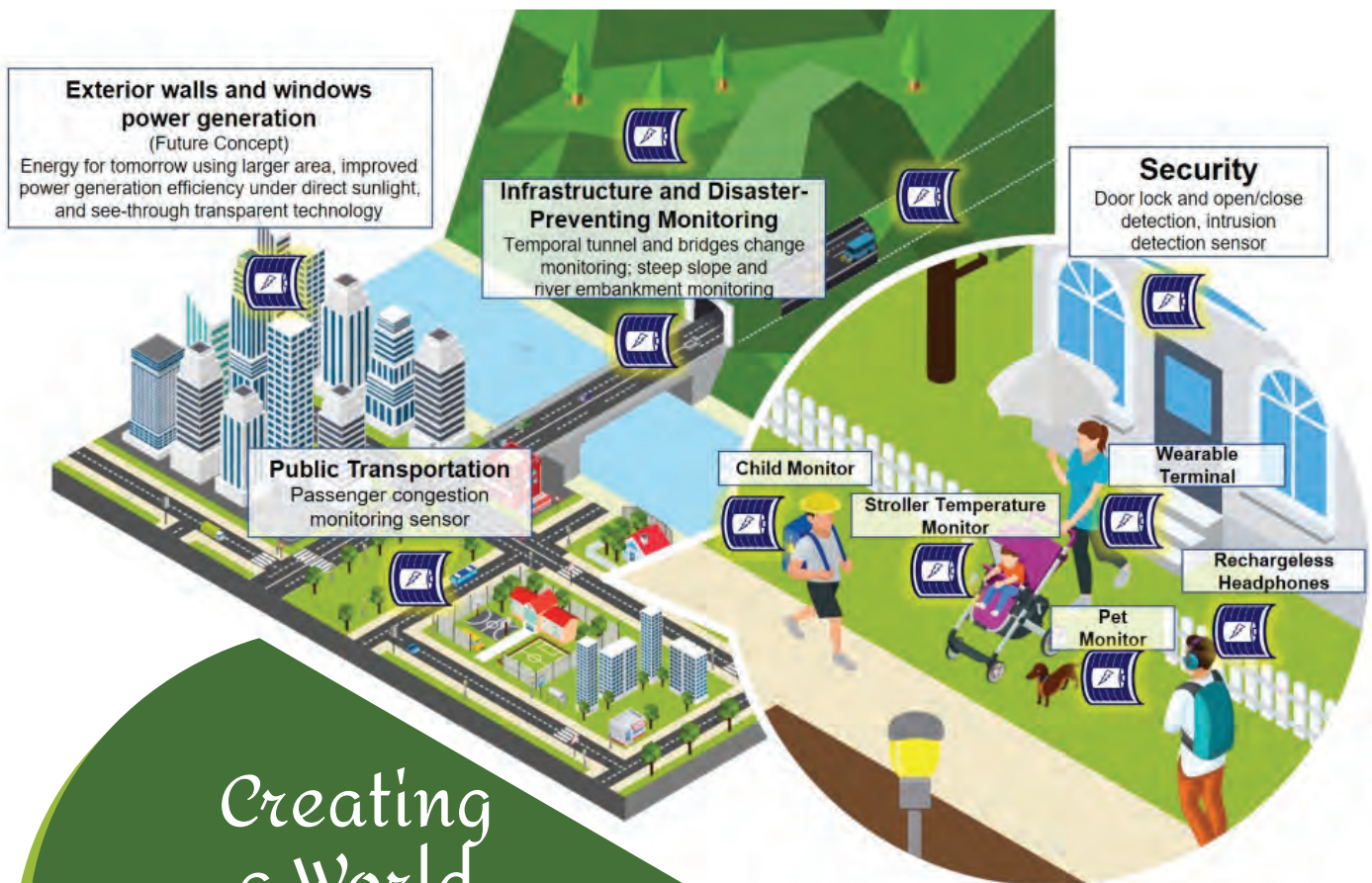
Experiment to address new grid management challenges

Drawing attention on the changing scenario, Pedro Puente, R&D Director at Prolec GE, said, “After all the research, development and thorough testing, the new flexible transformer technology has begun a field validation to authenticate its performance and demonstrate how this technology could lead to a major grid management change. It is exciting for us to participate in the transformation of the nation’s electric grid, identifying the challenges and the opportunities that led us to create one of the next-generation technologies for the efficient, resilient, and reliable delivery of electricity. The innovative flexible impedance technology has been successfully patented.”

The timely action

As Ndiaye pointed out, the introduction of new transformer technologies is coming at a pivotal time for the (US) nation’s grid infrastructure. Today, more than 70% of the U.S installed large transformer base (>60MVA) is 25-years or older, with around 15% exceeding the average life expectancy of 40 years. Gradual replacement of the existing fleet with more flexible power transformer solutions would greatly expand the grid capacity and accommodate more renewable resources and highly variable loads.

Ⓔ



Creating
a World
Free from the
Need of Charging

Example of the connection to a flexible power supply board...

Although we are too much used to charging our e-gadgets, the time is coming to obsolete this concept...

With a view to addressing the growing demand for Internet of Things (IoT) throughout the society, Ricoh has developed a flexible energy harvesting device that efficiently generates power indoors or in shaded areas as a stand-alone power source for the constant operation of a variety of sensors.

The device

The flexible energy harvesting device, sized 41mm by 47mm, uses a unique power generation Organic Photovoltaic (OPV)

material developed jointly from 2013 in an industry-academia collaboration with Kyushu University. The result is efficient power generation in low-light environment, such as indoors (approximately 200 lx), and medium-light such as shaded outdoor areas (approximately 10,000 lx). In addition, the thin, lightweight, and bendable film can be mounted on IoT devices of various shapes.

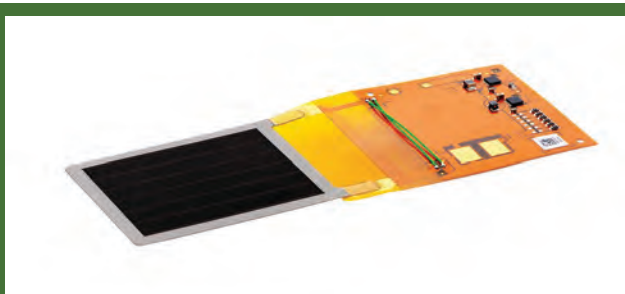
Application areas

These devices can be used as stand-alone power sources for mobile and



The jointly-developed flexible energy harvesting device...

portable wearable terminals, beacons, and are ideal for social infrastructure monitoring devices, such as ones installed in tunnels and under bridges. This will make it unnecessary to replace batteries in a wide variety of small consumer electronic devices, which is expected to improve convenience and contribute to the Sustainable Development Goal 'Affordable and Clean Energy'. Since the release of Solid-State Dye-Sensitized Solar Cells (DSSC) for indoor use in 2020, Ricoh aims to expand its product lineup as soon as possible by providing samples to IoT device manufacturers, service providers, and trading companies as the next environmental power generation device.



Example of the connection to a flexible power supply board...

Research work behind the development

Kyushu University and Ricoh collaborated on research and development to give shape to this product development. This research and development have been supported by JST's 'Adaptable and Seamless Technology transfer Program through target-driven R&D (A-STEP)' – 'Functional Innovation and Practical Technology Development of Organic Energy Harvesting Devices'.

Views of the developers

Commenting on the development, Professor Takuma Yasuda, Inamori Frontier Research Center, Kyushu

University, said, "Energy harvesting is a future-oriented energy technology that supports our future IoT society through advanced use of environmental 'ambient light'. We have been advancing energy harvesting research with Ricoh since 2013. The developed organic materials differ from conventional solar cell materials in that they exhibit excellent power generation performance even in indoor environments. The devices using these organic materials are as thin, light as paper, can be bent, and can generate power anytime and anywhere, even under dim-light conditions. This new energy technology is also expected to be widely implemented as a distributed and independent power source for various small electronic devices around us. We thus believe that this new energy technology will significantly contribute to achieving the SDG goal of 'Affordable and Clean Energy'. Through the joint industry-academia project A-STEP, we will continue to promote further research and development of energy harvesting technologies that will contribute to our future society through close industry-government-academia collaboration."

Detailing on their activities, Tetsuya Tanaka, General Manager, EH Business Center, RICOH Futures BU, said, "Our future is to create 'A World Without Charging'. We hope to realize a world where people do not have to consciously recharge or replace their batteries.

The Internet of Things (IoT) brings the power of the internet beyond standard computers or smartphones to a wide range of objects. Data from sensors attached to those objects can be collected and uploaded to the internet. The data can be used to monitor environments or object locations wirelessly, without the need for batteries. The use of sensors is expected to increase in the future. Energy harvesting technologies using light, heat, vibration, etc., are attracting wide-spread attention as an effective, and efficient, power source that can power sensors continuously.

Ricoh strives to realize a sustainable society and launched solid-state dye-sensitized solar cells (DSSC) in 2020. Now, we will be shipping samples of Organic Photovoltaic (OPV). We are also working on developing perovskite solar cells for the outdoors and even in space. We will continue to contribute to solving social issues through our business by expanding the applications of independent power sources to reduce the environmental impact through the growth of clean energy technology.

13



DETECTING EARTH OR GROUND FAULTS ON DELTA NETWORKS

Among the four main Medium Voltage distribution network earthing techniques, (Solidly/Effectively Earthed, Resistance Earthed, Unearthed and Compensated Neutral), delta networks offer significant challenges for detecting single line to ground faults...

Delta networks were historically selected for their resilience against the first single-phase fault condition, but the traditional inability to detect these faults posed a serious issue for electrical engineers.

Today, improvements in protection and switchgear technology in modern devices, such as the OSM Recloser system with RC Control, allow electrical engineers to detect these faults on delta networks.

According to NOJA Power Group's Managing Director Neil O'Sullivan, Delta networks earth fault detection has always been problematic and that can be solved by the solutions detailed in the next few paragraphs.



NOJA Power OSM Recloser in a Mining Substation...
© NOJA Power 2021

Techniques for detecting faults on Delta Networks

A couple of techniques for detecting these faults have been narrated subsequently, however, first let's look at a brief overview of fault behaviour on Delta networks.

Understanding Delta Network Behaviour under First Ground/Earth Fault: Earth/Ground Faults need a current path to flow. When using a solidly earthed network, the majority of fault current flows through the earthed star point of the transformer.

On unearthed delta networks, there is no solid connection. But this doesn't mean there is no fault current. The fault current is almost entirely capacitive, which is a result of the capacitance between the lines and the ground. Figure 1 shows this effect in action.

The fault driving energy is the Neutral Voltage Displacement. When a single line to ground fault occurs, the fault location becomes the new ground

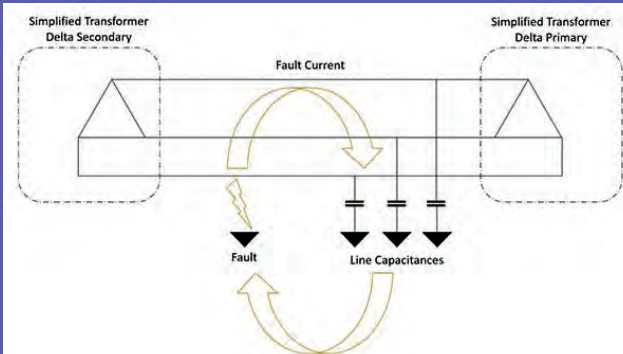


Figure 1 – Simplified Fault Diagram – Delta Single Phase to Ground Fault...
© NOJA Power 2021

reference. The un-faulted phases' voltage rises relative to this new ground reference, causing a "neutral voltage displacement."

The degree of Neutral displacement is proportional to the fault impedance. If the fault impedance is zero, then the faulted line voltage (at the fault location) goes to zero. This leads to maximum displacement of the other phases, where the un-faulted phase to ground voltage equals their pre-fault phase to phase voltage.

If the fault impedance were increased, the displacement would reduce, until the fault impedance is infinity, where the displacement is zero. This is the "un-faulted" state.

The simplified equations are:

Zero Sequence Impedance

$$Z_{(0)} = \frac{1}{jC\omega}$$

Where C is the network capacitance.

Using $V=IZ$ to calculate our fault current, where the voltage is the Neutral Displacement

$$I_f = \frac{3V_n}{Z_{(0)}}$$

Replacing our equation for $Z_{(0)}$

$$I_f = 3jC\omega V_n$$

This fault current would be visible on all feeders connected in the Delta scheme but would only be "forward" on the faulted feeder.

Protection technique 1 – Neutral Voltage Displacement – ANSI 59N: Considered the frontline detection method for single phase to ground faults on delta networks, Neutral Voltage Displacement operates on the movement of the neutral reference. Full displacement occurs when the fault has zero impedance, where un-faulted phases take on their Phase-to-Phase voltage in the Phase to Ground measurement.

For example, if the pre-fault phases on a 22 kV Network are as follows, with no displacement:

$$V_a = 12.7 \text{ kV}$$

$$V_b = 12.7 \text{ kV}$$

$$V_c = 12.7 \text{ kV}$$

Then the fully displaced values for a zero-impedance fault on phase A are:

$$V_a = 0 \text{ kV}$$

$$V_b = 22 \text{ kV}$$

$$V_c = 22 \text{ kV}$$

Practically speaking, a zero-impedance fault is unlikely, so the shift will not be so large.

The set-point for V_n is set just above the normal network load fluctuations. Typically, this range is between 10% to 30% of the Phase to Ground voltage.

The traditional challenge with this protection is that the displacement is almost equal on all connected parts of the feeder, with the only variation arising from line impedance. This made grading and fault location difficult in the past. Today however, with Reclosers such as the OSM Recloser system offering this protection feature, grading is accomplished on time. The protection devices furthest from the substation have the fastest operating time, and operating time is increased in each device closer to the substation.

With this scheme, the feeders will progressively shed the end of the line until the fault is cleared. This minimises the number of impacted customers.

The OSM Recloser can also report which phase had the lowest voltage at the fault site, allowing utility engineers to determine both the faulted phase and segment.

Protection technique 2 – In Sin Phi Sensitive Ground Fault protection: As we saw in the fault calculations, the earth fault current is not zero on a delta network, despite the lack of transformer earth. However, we do see that the fault current is mostly capacitive. This implies the fault current magnitude is proportional to network capacitance. The bigger the network, the

more capacitance. Underground cables also have more capacitance than overhead networks.

Before the development of the devices, such as the OSM Recloser with High Resolution SEF capability, detecting ground faults on overhead lines was challenging. Today however, the OSM Recloser can be set to detect 200 mA of primary current, giving sensitivity even on smaller overhead networks with lower neutral displacement fault driving voltages.

However, acting on magnitude of this fault alone is not sufficient to guarantee detection. Instead, born of European network practices, trigonometry is used to determine the capacitive direction. Once this is done, the fault magnitude in the reactive domain is checked against the operating quantity. This helps reduce the impact of leakage resistance from causing spurious tripping at low levels. In NOJA Power's OSM Reclosers, this practice is called Advanced SEF, using the $I_n \sin \theta$ algorithm technique.

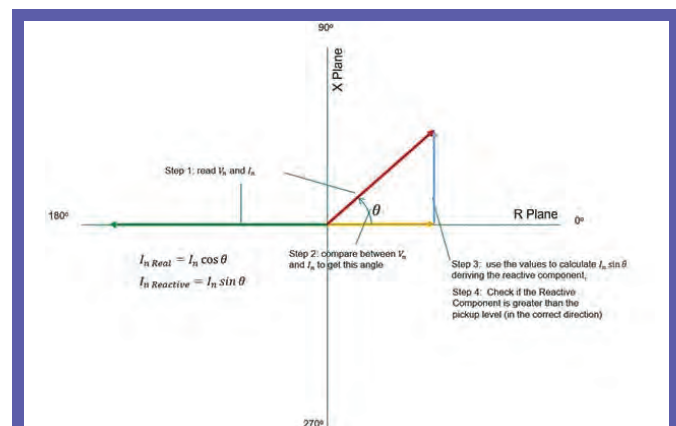


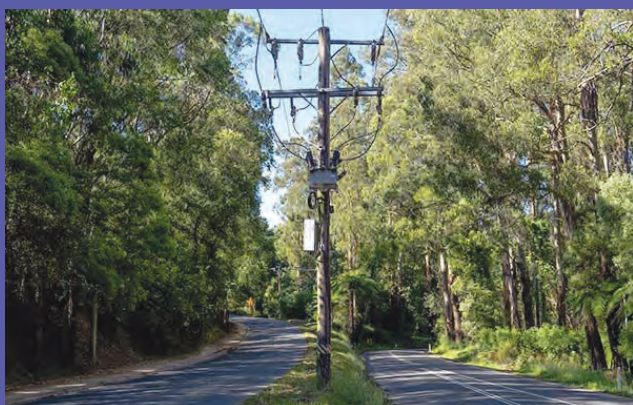
Figure 2 – $I_n \sin \theta$ Calculation...

As we see in figure 2, this method has 4 steps.

- First, we take readings for the Neutral Displacement and Residual current.
- Second, we compare the angles to get the value for θ .
- Third, we use trigonometry $I_n \sin \theta$ to remove all resistive leakage, leaving only the reactive component. This is directional, and only has the correct polarity on the faulted feeder.
- Fourth, we check if this capacitive current exceeds our pickup.

Combining this algorithm with the high-resolution SEF sensors in a NOJA Power OSM Recloser, we can detect ground faults on delta networks that have previously eluded detection.

Source: www.nojapower.com.au



NOJA Power OSM Recloser installed in Victoria Australia, with High Resolution SEF Protection enabled...

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New ICs for Battery Management Systems

The new ICs' high integration simplifies the design cycle and reduces customers' system BOM costs significantly...

Renesas Electronics Corporation has recently introduced a new family of multi-cell full Battery Front End (BFE) ICs for Battery Management Systems (BMS) built for the larger, high-voltage battery packs that power e-scooters, energy storage, high-voltage power tools, and other high-voltage equipment. The new ICs provide fast, flexible, cell balancing up to 200 mA+, a critical function to enable fast recharging and high utilization in large battery packs with hot plug tolerance up to 62V.

Detailing on the development, Andrew Cowell, Vice President, Mobility, Infrastructure and IoT Power Business Division at Renesas, said, "BMS serves as the 'brains' of the battery pack, and the increasing adoption of BMS in UPS and the data center is spiking demand for high-performance ICs that can support higher voltage and larger cell battery pack sizes. BFEs are a critical part of BMS, and we've built our new RAA489206 and RAA489204 ICs with the performance, flexibility, and integration that make it easier than ever for customers to simplify the design process and create robust, cost-effective battery systems for the growing mobility, UPS backup, energy storage markets."

Designed for higher voltage mobility applications where larger cell count and temperature variance across cells are more likely to lead to cell-to-cell imbalances, the RAA489206 provides full high-side battery protection and monitoring for 4S to 16S cell battery packs. The RAA489204 provides improved daisy chain operation with accelerated device-to-device communication and enhanced diagnostics compared with previous-generation devices, as well as internal cell balancing options and support for the higher voltages and cell count required by UPS systems, grid backup, and other energy storage systems.

The new ICs' high integration simplifies the design cycle and reduces customers' system BOM costs significantly, accelerating design and BOM selection time from months to weeks. The ICs also feature extensive built-in self-diagnostics, improving their safety functionality, reducing firmware workload, and easing the design burden for



meeting safety standards. Pin-to-pin compatibility with Renesas' previous BFE devices simplifies the design cycle even further, offering customers a quick and seamless migration path to the new BFE ICs.

Key Features of the RAA489206

- 16 cell voltage measurements
- Internal (10 mA) and external

(200 mA) cell balancing options

- Operating voltage range between 12V and 55V with +/- 10mV voltage measurement accuracy
- Up to 20 cm² board space reduction
- Low-side current sense measurement
- High-side charge/discharge FET battery protection

Key Features of the RAA489204

- Operating voltage range between 10V and 65V with +/- 10mV voltage measurement accuracy and +/-190mV pack voltage measurement accuracy
- Measures and performs read-back on all voltages, temperatures, and diagnostics for 112 cells in less than 10ms
- Cell balancing with both internal and external FETs supported
- Up to 6 external thermistor inputs
- Robust, low-power (typically 1mA when transmitting 10% of time) daisy chain communications
- Stackable up to 30 ICs

The RAA489206 and RAA489204 ICs are optimal for robust Battery Management System (BMS) applications. Renesas has designed multiple system architectures using complementary power, analog, and microcontroller offerings to create comprehensive solutions for a variety of applications.

This includes a new 20-28 Cell Battery Management System (up to 118V), providing a complete BMS system. Renesas' Winning Combinations are vetted solutions engineered to help customers accelerate designs and get to market faster. Renesas offers more than 250 Winning Combinations with compatible devices for a wide range of applications and end products.

For further information: www.renesas.com/win

A Truck with Fully Integrated Photovoltaics



Is it really possible to run heavy vehicles using photovoltaic techniques? The answer is 'Yes', a heavy-duty truck weighing 18 tons and equipped with a 3.5 kilowatt-peak photovoltaic system is now driving on Germany's roads...

Fraunhofer's commercial vehicle with integrated high-voltage photovoltaic system and feed-in to the 800-volt traction battery has been approved for road traffic. The solar power produced directly on the vehicle can cover 5 to 10% of the truck's energy needs. In the Lade-PV project, the Fraunhofer Institute for Solar Energy Systems ISE, with its project partners from industry and the Fraunhofer Institute for Transportation and Infrastructure Systems IVI, has developed solar PV modules and power electronics for integration in commercial vehicles. This truck, the first equipped with these PV modules, has now passed the technical inspection, marking a milestone towards more climate-friendly road freight transport.



The solar modules integrated into the box body make full use of the entire roof...
© Fraunhofer ISE

Explaining the significance of the development, Christoph Kutter, Project Manager at Fraunhofer ISE, said, "By successfully putting our high-voltage photovoltaic system into operation, we have achieved our goal of demonstrating the feasibility of vehicle-integrated photovoltaics for heavy-duty electric utility vehicles. The technical components have been integrated into the truck function as we expected." The particularly lightweight and robust PV module prototypes were developed by Fraunhofer ISE and built by Sunset Energietechnik GmbH. TBV Kühlfahrzeuge GmbH integrated the new modules into the box body of a Framo electric truck, which serves as the first demonstrator vehicle.

Safe Power Management

To ensure that the electricity yields are high and the material and cabling costs are low, the solar modules in

the truck roof are connected in series. The resulting high voltages of up to 400 volts could pose a safety risk in the event of an accident. To prevent this risk, Fraunhofer ISE has developed a separation device, which is located



Power management in the truck...
© Fraunhofer ISE

in the junction box of each PV module. In the event of an accident, the device disconnects the power within milliseconds, so that only harmless, low protective voltages are present throughout the system.

Power Electronics

As with the PV modules, the power electronics were also adapted to the requirements of the commercial vehicle. Project partner M&P Motion Control and Power Electronics GmbH developed a DC power controller that communicates with the vehicle control system via CAN bus and is integrated into the vehicle's safety concept. The photovoltaic power generated on the roof is fed directly into the on-board power supply of the commercial vehicle.

One-Year Test Under Real-life Conditions

The truck with integrated photovoltaic system is being used in the Freiburg area daily by the company Alexander Bürkle GmbH. The truck's operation is being regularly tested for one year to validate the electricity yield forecast and monitor the components under real conditions. Also, the energy forecast model "IVImon" of Fraunhofer IVI will accompany the truck on all routes throughout the year. This model forecasts the range, charging times and power generation for different routes depending on the vehicle consumption and the solar radiation.

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ACCELERATING ENERGY TRANSITION

India's mission of creating a pollution-free world through harnessing solar energy across the globe has been amassed through a recently forged partnership between the International Solar Alliance and the Global Energy Alliance for People and Planet. The partnership will help unlock USD 100 billion in public and private financing, to deliver on fast-tracking clean energy solutions in Africa, Asia, and Latin America...

www.electricalindia.in



The International Solar Alliance (ISA), an assembly of 124 countries initiated by India on November 30, 2015, at COP 21 in Paris, has made a big progress in the past few years; and recently at COP 26, the alliance has forged partnership with the Global Energy Alliance for People and Planet (GEAPP) for accelerating energy transition in Least Developed Countries and Small Island Developing States.

GEAPP has been launched during the COP 26 World Leaders' Summit on November 2, 2021. This alliance will aim to: 1) Address carbon mitigation by avoiding over 3 billion tonnes of greenhouse gases emission, 2) Provide energy access to 1 billion underserved people by extending clean and productive use of energy, and 3) Create millions of green jobs to alleviate poverty and spur economic growth.

The target behind forming partnership

The partnership will champion significant solar capacity generation globally while supporting grid-based and distributed renewable solutions. Over the next decade, it aims to unlock USD100 billion in public and private capital and tackle three profound human problems

simultaneously: 1) POWER – reaching one billion people with reliable, renewable energy; 2) CLIMATE – avoiding and averting four billion tons of carbon emissions; and 3) JOBS – building an on-ramp to opportunity by directly creating more than 150 million jobs.

Commenting on this partnership, Dr. Ajay Mathur, Director General, ISA, said, “We’re excited to be partnering with the GEAPP as part of our ongoing mission to accelerate our mission to solarize the world by 2030. With the right investment and regulatory conditions, solar

the poorest are falling farther behind and being battered by climate change’s effects. Green energy transitions and renewable electrification is the only way to restart economic progress for all while at the same time stopping the climate crisis. Providing people with an on-ramp to the modern economy while making real, measurable progress against the existential threat of climate change, the GEAPP is one of the boldest, most transformative initiatives in our history.”

The action plan

As part of the engagement, ISA will act as a global delivery



Dr. Ajay Mathur
Director General,
The International
Solar Alliance (ISA)



Dr. Rajiv J. Shah
President of The
Rockefeller Foundation

power has the potential to mobilize billions of dollars in green investments, empower billions of people while averting billions of tons of emissions.

The ISA is continuously looking at ways and means to support the socio-economic goals of our member countries. Through our partnership with the GEAPP, the ISA will create an enabling policy and regulatory environment by building capacity of government, convening and research, and provide best-in-class project development support to build a strong pipeline of investable solar projects. The partnership with GEAPP will provide much-needed support to Least Developing Countries (LDCs) and Small Island Developing States (SIDS) Member Countries in the implementation of innovative solar projects and in building resilience in key sectors such as agriculture and health with solar. The projects supported through this partnership will also help enable faster replication across other countries.

Through a large host of such interventions, I am confident that this partnership will make measurable progress in bringing clean, renewable energy to underserved communities around the world.”

Need behind formation of GEAPP

Pinpointing at the current scenario, Dr. Rajiv J. Shah, President of The Rockefeller Foundation, said, “The world is undergoing an economic upheaval, in which

partner for GEAPP, providing project development and policy support across distributed renewable and grid-based energy transition in LDCs and SIDS member countries. More specifically, ISA is set to engage across the following four key areas enabling the breadth and depth of impact.

- **Rallying governments to respond to GEAPP country partnership calls:** ISA will leverage its political leadership and country membership to help countries develop proposals in response to GEAPP country-partnership calls. This is critical to creating a pipeline of investable projects for the GEAPP.
- **Promoting the vision for global interconnected grids:** ISA will continue to drive the grid-connectivity initiative through institutional set-up, pilot implementation and research combined with knowledge sharing.
- **Build capacity of governments for enabling policy and regulation:** ISA will create an enabling policy and regulatory environment by building the capacity of government, convening and research, and providing best-in-class project development support to build a strong pipeline of investable solar projects.
- **Provide best-in-class project development:** Finally, ISA will serve as GEAPP’s delivery partner, supporting with implementation planning, project development as well as technical assistance in the 10 to 15 least developed countries.

Striding towards Hydrogen Economy

Europe's largest Polymer Electrolyte Membrane (PEM) water electrolyser has begun operations in 2021 to produce green hydrogen...

One of the most significant advancements in the field of development of Hydrogen Energy has taken place last year at Shell's Energy and Chemicals Park in Rhineland near Cologne. As part of the REFHYNE European consortium and with EU funding through the Fuel Cells and Hydrogen Joint Undertaking (FCH JU), the fully operational plant is the first to use this technology at such a large scale in a refinery.

Polymer Electrolyte Membrane (PEM) electrolysers are more compact than any conventional alkaline electrolyser. They are suited to working with renewable energy sources because they can operate dynamically using varying loads of electricity. This allows PEM electrolysers to operate when wind and solar energy generation is cheapest.

The REFHYNE project is at the forefront of the effort to supply Clean Refinery Hydrogen for Europe. The Rhineland electrolyser will use renewable electricity to produce up to 1,300 tonnes of green hydrogen a year. This will initially be used to produce fuels with lower carbon intensity. In the future, green hydrogen could also be used for industry, to heat homes and to power trucks.

Importance of the project

The REFHYNE project is at the forefront of the effort to supply green hydrogen for Europe. Hydrogen will play a key role to achieve the European Green Deal's climate targets by helping to decarbonise harder-to-abate sectors in transport and industry. The European Commission released a landmark Hydrogen Strategy in 2020, which aims at providing an enabling policy framework.

The European consortium backing the project consists of SINTEF (co-ordinator), Shell, ITM Power, Sphera and Element Energy. The electrolyser was manufactured by ITM Power in Sheffield, UK, and includes parts made in Italy, Sweden, Spain and Germany.

Remarks of the field visionaries

Bart Biebuyck, Executive Director, Fuel Cells and Hydrogen Joint Undertaking, said, "In order to achieve climate neutrality by 2050, we need to fundamentally reshape our energy system. Clean hydrogen will play a key role in e-mobility and in industry, as it has great potential for decarbonising sectors where direct use of renewable energy is not possible. Accordingly, we want to accelerate the market launch of fuel cells and



Image by pixabay.com

Bart Biebuyck
Executive Director,
Fuel Cells and Hydrogen
Joint Undertaking



hydrogen technology and tap into their advantages in Europe.”

Armin Laschet, North Rhine-Westphalia’s Minister-President, said, “We are a hydrogen region. With the commissioning of the largest PEM electrolysis plant in Europe, we are further expanding our leading role in this field. We are therefore laying the foundation for a modern and green industry, with highly skilled jobs. Today, 30% of German demand for hydrogen already comes from North

Armin Laschet
North Rhine-Westphalia’s
Minister-President



Rhine-Westphalia’s industry. Estimates predict that demand will double by 2030. This is why we need innovative solutions that will meet the demand for CO₂-neutral hydrogen. Projects such as Refhyne demonstrate how innovation can benefit both the environment and the economy.”

Huibert Vigevano
Director,
Shell’s Downstream



Shell’s Downstream Director, Huibert Vigevano, said, “This project demonstrates a new kind of energy future and a model of lower carbon energy production that can be replicated worldwide. Shell wants to become a leading supplier of green hydrogen for industrial and transport customers in Germany. In doing so, we want to be involved in the whole process — from generating power using offshore wind to increased production and distribution of hydrogen across all sectors. We want to be the supplier and partner of choice for our customers as we help them decarbonise.”

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RENEWABLE CAPACITY EXPANSION IN 2021

As one of the major concerns related to the climate change is the uncontrolled presence of pollutants in the atmosphere, the entire world is now in race to mitigate the menace. It is universally accepted now that deployment of complete Renewable Energy generation techniques is the only solution to this challenge. So, the question is how is the progress worldwide? Let us see what IEA has found recently through their survey...

Despite rising costs for key materials used to make solar panels and wind turbines, additions of new renewable power capacity in 2021 were expected to rise to 290 Gigawatts (GW), surpassing the previous all-time high set in 2020.

By 2026, global renewable electricity capacity is forecast to rise more than 60% from 2020 levels to over 4, 800 GW – equivalent to the

current total global power capacity of fossil fuels and nuclear combined.

Renewables are set to account for almost 95% of the increase in global power capacity through 2026, with solar PV alone providing more than half. The amount of renewable capacity added over the period of 2021 to 2026 is expected to be 50% higher than from 2015 to 2020. This is driven by stronger support from government policies and more ambitious clean energy goals announced before and during the COP 26 Climate Change Conference.

“



Fatih Birol
Executive Director, IEA

”

Commenting on the state of development in the field of renewable energy, Fatih Birol, Executive Director, IEA, said, “This year’s record renewable electricity additions of 290 gigawatts are yet another sign that a new global energy economy is emerging. The high commodity and energy prices we are seeing today pose new challenges for the renewable industry, but elevated fossil fuel prices also make renewables even more competitive.”

The growth scenario

The growth of renewables is forecast to increase in all regions compared with the 2015-2020 period. China remains the global leader in the volume of capacity additions: it is expected to reach 1200 GW of total wind and solar capacity in 2026 – four years earlier than its current target of 2030. India is set to come top in terms of the rate of growth, doubling new installations compared

with 2015-2020. Deployments in Europe and the United States are also on track to speed up significantly from the previous five years. These four markets together account for 80% of renewable capacity expansion worldwide.

Where is India?

Birol pointed out, “The growth of renewables in India is outstanding, supporting the government’s newly announced goal of reaching 500 GW of renewable power capacity by 2030 and highlighting India’s broader potential to accelerate its clean energy transition. China continues to demonstrate its clean energy strengths, with the expansion of renewables suggesting the country could well achieve a peak in its CO₂ emissions well before 2030.”

Growing importance of Solar PV

Solar PV remains the powerhouse of growth in renewable electricity, with its capacity additions forecast to increase by 17% in 2021 to a new record of almost 160 GW. In the same time frame, onshore wind additions are set to be almost one-quarter higher on average than during the 2015-20 period. Total offshore wind capacity is forecast to more than triple by 2026.

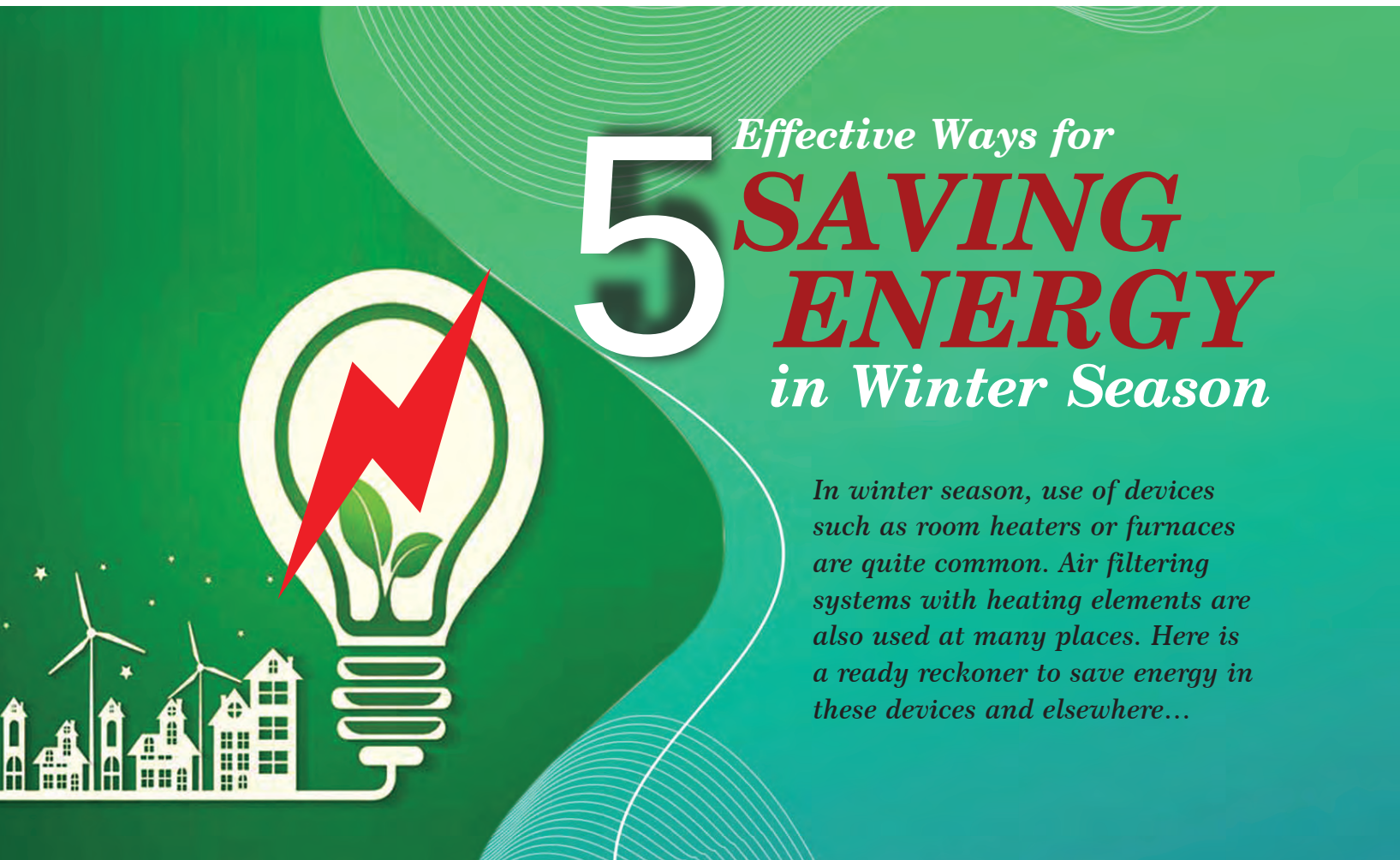
IEA expects this record growth for renewables to take place despite today’s high commodity and transport prices. However, should commodity prices remain high through the end of next year, the cost of wind investments would go back up to levels last seen in 2015 and three years of cost reductions for solar PV would be erased.

Despite rising prices limiting growth, global biofuel demand in 2021 was forecast to surpass 2019 levels, rebounding from 2020’s huge decline caused by the pandemic. Demand for biofuels is set to grow strongly to 2026, with Asia accounting for almost 30% of new production. India is expected to rise to become the third largest market for ethanol worldwide, behind the United States and Brazil.

Conclusion

Governments can further accelerate the growth of renewables by addressing key barriers, such as permitting and grid integration challenges, social acceptance issues, inconsistent policy approaches, and insufficient remuneration. High financing costs in the developing world are also a major obstacle.

However, even this faster deployment would still fall well short of what would be needed in a global pathway to net zero emissions by mid-century.



5 *Effective Ways for* **SAVING ENERGY** *in Winter Season*

In winter season, use of devices such as room heaters or furnaces are quite common. Air filtering systems with heating elements are also used at many places. Here is a ready reckoner to save energy in these devices and elsewhere...



Maintain your systems:

Have a certified professional give your gadgets a tune-up to make sure that they are operating efficiently and ready to perform at their best. Don't forget to change/clean your AC filters each month or according to the manufacturer's instructions.

1



Set your thermostat:

If you have a programmable thermostat, you can set it lower when no one is at home to maximize energy savings. Setting the thermostat to the lowest comfortable setting can help, and even just one degree can make a difference.

2

3

Close up gaps:

Take time now to caulk, spray foam or use weather-stripping to seal leaks and gaps around windows, doors and duct work.



Use your ceiling fans:

Set ceiling fans to run clockwise on low speed in the winter to circulate heat more efficiently. This creates an updraft that helps move warm air near the ceiling back out and around the room.

4

5

Don't block the heat:

Open curtains and blinds on sun-facing windows to allow the sun's rays to help naturally heat your home. Make sure registers are not blocked by drapes or furniture so warm air can easily circulate.



Source: Adopted from the note of PPL Corporation, UK.

Your Strong Partner for Machine Building

Phoenix Contact offers you an extensive portfolio of products and services – the decisive contribution to your competitiveness...

Machine building has a global and very dynamic market. The competition you are facing as a supplier is tough. For you, it is important that you meet the requirements of your customers and develop a range of products and services that allows you to be sustainably competitive. The focus is on the cost-effectiveness, quality, flexibility, and performance of your machines.

Safety for every function



Utilize PSR safety relays if your machine requires few safety functions and logical links to be implemented. The combination of innovative connection technology, space-saving style and clearly arranged design contributes to the quick

and economic implementation of the safety-related application.

Protecting network and data



The FL MGUARD security routers and firewalls protect your machine and your network against unauthorized access by people or malware.

Reliable power supply

QUINT POWER with SFB technology trips circuit breakers magnetically and quickly with six

times the nominal current. Only faulty current paths are switched off selectively, important machine parts remain in operation. The QUINT UPS-IQ uninterruptible power supply with its IQ technology thinks along and warns you early about a breakdown.



Intelligent motor switching



Switch and reverse motors quickly and reliably with CONTACTRON compact hybrid motor starters.

The micro processor control enables wear-free switching. This means that the service life of devices is up to ten times longer than that of purely mechanical devices.

Intelligent motor protection

The CONTACTRON motor manager combines overload and underload detection in a single device. This allows you to detect all critical load states. In the event of an emergency, the motor manager protects the motor and subsequently your machine, because the device shuts down the drive in case of a malfunction.

Securely connecting the field level to the controller

VARIOFACE system cabling connects the controller to the field-easy and error-free. Phoenix Contact provides the corresponding front adapters, system cables, and interface modules.



Protection against surge voltages

Surge voltages pose a risk for machines and can lead to the destruction of important function groups. Increase the safety and machine availability with effective surge protection in the supply and before signal interfaces.



Reliable connection with sensor/actuator cabling



The easiest way of performing the signal wiring in the field consists of the use of sensor/actuator cables and corresponding junction boxes. With M8 and M12 lines in variants for all different types of requirements, you can connect individual sensors

and actuators as quickly and as safely as modularly designed system components.

Space-saving and safe cable entry systems

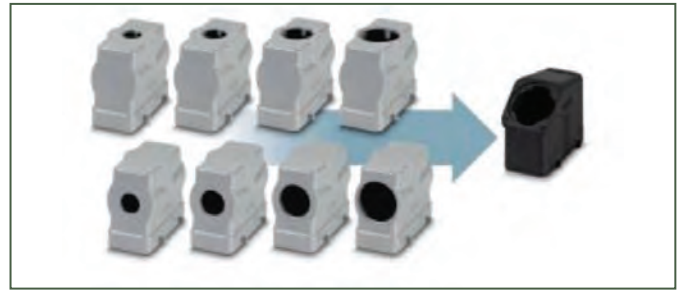


CES is the cable entry system for assembled cables and lines. It allows routing all types of different cables in a space-saving way from the control cabinet to the field. You assemble the

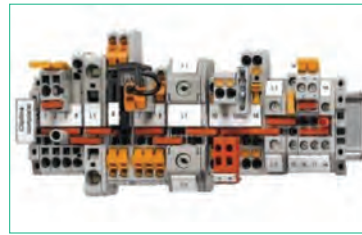
system consisting of individual sleeves and frames according to your requirements.

One system – fewer parts

The HEAVYCON EVO plug connector system features a standardized mount for cable glands from size M20 to size M40. The cable outlet direction can easily be determined on site. This allows up to eight conventional sleeve housings to be replaced.



All connection technologies, one system



With CLIPLINE complete, you can freely choose the connection technology. Whether screw, push-in, spring-cage, quick, bolt or plug connection: Combine all

connection types using the same accessories.

Optimum marking material for your application



The manifold product range covers all the requirements of terminal, cable and conductor marking as well as device and system marking. The quality labeling on plastic markers, labels and metal signs expand the applicability up to areas with increased requirements.

The right tool for every application

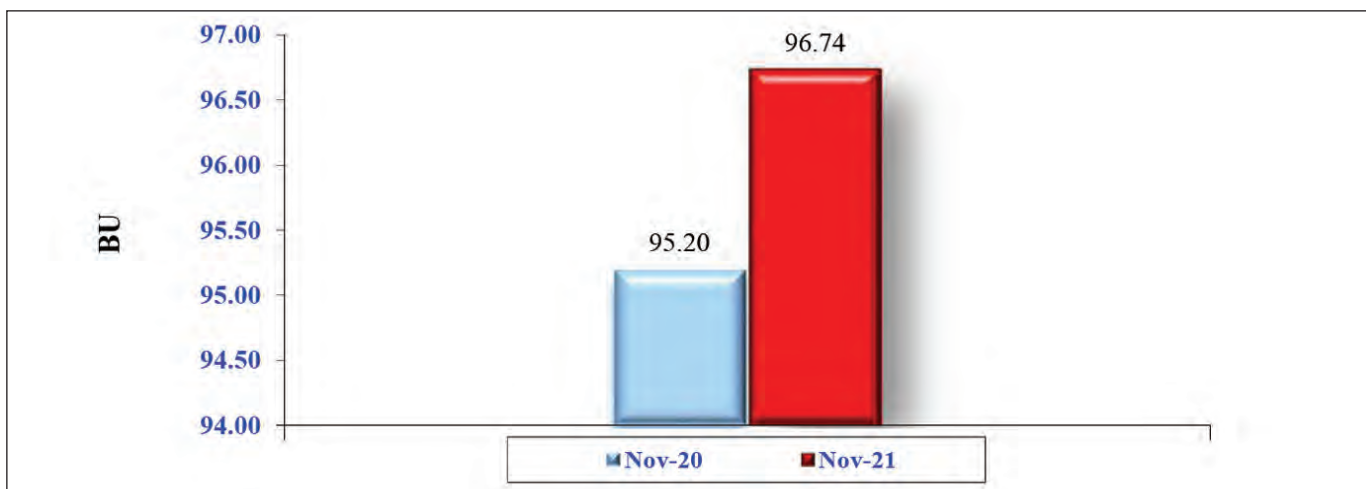


The Toolfox tool program offers excellent hand tools and machines for cutting, stripping, crimping, screwing and testing. Our ergonomically-designed tools convince through simple handling, high service life and best working results. 

For further information: E-mail : adverts@phoenixcontact.co.in, Website: www.phoenixcontact.co.in

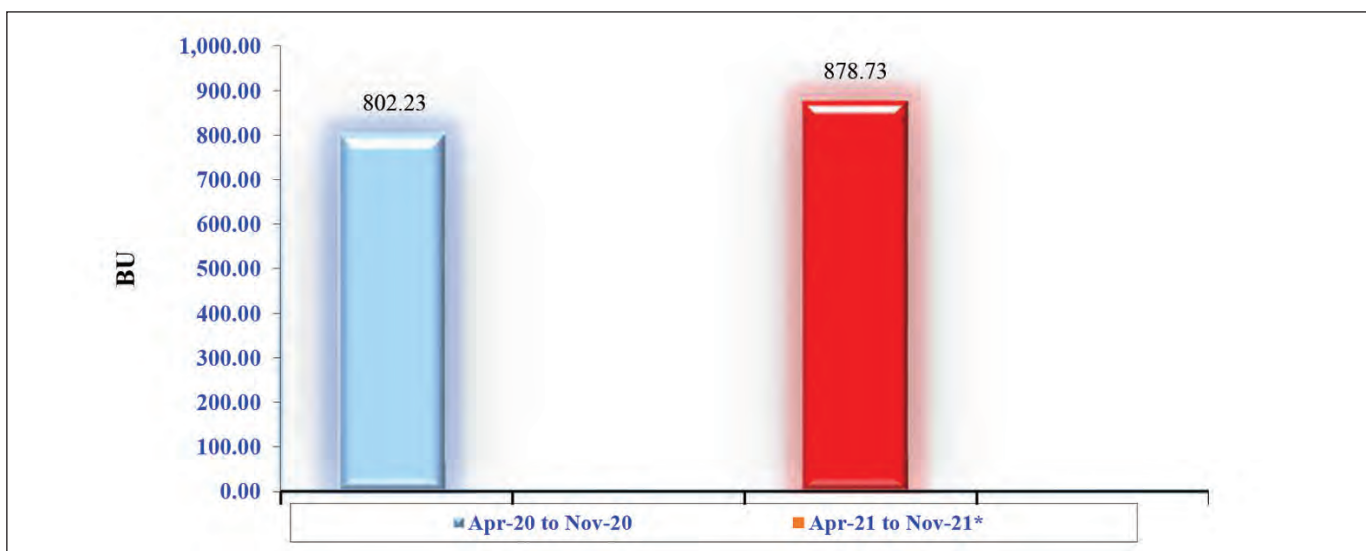
Electricity Generation for Nov-2021 (BU)

Type	Achievement	Targets	Achievement*	% Change of Achievement w.r.t. Nov-2020
	Nov-20	Nov-21	Nov-21	
Thermal	82.54	95.20	82.46	-0.09
Nuclear	3.83	3.84	4.00	4.42
Hydro	8.42	9.51	9.76	15.95
Bhutan Import	0.41	0.39	0.51	23.69
All India	95.20	108.92	96.74	1.62
*Provisional				



Electricity Generation During Apr-20 to Nov-20 & Apr-21 to Nov-21 (BU)

Type	Apr-20 to Nov-20	Apr-21 to Nov-21*	% Change w.r.t Apr-20 to Nov-20
Thermal	645.51	723.19	12.03
Nuclear	30.05	30.32	0.90
Hydro	118.49	118.10	-0.33
Bhutan Import	8.18	7.12	-13.01
All India	802.23	878.73	9.54
* Provisional			

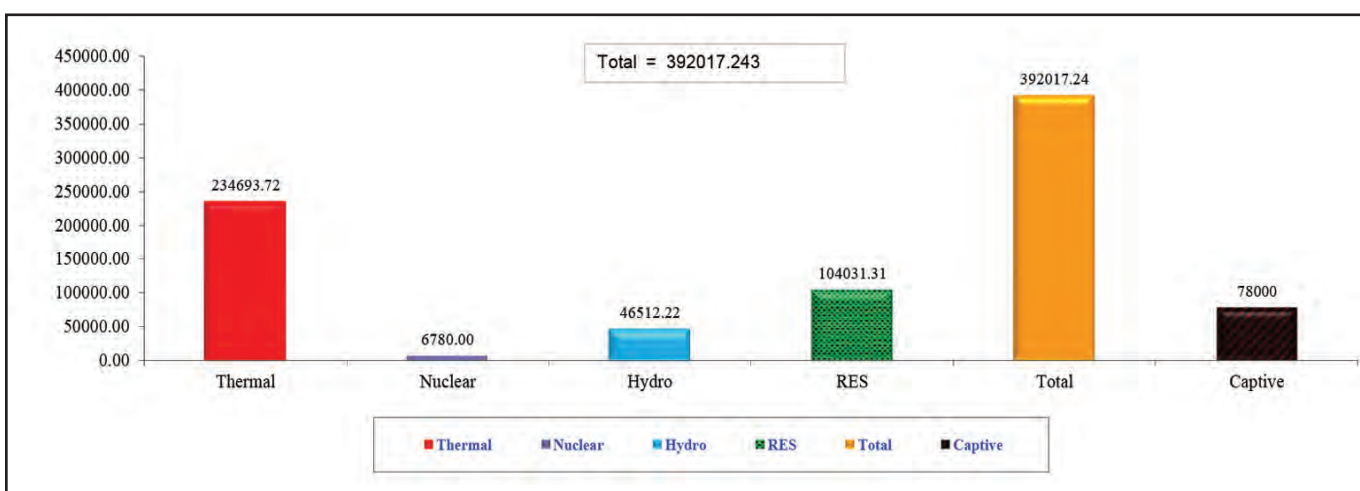


Source: CEA

Generating Capacity Addition for Nov-2021 (MW)				
Type	Achievement	Targets	Achievement	% Achivement w.r.t. Sep-2018
	Nov-20	Nov-21		
Thermal	0	0	250	NA
Hydro	0	0	0	NA
Nuclear	0	0	0	NA
All India	0	0	250	NA
NA -Not Applicable				

Generating Capacity Addition during Apr-20 to Nov-20 & Apr-21 to Nov-21			
Type	Apr-20 to Nov-20	Apr-19 to Sep-19	% Change w.r.t Previous Year
Thermal	1106.15	2370.00	114.26
Hydro	0.00	212.98	NA
Nuclear	0.00	0.00	NA
All India	1106.15	2582.98	133.51
NA -Not Applicable			

All India Installed Capacity (MW) Region-wise as on 30-11-2021									
Region	Thermal					Nuclear	Hydro	RES**	Grand Total
	Coal	Lignite	Gas	Diesel	Total				
Northern	55407.31	1580.00	5781.26	0.00	62768.57	1620.00	20433.77	23676.31	108498.65
Western	73716.27	1400.00	10806.49	0.00	85922.76	1840.00	7562.50	32224.30	127549.56
Southern	44904.52	3640.00	6491.80	433.66	55469.99	3320.00	11819.83	45947.33	116557.15
Eastern	27866.38	0.00	100.00	0.00	27966.38	0.00	4752.12	1721.34	34439.84
North-East	770.02	0.00	1719.96	36.00	2525.98	0.00	1944.00	424.02	4893.99
Islands	0.00	0.00	0.00	40.05	40.05	0.00	0.00	38.01	78.06
All India	202664.50	6620.00	24899.51	509.71	234693.72	6780.00	46512.22	104031.31	392017.24
** RES as on 28.02.2021									



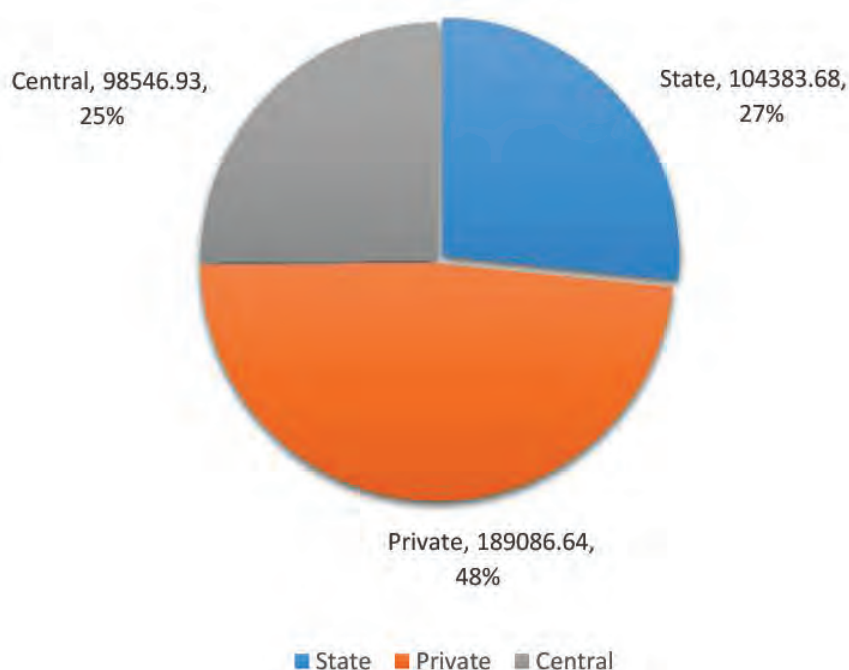
Source: CEA

All India Installed Capacity (MW) Sector-wise as on 30-11-2021

Sector	THERMAL					Nuclear	Hydro	RES*	Grand Total
	Coal	Lignite	Gas	Diesel	Total				
State	66381.50	1150.00	7087.36	236.01	74854.86	0.00	27114.50	2414.31	104383.68
Private	72673.00	1830.00	10574.24	273.70	85350.95	0.00	3751.00	99984.69	189086.64
Central	63610.00	3640.00	7237.91	0.00	74487.91	6780.00	15646.72	1632.30	98546.93
All India	202664.50	6620.00	24899.51	509.71	234693.72	6780.00	46512.22	104031.31	392017.24

*RES as on 31.03.2021

All India Installed Capacity(MW) (Sector-Wise)



Transmission Lines Added during Nov-2021 (Ckms)

Voltage Level	Nov-20	Nov-21
+/- 500 KV HVDC	0	0
+/- 800 KV HVDC	0	0
765 KV	0	465
400 KV	0	168
220 KV	345	329
All India	345	962

Transmission Lines Added during Apr-20 to Nov-20 & Apr-21 to Nov-21 (Ckms)

Voltage Level	Apr-18 to Sep-18	Apr-19 to Sep-19
+/- 500 KV HVDC	0	0
+/- 800 KV HVDC	3531	0
765 KV	2	3164
400 kV	1868	2863
220 KV	3038	3666
All India	8439	9693

Source: CEA

ALL INDIA INSTALLED CAPACITY (IN MW) OF POWER STATIONS
(As on 30.11.2021)

Region	Ownership/ Sector	Mode wise breakup					Nuclear	Renewable		Total	Grand Total
		Thermal						Hydro	RES * NRE)		
		Coal	Lignite	Gas	Diesel	Total					
Northern Region	State	17319.00	250.00	2879.20	0.00	20448.20	0.00	5888.25	731.35	6619.60	27067.80
	Private	22425.83	1080.00	558.00	0.00	24063.83	0.00	3061.00	22565.96	25626.96	49690.79
	Central	15662.48	250.00	2344.06	0.00	18256.54	1620.00	11484.52	379.00	11863.52	31740.06
	Sub Total	55407.31	1580.00	5781.26	0.00	62768.57	1620.00	20433.77	23676.31	44110.08	108498.65
Western Region	State	21290.00	900.00	2849.82	0.00	25039.82	0.00	5446.50	571.48	6017.98	31057.80
	Private	31947.17	500.00	4676.00	0.00	37123.17	0.00	481.00	30986.52	31467.52	68590.69
	Central	20479.10	0.00	3280.67	0.00	23759.77	1840.00	1635.00	666.30	2301.30	27901.07
	Sub Total	73716.27	1400.00	10806.49	0.00	85922.76	1840.00	7562.50	32224.30	39786.80	127549.56
Southern Region	State	20322.50	0.00	791.98	159.96	21274.44	0.00	11819.83	597.88	12417.71	33692.15
	Private	12747.00	250.00	5340.24	273.70	18610.95	0.00	0.00	44807.55	44807.55	63418.50
	Central	11835.02	3390.00	359.58	0.00	15584.60	3320.00	0.00	541.90	541.90	19446.50
	Sub Total	44904.52	3640.00	6491.80	433.66	55469.99	3320.00	11819.83	45947.33	57767.16	116557.15
Eastern Region	State	7450.00	0.00	100.00	0.00	7550.00	0.00	3537.92	275.11	3813.03	11363.03
	Private	5553.00	0.00	0.00	0.00	5553.00	0.00	209.00	1436.23	1645.23	7198.23
	Central	14863.38	0.00	0.00	0.00	14863.38	0.00	1005.20	10.00	1015.20	15878.58
	Sub Total	27866.38	0.00	100.00	0.00	27966.38	0.00	4752.12	1721.34	6473.46	34439.84
North Eastern Region	State	0.00	0.00	466.36	36.00	502.36	0.00	422.00	233.25	655.25	1157.60
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.00	160.77	160.77	160.77
	Central	770.02	0.00	1253.60	0.00	2023.62	0.00	1522.00	30.00	1552.00	3575.62
	Sub Total	770.02	0.00	1719.96	36.00	2525.98	0.00	1944.00	424.02	2368.02	4893.99
Islands	State	0.00	0.00	0.00	40.05	40.05	0.00	0.00	5.25	5.25	45.30
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.66	27.66	27.66
	Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10	5.10	5.10
	Sub Total	0.00	0.00	0.00	40.05	40.05	0.00	0.00	38.01	38.01	78.06
ALL INDIA	State	66381.50	1150.00	7087.36	236.01	74854.86	0.00	27114.50	2414.31	29528.81	104383.68
	Private	72673.00	1830.00	10574.24	273.70	85350.95	0.00	3751.00	99984.69	103735.69	189086.64
	Central	63610.00	3640.00	7237.91	0.00	74487.91	6780.00	15646.72	1632.30	17279.02	98546.93
	Total	202664.50	6620.00	24899.51	509.71	234693.72	6780.00	46512.22	104031.31	150543.53	392017.24

Figures at decimal may not tally due to rounding off

Source: CEA



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5 YEARS	60	4000.00	7000.00	8000.00	4000.00	9000.00	10000.00
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3 YEARS	18	2000.00	2900.00	3500.00	2000.00	3900.00	4500.00
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3 YEARS	18	3200.00	4100.00	4700.00	3200.00	5100.00	5700.00
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igus presents QuickRobot online tool

New version of the robot equipment configurator finds the right energy supply system for cobots, SCARA and industrial robots...

Highly flexible cables and hoses ensure that robotic applications are supplied with energy, data and media. Energy supply systems are required to protect them safely even with high dynamics and torsion. With the extended QuickRobot, igus offers a free online tool for the quick configuration of the individual

energy chain system for 418 robots. New features such as product videos support the selection process.

These robots weld, rivet, palletise and assist. In order for the small and large production to be able to work fail-safe in 24/7 operation, they need the right energy supply system to safely route the cables and hoses from axis 1 to axis 6. For the simple design of the individual energy chain for cobots, SCARA, 4-axis robots and 6-axis robots, igus has now expanded the capabilities of its robot equipment configurator. In the online tool, users can select their robot from 418 different models from 10 manufacturers and find the optimum energy supply for axes 1 to 6.

A suitable energy supply system:

The path to the customer-specific energy chain is



very simple. After selecting the robot model, the user is shown all compatible energy supply systems, such as the three-dimensional triflex R energy chains and retraction systems or the new SCARA cable solution. It features videos of the individual products, illustrating real applications and movements of the energy

chain. A visualisation of the robot and an exploded view of the components support the configuration. More detailed information on the components can be found by clicking on the help buttons for the individual fields. The customer can choose the best system for the robot. The price is calculated in real time. The parts list is created automatically, can be downloaded or can be transferred directly to the shopping cart. The CAD data of the individual components, a PDF report and also assembly videos of the components are offered by the tool as a supplementary service. Try the QuickRobot for yourself at: <https://www.igus.in/info/robotics-quick-robot> 

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AC / DC TRMS Clamp-On Multimeter For Solar Application MODEL – KM 3001

KUSAM-MECO has added yet another High Safety 'UL' listed unique AC/DC TRMS Clamp-on-Multimeter with VFD, EF-Detection, PC interface for solar application. It is one of its kind of clamp multimeter having so many functions packed in one instrument that even "Phoren Brands" do not have. It has 1500V DC Volts range specially suitable for Solar applications, Autocheck for Voltage & Ohms Function, VFD-V & VFD-HZ Function, 5ms CREST-Max Capture Mode (Peak Hold) Autoranging, Relative Zero Mode, EF-Detection (NCV), Backlight LCD Display, Auto Power Off. It has a Jaw Opening of 55mm. It has 3-5/6 digits (6000 counts) and 3½ digits (1999 counts) for Hz. It has a fast update rate of 5/second. To preserve the battery it shuts off after 34 minutes of no activity. It has Transient



Protection of 12 kV (1.2/50µs surge) not found in any other similar clamp meter in India. The Electrical specifications include AC current up to 2000 Amperes, DC current up to 2000 Amperes, DC+AC current up to 2000 Amps, DC voltage up to 1500V DC, AC volts upto 1000V AC, VFD-ACV, HZ Line level Frequency capacitance, Non-contact EF-Detection, Audible continuity Test, AC+DC Voltage, Resistance, Temperature, Diode Test CREST-MAX (Capture Mode).

The instrument is supplied with manual, batteries, Bkp60 banana plug type K-Thermocouple, test leads, Carrying case. Optionally software can be supplied to download the data to PC. 

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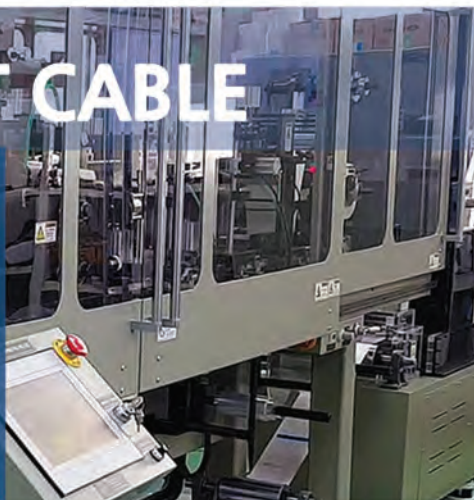
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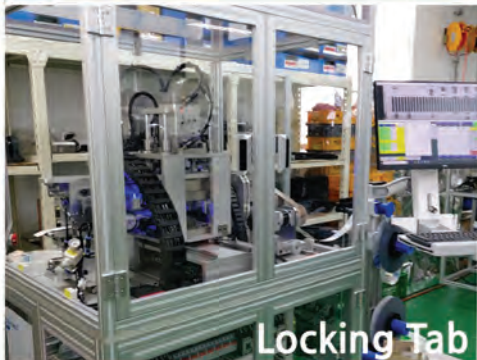


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TECH MASTER ELECTRONICS CO.,LTD.

VIETNAM

UJU ELECTRONICS CO.,LTD.

GERMANY

GERMAN COMPANY(NDA)

CHINA

RICHANG AUTO PARTS CO.,LTD.
HITACHI CABLE CO.,LTD.
HUNGFU GROUP.
FOXCONN TECHNOLOGY GROUP.
TSUJIMOTO ELECTRONICS CO.,LTD.
JESS-LINK PRODUCTS CO.,LTD.
TENNIRICH GROUP.
DEREN ELECTRONIC CO.,LTD.
ASEN MAGNET&ELECTRONIC CO.,LTD.
PETER'S TECHNOLOGY CO.,LTD.
DONGRI TECHNOLOGY ELECTRONICS CO.,LTD
NEW GRAND TECH CO.,LTD.
XINYA ELECTRONICS CO.,LTD.
SHS HARNESS MANUFACTURE LTD.
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HAMBURG INDUSTRIES CO.,LTD.
XIAMEN GUANLIAN ELECTRONIC
TECHNOLOGY CO.,LTD.
P-TWO ELECTRONIC CO.,LTD.
NICOMATIC (TIANJIN) ELECTRONICS CO.,LTD.
PARLEX (SHANGHAI) INTERCONNECT
TECHNOLOGIES CO.,LTD.
ZHENG HAO ELECTRONICS CO.,LTD.
DONGGUAN TANGSHA OZHEN ELECTRONIC CO.,LTD.
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HUSISHIN INDUSTRY.



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