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## From the Publisher's Desk

### Do Not Increase Economic Burden Now

In this CORONA infested phase, there is nothing much to especially talk about the Indian Power Sector. In most of the states, things are running smoothly except some small instances of breakdown, which are very common incidents. However, when the entire country is passing through a phase of dwindling economic activities, it's really a matter of pity that some of the DISCOMS are trying to raise money through Security Deposit at this crucial point of bad time.

Maharashtra State Electricity Distribution Company (MSEDCL) has decided to collect security deposit from its consumers now. Obviously, it is a great burden at this time of economic uncertainty. Not only the residential consumers but also for the MSMEs, it is a matter of great distress, which could have been easily avoided.

In Maharashtra, MSEDCL currently enjoys monopoly over all the consumers having connection less than 1MW. Due to this model, consumers do not have any other alternative but to surrender to MSEDCL's demands. Besides residential consumers, several MSME representatives are also opposing this step. Moreover, MSEDCL's new proposal to collect two months' average bill as security deposit – against the previous practice of one month's average amount has added more fuel to the fire.

When all the state governments are trying to ease the burdens on the citizens, in Maharashtra evidently MSEDCL is putting extra load on them. Obviously, it is yet another example of dictatorship because of monopoly. MSEDCL must stay away from such steps to trouble the citizens of the state. If they fail to collect their dues from a limited number of consumers, for that they cannot pressurise all the consumers that include a major portion of honest bill payers.

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# Low Noise Amplifier for NavIC L5 Band

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- > Wearables
- > Drones

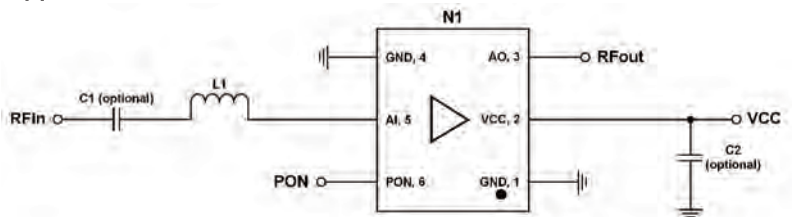
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## Application schematic:



# Electrical India

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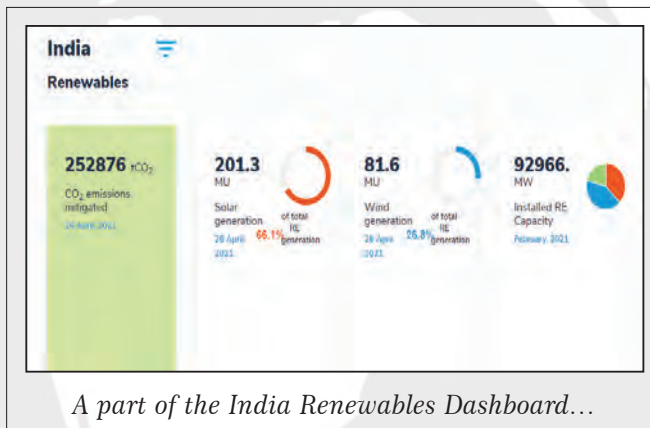
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## NEW DASHBOARD PRESENTS UPDATED DETAILS OF RE OPERATIONAL DATA

The Central Electricity Authority (CEA) and CEEW's Centre for Energy Finance (CEEW-CEF) have jointly launched the India Renewables Dashboard, a joint effort to provide detailed operational information on Renewable Energy (RE) projects in India. This information is freely available to policymakers, developers, financiers, and the public. The dashboard was launched by Sandesh Kumar Sharma, Member (Planning), CEA. Being supported by the Shakti Sustainable Energy Foundation, it captures daily generation data at the state, regional and national levels for the aggregate 93 GW of installed RE capacity in India. It also captures this data at a plant-level for a subset of projects.

Previously, such data required manual aggregation and was not easily accessible. The India Renewables



Dashboard addresses this challenge by automating the process of updating daily RE generation. Further, users can download the data in multiple formats and conduct their own bespoke analyses. This will allow them to gain invaluable insights for improving project implementation, infrastructure planning and power generation

forecasting in the renewables sector.

Gagan Sidhu, Director, CEEW-CEF, said, "Data accessibility is crucial for India to attract the hundreds of billions of dollars in investments that it needs to grow its RE capacity to five times the current 93 GW. In this context, the India Renewables Dashboard can help mitigate risk perception and make capital available for India's green transition at more affordable rates. By doing so, it can help accelerate India's much-needed energy transition." 

## PLI SCHEME RECEIVES NOD FROM THE UNION GOVERNMENT

*Manufacturers will be rewarded for higher efficiencies of solar PV modules and also for sourcing their material from the domestic market...*

Recently, the Cabinet has approved the Ministry of New & Renewable Energy's proposal for implementation of the Production Linked Incentive (PLI) Scheme 'National Programme on High Efficiency Solar PV (Photo Voltaic) Modules' for achieving manufacturing capacity of Giga Watt (GW) scale in high efficiency solar PV modules with an outlay of Rs.4,500 crore.

Solar capacity addition presently depends largely upon imported solar PV cells and modules as the domestic manufacturing industry has limited operational capacities of solar PV cells and modules. The National Programme on High Efficiency Solar PV Modules will reduce import dependence in a strategic sector like electricity. It will also support the Atmanirbhar Bharat initiative.

Solar PV manufacturers will be selected through a

transparent competitive bidding process. PLI will be disbursed for five years post commissioning of solar PV manufacturing plants, on sales of high efficiency solar PV modules. Thus, the PLI amount will increase with increased module efficiency and increased local value addition.

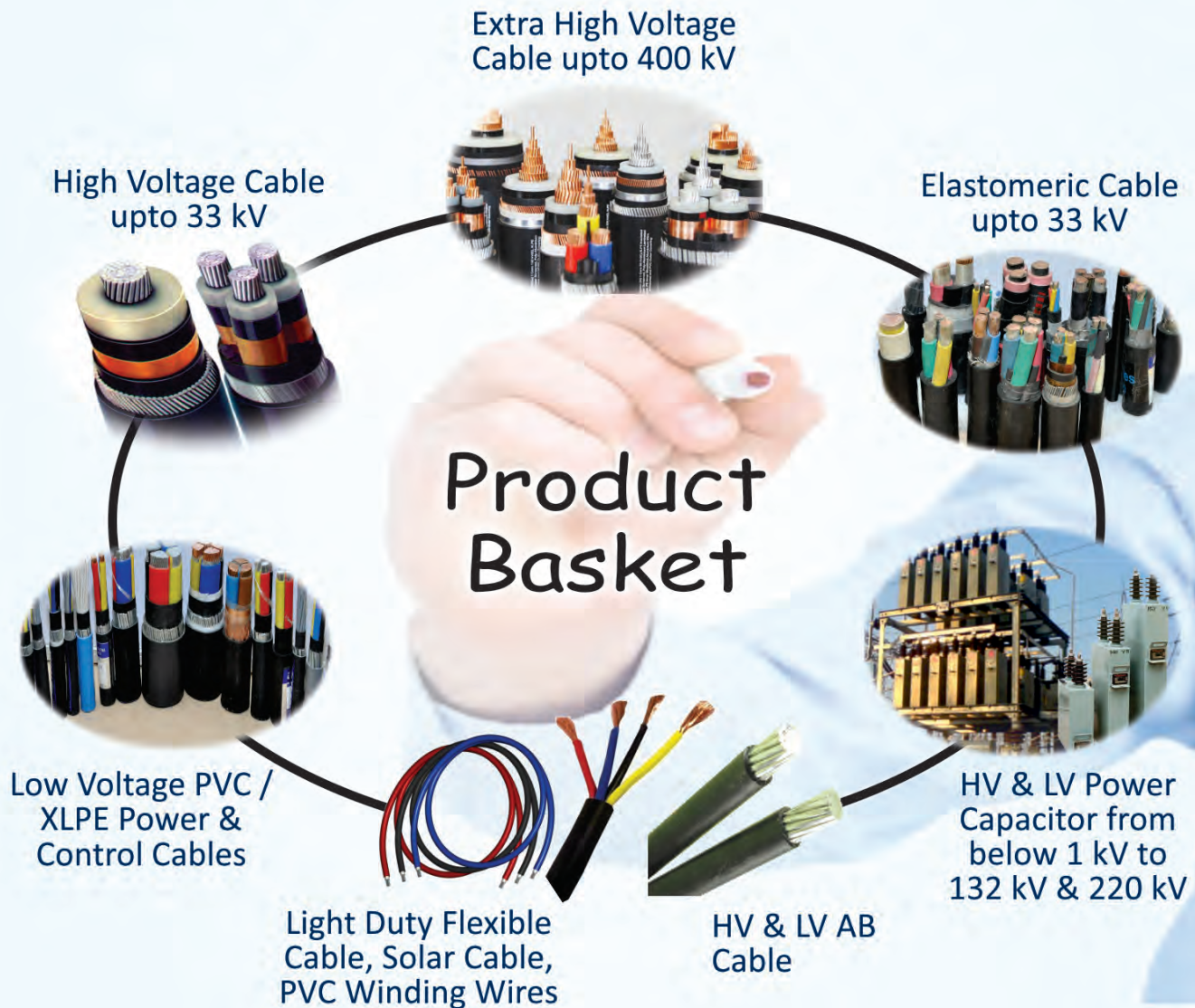
The outcomes or benefits expected from the scheme include: Additional 10,000 MW capacity of integrated solar PV manufacturing plants; Direct investment of around Rs.17,200 crore in solar PV manufacturing projects; Demand of Rs.17,500 crore over five years for 'Balance of Materials'; Direct employment of about 30,000 and indirect employment of about 1,20,000 persons; Import substitution of around Rs.17,500 crore every year; and Impetus to Research & Development to achieve higher efficiency in solar PV modules. 

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## PFC PAYS INTERIM DIVIDEND TO GOI

**G**overnment of India has recently received Rs. 1182.63 crore as an interim dividend from Power Finance Corporation (PFC). PFC is a Navratna Central Public Sector Enterprise under the Ministry of Power and India's leading NBFC for the Power Sector.

The interim dividend RTGS intimation bank advice was presented to R. K. Singh, Minister of State (Independent Charge) Power and New & Renewable

Energy & Minister of State for Skill Development and Entrepreneurship by Ravinder Singh Dhillon, CMD, PFC in the presence of Alok Kumar, Secretary (Power), Ashish Upadhyaya, Additional Secretary (Power) & FA, Government of India, P. K. Singh, Director (Commercial) PFC and Parminder Chopra, Director (Finance) PFC.

The interim dividend for FY2020-21 at the rate of Rs



*R. S. Dhillon, CMD, PFC is presenting the bank advice to R. K. Singh, Minister of State (IC) Power...*

8/- per equity share of face value of Rs 10 each was declared by the Board of Directors of PFC in its meeting held on 12th March 2021. PFC is the most preferred Financial Institution; providing affordable and competitive products and services with efficient and internationally integrated sourcing and servicing,

partnering the reforms in the Indian Power Sector and enhancing value to its stakeholders; by promoting efficient investments in the power and allied sectors in India and abroad. Contextually, PFC successfully raised USD 500 million on 29.01.2020 through the issuance of USD denominated Bonds under 'Reg S route' with a fixed maturity of 16.05.2031. E1

## IEX PIONEERS CROSS BORDER ELECTRICITY TRADE

*Nepal, Bangladesh and Bhutan to be among the first beneficiaries owing to the connectivity with the Indian electricity grid...*

**T**he Indian Energy Exchange has commenced the Cross Border Electricity Trade (CBET) on its platform. This is a first-of-its kind initiative for the Exchanges to expand their power markets beyond India to the South Asia region towards building an integrated South Asian regional power market. In a remarkable development following the notification of CBET Regulations by CERC in the year 2019 and the recent notification of CBET Rules in March'21 by the Central Electricity Authority (CEA), NVVN has secured approval from the CEA, for Nepal's participation in the day-ahead market on the Exchange. Currently, the Cross Border Trade with neighbouring countries for India stands at about

18 BU conducted through the medium to long term bilateral contracts.

As per the CEA and CERC, as on date, India imports 8.7 BU from Bhutan and exports 2.37 BU and 7 BU to Nepal and Bangladesh, respectively. The power trade with these countries is expected to increase to about 40 BU by FY22 and 70 BU to FY 27 according to a study by IRADe. While the macro-economic growth in the South Asia region have been one of the strongest in the world, the region has been confronting with challenges related to power demand-supply balance and the low per capita power consumption. With a large installed power generation capacity base of 382 GW and peak demand of about 185 GW. E1

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## TATA POWER DEPLOYS A CUTTING EDGE SOLUTION IN MUMBAI

Upholding the drive to sustainability, Tata Power has recently commissioned India's largest natural ester filled 110 /33 / 22 kV, 125 MVA power transformer in the Mumbai Transmission network at the BKC receiving station in active collaboration with Hitachi ABB Power Grids and Cargill.

The natural esters used in these transformers have a high fire point (350 degree Celsius) and eliminate the risk of fire. The fluid is made from a carbon neutral renewable resource, is biodegradable, nontoxic and nonhazardous in soil and water. This fluid allows designing the transformer with increased capacity and reduced carbon footprint, making it an ideal solution for congested cities like Mumbai, as opposed to conventional mineral oil filled transformers.



*The natural esters used in these transformers have a high fire point (3500C)...*

Speaking about the initiative, Dr. Praveer Sinha, CEO & MD, Tata Power said, "We have always been committed towards providing greener and sustainable solutions for our customers while ensuring uninterrupted power supply. We will continue to implement newer technological innovations and aim to reduce the carbon footprint along with improving overall performance."

A pioneer in providing reliable and uninterrupted power supply to the city of Mumbai, Tata Power Transmission caters around 70% of Mumbai's energy. It has a network of about 1200 circuit transmission lines in and around Mumbai with a transformation capacity of about 10500 MVA. The company is committed to implement cutting edge solutions to cater to the increasing power demand in the city where space is a constraint.

ET

## VISAKA INDUSTRIES RECEIVES PATENT RIGHTS FOR ATUM

*ATUM is a completely integrated, seamless solar roof made with poly or mono-crystalline solar cells and cement boards...*

The South African Patent Office has granted patent to Visaka Industries for its product "ATUM – Eco-Friendly Energy Generating Roofs." This is valid for 20 years. ATUM is a highly durable roofing material making it world's first solar panel that can be directly used as a roof.

South Africa, due to its geographic location, receives large amounts of solar energy. The patent from the South African Patent Office paves the way for the introduction of ATUM in South Africa and other African countries.

South Africa first introduced the Renewable Energy Independent Power Producers Procurement Programme (REI4P) in 2011. The goal of the REI4P is to reduce greenhouse gas emissions while minimizing the country's reliance on non-renewable

energy sources. South Africa is also a member of the International Renewable Energy Agency (IRENA), an international organization that promotes renewable energy policies.

ATUM secured the prestigious UL Certification as per International Electrotechnical Commission (IEC) standards. The product has also been certified by Campbell Corporation, to take a uniform load of 780 lbs per sqft, a snow load of 2200 lbs, and the jointing mechanism is a patented leak proof system as per American Society for Testing and Material (ASTM) standards. It is a roof, which is class A fire rated and designed to take wind speeds of over 150 kmph making it hurricane proof. ATUM uses GreenPro Certified material that makes it a highly sustainable, reliable, and safe solar roof.

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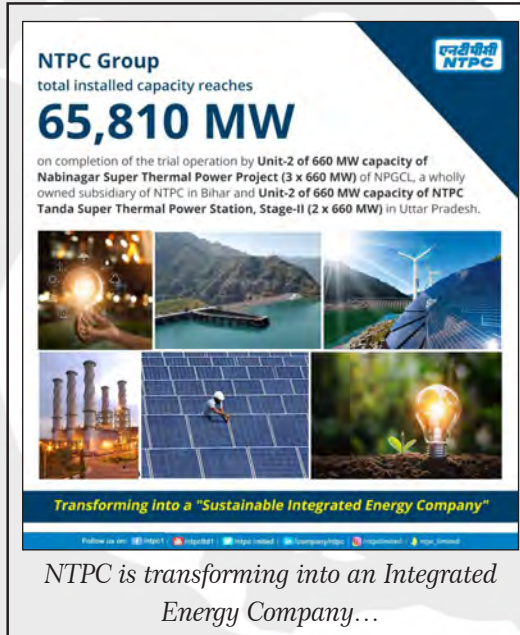
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## NTPC GROUP'S TOTAL INSTALLED CAPACITY REACHES NEW HEIGHT

With successful completion of trial operation by Unit-2 of 660 MW capacity of Tanda Super Thermal Power Station in Uttar Pradesh (U.P.) Stage-II (2 x 660 MW), NTPC's installed capacity has risen to 65,810 MW. This means the total installed capacity of NTPC Group has increased by 5.96% with 4,160 MW of capacity addition in FY21.

NTPC is striving to achieve highest reliability and efficiency keeping safety and environment issues on top. With global shift in energy space, NTPC is increasingly emphasising on ESG and changed its focus to renewable for future growth – while improving on sustainability matrix. Sustained efforts are underway for transforming into an Integrated Energy Company.

NTPC Group has 70 Power stations including 26 Renewable projects. The group has over 18 GW of capacity



under construction, including 5 GW of renewable energy projects. Uninterrupted supply of electricity through environment-friendly energy projects at affordable prices has been the hallmark of NTPC.

It's worth mentioning that besides power generation, NTPC has also ventured into various new business areas like e-mobility, Waste-to-Energy – and participated in the bidding for power distribution of Union Territories. NTPC is also actively exploring Green Hydrogen solutions and captive industries in its plant premises.

At present, NTPC Group has 70 Power stations including 26 Renewable projects. The group has over 18 GW of capacity under construction, including 5 GW of renewable energy projects. Uninterrupted supply of electricity through environment-friendly energy projects at affordable prices has been the hallmark of NTPC.

## AEML COMMISSIONS SYNTHETIC ESTER OIL-BASED TRANSFORMER

*AEML commissioned this in record time of 15 days by taking all required safety measures in current pandemic situation...*

Adani Electricity Mumbai Limited (AEML) has recently commissioned India's first Synthetic Ester Oil filled 220kV, 125MVA capacity power transformer in its Mumbai Transmission network at 220kV Borivali EHV substation. According to the company, unlike conventional mineral oil filled transformer, Synthetic Ester Oil transformer has higher fire point (>300 deg.C), low heat of combustion (30.8 MJ/kg). Moreover, it offers enhanced fire safety, better performance at higher temperature and prolonged life of insulation paper.

Further, its oil has better biodegradability – that means it is an environment-friendly oil. Considering this, Ester Oil Transformer is the best suitable for city like installation. Along with that it has other additional features like – Resin Impregnated Paper (RIP) bushings, Vacuum OLTC (On Load Tap

Changer) that improves reliability significantly.

This augmentation of Transformation capacity at Borivali EHV substation, will strengthen Transmission & Distribution (T&D) infrastructure, to meet incremental load growth in and around Borivali area, maintain reliable/quality power supply and availability of transmission system at desired level.

Adani Electricity Mumbai Ltd is an integrated Power utility, having presence in Generation, Transmission and Distribution verticals in Mumbai Power system. Its Transmission Division operates eight 220kV Extra High Voltage (EHV) Substations with an aggregate transformation capacity of 3,250 MVA and approximately 572 ckt. kms of 220kV lines. Five out of these eight EHV Substations are new technology vertically designed, compact Gas Insulated Switchgear (GIS) based EHV Substations.



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## ØRSTED EXPANDS ITS CUSTOMER BASE IN PHARMACEUTICAL INDUSTRY

**M**SD has entered into an agreement to purchase energy from the Armadillo Solar Center in Navarro County, Texas. With the PPA, Ørsted is extending its industrial customer base to the pharmaceutical industry. The center will be based in Navarro County in Texas, less than 50 miles from the Dallas-Fort Worth Metroplex. It is expected to be operational by early 2023.

Commenting on the development, Vishal Kapadia, Senior Vice President and Chief Commercial Officer of Onshore in Ørsted, said, “We’re happy to partner with MSD and expand our customer base to the pharmaceutical industry. It’s exciting to join forces with them in their efforts to advance the use of carbon-free energy in the medical industry.”

Highlighting the importance of the decision, Susanna



*Armadillo Solar Center in Navarro County, Texas...*

Webber, Senior Vice President, Global Supplier Management Group and Chief Procurement Officer, MSD, said, “This contract is an important step in MSD meeting its commitment to sustainability by bringing carbon-free energy to the grid in Texas and reducing the environmental impact of our operations. As a

human and animal health company, we see our renewable energy strategy as fully integrated with MSD’s mission to save and improve lives.”

The Ørsted vision is a world that runs entirely on green energy. Ørsted develops, constructs and operates offshore and onshore wind farms, solar farms, energy storage facilities and bioenergy plants. It also provides energy products to its customers. Ørsted ranks as the world’s most sustainable energy company in Corporate Knights’ 2021 index. **BI**

## PAKISTAN GETS ADB LOAN TO BOOST CLEAN ENERGY

*Balakot Hydropower Plant will also generate economic activity and improve the skills of local communities...*

**T**he Asian Development Bank (ADB) has approved a \$300 million loan to finance the construction of a 300-megawatt hydropower plant that will increase the share of clean energy in Pakistan and improve the country’s energy security. The plant will add 1,143 gigawatt-hours of clean energy annually to the country’s energy mix, enhancing the energy sector’s reliability and sustainability. The plant, which will incorporate seismic strengthening and climate-proofing measures, will be built on the Kunhar River near Balakot City in Khyber Pakhtunkhwa Province and commissioned by 2027.

Commenting on the step, ADB Principal Energy Specialist Adnan Tareen, said, “Pakistan is highly vulnerable to climate change, with water resources and energy particularly at risk from floods, droughts,

high temperatures and other extreme weather events. In line with Pakistan’s climate change adaptation and mitigation priorities, this climate-resilient hydropower plant will boost the country’s clean energy generation while effectively utilizing its vast water resources.”

Pakistan is rich in hydropower resources but only around 16% of its identified hydropower potential has been harnessed. The country’s power sector is reliant on imported fuel-based power generation and is burdened with a stressed transmission and distribution network. To balance the energy mix and reduce its dependence on imported fuel, the government has committed to increase its untapped renewable energy potential in hydro, solar, and wind.

Balakot Hydropower Plant will also generate economic activity and improve the skills of local communities. **BI**

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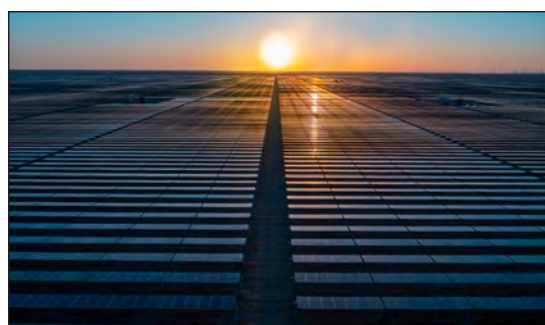


## SOLAR PROJECT COMMISSIONED AT SAKAKA CITY IN SAUDI ARABIA

**R**ecently, a 300MW photovoltaic (PV) solar project has been installed at Sakaka City in Al Jouf province of Saudi Arabia. It's a joint achievement of ACWA Power (70%) and AlGihaz's subsidiary AlGihaz Renewable Energy Company (30%).

The power plant, which is connected to the national electricity grid, will supply enough clean energy to power more than 75,000 Saudi Arabian households and avoid the production of more than 430,000t of carbon dioxide (CO<sub>2</sub>) a year. The project will offset approximately 10.5 million tonnes of CO<sub>2</sub> and avoid the use of more than 50 million barrels of diesel during its lifetime.

Sakaka solar project is the first utility-scale renewable energy project developed under the National Renewable Energy Programme of Saudi Arabia (NREP). Managed by Saudi Arabia's Ministry of Energy, Industry and



*Sakaka solar project will generate enough energy to power 75,000 homes...*

Mineral Resources (MEIM), NREP is designed to balance the country's energy mix to achieve long-term economic stability while reducing carbon emissions.

Sakaka is the first in a series of projects being built under the programme, which aims to generate 9.5GW of renewable energy by 2023 and 58.7GW by 2030.

The Renewable Energy Project Development Office (REPDO) of MEIM issued a Request For Proposal (RFP) for the solar project on April 2017 – and received eight bids from pre-qualified consortia led by international and regional renewable energy developers. The bid opening ceremony for the project was held in October 2017. ACWA Power was selected by REPDO for the development of the Sakaka solar project in February 2018.

ET

## FRENCH COMPANY SUBMITS TECHNO-COMMERCIAL OFFER TO NPCIL

*The Jaitapur Nuclear Power Plant project is a cornerstone of the bilateral cooperation between France and India: with an installed capacity of 9.6 GWe...*

**E**DF has submitted to NPCIL the French binding techno-commercial offer to supply engineering studies and equipment for the construction of six EPR reactors at the Jaitapur site in Maharashtra, India. This major milestone for EDF, its partners and the French nuclear industry will enable discussions aimed at converging towards a binding framework agreement in the coming months.

The offer is the culmination of the work carried out jointly with NPCIL further to the signature of the Industrial Way Forward Agreement on 10th March 2018 in Delhi, in the presence of the Prime Minister of the Republic of India and of the President of the French Republic, and to the submission of EDF's non-binding proposal at the

end of 2018. On that basis, the offer from EDF and its partners includes: i) the detailed technical configuration of the reactors, taking into account the information provided by NPCIL on the Jaitapur site conditions and the joint comprehensive work performed by EDF and NPCIL; and ii) the associated comprehensive commercial terms and conditions for the supply of engineering studies and equipment for six EPR reactors.

The socio-economic benefits of the project for India would be significant, with the creation of around 25,000 local jobs during the construction phase for a pair of EPR units, not to mention tens of thousands of indirect and induced jobs. Moreover, the operation of the six EPR units would create around 2,700 permanent jobs.

ET

## VENKATESH R. BECOMES MD (ENERGY BUSINESS), WÄRTSILÄ



*"I look forward to enhancing Wärtsilä India's market leadership with innovative life cycle solutions..."*

A subsidiary of the technology group Wärtsilä Corporation, Wärtsilä India has recently appointed Venkatesh R. as the new Managing Director & Director, Energy Business, India. Venkatesh has come with 30 years of experience in the Marine and Energy sectors. During his career in Wärtsilä for over 25 years, he has worked in India, Singapore and Finland managing various strategic roles.

Commenting on the appointment, Frederic Carron, Chairman, Wärtsilä

India Private Ltd and Vice President, Middle East & Asia, Energy Business has said, "Venkatesh has an outstanding career spanning over 30 years in the industry. We are confident that his experience in Business Strategy & Transformation, Project & Contract Management, and Quality & Operational Development will further facilitate profitable growth for Wärtsilä in India. We look forward to utilizing his expertise and experience in taking the company's goal and vision forward." 

## M. RHYMES TAKES OVER AS CIO OF ENTERGY CORPORATION



*He previously served as CIO since 2015 for Gates Corporation, a global manufacturing company...*

Michael Rhymes has been appointed as the Chief Information Officer (CIO) of Entergy Corporation. As CIO, Rhymes will be responsible for leading, planning and managing all of Entergy's information technology needs. He holds a Bachelor of Arts degree in economics and a Master of Business Administration, both from Texas A&M University.

Rhymes is reporting to Julie Harbert, Entergy's Senior Vice President, Corporate Business Services.

Commenting on the appointment,

Harbert, said, "We are pleased to welcome Michael to Entergy. Technology will play an increasingly critical role for Entergy, including areas such as grid and asset management, technology-driven capital projects, energy efficiency and customer service. Michael's experience in guiding IT strategy and leading technology transformations for large organizations have equipped him well for our ambitious technology goals as we build the premier utility on behalf of our customers and all of our stakeholders." 

## STERLITE POWER PROMOTES M. AGARWAL AS CEO (INFRA & SOLNS BIZ)



*He'll see both greenfield and brownfield transmission business of the company in India...*

A leading global developer of power transmission products, Sterlite Power has elevated Manish Agarwal as CEO of the Infrastructure Business, in addition to his existing role as CEO for the Solutions Business.

Manish is associated with the Sterlite Group for the last 22 years – and has held various leadership positions across the organization. Prior to his role elevation, he was CEO of the Solutions Business, which focuses on brownfield transmission comprising of

Master Systems Integration (MSI) and manufacturing of underground power cables and overhead products including High Performance Conductor & OPGW.

Commenting on the appointment, Pratik Agarwal, Managing Director, Sterlite Power, said, "Manish is a seasoned leader with rich experience in the power & telecom sectors. His strong leadership credentials give us tremendous confidence in his ability to lead this business in alignment with our organization's core-purpose and values." 



# CONTROLLING SPREAD OF DISEASES THROUGH MODERN SWITCHES

*Whether at home or in any of the public places, electric switches are the components, which are touched by the maximum number of people. Thus, these are the high potential junctions to spread infections in multiple directions. Contactless switching is the best way to prevent communication of diseases...*  
- P. K. Chatterjee (P. K.)

When the entire world is worried about the COVID -19 pandemic, which has already killed more than 3,155,048 people, the electrical goods segment has come forward to deliver its contribution to mitigate the chance of infection. The coronavirus disease is caused by a virus (SARS-CoV-X), and not by a bacteria or fungus. Thus, the best way to mitigate its activities is by maintaining distance from the surface on which it is present. Therefore, remote operation of electrical circuitry is a nice way to avoid contact with the devices like switches.

Electric switches are one of the mostly used components in the electrical circuits, which frequently receive multiple human contacts, whereby the chance of the spread of infection becomes manifold – however, frequent cleaning or sanitization of the electrical switches is not practically possible. Thus, this is the high time when the user community gets some products (switches) that offer inherent resistance to all disease causing agents.

Weak body or low immunity also increases the chance of catching the dreadful CORONA disease; thus, besides encountering CORONA; prevention of spread and attacks of bacteria, fungi and other germs is also equally important. With this backdrop, let us now look at some of the significant products that have been rolled out in this CORONA time, in India. There are many others, but all cannot be touched upon within this small article.

### **Schneider Electric in action**

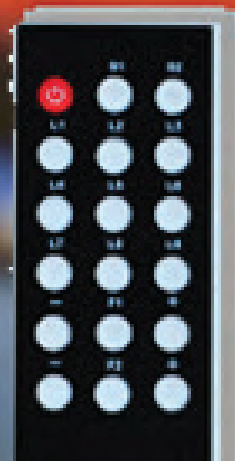
As switches are the most touched and used appliances at our homes and workplaces, naturally they are prone to be the major breeding grounds for all sorts of viruses and germs.

Schneider Electric has launched self-disinfecting anti-viral and anti-bacterial switches under its Clipsal X product range. Meeting international standards of testing, the switches are powered by Silver Ion technology that can kill over 99.9% of germs and self-disinfects itself. Available in two variants, these products have been conceptualised and manufactured in India as a part of Schneider Electric's commitments towards the making of an Atmanirbhar Bharat.

Schneider Electric has developed these switches using the state-of-the-art technology. They are designed to ensure the highest safety in our everyday lives and add to the existing portfolio of anti-



Srinivas Shanbhogue





Antimicrobial switches from Panasonic Life Solutions India...

bacterial switches by Schneider Electric. Technologically advanced, the Clipsal X range and its trendy dual-tone variants can complement the look of any home perfectly. They are also smart – ready and can easily be operated through mobile phones, Google Home or Alexa when connected to any Smart Home solution.

Commenting on the efficacy of these switches, Srinivas Shanbhogue, VP, Home and Distribution, Schneider Electric India, said, “The new Clipsal range of anti-viral and anti-bacterial switches are our latest innovation in the connected living device category. With its unique proposition of style, safety and strength, these energy efficiency products can not only infuse character and life to any space but also make safety of the users a top priority,” which is the need of the hour.

## Role of Panasonic Life Solutions India

Considering the alarming spread of the variants of COVID-19 viruses, a few months back, Panasonic Life Solutions India launched antimicrobial range of wiring devices.

As the company points out: Light switches, such as dimmers and sockets have the highest touch rates in any environment (say) at home or a public facility. This in turn increases the possibility of bacteria or viruses to hold a significant number of microbes on their surfaces.

The company’s antimicrobial electrical switches

and sockets series under Roma, Europa and Vision will offer comprehensive safety features. The new range of Antimicrobial wiring accessories is equipped with anti-bacterial and anti-fungal properties that promote a healthy environment by facilitating up to 99% reduction in bacterial development and prevents transmission. These series are excellently designed and are made from polycarbonate that contains silver ions. These ions act as robust support to kill the bacteria, stopping their growth on the product surface. The silver ions antibacterial structure is immune to light and heat and will further assist in fighting the germs for people’s safety.

Manufactured in India, this innovative range is combined with high quality and durability acting as a modern solution for any domestic wiring requirement. These switches and sockets don’t lose the antibacterial life even after years of use, hence providing value for money and security to the customer. This range offers a plethora of features like an extra layer of protection and fire retardancy by providing an all-inclusive safety cover.

Moreover, given the current pandemic situation, there will be a high demand for products that emphasize more on healthcare technologies. It will be a game-changer for future building designs that will help people feel safe and comfortable.



Myrius Next Gen from Legrand...

## Products of Havells India Limited

Last year, Havells India Limited also launched its anti-bacterial/ anti-fungal switches under its Crabtree electric switch range. The innovative switch range named Athena, Signia and Verona can contain the growth and spread of harmful microbes through human touch with 99.99% efficacy. The switch range will act as a catalyst to lead a 'Healthy life' for customers by avoiding bacteria led diseases like food poisoning, pneumonia, conjunctivitis etc.

As per the company, with the context of the pandemic, it has become imperative to ensure hygiene and infection control in all kinds of facilities such as hospitals, hotels, institutes and homes etc., more than ever. The offering from the brand uses metal compounds that are more effective than metal oxides and other metal complexes and have higher efficacy as compared to silver ions to contain the growth of bacteria and fungi. Along with that, the range of switches offers a long-lasting usage with good weatherability that ensures non-discoloration under high temp and humidity. The product's base material is approved by FDA, ECHA and EPA – and has also been tested by the third-party labs such as JIS and ISO.

## The feat of Legrand India

Legrand India has also come out with its range of wiring devices 'Myrius Next Gen'. This is expected to build a value and strengthen Legrand's presence in the premium segment

with its modern technology. The product range is targeted at the residential and commercial segment with also a focus on architects, builders, electricians, consultants, contractors, developers, system integrators and retailers.

This new range of products has been developed using the intelligence of IoT that includes wireless technology, controlling it remotely (even when away from home), voice control, app control, can monitor electricity usage and get alerts. With this the brand promises its customers savings, safety, convenience and control.

Legrand's IoT enabled Home/Away Wireless Master Switch lets its users switch on or off multiple things like all lights, shutters or sockets by just pressing one switch at home or by tapping the app on the user's phone, even when the user is out of home. All the products in this range are designed in such a way that it is retrofittable, now the customers don't need to worry about changing the electrical infrastructure.

## Bottomline

With the spread of the dreadful CORONA disease, when the citizens of India are repeatedly being advised to maintain social distancing and avoid spread of contamination through repeated hand washing, remote-controlled switches are very useful. Also, the anti-fungal or anti-bacterial switches that are now available in the domestic market have a great role to prevent many other diseases.

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# OVERCOMING

## MAJOR CHALLENGES

**E**nergy is the cornerstone for every nation's development. It is the basic need for the survival of rural and urban areas, which is largely driven by efficient energy utilization. However, the consumption patterns in rural and urban areas are quite different. The villages are more vulnerable due to insufficient resources, poor connectivity and the use of traditional energy sources is higher. Even when the government is actively launching initiatives to provide electricity on a national level, nearly one-fifth of India's rural households (around 31 million) still remain in acute darkness.

In rural areas, electrification is the backbone of the rural economy that also improves the quality of life. Access to energy is not only limited to fulfilling household energy needs. While most urban areas use electricity as the main source of lighting and networking, only half of the rural households in India had access to electricity in 2011. Furthermore, the inadequate or poor supply may negatively impact the mechanization of rural activities such as farming, irrigation, communication network connectivity; smooth functioning of small-scale industries etc. The hampering of these activities due to poor energy supply obstructs economic growth and development of these areas.

**Even after more than seven decades of independence, providing proper quality power supply to rural India imposes several challenges. This article highlights some of those challenges and suggests ways to ensure universal connectivity...**

## Role of government in rural electrification

Universal electrification plays a crucial role in the holistic development of the country. Over the years, it has been a priority for the government to initiate programs and policies that meet the energy needs of rural India. Presently, rural India is standing on the verge of energy transformation. The push for rural India's electrification started in 2005 with the launch of Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) further accelerating in 2010-2011. The Yojana was later renamed to Deendayal Upadhyaya Gram Jyoti Yojana by the present ruling government. With the constant efforts of the Government of India, the majority of villages have access to power supply; however, many of them still live without power and lack quality of supply.

Considering the energy scenario in India, the central government promised for reliable power supply for all in 2014. According to the estimates shared by the government officials, the promise of electrifying Indian villages has been achieved electrifying over 591,685 out of 597,464 census villages (or 99 per cent). In 2018, it was also reported that in the past four years, the central government has doubled the expenditure on rural electrification to Rs. 24,890 crore.

Additionally, over 50.41 lakh rural households were given a free electricity connection, which is five times more than 9.62 lakh connections given in the period of 2013-14.

It is imperative to know that the goal of electrification in the country can only be achieved by efficient and seamless power distribution. In this regard, the Union Government also allocated Rs. 3.05 Lakh Crore for the adequate and smooth distribution of power. As per the Finance Minister of the country, the allocated funds will be released on the basis of the financial performance and viability demonstration by the distribution companies (DISCOMS).

## Challenges in rural electrification

Success in rural electrification is not impossible to achieve. However, lack of adequate infrastructure in rural areas is the major obstruction in providing continuous energy supply. Furthermore, the limited availability of properly trained manpower at the district level also impedes electrification work. This is further worsened by the limited availability of equipment and other operational resources that shoots up the cost of electrification, making the entire process inefficient.

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Photographs (in clockwise order from top right):  
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2. Frontec SMVT  
3. Frontec Porcelain MVT  
4. Frontec STOC  
5. Installed MVO, Kandraghat  
6. Typical installation use for Tap Off Connectors

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The success of rural electrification also becomes difficult due to a major concern of delinking of transmission lines, especially in remote areas. Moreover, the reliability in the supply of electricity also plays a critical role in the electrification of such areas. Presently, the electricity supply in rural households is highly unreliable. Unlike urban areas, rural areas face long and frequent power cuts, affecting the quality of supply. For instance, there was no supply of electricity from 5 pm to 11 pm in the rural villages of Uttar Pradesh and Bihar during 2016. On the contrary, on an average, Lucknow did not witness any power cuts in the same period.

## Ways to mitigate it

The demand for energy is constantly increasing and there has been an urgent requirement for an increased understanding, awareness, and implementation of the latest technologies. This can mitigate the roadblocks in the transmission sector.

## Adoption of AI-based technologies

Artificial Intelligence (AI) is resulting in a tremendous transformation of industries across the world and the power sector is no exception. The energy sector faces severe challenges due to the rising demand for power supply, inefficiency, demand pattern and lack of analytics. The acceleration in the adoption of AI-based technologies may have a positive impact on rural electrification. It is projected to play an integral role in providing clean, affordable and reliable energy supply to rural areas. AI works as an enabler of automation. The accelerated use of AI-integrated software can automate human-oriented tasks while bringing more efficiency to rural electrification. Additionally, AI-based technologies can enable optimal management of the grid to ensure quick responses and optimal grid performance.

## Integration of technology in electricity assets

The power sector in India is leveraging the integration of technology in rural electrification. There is increased adoption of advanced technologies like an evolved grid system, smart metering, digital asset management. As a result, this will help transform the seemingly conventional, manpower-heavy sector into a smarter and more efficient power system. This will also play a significant role in streamlining the process of developing proper infrastructure for rural electrification. In this regard, the installation of smart metering can benefit

rural households by providing real-time information on the usage and wastage of electricity and optimizing the consumption accordingly.

## Use of robotics

The power sector faces challenges in meeting the growing demand for electricity in rural India. The biggest concern arising in rural electrification is extensive labour and transportation costs. The use of robotics in power transmission can save huge Operation and Maintenance (O&M) costs by automating manual tasks through completely automated robotic systems. This can improve cost efficiency by reducing labour charges and avoiding operational delays and risks. Furthermore, the use of robotics in handling time-consuming and risky tasks helps in maintaining power assets, which further improves the operation. On the other hand, the use of robotics is still at a nascent stage in India; however, it is still undergoing extensive research and development to provide sustainable power resources in rural areas.

## Major implications

Rural areas in India have emerged as one of the primary contributors to the nation's economic development. Accessing reliable and durable electricity is the need of the hour. For proper rural electrification, power distribution companies (DISCOMs) should emphasize on electrification of not only the households but also small-scale enterprises and non-farming activities. Such customers have constant electricity demand and look for quality power supply to keep their activities going. Many enterprises usually have to use expensive sources of energy such as diesel generators that increase their expenditure and impact their performance and revenue generation.

Another major implication in rural electrification is an improved level of customer service. By improving the reliability and quality of the power supply, the satisfaction of rural customers can be achieved. Consequently, it will enable the customers to focus on more productive tasks and expand their earning potential. Thus, there should be proper planning and implementation of policies to stimulate power demand in rural India. 



**Shashank Agarwal**

The author is the Managing Director of Salasar Techno Engineering Ltd.



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*For mitigating global warming, it is absolutely essential to immediately reduce the carbon footprint. Installation of rooftop solar power plants can to a great extent help the process. However, to speedify promotion of the adoption of rooftop solar installations, some immediate changes in policy are necessary...*

Climate is not changing, it has changed. Today, the world faces an Energy Paradox, wherein more energy is required to ensure fast-paced economic growth, while rampant use of energy is causing catastrophic climate change. Nearly, 80 to 85% of our energy needs are being fulfilled through fossil fuels. Coal, crude oil and natural gas take a very large share in our energy mix. Together, they stand as the major cause for global warming.

World is already warmer by more than 1°C. As per the Intergovernmental Panel on Climate Change, we need to ideally limit global warming to 1.5 Degree Celsius, if not 2 Degree Celsius. And, as per the remaining carbon budget, there is only 6 to 7 years left before we touch the global warming of 1.5 Degree Celsius. This is a target that looks unachievable now – and therefore many countries are setting their Net-Zero emission year to achieve the **“well below 2 degrees Celsius”** target.

### A new approach is essential

The remaining time is so short and the target is so hard, that business-as-usual approach is not going to work. If India has to set its target for net-zero by 2050, a completely fresh approach towards adoption of renewable energy has to be adopted. India has set the target of renewables in power generation from 175 GW by 2022 to 450 GW by 2030. However, that will need a lot of innovations in policy. Satisfying all the stakeholders like consumers, DISCOMs, Energy Regulators and the Government itself will not be easy.

To produce 175 GW power from renewable energy sources by 2022, distribution is done as 100 GW from solar power (60% through ground level panel installation method and the other 40% is to be recovered by rooftop panel installation), 60 GW from wind energy and 10 GW from biomass and 5 GW from small hydro projects.

In India, because of geographical advantage, average solar radiation present in most parts of the country

is 4-7 kWh/sq.m/day. Also, the cost of solar energy technologies is rapidly declining and will continue to decline in the near future. Decentralized distribution of energy can empower people at the grassroots level. However, there are many hurdles in the solar sector, making it difficult to reach its target, especially the simplifying and befitting policy incentives.

### The need of the hour

If India has to cut down its GHG Emission using clean energy technologies, then this is the time to fill the gaps and strengthen the solar policies. One of the key elements recently in discussion, which can increase the growth in solar rooftop installation is – Net-Metering. Not implementing the Net-Metering scheme for all types of consumers in Solar Policies of all states is highly criticised and argued that it will hinder the adoption of solar rooftops.

Net-Metering scheme can be taken as a major tool to motivate people towards solar installations. Mostly, distribution companies (DISCOMs) are vehemently opposed to net metering across states since it's affecting it financially by depriving them of the opportunity to earn more revenue from premium consumers due to lower sales and ending up paying stranded power purchase costs. Also, it is affecting the subsidies balance – since generators' fixed cost and infrastructure cost recovery are passed on to other consumers of DISCOM.

### Role of Net-Metering

The Ministry of Power (MoP) has issued No Net-Metering for Rooftop

Solar Systems over 10 kW. In many states gross metering schemes are there for above 10kW Rooftop Solar Systems. States like Rajasthan are not allowing Net-Metering for Commercial and Industrial (C&I) Projects. This rule is making Solar rooftop unviable for C&I consumers. The target for solar rooftop panel installation is 40 GW up to 2022 and till now the installed rooftop capacity is 6 GW only, most of which was developed by C&I consumers. It seems that the government is trying to financially save DISCOM by limiting to 10 kW Net-Metering. However, this is the time to achieve the solar rooftop target to save the planet by achieving the **“well below 2 degrees Celsius”** target.

Under the Net-Metering Scheme, the rooftop solar power used for self-consumption and excess energy fed back to the grid is credited at a net feed-in tariff determined by the state that is still cumbersome. Also in many states, consumers have to get self-registered for Net Meter and the paperwork process is very confusing and lengthy.

In gross metering, the entire energy generated by the solar PV system is fed back directly into the utility grid and the owner gets incentives based on feed-in tariffs proportional to the energy fed back to the grid. The Utility Company will decide the tariff for both import and export of power. Generally, import retail tariff is used to be higher than the export feed-in tariff to cover the revenue lost by DISCOMs in Net Metering Scheme.

Gross-metered consumers were compensated for the export of solar power to the grid at rates of Rs 2-4 per kWh. However, current rooftop

power purchase agreements signed by tier-1 developers have tariffs in the range of Rs 3.5-4 per kWh. This will increase the payback period for gross-metered consumers and also, they cannot self-consume the units generated by their own system. This is pushing back the C&I Consumers to install solar rooftop.

India has to think about some innovative path to achieve “well below 2 degrees Celsius” target by achieving solar rooftop installation target and also financial health of all consumers and DISCOMs.

### Some recommendations to propel the rooftop solar market

Let there be no money transaction between DISCOM and solar rooftop user, in either direction. Even the monthly fixed charges should be abolished to encourage net metering consumers. No incentives of such kind (capital or tariff based) are provided to consumers so that the policy is open to everyone, without having any limit on number.

Instead of taking monthly fixed charges from consumers, the DISCOMs can charge a one time high connection fee. After that there will be no transaction between the consumer and DISCOMs remaining. Also, the getting net-metered connection should be easy and on demand.

The net metering connection should provide only on condition of being Net Positive Use (NPU) on a monthly basis. This implies the user has to install enough solar PV capacity on the roof to generate more than he consumes in a month and has to get NO bill to pay at the end of the month. Users will

be happy that there is no monthly electricity bill, and in efforts to be net positive users, they will end up generating more units than they consume. These extra units will be free electricity for DISCOMs, which will help them financially.

In special cases, like marriage function at home, if a consumer needs electricity from the grid apart from its own generation then DISCOMs can charge a penalty for being net negative or at a rate higher than normal electricity rate like Rs. 15 to 20 per unit. This will be beneficial for DISCOMs to get some revenue. Also, consumers will try to use electricity in a constrained manner that will help in further decreasing its own carbon footprint.

DISCOMs are the integral parts of the power sector – and should also be the part of adopting solar rooftop installation and part of supply kitty. They should help people in installing a solar rooftop in a much easier way by making flexible paperwork.

DISCOMs can make some provisions for ground level education for the consumers to make more efficient operation for Net-Metering Scheme.

### Conclusion

Above is a very green scenario and dream scenario in our views. It is less likely to happen in real life, because climate change is only for activists, for policy makers and consumers only growth is most important.

We believe that there is a net problem in net metering. It seems that implementation and simplification of policies will take a lot of time – and will not be in pace with the rate at which climate

is changing. The main reason for using solar energy should be to decrease the CO<sub>2</sub> release and save our natural climate to ensure human survival without hardships.

Therefore, due to advancement of solar PV technology and cost reduction, we at Energy Swaraj Foundation believe that instead of net-metering, people should start surrendering their electricity connection and become ‘atmanirbhar’ on solar energy. An ‘atmanirbhar’ individual is required for ‘Atmanirbhar’ Bharat. 



**Chetan Singh Solanki** is a Professor at the Department of Energy Sci. and Engg., in Indian Institute of Technology, Bombay. He is also the founder of Energy Swaraj Foundation.



**Nikita Lihinar** is associated with the Energy Swaraj Foundation in the capacity of Vice President - Research & Policy and has a postgraduate degree in Economics.



**Bhumika Parihar** is associated with the Energy Swaraj Foundation as Technical Consultant and has a postgraduate degree in Electrical Engineering.

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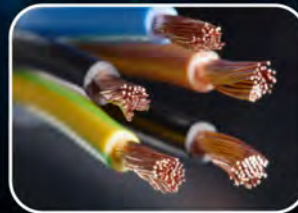
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# BUSDUCT SYSTEM DESIGN

## Part 2



*In order to have low losses and enhanced reliability in the distribution system, bus-ducts are preferred over cables for higher current ratings and shorter lengths at different voltage levels. Though Sandwich Bustrunking System with rated operational voltage ( $U_e$ ) 1000 Volt are easily available, when it comes to economics—Air insulated bus ducts have an edge. This article focuses on the types of air insulated busducts and their selection guidelines, design requirements, de-rating factors and sizing requirement...*

### Voltage Drop

The voltage drop across a bus system should be as low as possible and generally within 2% of the rated voltage. The length of the bus system in most of the applications may not be long enough so as to cause a voltage drop  $IZ$ . It may be the connection from the incoming transformer to the main receiving switchgear. Applications requiring long current carrying conductors, however, may have large impedance and may cause high voltage drops of the order of 3-5% and even more. When so, they may affect the stability of the system as well as the performance of the connected load. To fix the voltage drop in such cases it is essential to ascertain the actual values of the conductor's own resistance, reactance and the impedance

under actual operating conditions. It may be noted that reactance is the major cause of a high voltage drop. Skin and proximity effects play a vital role in affecting the resistance and reactance of such systems.

### Skin effect and proximity effects on a current carrying conductor

In a DC system the current distribution through the cross section of a current carrying conductor is uniform as it consists of only the resistance. In an AC system the inductive effect caused by the induced electric field causes skin and proximity effects. These effects play a vital and complex role in determining the current distribution through the cross section of a conductor. In an AC system, the inductance of a conductor varies with respect to the depth of the conductor due to skin effect. This inductance is further affected by the presence of another current carrying conductor in the vicinity, which is known as proximity effect. Both these factors of an AC system tend to increase as the effective resistance and the impedance of the conductor cause a higher  $I^2R$  loss and a higher voltage drop  $IZ$  and reduce its current carrying capacity.

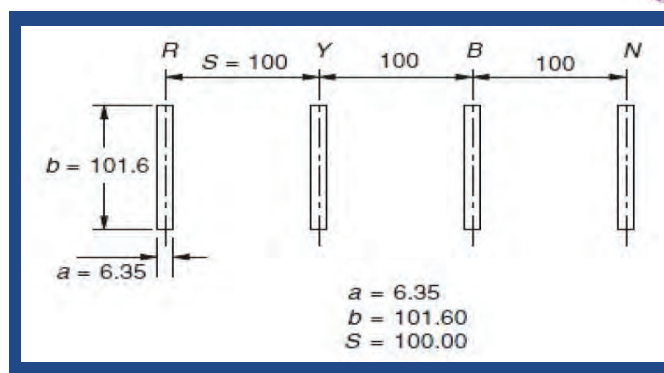
#### Skin effect

A current carrying conductor produces an electric field around it which induces a back emf and causes an inductive effect. This emf is produced in the conductor by its own electric field cutting the conductor. It is denser at the centre and less at the surface. The conductor thus has a higher inductance at the centre than at the surface and results in an uneven distribution of current through its own cross section. The current tends to concentrate at the outer surface of the conductor i.e. its skin shares more current than the other parts of the conductor and reduces with depth.

The phenomenon of uneven distribution of current within the same conductor due to the inductive effect is known as the skin effect and results in an increased effective resistance of the conductor. The ratio of AC to DC resistance,  $R_{ac}/R_{dc}$ , is the measure of the skin effect and is known as the 'skin effect ratio'. Figure-4 illustrates the skin effect for rectangular sections.

#### Determining the skin effect

Ratings of up to 3200A are normally required for distribution purposes such as for interconnecting a distribution transformer to a PCC, or a large PCC to another large PCC in a substation. The common practice for making such connections is to use rectangular cross



sections, which are easy to handle, make joints compared to a channel or tubular section. It is however preferred to use such sections for ratings above 4000A for better utilization of active metal compared to flat sections.

Example-2: Consider a section of 101.6mm x 6.35mm of grade EIE-M as in figure-5, the resistance considering skin effect would be

Figure-5:

$R_{dc} = 44.55 \times 10^{-6} \text{ ohm/m}$  at 20deg.C (from table-12)

Area =  $101.6 \times 6.35 \times 10^{-2} \text{ cm}^2 = 6.4516 \text{ cm}^2$

Since the operating temperature should be considered to be 85deg.C

$R_{dc} \text{ at } 85\text{deg.C} = R_{dc}_{20} (1 + \alpha_{20}(\theta_2 - \theta_1))$

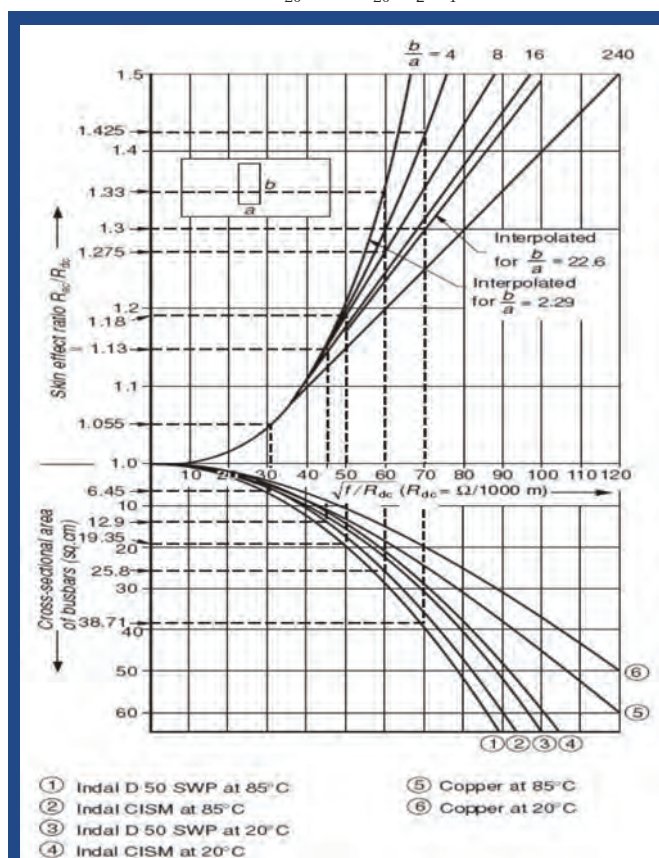


Figure 4: Skin effect in rectangular busbars...

# Conductor

$\alpha_{20}$  = temperature coefficient of resistance for Aluminium  
= 0.00403 at 20deg.C

$R_{dc} = 44.55(1 + 0.00403(85 - 20)) = 0.056 \text{ ohm/1000m}$

Now refer to figure-4 to obtain the skin effect ratio  $R_{ac}/R_{dc}$ . Consider the cross-sectional curves for EIE-M grade of flat busbars at an operating temperature of 85 deg.C for a cross sectional area of  $6.45 \text{ cm}^2$  and the  $R_{ac}/R_{dc}$  ratio on the skin effect curve would be

$b/a = 101.6/6.35 = 16$

$R_{ac}/R_{dc} = 1.055$

i.e. an increase of almost 5.5% due to the skin effect alone and  $R_{ac} = 1.055 \times 0.056 = 0.059 \text{ ohm/1000m}$

| Table 4: Grades of Aluminium alloys for electrical purposes |                               |                                                      |
|-------------------------------------------------------------|-------------------------------|------------------------------------------------------|
| Grades as the old Designation                               | Grades as in 2898 (ISO 209-I) | Equivalent grades of Indian Aluminium (Indal) alloys |
| EIE-M                                                       | 1350                          | CIS-M                                                |
| EIC-M                                                       | -                             | 2 S-M                                                |
| E-91E                                                       | 6101 A                        | D 50 S-WP                                            |
| HE-9-W                                                      | 6063 A                        | 50 S-WP                                              |

Source: Industrial Power Engineering and Applications Handbook - K.C. Agrawal

## Skin effect for more than one conductor per phase

In such cases, the group of busbars in each phase may be considered to be one large conductor and outside dimensions  $a$  and  $b$  as illustrated in figure-6 measured for all calculations.

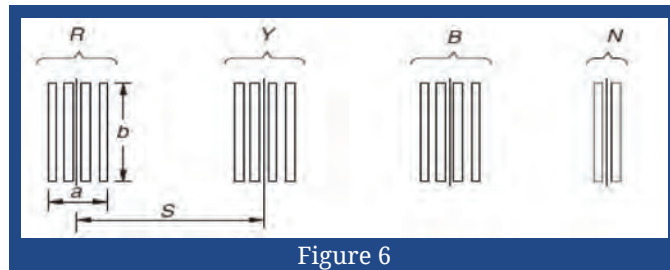


Figure 6

Example-3:

Considering a four conductor system of section  $101.6 \text{ mm} \times 6.35 \text{ mm}$  in each phase (Figure-7) of grade ELE-M for a current of 2000A,  $R_{ac}$  would be

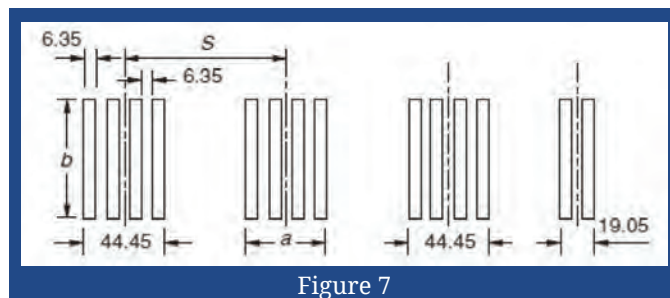


Figure 7

As calculate before

$R_{dc} = 0.056 \text{ ohm/ 1000m}$  per conductor of four bus sections in parallel

Skin effect ratio from graph at an operating temperature of 85 deg.C for a cross sectional area of  $25.8 \text{ cm}^2$  for an EIE-M grade of Aluminium having

$b/a = 101.6/44.45 = 2.3$

$R_{ac}/R_{dc} \approx 1.33$

$R_{ac}$  for the phase =  $1.33 \times 0.056 / 4 = 18.62 \times 10^{-3} \text{ ohm/1000m}$  (as four sections in parallel)

## Proximity Effect

If there exists more than one current carrying conductor not of the same phase, placed adjacent to each other, so that the electric field produced by one can link the other and thus mutual induction will take place. The magnitude of this will depend upon the amount of current and the spacing between the two. This tends to further distort the self-resistance of the conductor in addition to the distortion already caused by the skin effect current distribution through its cross section. Figure-8 shows distortion of current flow in a round conductor and also the mechanical forces exerted on the

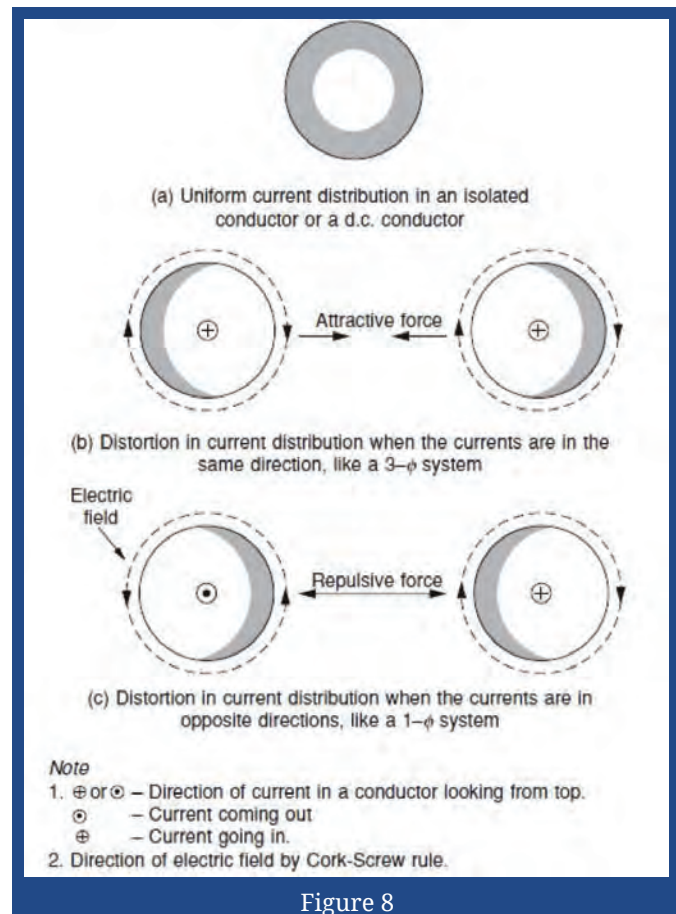


Figure 8

conductors, due to this distorted current distribution. There is always a force between two current carrying conductors placed adjacent to each other, be it DC or an AC system. The proximity effect, however is limited to an AC system due to mutual induction between the two current carrying conductors.

The displacement of current and the forces on the conductors are two different effects. The effect of current displacement is to increase the effective resistance and the impedance of the conductor on one side as shown in figure-8 (b) & (c) and cause a distortion in its heating pattern. This will lead the various conductors of a particular phase to operate at different temperatures and contribute to  $I^2R$  losses. The rating of all the conductors of one phase must therefore be determined by the hottest conductor. The distortion of current will also distort the heat produced. The area having high current density will produce higher heat. The proximity effect thus also causes a derating in the current carrying capacity of a conductor.

The proximity effect is directly proportional to the magnitude of the current and inversely proportional to the spacing between the two conductors as stated earlier. The smaller the phase spacing, the greater will be the effect of proximity as well as derating and vice versa. But the reactance of the two phases is directly proportional to the spacing. Reactance is the main cause of an excessive voltage drop. The smaller the spacing, the lower will be the reactance and vice versa. While the requirement of a lower reactance will require less spacing and will mean higher forces, demanding stronger busbar supports and mounting structure. Contrarily, requiring a lower effect on current carrying capacity would require a larger spacing between the phases, which would result in a higher reactance and consequently a higher voltage drop. But a high reactance would help to reduce the level of fault current and also forces between conductors.

A compromise is therefore required to meet both the needs and obtain a more balanced system. In that case, other methods can also be adopted to reduce the skin and proximity effects.

#### **Proximity effect in terms of busbar reactance**

Reactance  $X_a$  of the conductor plays a significant role in transmitting the power through a bus system from one end to other. For long bus systems, it must be

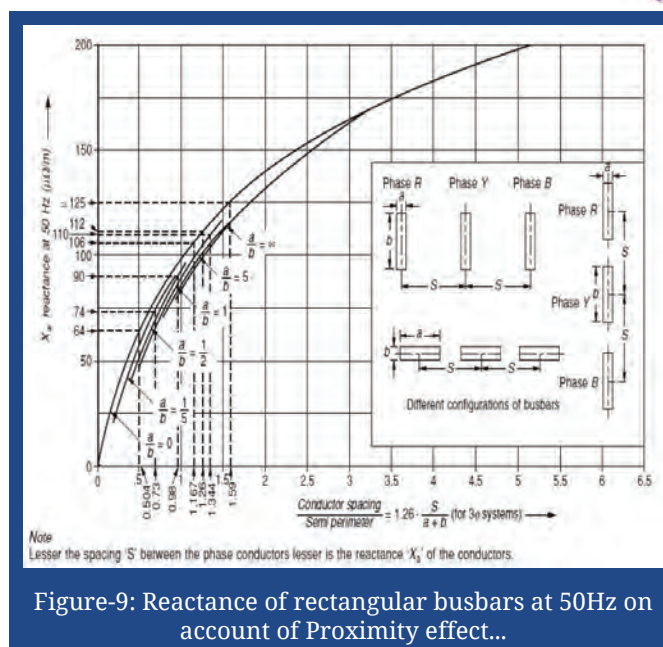


Figure-9: Reactance of rectangular busbars at 50Hz on account of Proximity effect...

determined at the design stage whether the voltage drop in the total bus length on account of this will fall within the permissible limits, particularly for higher ratings (2000A and above) besides the current carrying capacity. A higher reactance means higher drop. For smaller ratings and shorter lengths, as well as HT systems, this drop would be too low as a percentage of the rated voltage. For higher ratings, however it may assume a greater significance and precautionary measures may become necessary to restrict it within permissible limits. To determine  $X_a$ , proximity effect curves have been established by conducting tests on the metal and are available for rectangular section. Figure-9 shows the curve for rectangular section for 50Hz.

The reactance is drawn as a function of Centre spacing/ Semi-perimeter  $(a+b)$ . At lower spacings this value will be influenced by the width and thickness of the conductor. At lower spacings, therefore proximity curves are different for different ratios of  $a/b$  whereas for large spacings they approach the same curve. When more than one section is used together, to make larger ratings, all the sections of one phase may be considered to be one large section.



#### **Chanukya Annepu**

The author is from the Engineering Services Division, Indira Gandhi Centre for Atomic Research, Kalpakkam, India



**“We insist on 70% placement by our training partners...”**

*Power Sector Skill Council (PSSC) has been promoted by the Ministry of Power (MoP) through Central Electricity Authority (CEA), Ministry of New and Renewable Energy (MNRE) and Indian Electrical & Electronics Manufacturers' Association (IEEMA) with necessary support by National Skill Development Corporation (NSDC). In an exclusive e-interview with Electrical India, Ravi P. Singh, Chief Executive Officer of PSSC fields questions from P. K. Chatterjee (P. K.). Excerpts...*

**What's your take on the gap between education and employability in our country, especially in the power industry?**

Mismatch continues between education and skill sets that the power industry presently needs. Surveys are done for knowing the gap but the same do not give a correct picture as the labour contractors in informal manner supply the manpower to match the demand. These contractors deploy labour in power plants or sub stations, but without enough skill and education. Many a time, they do not even have enough knowledge of safety precautions, resulting in accidents. This is a serious matter, and we need to plug the skill gaps by training people with top

priority. The power industry should ensure that they allow only certified workmen.

**How does the Power Sector Skill Council attempt to bridge the gap?**

We conduct intensive surveys in the industry to know the real gaps. Based on the findings of the surveys, job roles are prepared in each specified area, and the necessary training programs are designed to improve skill. So far we have created 34 job roles in various segments of electrical industry, i.e., Generation, Transmission and Distribution.

**What are the job roles on which comprehensive trainings are provided?**

Distribution sector is being focused these days and

training of industrial & domestic electricians are in much demand, but I personally feel that training in transmission should be given priority – as it is the most difficult work in this sector and very good training centres are not available for training in this area. Comprehensive training in transmission sector is a must.

#### How are you modifying your training systems keeping in view the ongoing disturbed situation due to the spread of COVID 19 pandemic?

We have concentrated mostly on training of trainers & assessors during this Covid-19 affected phase, because they have an idea about the system & even if taught on line through some videos or cameras, they are able to understand the point.

#### Who are your training activity partners?

We have empanelled many training providers and developed Centre of Excellence and Academies in collaboration & with help of big industry giants like L&T, Tata Power, Adani, Powergrid etc.

#### What kind of opportunities do the students get after being trained?

They get employed in PSUs, State Sectors, Private Sectors, Discoms etc. Contractors are also recruiting skilled workmen these days.

#### What's your role in that?

We insist on 70% placement by our training partners, develop needed job roles, co-ordinate Job Melas. A Rozgar portal has been made functional for this purpose.

#### Are your certificates valid internationally?

Our certificates are Nationally Valid, but they are of International Standard. Any industry abroad will have no hesitation to adopt it.

#### What would you like to communicate to the prospective candidates?

Candidates should take up job roles where expertise matters more. For example, the Transmission Segment. The job is difficult, but payment is much more as compared to that of the domestic electricians.




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# Festival of Nations: Thermal Images to Protect Against Covid-19

*Despite continued concerns over the novel coronavirus/COVID-19 infections, the Bavarian state government hoped to convey a sense of normalcy in 2020 by holding the “Festival of Nations” in the Weltheilbad in Bad Wörishofen/Allgäu. A central component in realizing a safe, educational cultural event was to promote hygiene during the event and provide some protections by setting up four skin temperature screening stations with thermal imaging cameras from FLIR...*

More than 25 years ago, an idea became reality: a single children's event grew into a variety of support projects for children and young adults. The “Festival of Nations”, which has set many unknown artists on the road to international recognition, established a mission to preserve tradition, discover new talent, and realize innovative projects through the enthusiasm of young people. For this reason, support projects form one of the three pillars of the classical festival, along with the festival's promotion of current star artist and “Young World Elite” upcoming artists.

## Festival of Nations

COVID-19 turned the start of the festival year 2020 upside down. Festival director Winfried Roch and his team were concerned they wouldn't be able to open the festival safely, but thanks to the director's professional connections in Asia, a sound hygiene and safety concept was developed. By placing FLIR thermal imaging technology at the entrances in the concert hall foyer, the team was able to provide some safety assurances to concert-goers.

## Sophisticated Concept

The plan for holding a safe event amid a pandemic was subject to strict health requirements, which the Festival team conveyed transparently to the audience: masks covering the mouth and nose worn until the guest took their seat (with a recommendation that masks be worn voluntarily during the concert), a limit of 200 guests in a hall normally designed for 900, individual admission times to prevent queues, four different entrances with a colored guidance system all the way into the hall, and thermal image screening stations at the four entrances.

The plan was convincing, so local authorities allowed the festival to take place in 2020 despite all adversities. “All of our internationally renowned artists such as Rolando Villazón, Julia Fischer, Rudolf Buchbinder,

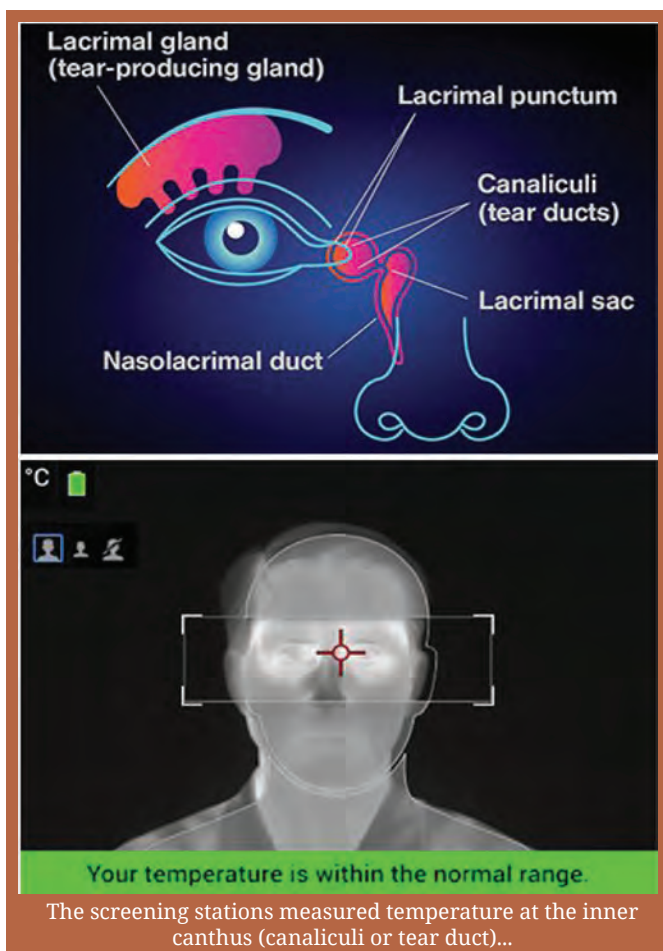


Each screening stations included a FLIR thermal imaging camera with Screen-EST™ mode activated...

Alice Sara Ott, Daniil Trifonov and the 12 cellists of the Berlin Philharmonic Orchestra supported our concept and performed as planned,” festival director Winfried Roch confirmed – even two times each, due to the restrictions. So that as many visitors as possible could enjoy the concerts in the hall, which was limited to 200 guests, each performance was repeated in front of a new audience after a break.

## Installation of Four Screening Stations

From the very beginning it was clear that thermal imaging camera screening stations should contribute to ensuring maximum safety for visitors and artists. For these, director Winfried Roch approached TOPA ([www.topa.de](http://www.topa.de)), a FLIR Platinum Partner for thermal imaging cameras. TOPA recommended one temperature screening station at



each of the four entrances to the concert hall. The thermal cameras measure skin temperature at the inner canthus, or the eyes' tear duct. While the cameras cannot detect fever or disease, the presence of an elevated skin temperature could be one sign of fever. If further checks showed the guest's temperature was truly elevated, they were not allowed to enter.

"We are familiar with these thermal imaging cameras from Asia," explained festival director Winfried Roch in the newspaper Augsburg Allgemeine Zeitung. "They

have not really taken off in Europe yet. But we think they are an important step towards greater safety."

### The Screen-Est Measurement Mode

At three entrances, TOPA used a FLIR E54-EST on a tripod. This camera offers FLIR Screen-EST mode to measure and visualize heat for rapid detection of an elevated skin temperature. With a resolution of  $320 \times 240$  thermal image pixels and a bright touchscreen display, the E54-EST provides accurate, easy-to-interpret temperature measurement. The FLIR Screen-EST mode integrated into the camera offers visual positioning marks, automatic sampling to update the average temperature and a graphical pass/fail display of the results: if there is no elevated temperature, the connected screen turns green.

### Vip Screening with Additional Software

A FLIR A500-EST was used at the fourth entrance. With its  $464 \times 348$ -pixel thermal imaging detector and FLIR Screen-EST mode integrated into the camera, the A500-EST can be used as a stand-alone screening station or within a network. But the camera can also be connected to most video management systems and is compatible with the desktop software FLIR Screen-EST. Although this software requires an additional computer on site, it has the advantage of faster throughput compared to the other three systems used.

### Summary

"The execution of the Festival of Nations has shown that culture does have a chance, even in challenging times, and, with a professional hygiene and safety concept, can delight large numbers of concert-goers," says festival director Winfried Roch, in summary. "The TOPA team and the manufacturer FLIR supported the central message: safe concerts despite coronavirus!"

For further information: [www.flir.com](http://www.flir.com)



One of three skin temperature screening stations with a FLIR E54-EST camera. Clear instructions helped streamline the temperature measurement process...



The FLIR A500-EST screening station was positioned at the VIP entrance where most visitors were invited guests...



A green screen means: no elevated temperature, admission allowed...

# OPTIMIZING P2P ENERGY TRADING

Image by pexels.com

*Contrary to the common notion, Blockchain technology can create marvels in the power trading industry, and the time is not so far when this technology will find application at all quarters of transaction including power trading. Recently, Japan's Mitsubishi Electric Corporation has stepped into a bold trial to facilitate more flexible trading environments and expanded use of surplus electricity from renewable energy...*

As a measure against global warming, Japan introduced a Feed-In Tariffs (FIT) system to enable electric utilities to purchase electricity generated from solar and other renewable energy sources at fixed prices. The law for this system, however, has been gradually retired since November 2019. With buy-seller contracts under the FIT system now expiring, prosumers need to find alternative retail-power suppliers to sell their surplus electricity at acceptable prices.

As a new method of trading surplus power, P2P energy trading is attracting attention by allowing prosumers to directly trade surplus energy at optimal prices. Since the current Electricity Utilities Industry Law allows only retail power companies to sell electricity to consumers, demonstrations are now being conducted to test the use of blockchain technology for P2P power transactions

under the management of retail electric operators, aiming at verifying the effectiveness of such transactions while identifying any possible issues.

Mitsubishi Electric Corporation and Tokyo Institute of Technology (Tokyo Tech) together have developed an original blockchain (a distributed ledger technology that connects blocks of transaction information in a chain along a timeline) technology that can optimize Peer-to-Peer (P2P) energy trading {direct trading of electricity between consumers (users) and prosumers (producers who are also users)}. The technology is expected to contribute to more effective use of surplus electricity from renewable energy by creating trading environments that flexibly respond to shared trading needs,

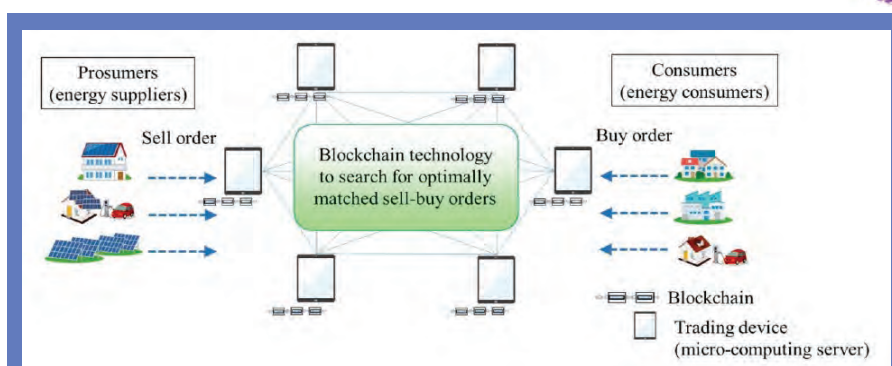


Fig. 1: P2P energy trading using blockchain technology to search for optimally paired orders...

Source: Mitsubishi Electric Corporation

particularly to maximize the amount of surplus electricity available in the market at any given time. Beginning in April, the P2P energy trading system's performance will be evaluated to further optimize the algorithm as required, aiming at the earliest possible commercialization.

In the collaboration, Mitsubishi Electric has taken charge of designing the P2P energy trading system and its clearing (transaction-completion) functions –while Tokyo Tech has handled blockchain technology R&D and the design of an optimal clearing algorithm.



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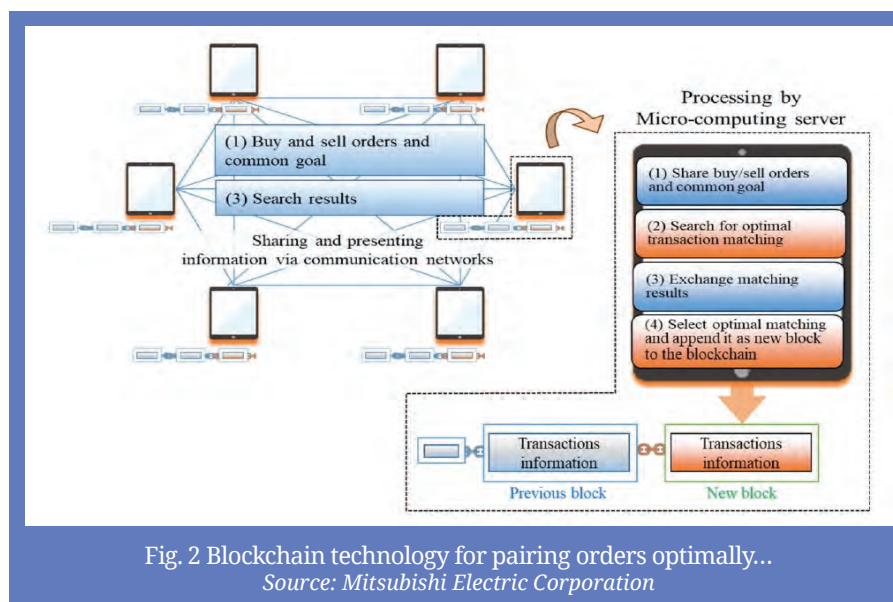
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## Flexible P2P Energy Trading

General blockchain technologies, such as those used for trading cryptocurrencies, require a large number of high-performance computers to perform massive calculations, or mining, (the use of extensive iterative calculations to search for a value that satisfies an uncommon condition. In a typical blockchain, the first person to succeed in a search receives a processing fee), when determining the creator of a new block to record trading information. To clear buy and sell orders, a conventional method (a contract method used in the stock and wholesale electricity markets, known as the continuous double-auction method) can be used to match conditions and process transactions, but this does not optimize matches.

Mitsubishi Electric and Tokyo Tech have developed an original blockchain technology to optimize P2P energy trading. Their newly devised distributed-optimization algorithm enables customer computers to share trading goals and data and then optimally match buy and sell orders using minimal computations. Also, the new mining method is executable on a micro-computing server (Table 1).

As shown in Fig. 2, using the new technology involves four steps. In the first step, information on buy and sell orders with a common trading goal (market surplus, profit, etc.) are shared by computing servers during a predetermined timeframe. Second, each server searches for buy and sell orders matched to the common goal



in the first step. Third, each server shares its search results. In the fourth and final step, each server receives the search results and generates a new block by selecting trades that best meet the shared goal, which it adds to each blockchain.

## Advantages of Deploying Blockchain Technology

P2P energy trading benefits consumers by enabling them to engage in direct trading – as buyers. Sellers sometimes make trades even above offer prices or below bid prices – if the right match is found. In addition, since new offers and bids can be issued, a customer who fails to make a trade can improve the chances of making a trade by changing the price or quantity in the next offer or bid after referring to the previous offer/bid conditions.

The trading goal shared among consumers can be changed to meet specific needs. For example, if the

goal is to maximize the amount of surplus electricity available in the market, the best offer-bid match can be searched with respect to this common goal. If a surplus exists, the trading price would likely decrease according to market principles. Thus, demand for recharging electric vehicles would likely increase due to cheaper prices. As a result, surplus power usage would be maximized without retail power companies having to respond to market fluctuations.

If the priority is the profits of prosumers and consumers, the shared goal can be adjusted to increase total profits, or raise the lowest profits, of all prosumers and consumers. By allowing the shared goal to be adjusted, the system enables flexible P2P energy trading.

To ensure fair trading, the decentralized search of a solution occurs in parallel on multiple computers where equivalent (orders where all information, except order name, is the same, including order time, price, quantity and type of buy or sell) matches are selected randomly.

| Type of blockchain      | Features                                                                                                                              |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Conventional blockchain | <ul style="list-style-type: none"> <li>• Mining to determine block generators</li> <li>• Run on high-performance computers</li> </ul> |
| New system's blockchain | <ul style="list-style-type: none"> <li>• Mining to optimize trading</li> <li>• Run on small computers</li> </ul>                      |

# Raising the Paradigm of Sustainability and Innovation

*Panasonic Life Solutions India has recently rolled out its UNO Switchgear range. The series is characterized by its versatile features that contribute to providing operational ease and convenience along with enhanced energy saving and upgraded safety features...*

**T**ransformation of the electrical construction material industry, especially in the switchgear market is expected to drive the demand for sustainable switchgear products. The switchgear is turning intrinsically intelligent, allowing consumers to have better asset management and go for predictive maintenance, thereby reducing interruption. With the expansion of smart grids, the need for quality power is also increasing. To address the consumer needs of smarter solutions, the demand is linked to the construction of new houses, replacement of conventional fuses, and growing awareness about safety. To cater to this, Panasonic Life Solutions India keeping in mind all the safety measures, durability and sustainability introduced its new UNO Switchgear range.

Electrical security is one of the primary aspects of any property, be it residential or commercial. The introduction of UNO switchgear is a breakthrough in this segment, with its cutting-edge technology that fits perfectly to prevent electrical hazards. The product is a complete class apart from the ordinary, thus making Panasonic Life Solutions the 'most trusted brand' in the electrical construction material sector.

The series offers optimal security such as trip indication by mid-trip, positive contact indication, energy-efficient MCB. The UNO Switchgear range comprises premium Distribution Boards, MCBs, RCCBs, Isolators & Mini-MCBs (Modular & Non-Modular), COS, ACCL, Busbar DB, MCCB, etc. The products under this extensive range offer versatile features

that contribute to providing operational ease and convenience. Additionally, the multi functionalities aim to reduce energy consumption and thus improving minimum energy wastage sustainability.

The UNO MCCB, HR RCCB, Busbar DB, Rotary switch with enclosure & range of MCCB enclosure with DBs are new products to complete the UNO basket for domestic products S/G. These incorporate all the safety features as per the set standards. The UNO series products are all tested under in-house as well as a third party to ensure that our quality follows the world-class standard products.

UNO MCCB range of products has been recently launched with premium features & high-performance quality supports. It is a bridge between domestic and industrial switchgear products. These products will definitely stand as a game-changer – not only in the trade segment but also in the residential & commercial projects with control panel builders and manufacturers.

This new range thus offers sustainable products with the energy saving and longer durability aspect. The UNO Switchgear rings in a new dimension of security for modern spaces due to its best-in-class manufacturing processes, use of superior raw-materials and stringent quality control adding to the comfort and safety of millions of Indians. 



**Yogesh Verma** is an Industrial Production Engineering graduate. He also holds PGDSCM from Symbiosis, Pune.





# INCREASING INTEREST FOR ADOPTION OF EVs

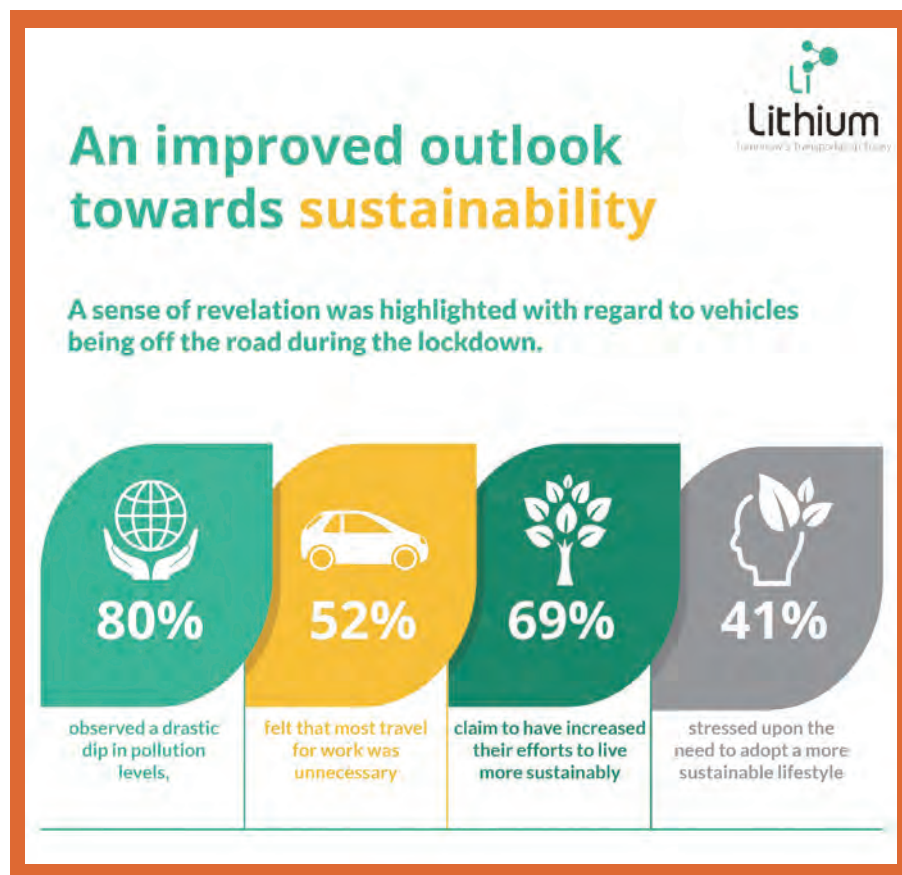
Photo by Michael Fousert on Unsplash

*COVID-19 pandemic has influenced the mindsets of majority of the potential Indian car purchasers. In general, people are now more inclined towards sustainable mobility. A whopping 80% of the respondents show their interest in adopting Electric Vehicles (EVs)...*

COVID-19 has been a trigger for many around the world with regard to their habits and conscious choices have been made towards living a sustainable lifestyle, particularly for those working from home. With the lockdown extending for almost a year, the environment has had the time to bounce back while people have had the opportunity to rethink the way they can contribute to a cleaner environment and corporates have had to realign their sustainability goals and give back to society in a more meaningful way. Lithium Urban Technologies, a corporate sustainable mobility solutions provider, administered a survey among the corporate community in India with the aim to assess their preference for sustainable mobility and electric vehicles in light of the

pandemic. Over 3500 respondents shared their views from 7 cities including Delhi, Mumbai, Bangalore, Chennai, Kolkata, Pune, Jaipur, and Hyderabad.

### Key highlights of the survey



### An improved outlook towards sustainability

A sense of revelation was highlighted with regard to vehicles being off the road during the lockdown - 80% of respondents observed a drastic dip in pollution levels, and 52% realized that most travel was unnecessary as their work carried on without any disruption.

Having taken the opportunity to increase self-awareness towards sustainability, a significant 69% of respondents feel that they have increased their efforts to adopt a more sustainable way of living since

the onset of the pandemic. Amongst this, 86% of people of age 55+ top the list. Interestingly, those residing in Mumbai (85%) and Bangalore (68%) have a higher claim towards living a more sustainable lifestyle,

compared to those residing in Delhi (62%) and Chennai (50%).

Though most of the respondents had an improved outlook towards sustainability, 41% of respondents stressed upon the fact that there is a need to adopt a more sustainable lifestyle going forward.

### Awareness of company-led sustainability efforts high among employees

When asked about the respondents' companies' policies on sustainability, 55% of them claim that their company has sustainability-related goals, while 19% of respondents are

not aware about their organisation's commitment to sustainability. Amongst them, a higher percentage of those working in medium to large enterprises believe that their company is more conscious about the environment (>75%), than those working in smaller enterprises (<52%).

### Preference of sustainable mobility services at an all-time high

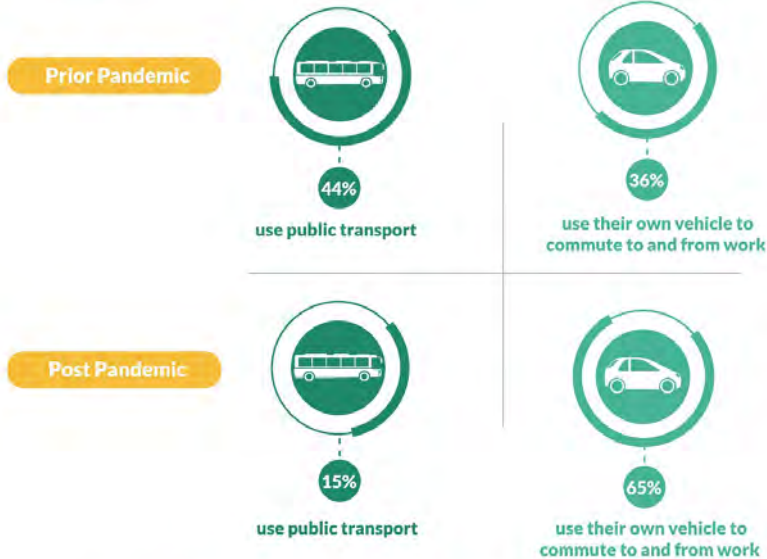
While only 17% of respondents claim that their office provides an option for sustainable mobility, Bangalore was seen witnessing the highest provision of sustainable mobility by offices, which is much higher than the national average. The insights also stress upon the fact that there is a willingness from the respondents to shift towards sustainable mobility solutions as a whopping 88% believe they would be more likely to opt for office transportation if it were in an electric vehicle format.

### Massive shift from public transport to own vehicles in the post-COVID world

COVID-19 has caused a massive shift in the daily commuting preferences - from 44% of respondents using public transport and 36% using their own vehicle to commute to and from work prior to the pandemic, to only 15% willing to use public transport and 65% willing to use their own vehicle in the post COVID world. A significant change is seen among Gen Z respondents with only 50% of them sticking to public transport as compared to the pre COVID era. City-wise, Delhi retains the highest percentage of residents who wish to use their own vehicle that stands at a whopping 75%. On the other

### Massive shift from public transport to own vehicles in the post-COVID world

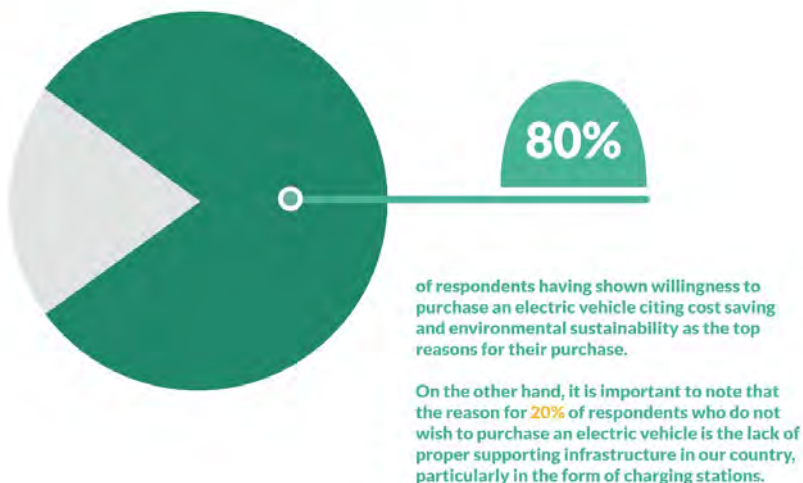
COVID-19 has caused a massive shift in the daily commuting preferences -



Mumbai tops the charts in the usage of public transport with increased willingness to use shared vehicles or carpools.

### Say yes to green mobility!

Overall there is an increasing preference for electric vehicles especially amongst the younger generations.



hand, Mumbai tops the charts in the usage of public transport with increased willingness to use shared vehicles or carpools.

### Say yes to green mobility!

Overall there is an increasing preference for electric vehicles, especially amongst the younger generations with close to 80% of respondents having shown willingness to purchase an electric vehicle – with higher preference being from the male respondents as compared to the female respondents – with cost saving and environmental sustainability being the top reasons for their purchase. On the other hand, it is important to note that the reason for 20% of respondents who do not wish to purchase an electric vehicle is the lack of proper supporting infrastructure in our country, particularly in the form of charging stations.

### Bottom line

Commenting on the survey insights, Sanjay Krishnan, Founder, Lithium Urban Technologies said, “It is safe to conclude that sustainability has hit the mainstream with a clear behavioural change seen in a corporate consumer since the onset of the pandemic and the lockdown. The insights from this survey are indicative of the fact that the younger generation will be the key stakeholders in influencing the general sentiments among their peers and older generations towards sustainable mobility as a long-term solution and investment. Moreover, an increased interest towards adoption of EVs clearly implies that pandemic has strengthened the belief of being environmentally conscious while keeping in mind cost effectiveness.”

# New Han modules for compressed air, energy storage and Ethernet

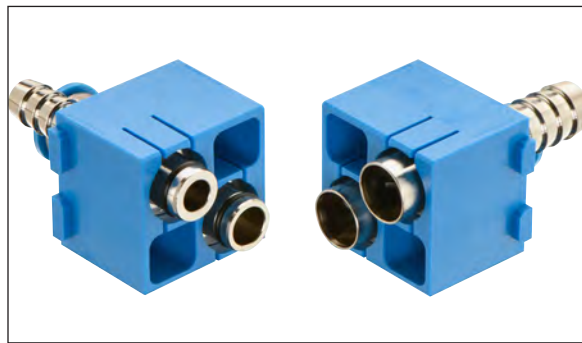
## Greater capacity, less weight

In the Han-Modular series, HARTING offers numerous connectors with which the energy efficiency of machines and systems can be sustainably increased. The latest example of this is the Han 300 A module. It fits in with the classic development goal for energy storage systems by enabling more capacity with less weight. Today's energy storage systems often work with outputs of 200 A / 800 V DC. Future applications with higher energy density will require transmissions of 300 A / 1200 V DC and more. The Han 300 A module is the matching interface.

The Han 300 A module is suitable for connecting new energy storage units, as well as for upgrading existing systems (being plug-in compatible with the Han 200 A module). Equipped with touch-safe contacts, it can be connected directly to the busbar or integrated into storage drawers.

The M12 connector format is new to the Han-Modular range. Two connectors, either X- or D-coded, each fit into one module. In this way, for example, it is possible to integrate 10 Gbit/s Ethernet into a modular interface in a particularly compact, space-saving manner. By comparison with conventional RJ45 solutions, the M12 interface is significantly more robust. All common bus systems can be easily adapted, including Profibus, Profinet, CAN, Ethernet Cat. 5 and Cat. 6A.

The trends towards greater digitization and modularization will also continue to grow. The Han® Shielded Power Module represents a space-saving and easy-to-maintain alternative to hard-wired shielded power cables. The module features three power contacts (16 A/400 V) and is suitable for connecting frequency-controlled drives, for example. Moreover, the series has



Han-Modular pneumatic double module for the installation of powerful compressed air networks in industrial connectors...

also been supplemented with an EMC-protected module for signal transmission: with a large-area shield transfer and a 360° shield plate, the Han Shielded Module Basic not only offers good shielding, it also enables a great deal of transmission in a compact installation space. Up to 27 shielded D-Sub contacts with 4 A/32 V can be plugged in.

There are already several solutions for 360° shielded

data transmission in the Han-Modular programme, including the Han Megabit module, among others. A new feature, however, is an adapter for the module that allows it to be plugged onto printed circuit boards. The module features 8 data pins and a shield contact and enables Ethernet transmission with two lines according to Cat. 5 or with one line according to Cat. 6A.

Introducing the Han Pneumatic Double Module, a new HARTING connector for compressed air transmission will be launched in the current quarter. The contacts of the interface have a larger connection range of 8 or 10 mm. This enables the design of compressed air transmission with sufficient capacity to operate valve terminals for various consumers.

What's more, the double module is also easy to assemble: A push-in solution using the proven quick connection technology and alternatively a conventional pneumatic connection are available for the hose connection. The combination can be inserted into the module – tool-free. With this module, HARTING is now further expanding its range of compressed air interfaces: Systems with internally and externally calibrated pneumatic tubing of 3, 4, 6, 8 or 10 mm can now be reliably installed with the help of pneumatic modules. 

For further information: E-mail: [Ada.Fung@HARTING.com](mailto:Ada.Fung@HARTING.com),  
Website: [www.HARTING.com/IN](http://www.HARTING.com/IN)

### ALL INDIA INSTALLED CAPACITY (IN MW) OF POWER STATIONS (As on 31.03.2021)

| Region                     | Ownership/<br>Sector | Mode wise breakup |         |          |        |           |         |          |               | Grand<br>Total |
|----------------------------|----------------------|-------------------|---------|----------|--------|-----------|---------|----------|---------------|----------------|
|                            |                      | Thermal           |         |          |        |           | Nuclear | Hydro    | RES *<br>NRE) |                |
|                            |                      | Coal              | Lignite | Gas      | Diesel | Total     |         |          |               |                |
| Northern<br>Region         | State                | 16659.00          | 250.00  | 2879.20  | 0.00   | 19788.20  | 0.00    | 5888.25  | 725.51        | 26401.96       |
|                            | Private              | 22425.83          | 1080.00 | 558.00   | 0.00   | 24063.83  | 0.00    | 2916.00  | 17487.12      | 44466.95       |
|                            | Central              | 15742.56          | 250.00  | 2344.06  | 0.00   | 18336.62  | 1620.00 | 11484.52 | 379.00        | 31820.14       |
|                            | Sub Total            | 54827.39          | 1580.00 | 5781.26  | 0.00   | 62188.65  | 1620.00 | 20288.77 | 18591.63      | 102689.05      |
|                            |                      |                   |         |          |        |           |         |          |               |                |
| Western<br>Region          | State                | 21500.00          | 900.00  | 2849.82  | 0.00   | 25249.82  | 0.00    | 5446.50  | 569.28        | 31265.60       |
|                            | Private              | 32847.17          | 500.00  | 4676.00  | 0.00   | 38023.17  | 0.00    | 481.00   | 28016.71      | 66520.88       |
|                            | Central              | 19972.95          | 0.00    | 3280.67  | 0.00   | 23253.62  | 1840.00 | 1635.00  | 666.30        | 27394.92       |
|                            | Sub Total            | 74320.12          | 1400.00 | 10806.49 | 0.00   | 86526.61  | 1840.00 | 7562.50  | 29252.29      | 125181.40      |
|                            |                      |                   |         |          |        |           |         |          |               |                |
| Southern<br>Region         | State                | 20322.50          | 0.00    | 791.98   | 159.96 | 21274.44  | 0.00    | 11774.83 | 586.88        | 33636.15       |
|                            | Private              | 12747.00          | 250.00  | 5340.24  | 273.70 | 18610.95  | 0.00    | 0.00     | 43471.37      | 62082.32       |
|                            | Central              | 11835.02          | 3390.00 | 359.58   | 0.00   | 15584.60  | 3320.00 | 0.00     | 541.90        | 19446.50       |
|                            | Sub Total            | 44904.52          | 3640.00 | 6491.80  | 433.66 | 55469.99  | 3320.00 | 11774.83 | 44600.15      | 115164.97      |
|                            |                      |                   |         |          |        |           |         |          |               |                |
| Eastern<br>Region          | State                | 7450.00           | 0.00    | 100.00   | 0.00   | 7550.00   | 0.00    | 3537.92  | 275.11        | 11363.03       |
|                            | Private              | 6153.00           | 0.00    | 0.00     | 0.00   | 6153.00   | 0.00    | 96.00    | 1300.22       | 7549.22        |
|                            | Central              | 14249.45          | 0.00    | 0.00     | 0.00   | 14249.45  | 0.00    | 1005.20  | 10.00         | 15264.65       |
|                            | Sub Total            | 27852.45          | 0.00    | 100.00   | 0.00   | 27952.45  | 0.00    | 4639.12  | 1585.33       | 34176.90       |
|                            |                      |                   |         |          |        |           |         |          |               |                |
| North<br>Eastern<br>Region | State                | 0.00              | 0.00    | 466.36   | 36.00  | 502.36    | 0.00    | 422.00   | 233.25        | 1157.60        |
|                            | Private              | 0.00              | 0.00    | 24.50    | 0.00   | 24.50     | 0.00    | 0.00     | 105.92        | 130.42         |
|                            | Central              | 770.02            | 0.00    | 1253.60  | 0.00   | 2023.62   | 0.00    | 1522.00  | 30.00         | 3575.62        |
|                            | Sub Total            | 770.02            | 0.00    | 1744.46  | 36.00  | 2550.48   | 0.00    | 1944.00  | 369.17        | 4863.64        |
|                            |                      |                   |         |          |        |           |         |          |               |                |
| Islands                    | State                | 0.00              | 0.00    | 0.00     | 40.05  | 40.05     | 0.00    | 0.00     | 5.25          | 45.30          |
|                            | Private              | 0.00              | 0.00    | 0.00     | 0.00   | 0.00      | 0.00    | 0.00     | 24.87         | 24.87          |
|                            | Central              | 0.00              | 0.00    | 0.00     | 0.00   | 0.00      | 0.00    | 0.00     | 5.10          | 5.10           |
|                            | Sub Total            | 0.00              | 0.00    | 0.00     | 40.05  | 40.05     | 0.00    | 0.00     | 35.22         | 75.27          |
|                            |                      |                   |         |          |        |           |         |          |               |                |
| ALL<br>INDIA               | State                | 65931.50          | 1150.00 | 7087.36  | 236.01 | 74404.86  | 0.00    | 27069.50 | 2395.27       | 103869.64      |
|                            | Private              | 74173.00          | 1830.00 | 10598.74 | 273.70 | 86875.45  | 0.00    | 3493.00  | 90406.21      | 180774.66      |
|                            | Central              | 62570.00          | 3640.00 | 7237.91  | 0.00   | 73447.91  | 6780.00 | 15646.72 | 1632.30       | 97506.93       |
|                            | Total                | 202674.50         | 6620.00 | 24924.01 | 509.71 | 234728.22 | 6780.00 | 46209.22 | 94433.79      | 382151.22      |

Figures at decimal may not tally due to rounding off

Source: CEA

## Energy Supply Position Report (Revised)

Figures in MU net

| States                 | March,2021         |                 |                     |            | April,2020 to March,2021 |                  |                     |            |
|------------------------|--------------------|-----------------|---------------------|------------|--------------------------|------------------|---------------------|------------|
|                        | Energy Requirement | Energy Supplied | Energy not Supplied |            | Energy Requirement       | Energy Supplied  | Energy not Supplied |            |
|                        | (MU)               | (MU)            | (MU)                | %          | (MU)                     | (MU)             | (MU)                | %          |
| Chandigarh             | 99                 | 99              | 0                   | 0.0        | 1,523                    | 1,523            | 0                   | 0.0        |
| Delhi                  | 2,097              | 2,097           | 0                   | 0.0        | 29,559                   | 29,555           | 4                   | 0.0        |
| Haryana                | 3,995              | 3,984           | 10                  | 0.3        | 53,161                   | 53,108           | 53                  | 0.1        |
| Himachal Pradesh       | 1,832              | 960             | 1                   | 0.2        | 10,171                   | 10,116           | 56                  | 0.5        |
| UT of J&K and Ladakh   | 1,738              | 1,556           | 275                 | 15.0       | 19,773                   | 17,222           | 2,551               | 12.9       |
| Punjab                 | 4,061              | 4,055           | 6                   | 0.2        | 58,460                   | 58,393           | 67                  | 0.1        |
| Rajasthan              | 7,277              | 7,255           | 22                  | 0.3        | 85,325                   | 85,219           | 106                 | 0.1        |
| Uttar Pradesh          | 9,591              | 9,502           | 88                  | 0.9        | 124,087                  | 123,103          | 984                 | 0.8        |
| Uttarakhand            | 1,136              | 1,132           | 4                   | 0.4        | 13,809                   | 13,800           | 8                   | 0.1        |
| <b>Northern Region</b> | <b>31,049</b>      | <b>30,641</b>   | <b>408</b>          | <b>1.3</b> | <b>395,868</b>           | <b>392,039</b>   | <b>3,829</b>        | <b>1.0</b> |
| Chhattisgarh           | 3,279              | 3,279           | 0                   | 0.0        | 31,021                   | 31,007           | 14                  | 0.0        |
| Gujarat                | 11,824             | 11,824          | 0                   | 0.0        | 112,085                  | 112,085          | 0                   | 0.0        |
| Madhya Pradesh         | 7,145              | 7,145           | 0                   | 0.0        | 83,514                   | 83,513           | 0                   | 0.0        |
| Maharashtra            | 16,375             | 16,375          | 0                   | 0.0        | 151,097                  | 151,081          | 16                  | 0.0        |
| Daman & Diu            | 229                | 229             | 0                   | 0.0        | 2,225                    | 2,225            | 0                   | 0.0        |
| DNH                    | 606                | 606             | 0                   | 0.0        | 5,495                    | 5,495            | 0                   | 0.0        |
| Goa                    | 364                | 364             | 0                   | 0.0        | 4,027                    | 4,027            | 0                   | 0.0        |
| <b>Western Region</b>  | <b>39,820</b>      | <b>39,820</b>   | <b>0</b>            | <b>0.0</b> | <b>389,464</b>           | <b>389,435</b>   | <b>30</b>           | <b>0.0</b> |
| Andhra Pradesh         | 6,597              | 6,597           | 0                   | 0.0        | 62,086                   | 62,082           | 4                   | 0.0        |
| Telangana              | 8,399              | 8,399           | 0                   | 0.0        | 67,062                   | 67,058           | 4                   | 0.0        |
| Karnataka              | 8,108              | 8,092           | 16                  | 0.2        | 68,951                   | 68,931           | 19                  | 0.0        |
| Kerala                 | 2,562              | 2,562           | 0                   | 0.0        | 25,132                   | 25,116           | 16                  | 0.1        |
| Tamil Nadu             | 10,335             | 10,335          | 0                   | 0.0        | 101,177                  | 101,172          | 5                   | 0.0        |
| Puducherry             | 252                | 252             | 0                   | 0.0        | 2,641                    | 2,641            | 0                   | 0.0        |
| Lakshadweep #          | 5                  | 5               | 0                   | 0.0        | 56                       | 56               | 0                   | 0.0        |
| <b>Southern Region</b> | <b>36,252</b>      | <b>36,237</b>   | <b>16</b>           | <b>0.0</b> | <b>327,048</b>           | <b>327,000</b>   | <b>48</b>           | <b>0.0</b> |
| Bihar                  | 2,978              | 2,978           | 0                   | 0.0        | 34,227                   | 34,095           | 132                 | 0.4        |
| DVC                    | 1,903              | 1,903           | 0                   | 0.0        | 21,212                   | 21,212           | 0                   | 0.0        |
| Jharkhand              | 825                | 820             | 5                   | 0.6        | 9,857                    | 9,628            | 229                 | 2.3        |
| Odisha                 | 2,904              | 2,904           | 0                   | 0.0        | 29,806                   | 29,806           | 0                   | 0.0        |
| West Bengal            | 4,812              | 4,812           | 0                   | 0.0        | 51,345                   | 51,248           | 97                  | 0.2        |
| Sikkim                 | 52                 | 52              | 0                   | 0.0        | 545                      | 545              | 0                   | 0.0        |
| Andaman-Nicobar #      | 29                 | 27              | 2                   | 6.7        | 346                      | 323              | 23                  | 6.7        |
| <b>Eastern Region</b>  | <b>13,474</b>      | <b>13,469</b>   | <b>5</b>            | <b>0.0</b> | <b>146,992</b>           | <b>146,534</b>   | <b>458</b>          | <b>0.3</b> |
| Arunachal Pradesh      | 68                 | 68              | 1                   | 0.9        | 717                      | 712              | 5                   | 0.7        |
| Assam                  | 841                | 796             | 45                  | 5.3        | 10,195                   | 9,818            | 377                 | 3.7        |
| Manipur                | 75                 | 75              | 0                   | 0.5        | 971                      | 966              | 5                   | 0.5        |
| Meghalaya              | 186                | 172             | 14                  | 7.6        | 2,031                    | 2,005            | 26                  | 1.3        |
| Mizoram                | 50                 | 50              | 0                   | 0.7        | 724                      | 720              | 4                   | 0.6        |
| Nagaland               | 67                 | 66              | 0                   | 0.6        | 829                      | 825              | 4                   | 0.5        |
| Tripura*               | 124                | 124             | 0                   | 0.3        | 1,494                    | 1,491            | 3                   | 0.2        |
| <b>North-Eastern</b>   | <b>1,411</b>       | <b>1,350</b>    | <b>61</b>           | <b>4.3</b> | <b>16,962</b>            | <b>16,538</b>    | <b>424</b>          | <b>2.5</b> |
| <b>All India</b>       | <b>122,006</b>     | <b>121,517</b>  | <b>489</b>          | <b>0.4</b> | <b>1,276,335</b>         | <b>1,271,546</b> | <b>4,789</b>        | <b>0.4</b> |

# Lakshadweep and Andaman & Nicobar Islands are stand- alone systems, power supply position of these,does not form part of regional requirement and energy supplied. \* Excludes energy exported to Bangladesh.

Note: Power Supply Position Report has been compiled based on the data furnished by StateUtilities/ Electricity Departments.

Source: CEA

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| 2 YEARS                        | 24            | 1750.00        | 2950.00              | 3350.00    | 1750.00   | 3825.00              | 4225.00    |
| 3 YEARS                        | 36            | 2500.00        | 4300.00              | 4900.00    | 2500.00   | 5550.00              | 6150.00    |
| 5 YEARS                        | 60            | 4000.00        | 7000.00              | 8000.00    | 4000.00   | 9000.00              | 10000.00   |
| LIGHTING INDIA                 |               |                |                      |            |           |                      |            |
| 1 YEAR                         | 6             | 750.00         | 1050.00              | 1250.00    | 750.00    | 1425.00              | 1625.00    |
| 2 YEARS                        | 12            | 1350.00        | 1950.00              | 2350.00    | 1350.00   | 2625.00              | 3025.00    |
| 3 YEARS                        | 18            | 2000.00        | 2900.00              | 3500.00    | 2000.00   | 3900.00              | 4500.00    |
| 5 YEARS                        | 30            | 3000.00        | 4500.00              | 5500.00    | 3000.00   | 6000.00              | 7000.00    |
| MEDICAL EQUIPMENT & AUTOMATION |               |                |                      |            |           |                      |            |
| 1 YEAR                         | 6             | 750.00         | 1050.00              | 1250.00    | 750.00    | 1425.00              | 1625.00    |
| 2 YEARS                        | 12            | 1350.00        | 1950.00              | 2350.00    | 1350.00   | 2625.00              | 3025.00    |
| 3 YEARS                        | 18            | 2000.00        | 2900.00              | 3500.00    | 2000.00   | 3900.00              | 4500.00    |
| 5 YEARS                        | 30            | 3000.00        | 4500.00              | 5500.00    | 3000.00   | 6000.00              | 7000.00    |
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| 2 YEARS                        | 12            | 2160.00        | 2760.00              | 3160.00    | 2160.00   | 3435.00              | 3835.00    |
| 3 YEARS                        | 18            | 3200.00        | 4100.00              | 4700.00    | 3200.00   | 5100.00              | 5700.00    |
| 5 YEARS                        | 30            | 4800.00        | 6300.00              | 7300.00    | 4800.00   | 7800.00              | 8800.00    |



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## Quickly print wear-resistant parts for food contact with new igus filament

*3D printing material, iglidur A350, ensures lubrication-free, FDA-compliant and temperature-resistant special parts in the packaging industry.*

Special hygienic solutions are the be-all and end-all in the packaging and food industry. For this reason, many users are already using the FDA-compliant iglidur plain bearings and bar stock made of high-performance polymers from igus. To enable the users to have even more design freedom in the construction of their machine, igus has now developed its temperature-resistant, long-lasting and proven material iglidur A350 as a 3D printing tribo-filament.

“As the machines in the packaging and food industry are becoming more and more customised, solutions for plain bearings and wear-resistant parts in special shapes are required”, explains Niklas Eutebach, Additive Manufacturing Development Engineer at igus GmbH. “In order to give the user even more design freedom in the construction of their system, we have now developed iglidur A350 as a tribo-filament.” The lubrication-free and



maintenance-free material is specifically designed for use in food and packaging technology.

### Approved for the food sector

The iglidur A350 material complies with EU Regulation 10/2011 and the FDA and is therefore officially approved for contact with food. At the same time, it also meets

the fire protection requirements of the United States Federal Aviation Authority (FAA) for aircraft interiors. Due to its blue colour, iglidur A350 is easier to detect and increases safety in production. The durability of the material is particularly evident in pivoting and rotary applications and with high and medium loads on stainless steel shafts. The filament is available for self-printing on a high-temperature 3D printer, as well as in the 3D printing service from igus.



For further information: E-mail: [nitin@igus.net](mailto:nitin@igus.net),  
Website: [www.igus.in](http://www.igus.in)

## “Kusam-Meco” True RMS Digital Clampmeter Model KM 2719

KUSAM-MECO has introduced a new Clampmeter Model KM 2719 which is an upgraded version of their earlier Model KM-2718. The instrument is suitable for HVAC measurements. The new Clampmeter has 11 functions & 37 Ranges. It has 4000 counts display. The Measurement is True RMS measurement. It measures AC current upto 400 amperes (frequency response 50Hz -100Hz). It has AC Voltage range upto 600 Volts (Frequency response 10Hz - 10KHz) with a resolution 1mV. It has DC Voltage Range upto 600 Volts with resolution 0.1mV. The Resistance measuring range is 40 mega with a resolution 0.1 Ohm. The Capacitance range is upto 4.000 mF with a resolution of 0.001 nF. It also has Diode & Continuity test function. It can measure Frequency upto 10MHz with resolution 0.01Hz. It also has Temperature measurement



function with K-type Thermocouple having range upto 1000 degree C. The Thermocouple supplied along with the clampmeter is suitable upto 250 degree C. Additionally it has Non-Contact Voltage Detection function.

The Jaw opening is 28mm diameter. Over load input signal is displayed by “OL”. If there is no operation of any function switch or any button for 15 minutes the instrument will be automatically power off. It is light in weight (approximately 248g including batteries). The clampmeter is supplied with Test lead, Battery, User Manual, K-Type Temperature Probe range upto 250 degree C & Carrying case. Optionally, thermocouple upto 1000



degree C can be supplied.  
For further information: E-mail: [sales@kusam-meco.co.in](mailto:sales@kusam-meco.co.in),  
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## VEHICLE ELECTRIFICATION EXPO

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