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From the Publisher's Desk

A noteworthy step to promote clean energy

As far as the deployment of Solar Energy is concerned, by now India's foremost role is well-known to the world. However, mere installation of solar plants is not enough, for their long-term healthy operation, developing field-specific maintenance staff force is very essential. Considering this factor, recently, the UN Environment Programme (UNEP); India's leading clean energy company, ReNew Power; and the Self-Employed Women's Association (SEWA) have forged a partnership in Gujarat to educate women from the informal sectors that will allow them to work in the modern clean energy industry.

The multi-pronged programme will facilitate the training of salt pan workers from the Rann of Kutch in solar power technologies to help them leapfrog from traditional energy sources to renewable and clean energy and new livelihood opportunities. The initiative, which will kick off in Gujarat in early 2022 with an estimated 1,000 women, will see salt pan workers trained as solar panel and solar pump technicians across SEWA training centres and ReNew Power's facilities in the state with technical training provided by Electronics Sector Skills Council of India (ESSCI).

Speaking on behalf of SEWA, Reema Nanavaty, one of the leaders of SEWA, informed, "This programme will not only help create alternative livelihoods for our SEWA sisters and help mitigate the environmental challenges that exist in the current energy use practices in traditional sectors, but it will also help achieve a just transition towards environmental sustainability. We look forward to replicating this programme across other regions of the country with support from organizations such as ReNew Power and UNEP."

I whole-heartedly appreciate such a great initiative, and wish all the success to it.

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Electrical India

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POWERGRID TO BE PART OF AFRICA'S FIRST TRANSMISSION PPP PROJECT IN KENYA

Power Grid Corporation of India Limited (POWERGRID) has signed a Joint Development Agreement with Africa50, the pan-African infrastructure investment platform to continue to develop the Kenya Transmission Project on a Public-Private Partnership (PPP) basis.

The project entails the development, financing, construction, and operation of the 400kV Lessos – Loosuk and 220kV Kisumu – Musaga transmission lines under a PPP framework. Once completed, the project will be the first Independent Power Transmission (IPT) in Kenya and will set a reference point in Africa as the first financing of transmission lines on a PPP basis. This Project will also improve both the supply and reliability of power transmission in Western Kenya and further create a demonstration effect to help increase private sector investments into



A robust transmission network spurs the competition that results into competitive electricity prices...

Representative Photo by Andrey Metelev on Unsplash

the expansion of Africa's power transmission networks, which is critical to bridging the continent's electricity access gap.

Signing the agreement, K. Sreekant, Chairman and Managing Director of POWERGRID, said that POWERGRID hopes that the present transmission project in Kenya shall serve as a model for undertaking more such projects in Kenya as well as other African countries. POWERGRID with its rich technical and managerial experience in undertaking

transmission systems under PPP mode shall be pleased to be associated in this journey, he added.

Commenting on the development, Alain Ebobissé, CEO of Africa50, said that it is time to focus on catalyzing private investment into the development of power transmission networks across Africa as these are a critical link to improving electricity access, especially in underserved communities. **EI**

NTPC VIDYUT VYAPAR NIGAM ACQUIRES 5% EQUITY STAKE IN PXIL

PXIL was promoted by NSE Investment Ltd. & NCDEX and has been providing innovative and credible solutions since 2008...

NTPC Vidyut Vyapar Nigam Ltd. (NVVN), a wholly owned subsidiary of NTPC Ltd. has recently acquired 5% equity stake in Power Exchange of India Ltd (PXIL). NVVN has purchased these shares from NSE Investment Limited, a co-promoter shareholder of PXIL.

NVVN is one of the top power traders in India and the acquisition of an equity stake in PXIL is a strategic opportunity for NVVN to achieve and maintain a leadership position in the rapidly changing Power trading market.

NVVN was formed by NTPC Ltd., India's largest power generator and a Maharatna Company, in the year 2002, as its wholly owned subsidiary to tap the potential of power trading in the country. NVVN holds a highest Category 'I' power trading license

in terms of latest CERC regulations. The company has 200 total employees across all of its locations, and there are 203 companies in the NVVN corporate family.

Power Exchange India Limited (PXIL) is India's first institutionally promoted power exchange. The company has been providing innovative and credible solutions since 2008, and has revolutionized the way Indian power markets operate. PXIL's unique combination of local insights and global perspectives has helped its members make better informed business and investment decisions, and has improved the overall efficiency of power markets in India by accurately and seamlessly connecting buyers and sellers. PXIL's 'PRATYAY' is a trading system for meeting all customers' trading requirements. **EI**

POWER MINISTER INTERACTS WITH STAKE HOLDERS ON THE DRAFT POLICY ON ESS

The Union Minister of Power and New and Renewable Energy, R.K. Singh recently interacted with Renewable Energy developers, industry and various government representatives to discuss the elements of the draft Policy on Energy Storage System (ESS) to promote the creation of storage systems on a large scale across the country. The policy aims at the creation of technology-agnostic storage system across the value chain of the electricity sector viz. at generation, transmission, and distribution levels.

In the meeting held on 25th January 2022 with representatives of the industry, Singh galvanized the industry representatives and called for their active participation in establishing storage systems and associated manufacturing industries domestically within the country.

On a later date, the minister also took a subsequent



ESSs will benefit Gencos, Discoms, Grid Operators, and other players...

meeting with Principal Secretaries and CMDs of Renewable Energy Rich States viz. Punjab, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Telangana, Kerala, Tamil Nadu, Gujarat & Madhya Pradesh. The states welcomed the policy initiative taken by the Government of India for promotion of Storage Systems in the country. They also

highlighted the efforts being taken on their side to promote pumped storage projects and Battery Energy Storage Systems.

Singh stressed on the need to establish storage systems on a wide scale in the country. He informed that Energy Storage System (ESS) shall be an integral part of the power system under the Electricity Act and that setting up of standalone ESS may be made as a delicensed activity.

MOP PROMULGATES THE REVISED CONSOLIDATED GUIDELINES & STANDARDS FOR CHARGING INFRASTRUCTURE FOR EVS

Tariff for power supply to Public EV Charging Stations shall be a single part tariff and shall not exceed the 'Average Cost of Supply' till 31.03.2025....

The Union Ministry of Power (MoP) has promulgated the revised consolidated Guidelines & Standards for Charging Infrastructure for Electric Vehicles (EV) on 14th January, 2022. The objective is to enable a faster adoption of electric vehicles in India by ensuring safe, reliable, accessible and affordable Charging Infrastructure and eco-system. This would also promote energy security and reduction of emission intensity of the country by promotion of entire EV ecosystem.

These guidelines are exhaustive and include provisions for individual owners of Electric Vehicles and for Public Charging Stations (PCS). Owners may charge their Electric Vehicles at their residence/offices using their existing electricity connections.

Any individual/entity is free to set up public charging stations without the requirement of a license provided

that, such stations meet the technical, safety as well as performance standards and protocols laid down under the guidelines as well as norms/ standards/ specifications laid down by Ministry of Power, Bureau of Energy Efficiency (BEE) and Central Electricity Authority (CEA) from time to time. An exhaustive list of compliance requirements for Public Charging Station (PCS) have also been outlined. These include norms for 'appropriate' infrastructure for civil, electricity and safety requirements.

The BEE shall be the Central Nodal Agency for rollout of EV Public Charging Infrastructure. All relevant agencies including CEA shall provide necessary support to Central Nodal Agency. Every State Government shall nominate a Nodal Agency for that State for setting up charging infrastructure.

UNION MINISTER DEDICATES BHEL'S INDIGENOUSLY-DEVELOPED, COAL TO METHANOL PILOT PLANT TO THE NATION

Recently through a virtual ceremony, the Union Minister for Heavy Industries, Dr. Mahendra Nath Pandey has dedicated India's first, BHEL-built Coal to Methanol (CTM) pilot plant, to the nation. Dr. Nalin Shinghal, CMD, BHEL, Jeetendra Singh, Joint Secretary, Ministry of Heavy Industries, Functional Directors on the Board of BHEL and senior officials of the Ministry of Heavy Industries and BHEL were present in the occasion.

Speaking on the occasion, Dr. Pandey said that one of the important goals of our Hon'ble Prime Minister Narendra Modi's vision is to build a self-reliant nation. The role of the manufacturing sector will be crucial in realising this vision. The government has already highlighted the importance of the manufacturing sector



A glimpse of the virtual meeting...

through schemes like Make in India and Aatmanirbhar Bharat. The capital goods industry is the backbone of the manufacturing sector. It provides critical inputs such as machinery and equipment to a broad set of user industries. Being the largest engineering and manufacturing enterprise, the role of BHEL in fulfilling the vision of the

government is of particular importance.

Notably, the 0.25 TPD capacity CTM pilot plant, indigenously designed, developed and installed by BHEL, is currently producing methanol with purity of more than 99% from high ash Indian coals. Significantly, this conversion of high ash Indian coals to methanol through the gasification route, is the first of its kind technology demonstration in India. E1

TATA POWER PARTNERS WITH APOLLO TYRES TO DEPLOY EV CHARGING STATIONS

It is a big stride by the two committed companies to accelerate the transition to electric vehicles...

Tata Power and Apollo Tyres Ltd., have agreed on a strategic partnership for the deployment of public charging stations across India. These charging stations will be deployed at Apollo Tyres' Commercial and Passenger Vehicle Zones spread across the country. Tata Power has a presence across all the segments of the EV charging ecosystem and has deployed all types of chargers – DC 001, AC, Type 2, Fast DC chargers up to 50kWh and up to 240kWh chargers for buses. Based on location, this classification of chargers will support EV charging for two-wheelers and four-wheelers, respectively.

As per the agreement, Tata Power will set up charging stations at 150 branded retail outlets – CV and PV Zones – of Apollo Tyres initially. In addition

to the customers visiting these tyre retail outlets, the charging stations would also remain open for use by the general public, throughout the year.

Commenting on the agreement, Dr. Praveer Sinha, CEO and MD of Tata Power, stated, "We are glad to partner with Apollo Tyres for the deployment of EV charging stations across their commercial & passenger vehicle zones. This partnership reflects our commitment to developing and expanding the electric vehicle ecosystem in the country."

Focusing on this move, Satish Sharma, President, Asia Pacific, Middle East & Africa, Apollo Tyres Ltd., said, "The setting up of EV Charging Infrastructure at our Business Partner's premises strengthens our resolve towards promoting green mobility in the country." E1



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L&T, HYDROGENPRO SIGN MOU FOR MANUFACTURING HYDROGEN ELECTROLYSERS IN INDIA

Larsen & Toubro (L&T) has entered a Memorandum of Understanding (MoU) with HydrogenPro AS (a Norway-based leading Electrolyser technology and manufacturing company) for partnership to tap the emerging Green Hydrogen market.

As per the agreement, L&T and HydrogenPro will jointly work towards setting up of a joint venture in India for Gigawatt-scale manufacturing of Alkaline Water Electrolysers based on HydrogenPro technology for Indian market and other select geographies. The proposed joint venture in India is in line with L&T's strategic vision to be present across the green energy value chain and HydrogenPro's strategy of establishing a global manufacturing footprint to maintain cost leadership and ensure local presence.

Commenting on the occasion, S N Subrahmanyam, CEO & MD, L&T said, "The energy industry is



S N Subrahmanyam,
CEO & MD, L&T



Elling Nygaard,
CEO, HydrogenPro

undergoing a tectonic shift with Green Hydrogen emerging as a key fuel in the future energy basket. We are delighted to have signed this MoU with HydrogenPro. This will be a win-win partnership given our extensive relationship across the energy industry, deep EPC experience in this sector and successful ongoing

collaborations with many MNCs and HydrogenPro's focus to stay ahead of the curve as far as technology leadership is concerned."

Expressing their view, Elling Nygaard, CEO, HydrogenPro, said, "We're extremely pleased to enter this Memorandum of Understanding with L&T, an E&C powerhouse which is the perfect partner to establish HydrogenPro in the Indian market, a huge and growing energy market with tremendous potential for hydrogen-based solutions."

ET

RENEW POWER COMMISSIONS GUJARAT'S FIRST WIND-SOLAR HYBRID PROJECT

The project is expected to mitigate a total of ~150,000 tCO₂e (carbon) emissions each year...

ReNew Power has set up Gujarat's first wind-solar hybrid project at the Chlor-Alkali unit of Grasim Industries Limited in Vilayat, Bharuch, in southern Gujarat. The first phase of the hybrid project, with 17.6 MW commercial-scale wind-solar, has recently commenced operations and is expected to generate ~80 million units of renewable energy every year, mitigating ~75,000 tCO₂e (carbon emissions) annually. The partnership will expand further with an additional 16.68 MW, which will be commissioned in the next financial year (FY23), as part of the second phase.

The project is being developed by ReNew Green Solutions (RGS), the B2B arm of ReNew Power. Both the parties have entered into a 25-year PPA, which will see the project supply power for the plant at Vilayat,

Bharuch, via an Open Access mechanism. Once both phases are commissioned with a combined capacity of 34.28 MW, the partnership is expected to generate a total of approximately 160 million units of renewable electricity annually, mitigating a cumulative ~150,000 tCO₂e (carbon emission) a year (The tCO₂e value has been calculated as per CEA database version 16). Both phases together have a total investment of INR ~3.82 billion (~\$51 million) through an equity partnership.

Speaking on the project, Mayank Bansal, Chief Commercial Officer, ReNew Power, said, "With corporates increasingly harnessing renewable energy, ReNew aims to develop around 250 MW of wind-solar hybrid projects in Gujarat for commercial & industrial consumers, like we have just done at Vilayat, Bharuch."

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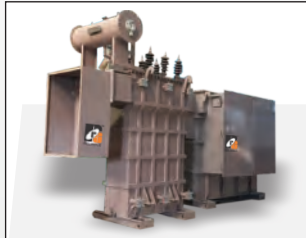
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NSG GROUP INTRODUCES RENEWABLE ELECTRICITY IN POLAND TARGETING CARBON REDUCTION

NSG UK Enterprises, a part of the NSG Group, has signed a Power Purchase Agreement (PPA) with EDP Renewables (EDPR), the world's fourth largest renewable energy producer, for the renewable electricity generated by a wind farm located in Poland.

Detailing on the development, John Wilgar, Head of Procurement at NSG Group, said, "We are delighted to sign our first virtual PPA with our partner EDPR for the majority of our electricity demand in Poland. This helps us to secure renewable electricity at predictable costs over the long term in a market with a highly carbon intensive grid. It is a huge step towards our sustainability objectives in support of our actions on climate change."



A glimpse of the RE power plant in Poland...

It is the first virtual PPA by NSG Group and the first PPA signed by a glass manufacturer in Poland. NSG will offtake 51% of the output from the wind farm, which has a total installed capacity of 70 MW. The PPA will have a duration of 10 years, starting in January 2022.

The contract will see approximately 100 Giga Watt Hours (GWh) of

NSG Group's annual electricity demand supplied at a fixed price reducing exposure to the volatile wholesale electricity prices currently seen. This amount of clean energy is equivalent to avoiding the carbon emissions from nearly 15,000 passenger vehicles driven for one year, or more than 278 million kilometres driven by an average passenger car.

BI

SPEN APPOINTS ARCADIS FOR TIMELY TRANSITION TOWARDS SUSTAINABLE ENERGY IN SCOTLAND

The energy sector plays a crucial role in providing the solutions that is needed to limit global warming to 1.5°C and tackle climate change...

Arcadis has been appointed by Scottish & Southern Electricity Networks (SSEN) and Scottish Power Energy Networks (SPEN) to support their aims of maximizing renewable energy through two pivotal frameworks, as they navigate the regulator's new price control model, known as 'RIIO-T2'. The various framework durations are five years and have an expected combined potential value of circa £25 million over the period.

The five-year multi-disciplinary transmission and distribution framework with SSEN will support the organization in delivering infrastructure that will accommodate 10GW renewable generation by 2026. SSEN's new framework will require delivery of the RIIO-2 baseline and a sustainable delivery model to future-proof their network. The work leverages the scale of Arcadis' multi-disciplinary expertise,

spanning electrical, civil and structural, telecoms, protection and control design, cable, building services (both mechanical and electrical), commissioning and project management.

SPEN appointed Arcadis as lead designer on their detailed engineering framework for transmission works. Arcadis' team will work on multiple sites in the UK and focus on enabling new wind farm connections, including substation design, cable and overhead line designs, protection and control, along with civil works. Two-thirds of the SPEN framework projects will involve modernizing existing substations and will include several design projects, including switchgear and electrical replacement, transformer and reactor refurbishment and supporting civil works. The remaining one-third will focus on connecting end-users to their renewable energy.

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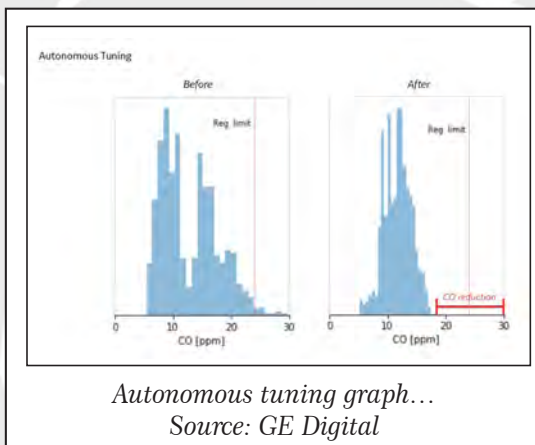
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GE DIGITAL'S SOFTWARE BRINGS SEVERAL BENEFITS ENABLING CONTINUOUS TUNING FOR GAS TURBINES

Gas turbines require seasonal adjustment of flame temperatures and fuel splits, which is generally a manual process, and may take a few days to complete. However, manual seasonal tuning is only efficient for the precise conditions in which it was completed and does not respond to changes in ambient temperature or fuel properties.

GE Digital has recently introduced a software that ensures gas turbines operate with ideal combustion for reduced emissions and fuel consumption. Autonomous Tuning uses Artificial Intelligence (AI) to build a Machine Learning (ML) Digital Twin model of a gas turbine to continuously find optimal flame temperatures and fuel splits to minimize emissions and acoustics. The on-premises software senses changes in ambient temperature, gas fuel properties, and degradation, and sends real-time



automatic adjustments to the controls every two seconds.

The goal of Autonomous Tuning is to allow for tracking of the turbine's 'sweet spot' (operational conditions with low acoustics and low emissions) in response to changes in environmental conditions, fuel properties, or physical degradation, and reduce the need for seasonal remapping.

The software is applicable to any OEM gas turbine platform. It is also fully bound by the turbine controls system's safety-critical programming – ensuring it cannot harm the turbine.

Commenting on the software, Joe Perino, Principal Analyst at LNS Research, said, "This is a real-world application of AI for decarbonization with tangible reductions in emissions and fuel for gas turbine operators. This, and other building block sub-systems, are a step toward autonomous operations."

CQUANT.IO ENERGY ANALYTICS PLATFORM TO USE THE POWER OF MICROSOFT AZURE

Analytics are a key piece to decoding the ever-evolving mission to becoming carbon-free and both cQuant and Microsoft look forward to moving together in the same direction...

cQuant.io, an energy analytics company, has worked with Microsoft to scale its cQuant energy analytics solution, helping customers reduce their greenhouse gas emissions with reliable renewable energy purchases. Specializing in Total Portfolio Analysis, cQuant's cloud-native platform enables physical asset, financial contract, market simulation and risk management analytics in one place.

As organizations move forward to reduce their carbon footprint, the procurement of renewable energy often becomes a key strategy. This procurement usually includes long term Power Purchase Agreements (PPA) wrought with uncertainty around price and generation which the industry calls risk. cQuant's cloud-native energy analytics platform is now using the power of Microsoft Azure.

Explaining the reason behind working together, David

Leevan, CEO of cQuant, said, "A modern energy analytics platform requires significant computing resources, which makes working with Microsoft a natural choice. The high-performance computing and scalability inherent in the Azure cloud platform in combination with the cQuant's advanced analytics platform has helped to deliver timely results to our clients."

The cQuant energy analytics solution provides insightful and powerful information to companies in moving towards a carbon-free footprint. Companies on this journey often find that this process is complex and look for vendor solutions that support their internal teams to identify the best path forward. With cQuant, companies can individually analyse and manage their renewable assets and get a holistic view of their complete energy portfolio, allowing for smarter decision making.

B. VEERA REDDY ASSUMES THE CHARGE OF DT OF COAL INDIA LIMITED



Before joining CIL, he worked in Adriyala Longwall project area of the SCCL...

B. Veera Reddy has taken over as Director-Technical (DT) of Coal India Limited (CIL). He has worked in various capacities, and was working as DT, ECL before taking over as DT, CIL. He has over 34 years of rich experience in coal mining, planning, procurement, operation & grounding of green field projects.

Reddy received his B. Tech. in Mining from Kothagudem School of Mines, under Osmania University in the year 1986. Later in the year 1990, he obtained First

Class Managers Competency Certificate from DGMS. Then he completed Master of Technology in Mine Planning from Kothagudem School of Mines, Osmania University in 2000.

He joined Singareni Collieries Company Limited (SCCL) in the year 1987 and possesses more than 32 years of experience in coal mining, planning, procurement and operations – managing mechanized underground and opencast mines and in Corporate Project Planning department of SCCL. 

S. HARDY JOINS PORTABLE ELECTRIC AS CEO, A MEMBER OF ITS BOARD OF DIRECTORS



Beside being the CEO and Board Member of PE, he'll also invest in the company...

Portable Electric (PE), a Vancouver-based global leader in clean energy power stations, has recently appointed Scott Hardy as the company's new Chief Executive Officer (CEO) and a Member of the Board of Directors. Mark Rabin, PE's founder and CEO, will now function as the Founder and Chief Visionary Officer.

A technology industry leader with a distinguished resume spanning four decades, Hardy has joined Portable Electric after a successful tenure as CEO

of DDS Wireless International – where he helped drive growth by transitioning the technology firm to a SaaS-based business model, and moving away from a traditional enterprise software business. Despite this challenging transition, DDS was able to nearly double the company's annual revenue. Prior to DDS, Hardy spent 30 years with IBM, where he held several senior executive positions while managing a portfolio worth over \$650 million, and providing business direction to over 4,000 staff. 

J. DOLGER TAKES OVER AS EXECUTIVE VP OF FUELCELL ENERGY



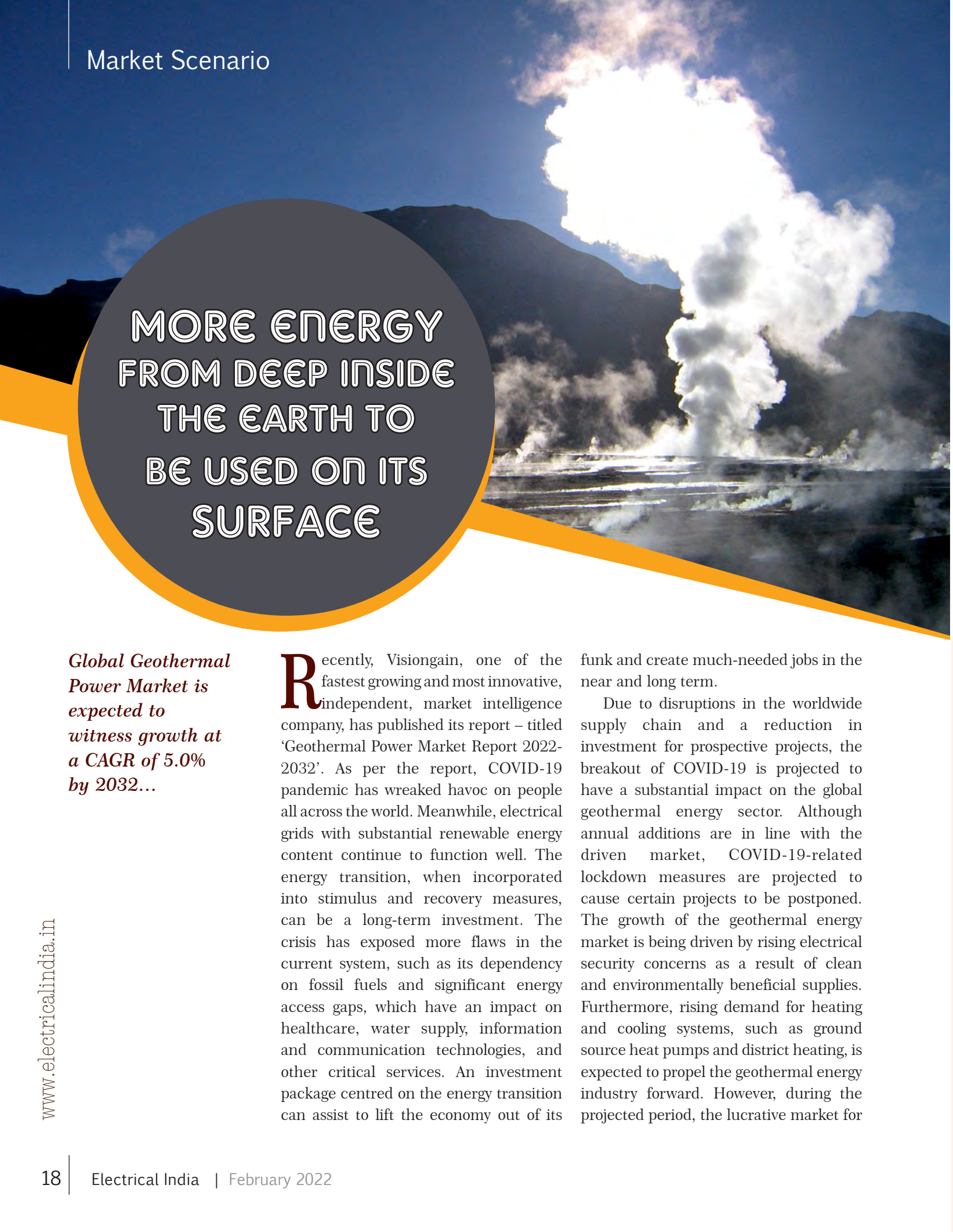
He has brought extensive experience in corporate and public company legal practice...

The Board of Directors of FuelCell Energy (FCE), Inc., a global leader in fuel cell technology with a purpose of utilizing its proprietary, state-of-the-art fuel cell platforms to enable a world empowered by clean energy, has recently appointed Joshua Dolger as the company's Executive Vice President, General Counsel and Corporate Secretary. Josh had been serving the company as interim General Counsel and Corporate Secretary since June 2021.

Prior to joining FCE in May 2021,

Josh held a variety of legal positions of increasing responsibility at the headquarters of Terex Corporation, a global manufacturer of aerial work platforms and materials.

Commenting on Josh's recent engagement, Jason Few, FuelCell Energy President and CEO, said, "We are extremely pleased to remove the interim designation from Josh's title and appoint Josh as our Executive Vice President, General Counsel and Corporate Secretary, adding depth to our senior leadership team." 



MORE ENERGY FROM DEEP INSIDE THE EARTH TO BE USED ON ITS SURFACE

Global Geothermal Power Market is expected to witness growth at a CAGR of 5.0% by 2032...

Recently, Visiongain, one of the fastest growing and most innovative, independent, market intelligence company, has published its report – titled ‘Geothermal Power Market Report 2022-2032’. As per the report, COVID-19 pandemic has wreaked havoc on people all across the world. Meanwhile, electrical grids with substantial renewable energy content continue to function well. The energy transition, when incorporated into stimulus and recovery measures, can be a long-term investment. The crisis has exposed more flaws in the current system, such as its dependency on fossil fuels and significant energy access gaps, which have an impact on healthcare, water supply, information and communication technologies, and other critical services. An investment package centred on the energy transition can assist to lift the economy out of its

funk and create much-needed jobs in the near and long term.

Due to disruptions in the worldwide supply chain and a reduction in investment for prospective projects, the breakout of COVID-19 is projected to have a substantial impact on the global geothermal energy sector. Although annual additions are in line with the driven market, COVID-19-related lockdown measures are projected to cause certain projects to be postponed. The growth of the geothermal energy market is being driven by rising electrical security concerns as a result of clean and environmentally beneficial supplies. Furthermore, rising demand for heating and cooling systems, such as ground source heat pumps and district heating, is expected to propel the geothermal energy industry forward. However, during the projected period, the lucrative market for

alternative clean energy sources such as solar and wind is likely to stifle market expansion.

Production and supply chains have been disrupted, demand for goods and services has diminished, commodity prices have fallen, and there has been a significant economic recession around the world as a result of the response measures, which include widespread lockdowns. Hundreds of millions of people have lost their employment or had their livelihoods jeopardised as a result of the health crisis. Renewable energy has proven to be more resilient than other sections of the sector, despite suffering along with the rest of the world's economy. Fossil fuels have taken a beating as energy demand for transportation and industry falls. Even as fossil fuels continue to show signs of revival, at least in the short term, oil prices have plummeted, increasing concerns about volatility and long-term viability.

The Binary Cycle Power Plants Segment

The water or steam beneath the soil never comes into direct contact with the turbines in binary cycle power plants. Instead, geothermal water is pushed via a heat exchanger, where it warms a second liquid-like isobutene (which boils at a lower temperature than water). This second liquid is converted into steam, which drives the generator's turbines. The first liquid is recycled through the turbine and back into the heat exchanger, where it can be utilised again, while the second liquid is recycled into the soil through the injection well.

Investing in the Energy Transition

Investment in the energy transition can help the economy recover in the years 2021-2023 and create a variety of jobs. Stimulus measures can hasten the progression of beneficial trends. Renewables and other transition-related technologies generated USD 824 billion in investments in 2019. During the recovery phase, such investments should roughly treble to about USD 2 trillion, and then expand at a rate of USD 4.5 trillion per year over the next decade. Government funds can multiply private investments by a factor of three to four, and they should be widely deployed to drive investment and finance decisions in the right direction.

To properly comprehend the implications of the transition and guarantee that it is timely and just, the energy sector must be understood as an important element of the broader economy.

Increasing Technological Advancements

The benefits of geothermal energy are driving the market.

Furthermore, the expanding technical advancements in the geothermal energy industry are expected to drive the geothermal power market's growth. Geothermal energy is quickly becoming one of the most dependable renewable energy sources. Because of its eco-friendly nature and consistent availability, it is gaining traction over traditional and non-renewable energy sources. Geothermal reservoirs are refilled naturally and have enormous power generation potential, with the ability to supply world baseload demand by generating up to 2 terawatts of power. Because of their high efficiency and low maintenance requirements, geothermal resources will continue to be used in the generation of power. As a result, geothermal energy's benefits are likely to drive market expansion over the projection period.

The Expansion of the Geothermal Power Market

Increasing investments in geothermal energy in various nations would further boost the geothermal power market forward throughout the forecast period. Breakthrough Energy Ventures announced in March 2019 that it would invest \$12.5 million in Baseload Capital, a geothermal project development company. It is a project investment firm that provides funding for the development of geothermal power facilities using technology developed by Climeon, the company's Swedish parent. EnergiMiinas, a Philippine-based geothermal firm, aims to put two geothermal power plants in Peru into operation by 2026 or 2027, with each project costing \$1 billion. Thrive Renewables has also announced intentions to invest roughly 6.5 million in the UK's first geothermal power plant, with the goal of supplying approximately 3 MW of electricity to the National Grid and up to 12 MW for local consumption.

Competitive Landscape

The major players operating in the geothermal power market are Atlas Copco, Ansaldo Energia S.P.A, BHE, Calpine Corporation, Chevron Corporation, ElectraTherm Inc., ENEL SPA, Fuji Electric Co. Ltd., General Electric, Halliburton, Innergex Renewable Energy Inc., KenGen, Mitsubishi Corporation, Ormat Technologies Inc, Pertamina, Terra-Gen, and Toshiba Corporation. These major players operating in this market have adopted various strategies comprising M&A, investment in R&D, collaborations, partnerships, regional business expansion, and new product launch. 

For further information: contactus@visiongain.com



A PRUDENT BUDGET TO STEP INTO A SUSTAINABLE FUTURE

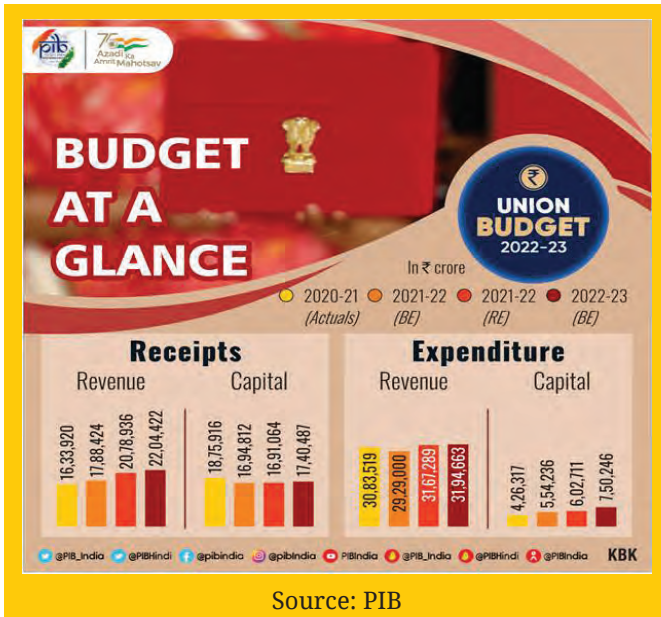
Considering the forthcoming elections in five states, the Union budget 2022-23 was expected to be a populist one, however, contrary to that, it has stressed on strengthening the foundation to make the nation self-reliant.

Although it is meant for one year, this financial year will witness the beginning of a long journey through the path of sustainability...

- P. K . Chatterjee (PK)

Although several rumours are hovering around this year's Union Budget, it cannot be denied that this is a perfectly future-oriented budget. When the entire global economy is passing through a transitioning phase, India cannot be an exception. Thus, contrary to the expectation of presenting a populist budget before the pending elections in five states, our Finance Minister (FM) Nirmala Sitharaman has delivered a future-focused annual budget.

Although I am not a budget expert, I understand the need of the hour in our Electrical (Power) industry, and from that point of view, I find this is a highly supportive budget for the fundamental growth of our industry – and of course considering a long time frame. Thus, I will first highlight the key supportive points for our industry then I will keep a few comments from the industry forerunners.



A few key points in favour of the electrical industry

As our government's entire planning is focused on transitioning towards a Carbon Neutral Economy, the budget presented this year gives a proper indication to that. Let us now have a brief look at what Annual Budget 2022-23 has offered to our electric power industry:

- Co-firing of 5% to 7% biomass pellets in thermal power plants has been proposed by Union Minister that will result in CO₂ savings of 38 MMT annually. This will also provide extra income to farmers and job opportunities to locals and help avoid stubble burning in agriculture fields.
- Four pilot projects for coal gasification and conversion of coal into chemicals required for the industry have also been proposed to evolve technical and financial viability.
- Energy efficiency and saving measures through setting up of Energy Service Company (ESCO) business model in large commercial buildings will also facilitate capacity building and awareness for energy audits, performance contracts, and common measurement & verification protocol.
- Considering the constraint of space in urban areas for setting up charging stations at scale, a battery swapping policy will be brought out and interoperability standards will be formulated. The private sector will be encouraged to develop sustainable and innovative business models for 'Battery or Energy as a Service'. This will improve efficiency in the EV eco-system.
- As a part of the government's overall market borrowings

in 2022-23, sovereign Green Bonds will be issued for mobilizing resources for green infrastructure. The proceeds will be deployed in public sector projects, which help in reducing the carbon intensity of the economy.

Lauding the effort of our FM, Union Minister for Power and MNRE, R. K Singh has said, "Congratulations to Finance Minister on a forward-looking Union Budget 2022-23. Aatmanirbhar Bharat Ka Budget of 2022 has laid the blueprint for India's Amrit Kaal, covering areas like infrastructure, digitization, agriculture, fiscal management, technology & manufacturing. Budget 2022 is a step towards innovative & sustainable development in new India to strengthen our Energy Transition journey and fight climate change."



Reactions from IEEMA managing committee

Indian Electrical and Electronics Manufacturers Association (IEEMA) has welcomed the Union Budget 2022, and termed it as progressive and growth oriented. According to IEEMA, some of the welcome features of the Union Budget 2022 include a clear emphasis on energy transition through various measures viz: boost to solar energy, storage, battery and e-mobility. This will pave the way to achieving India's commitment on tackling clean energy and tackling climate change. This shows a pathway to the Government vision for India@2047.

Reacting on the budget Vipul Ray, President – IEEMA, said, "IEEMA welcomes the Union Budget 2020. Its clear focus on transition on energy transition through various measures that give boost to solar energy, storage, battery and e-mobility will pave the way to achieving India's



commitment on tackling clean energy and tackling climate change. The zero fossil fuel policy, battery swapping policy and focus on charging infrastructure for EV ecosystem will provide the impetus to a future ready electrical and allied electronics sector.”

IEEMA has welcomed the increased focus on infrastructure through Gatishakti master plan and Atmanirbharata in Defence that will open up more business opportunities for electrical and allied electronics industry. Ray further added, “The introduction of e-Bill System for reducing delays in payments is a progressive step. IEEMA thanks the Hon’ble Finance Minister for her announcement allowing use of surety bonds as a substitute for bank guarantee as acceptable in Government procurements. This will improve the working capital of suppliers and work contractors. This has been IEEMA’s long standing demand.”



Rohit Pathak,
Senior Vice
President, IEEMA

Rohit Pathak, Senior Vice President, IEEMA, said, “We are happy that the Union Budget maintains the continuity of focus on increased infrastructure spending coupled with AtmaNirbharta. To facilitate domestic manufacturing and to meet the ambitious goal of 280 GW of installed solar capacity by 2030, the additional allocation of Rs 19,500 cr for Production Linked Incentive scheme (PLI) for manufacturing of high efficiency modules is very welcome step. The idea to facilitate funding for clean energy projects and further targeted PLIs for e-mobility and clean energy value chain have the potential to change the course of India’s energy roadmap.”



Hamza Arsiwala,
Vice President,
IEEMA

Hamza Arsiwala, Vice President, IEEMA, stated, “Battery swapping and support for distributed renewable energy projects are also critical announcements. Distribution sector is critical to achieving the vision of clean energy transition. Overall, this is a budget that we welcome with enthusiasm.”

Supushpa Kaushal, Chairman, Economic & Taxation Cell – IEEMA said, “The budget is a fine balance to support economic recovery. The inclusion of green bonds in the borrowing plan is an interesting innovation. In terms of specific policy announcements, the move towards self-reliance through shield for domestic manufacturers i.e., calibration of custom rates to boost manufacturing of electronics, including smart meters supports the long-term goal of AatmNirbhar Bharat.”

Charu Mathur, Director General – IEEMA cited, “This is a progressive budget with emphasis on Renewable sector, Digitalisation, EV and investment on infrastructure projects will create huge opportunities for our IEEMA members to scale up their Business.”

A few opinions from the players in the power industry

Expressing his view on the future prospect, Tejas Kusurkar, Co-founder and CEO, Offgrid Energy Labs, said, “Budget 2022 has laid a strong emphasis on promoting digital and technological innovations across sectors. The three identified focus areas of technology-led development, energy transition and climate action will create a conducive environment for deep tech innovators operating at the intersection of technology and energy to flourish in the country. An allocation of Rs 19,500 crores towards solar energy PLI schemes will spur large-scale demand for the next level of stationary-energy-storage capacities. This will unravel an entirely new ecosystem comprising of battery technology innovators, energy storage platforms, as well as manufacturers and service providers across the energy value chain. At Offgrid Energy, we are particularly excited at prospects unfolding for deep tech companies in the energy storage space.”



Tejas Kusurkar,
Co-founder and CEO,
Offgrid Energy Labs

Appreciating the proposed steps to ensure sustainability in the budget, Mahesh Palashikar, President, GE South Asia, said, “I am happy to see this year’s Union Budget laying down a blue print for sustainable development in the future. We applaud the Govt. for its consistent commitment and sharp focus on the important priorities of improving climate change and accelerating energy transition. The suggested framework around Gati Shakti (infrastructure development) and inclusive development will lay a good foundation for long-term infrastructure with an eye on short term economic and job growth. We also welcome the actions on national Digital Health mission.



Mahesh Palashikar,
President,
GE South Asia

The launch of the sovereign green bonds is an evidence of the Government’s active support to ‘Green,’ which will significantly help reduce the carbon intensity in the years to come. For India to achieve its climate goals, financing is the need of the hour. This will require deep public-private partnerships. We at GE, have been investing in sustainable technologies for decades. We welcome the encouragement to private industry for taking up the design and development of military platforms and equipment in collaboration with DRDO. We are committed to bringing those technologies in the areas of sustainable aviation, green hydrogen, emission controls and decarbonization to India to support the country’s goals.”

Expressing his satisfaction, Gyanesh Chaudhary, Vice Chairman & Managing Director, Vikram Solar Ltd., said, “The Union Budget 2022-23 is visionary and action oriented. The key measures announced in the budget towards enabling ease of doing business, climate action,



Gyanesh Chaudhary,
Vice Chairman &
Managing Director,
Vikram Solar Ltd.

digital economy, strengthening the start-up ecosystem, job creation and supporting industrial growth, will propel a strong growth momentum.

The Budget 2022 is growth focused with clear roadmap for infrastructure. The PM Gati Shakti master plan focusing on seven growth engines and four big priorities, including the Energy Transition and Climate Action will bring transformational changes and accelerate India’s green energy growth. The increase in capital expenditure by 35.4%, as a pump-priming measure, is a significant boost for employment generation.

We are glad the finance minister, continued to focus on enabling India’s clean energy transition. We welcome the additional PLI allocation of INR 19,500 crore for manufacturing high-efficiency solar modules for the existing wait-listed PLI bidders. This will strengthen the domestic solar manufacturing ecosystem, thereby reduce our import dependence, create jobs, attract investments and enable the Make in India vision. Additionally, the sovereign green bonds will boost green infrastructure development which will help in meeting India’s carbon emission reduction targets. Green bonds will also enable international yield curve for Indian corporates leading to better pricing for bonds. The battery-swapping policy with interoperability standards will boost the Electric Vehicle (EV) ecosystem.

As domestic solar manufacturers, we are appreciative of the Government’s focus towards strengthening domestic solar industry by notifying the Basic Custom Duties on solar modules and solar cell effective 1st April 2022. We are confident, with the implementation and roll-out of the measures announced in Budget 2022, we will move closer towards realizing the Aatmanirbhar Bharat vision in solar sector and India’s Energy Security through green power.”

Final remark

While mitigating global climate change was posing enormous challenge to the world, and with the strong leadership of our prudent Prime Minister Narendra Modi, we were progressing well to tackle the challenges, suddenly the spread of COVID-19 decelerated and (to some extent) disrupted the growth momentum in the last almost two years. With this background, the Union Budget 2022-23 has not only focused on speeding up the effective development of the nation but also planned ways to build its indigenous all round capability. It is time to watch how smoothly and speedily the Government can implement the proposals.



A Portal to GLOBAL ELECTRIC AGE



Energy has become as much a part of human life as basic amenities such as food, clothing and shelter. Energy self-sufficiency is needed to become the India of Dr. APJ Kalam's vision. To achieve this, we need to reduce the use of polluting energy sources, i.e., fossil fuels...

Almost 80% of India's energy demand is met by fossil fuels. But the reservoirs of these resources are limited and their overuse is causing pollution, loss of biodiversity, irreparable damage to nature. At the same time, with the increase in demand for fossil fuels our economy continues to falter over oil exporting countries. With the 2nd largest population and 3rd largest economy with a purchasing power parity basis, a large part of the budget goes for it. Most importantly, India stands 4th largest energy consumer besides China, USA and European Union and is believed to overtake the European Union.

Almost 18% of total consumption of energy in India is accounted for transport systems, which is expected to be more than double over the next two decades. But given the skyrocketing prices of petrol and diesel in recent times, there has been no alternative but the use of renewable sources. Ultimately, increasing the use of renewable energy such as solar energy and electrochemical-based energy systems, would be in the best interest of human beings, which in turn would lead to attain economic and international political autonomy.

Electrochemical-based systems

Electrochemical-based systems can come in various forms such as Fuel cells, Supercapacitors and Batteries. More to it, even hybrid systems are being tried out where they give collective performance with the combined mechanisms of batteries and supercapacitors. It not only replaces the present fuel quota, but also comes with other advantages including decline of the carbon emissions leading to decrease in environmental degradation, which fulfills the climate change commitments made by Government of India during the COP21 Summit held at Paris to reduce emission intensity by 33- 35% by 2030 from 2005 levels.

Steps taken by our government

To achieve this, the Indian government has planned and carried out various missions where they have promoted every automobile industry existing in India to dedicate a plant for electric vehicles by 2022. They have kept a vision to scrap out every conventional transport system working on fossil fuels by 2030 and replace entire country's transport systems powered by batteries, CNG, bio-fuels or fuel cells.

The National Electric Mobility Mission Plan launched in 2012 targets 30% of EV penetration by 2030. Similarly, Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) is a phase I & II plan that offers incentives over the Electric Vehicles (EV). Many esteemed industries including Mahindra Electric, TATA Motors, Hyundai, are coming forward to adopt this technology to create a boon out of it. Also, various global establishments have realized India's innovation specific policy support and its global potential market and hence coming forward to invest in India.

Besides, the Government of India started the Electric Vehicles (EV) Accelerator program in association with the partnership of Huddle and growX ventures.

Accelerator program supported upfront investment of up to \$150,000. It also gave an opportunity to raise an investment of \$500,000 and above from a larger network of mentors, investors and corporations on a demo day to showcase their efforts.

Some of the top ongoing start-ups in the market:

- Ather Energy-Bengaluru Boon (bike and electric charging grid)
- Yulu-Rent a ride out (scooter and bicycle renting)
- Tork- (electric motorcycle and charging infrastructure)
- Euler- Transportation electrified (light commercial electric vehicles for intra-city transportation and battery packs for their vehicles)
- Emote Electrics- Electric on gears (high power motorcycles, fastest e-bikes with gears)
- Revolt motors- Revolting against oil (AI enabled e-bike)
- Ultraviolet Automotive- Ultra electric (electric motorcycle equivalent to conventional motorcycle with 200-250 cc segment)
- Strom- Taking the car industry by storm (3-wheel and 2-wheel sector with fully charged vehicles in 3 hrs, the same as that of standard mobile phone)
- Orxa Energies- Electrically amped (electric bikes going from 0 to 100 km/hr in 8 sec.)
- Emflux Motors- Electric in efflux (fastest electric bike going from 0 to 100 km/hr in 3 sec with top speed of 200 Kmph)
- Ola Electric (electric scooters made with AI enabled robots)
- Hero Electric (developer of electric scooters)
- GMW (developer of electric rickshaws and bicycles)
- Sun Mobility (Operator of swappable battery stations for electric vehicles for 2 and 3 wheelers and also provides battery solutions for buses)

Pros and cons of Lithium-ion (Li-ion) batteries

At present Lithium-ion batteries are on the forefront of powering every system with best performance and stability compared with the conventional lead-acid batteries. It not only provides high storage capacity in the range of 110-250 Wh/kg (for lead acid its 30-40 Wh/kg), but also the charging time of Li-ion batteries is less as compared to conventional one. It is comparably light weight benefiting its easy installation. It has low maintenance and provides high cell voltage (3.6 V), which decreases the number of cells in battery applications and its broad

use from small devices such as smartphones to large applications like EV.

Need and solution of the hour

Right now, only 1% of total vehicle sale constitutes for electric vehicles. We need long lasting, quick-charging batteries for the expansion of the electric vehicle market, which seeks another viable option to fulfil the need of the hour. Moreover, since India does not have sufficient Lithium resources, it has to be imported from Chile, China, etc. leading to dependency and cost issues. Due to this, cost of electric vehicles is not in the range of a common man, which solely depends on high cost of raw materials. Fortunately, TES have been emerged as low-cost solution as sodium is abundantly available and its low-cost extraction- purification makes it a potential candidate against lithium. It demonstrates almost 20% higher performance with the same amount of electrolyte used in Li-ion batteries, making it work in low concentration for cost reduction. Due to absence of over-discharge characteristics, it is allowed to discharge to 0 volts unlike for lithium, which makes lithium-ion batteries useless when fully discharged and need to be kept above the optimum charge value. It provides energy density of 75-165 Wh/kg, which is quite comparable. Its abundance in earth, high stability, high safety, low weight and cost effectiveness have attracted a scientific community and its commercialization will soon be realized.

Nevertheless, inconvenience faced due to non-availability of charge stations at concerned places, lack of infrastructure for charging at homes, rental houses, for homeless people, etc. are some major concerns at the moment. People are also sceptical about the safety of batteries in EV as they consist of chemicals and air sensitive material like lithium, whose mishandling, damage or exposure to air leads to explosion.

On an average, practically one can use these batteries for 3-4 years, which demands its replacement, recycling or proper disposal. Dumping of waste is always out of the equation as it contains hazardous chemicals, harming not only with direct contact but also through air, water and soil. People around the world are working with recycling where they could extract the active material and other components and reuse it after proper treatment, which also has its own challenges as it's not a virgin material and could compromise productivity. To overcome this, they are also trying to perform various

treatments and addition of additives. Other developed countries such as Korea and Japan import used batteries from India. Many industries in India are trying to recycle the batteries, which is also a potential market for consumers. Companies like Gravita India Ltd., Tata Chemicals Ltd, Mahindra Electric, TES-AMM, Exigo, Sungeel Hi-metal, ECOTantra, EXIMO Recycling have already started their units. Battery swapping is also a considerable option, which could help consumers to connect directly with industries for battery recycling.

Battery production and recycling in India

The Government of India is trying to promote industries, which could not only have battery production and recycling units but also trying to couple them up with the raw materials and component producers from India itself. It would not only bring down the prices of the EV but also grant employment for skilled people in the industry sector. It is also trying to maximize the charging stations by partnering up with various petrol and gas stations to provide accessibility for Electric Vehicles with all the amenities needed for it. It will not only help India to fully electrify but also help to develop this technology on the home ground with resources and power solely belonging to the country, which could also help to boost the country's economy. It would also help to invest in innovation rather than basic cost leading to a cost-effective model resulting in penetration of product at every level of society fulfilling the vision of Dr APJ Kalam's India.

ET



Dr. L. D. Jadhav has specialization in the field of Electrochemical Energy Materials including Battery and Solid Oxide Fuel Cell materials, Thin films, Nanomaterials and Energy Science. She is presently a Professor of Physics at Govt. of Maharashtra's Rajaram College and I/C Director, Pre IAS Training Center, Kolhapur.



Rohan S. Kamat is currently a Ph.D. research scholar at Electrochemical Energy Materials Laboratory, Rajaram College, Kolhapur (MH, India). His research interests include Synthesis of MXene and its composites and their applications in electrochemical energy storage devices (Supercapacitors and Batteries).

2021 ENDED AN WITH UPWARD TREND

Coal-based power generation registered a growth of 11.84% in the month of December 2021...

India's total coal production increased by 6.74% to 74.78 Million Ton (MT) during December, 2021 as compared to the same period in 2019. Out of the total production during December last year, Coal India Ltd., (CIL) achieved a growth of 3.79% by producing 60.220 MT. Captive blocks registered a growth of 40.98% by producing 8.91 MT of coal during the period. At the same time, Singareni Collieries Ltd (SCCL) registered a negative growth of 1.12% by producing 5.65 MT of Coal during December. Coal production of financial year 2022 has been compared with FY 20 as FY 21 has been considered abnormal year due to restriction imposed on commercial activities in the wake of Covid-19.

Coal dispatch increased by 14.62% to 75.05 MT from 65.48 MT during Dec 2021 as compared to Dec 2019. Out of the total production during this period, Coal India Ltd (CIL) achieved a growth of 12.70% by dispatching 60.67 MT of Coal, Singareni Collieries Ltd (SCCL) achieved a growth of 2.01% by dispatching 5.70 MT of Coal and captive blocks registered a growth of 43.23% by dispatching 8.68 MT.

The Power utilities dispatch has grown by 20.06% to 63.32 MT in the month of Dec 2021 as compared to 52.74 MT in Dec 2019. There is fall in import price of coal since the end of Oct 2021, however, import prices are still at high level discouraging import. Further, coal-based power demand has increased by 12.7% up to November 2021 against the same time of 2020.

Coal-based power generation has registered a growth of 11.84 % in the month of Dec 2021. The overall power generation in Dec 2021 has been 8.32% higher than the power generated in Dec 2019. Coal-based power generation in the month of Dec 2021 has been 85579 MU in comparison to 75620 MU the previous month and registered a growth of 13.17%. Total power generation has also increased in Dec 2021 to 113094 MU from 103177 MU in November.

Out of top 35 mines in coal production 11 of them produced more than 100% and another 12 mines' production stood at more than 8% but less than 100%. 



ELIMINATING ELECTRICAL SHOCK DEATHS OF FARMERS

Causes for farmers' electrical shocks and their preventive measures by adopting stand-alone photovoltaic systems are covered in this article. Surprisingly Prime Minister's component B of KUSUM Yojana is a programme targeted to protect farmers from electrical shocks. Prevention of farmers' electrical shock deaths is an additional benefit gained by KUSUM Yojana, a hidden fact, which requires wide publicity...

According to an article published in THE TIMES OF INDIA on 23rd May 2021, 11 thousand agricultural workers are dying due to electrocution in India every year. On an average 30 persons are dying every day. The reasons are attributed to standards not being followed in wiring, cut and fallen transmission lines due to ageing, corrosion and formation of conductive path on motor casing and control box under damp conditions.

Whatever be the reason, it is very sad that our farmers, the food providers for our nation, are dying in sincerely carrying out their daily routines.

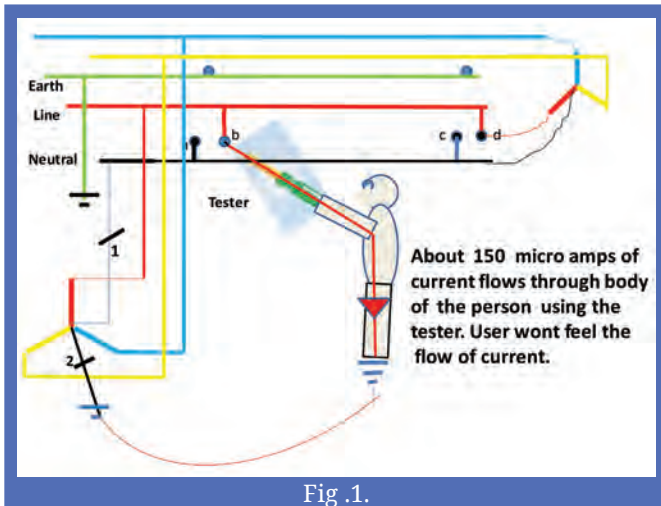


Fig .1.

A normal person feels the sense of current only if the magnitude is more than 1 milli ampere. Currents of magnitude less than this value are not sensed by human body. About 150 micro amperes of current flows through the body of the person using line tester.

Higher voltages allow for more current. Any voltage above 30 V is considered to be capable of delivering shock currents. Effect depends upon current path in the body. Worst condition is the flow of current from hand to hand involving passage through heart. Above 100 milli-amp current passing through human body is considered to be harmful.

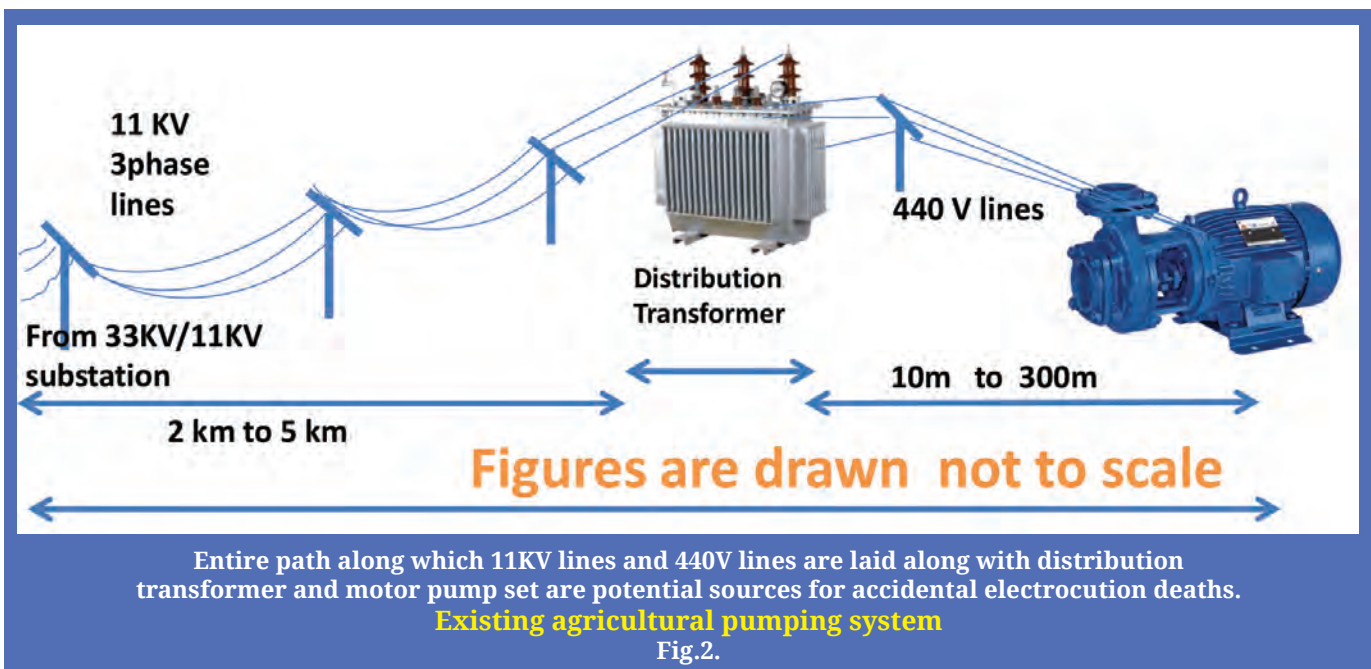
Severity of electric shock depends on through which part of human body current flows and also skin condition at that instant (dryness).

Normally, distribution transformers are located close to agricultural lands or in the land itself. 11/33 kV high voltage lines are laid from substation to distribution transformers. Agricultural pumpsets are installed on 440 V side of the transformer at a distance anywhere between 10 to 300 metres. This entire path, which is shown in the figure.2. is electric shock risk zone.

Due to corrosion, ageing and proper standards not being followed during erection, power lines break and fall on the ground. Cut live wire falling on the ground is one of the main causes of electrocution deaths. Most of the times earth offers less resistance but not a perfect short. Magnitude of the current that flows is not sufficient enough to trip the circuit breaker but enough to give fatal shock. The cut wire lying on the soil will not be visible



Fig .3.



in majority of cases and is merged in damp clayey soil. Humans and animals unknowingly stepping on this wire get electrocuted. Cut electrical wires falling on the ground is more common in agricultural fields due to loose soil, damp weather conditions and weak foundations.

Observe the tilted electric pole shown in Fig.3., about to fall any time. It is due to loose soil and inadequate foundation. Same is the case with majority of installed transmission lines in our agricultural fields.

If standalone (grid independent) system is installed this entire path, which is shock risky zone can be eliminated.

Live conductor coming in contact with casing of the motor or control box due to insulation break down, corrosion and formation of conductive path during humid weather conditions is a frequently occurring phenomenon. Under such condition, physical contact with metal casing of motor pumpset and control box leads to fatal shock if proper earthing is not provided.

In agricultural water pumping systems required care is not being taken for earthing. Even under improper



An ideal earthing system
The size of the pipe used for earth is of 3.8cm diameter and 2.5m in length. More than 2 meters of the rod is buried in the 'earth pit'. Pit is filled with mixture of powdered coal, salt and sand. Care should be taken to keep the soil of the pit wet.

Fig .4.

earthing conditions if low operating voltages are chosen, electrical shocks can be completely eliminated.

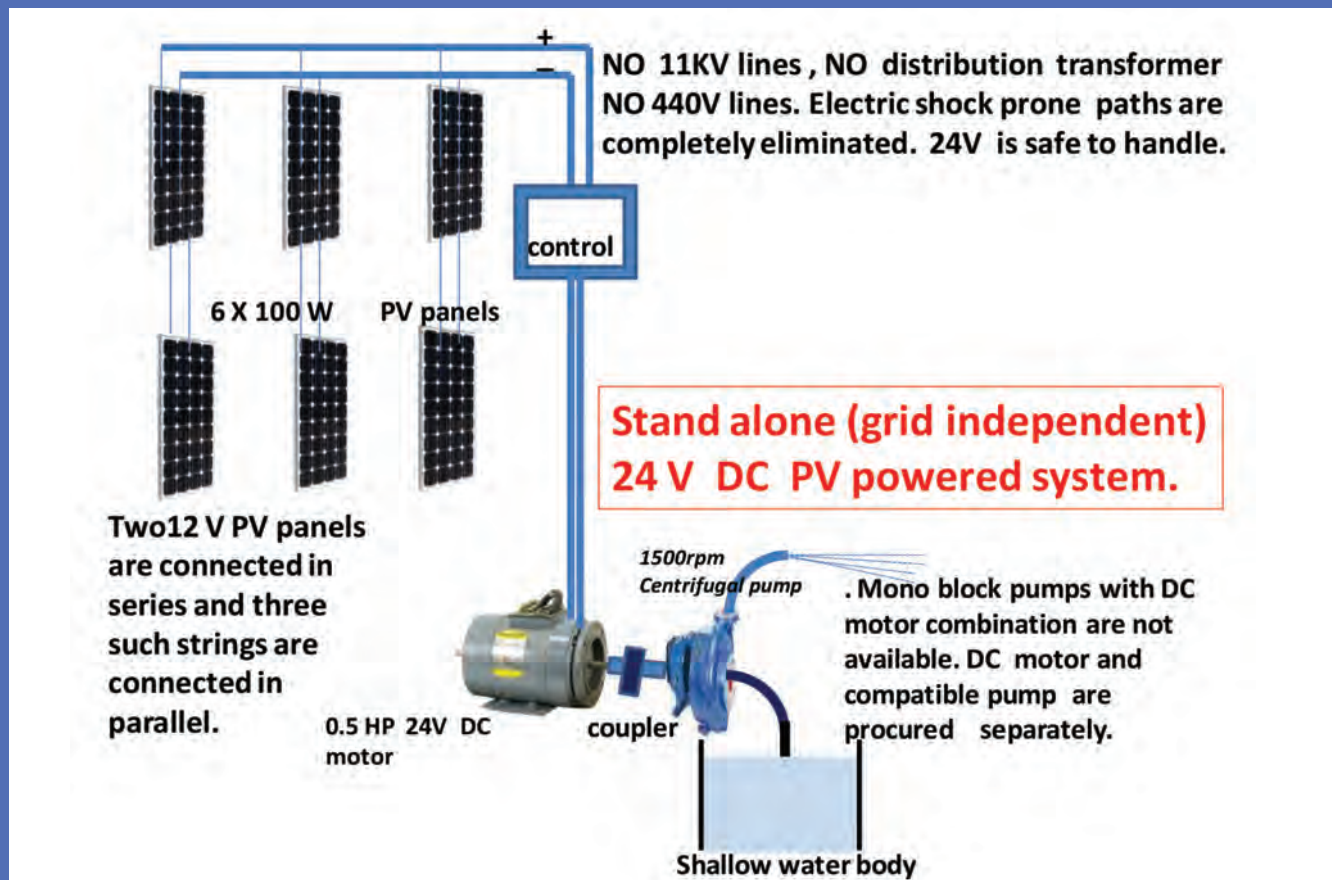
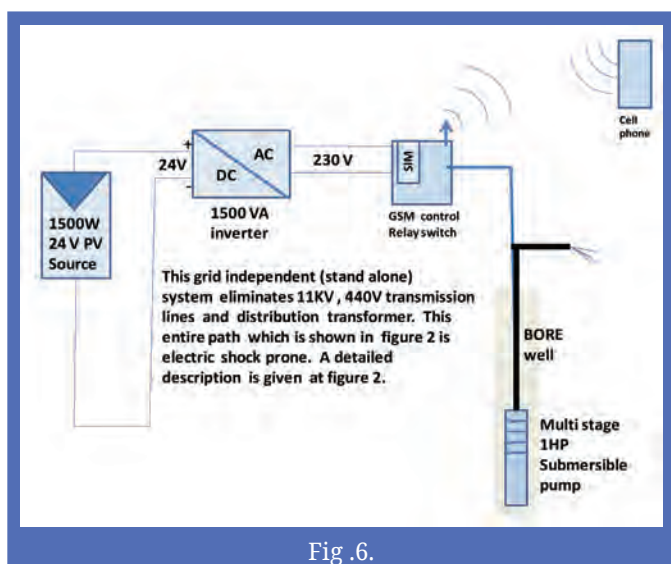


Fig .5.



The solution

Stand alone dedicated photovoltaic water pumping system with 24V operating voltage is described here. 0.5 HP 24 V DC powered water pumping system approximately costs Rs. 50,000 and 1 HP system costs Rs. 1 lakh.

Cost of the system is directly proportional to power. For higher flow rates, high power motors can be used. At 24 V operating voltage motors are available up to maximum power of 3HP today. These motors are suitable for running aerators in aqua farms. This is one time investment and running cost is zero.

There is a limitation on the suction head of centrifugal pump. It should not be more than the atmospheric pressure in terms of height of water column in pumps. Theoretical limit is 10.3 m (at sea level). If suction head of the pump is more than atmospheric pressure, it won't function. For drawing water from deep wells (more than 10m deep) submersible pumps are to be installed. Depending on the depth of bore well, number of pump stages are to be decided. DC powered submersible motor pump sets are not available in the local market. Submersible motor pump sets operating on 24V are still in the development stage. We have to make use of the available systems. This system is described below.

The output of PV panels is 24 Volts. This is applied to the input of the inveter. 230V AC output from the inverter is applied to the submersible motor through wireless controlled GSM (Global system for mobile communications) relay switch. On / Off control is through cell phone, which can be operated from anywhere in the country. Status information can be obtained back as sms to cell phone.

As physical contact is eliminated for switching 'on and off' of pumpset, it is completely safe from electrical shock point of view even in the worst weather conditions.

Two water pumping systems described above both for shallow water bodies and deep bore wells are fabricated and practically proven.

Implementation of the Paris agreement

The Paris agreement was signed by 175 countries on 22nd April 2016. It is aimed at reducing the global warming to pre-industrial levels. It is by minimizing the usage of fossil fuels and by replacing coal based thermal power generation with renewable energy sources.

For implementing Paris agreement, India has launched Pradhana Manthri's KUSUM Yojana (Kisan Urja Suraksha Evam Utthaan Mahabhiyan) in the year 2019. Under component B of KUSUM Yojana, 17.5 lakh stand alone, solar powered agricultural pumps each with maximum capacity 7.5 HP will be installed where grid supply is not available. Pumps of capacity higher than 7.5 HP can also be installed, however, the financial support is limited to 7.5 HP capacity. Prevention of farmers electrical shock deaths is additional benefit gained by KUSUM Yojana, a hidden fact, which requires wide publicity. It is necessary to implement component B of KUSUM Yojana with more thrust and dedication. It is the activity towards implementation of Paris agreement, which was signed by 195 countries. It is to reduce global warming by reducing consumption of fossil fuels.

With slight modification, if this scheme is extended to replace grid powered pumps also (now the scheme is not covering grid powered pumps), it helps in reducing farmers electrical shock fatalities to maximum extent.

Conclusion

KUSUM Yojana should be implemented with the highest priority – and to the extent possible is to be extended to cover more number of water pumping systems. This is going to be a great relief to our farmers.



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AUTONOMOUS RESILIENT POWER GRIDS PART-1

The landscape of today's electric grid is fast changing due to the high penetration of distributed renewable energy sources. The soaring number of grid-tied devices has a negative cumulative impact on these grids which makes a centralized system more impractical. This highly distributed energy future can be handled by power electronics based autonomous self-resilient energy systems. The concept and core technology of this grid system makes use of power electronic based players, which mimic the dynamics of a synchronous machine for synchronization with the grid. The concept of an autonomous energy grid uses artificial intelligence, renewable energy and energy storage to optimize the grid. This grid architecture automatically senses and instantly reacts to drop in system frequency power imbalance, system instability, voltage fluctuation etc and takes the maximum benefit from renewable energy sources. Thus this cutting-edge technology paves the path for green energy sources...

Autonomous resilient energy grids (AEGs) are the electric networks of the future as they encompass the power electronic interface to the power system. The growth of AEGs accelerates our progression to clean energy sources. Today's energy grid faces few challenges in terms of stability, reliability, security and resiliency. The electricity generation in the current power grid is dominated by large centralized power plants that use combustion of non-sustainable fossil fuels and contribute to climate change (emission of greenhouse gases). To overcome this problem renewable Distributed Energy Sources (DERs) are used but integration of large scale renewable DERs raises stability and reliability concerns. As we know, smart grid makes the energy grid more efficient but the information and

communication technology (ICT) system, which makes a grid smart also increases the chance of cyber-attack on power systems. Another problem faced by operators is that the grid is functioning under unpredictable supply and demand. And the current grid systems rely on centralized computing platforms for grid control, which cannot handle this amount of coordination. These problems can be solved by autonomous energy grids.

Autonomous Energy Grids (AEGs) could self-organize and control themselves using advanced machine learning and simulation. This is possible through scalable cellular blocks, which are similar to micro grids. AEGs can self-optimize when islanded, runs at high efficiency, ensures system operation by quickly bouncing back from outages and participates in optimal operation when interconnected to a larger grid. Thus, the application of an autonomous system to the power grid reduces the operation cost, increases the utilization of renewable energy sources and improves system resiliency. This technology ensures the flexibility necessary for the robust control of the power system and facilitates future transactive energy markets.

Future Energy Grids

Based on the current dynamics of the electric grid, there is a need to reevaluate the operational capacity due to the growing penetration of renewable power and aging grid infrastructure. And future energy grids will be more distributed and very complex to control with today's technologies and techniques. With autonomous and decentralized control, large-scale complicated networks such as power grids can be decomposed into smaller sized networks. This new architecture will relieve the power system from traditional centralized control where a small number of large facilities control system stability to democratized interaction of a large number of relatively small generators and flexible loads. In this technology, the inherent synchronization mechanism of a synchronous machine is used to achieve legal equality among the heterogeneous players. i.e. to maintain voltage and frequency around the rated value, it is important for all individuals to synchronize with each other. This mechanism is achieved by depending on a communication channel through the electrical system. Future energy systems will depend on scalable cellular blocks, which can automatically optimize in real time when disconnected from a larger network and can also participate in optimal operation when it is interconnected

to the same large network. These scalable cells can be part of the power grid that can independently work as a microgrid, which are segregated from a control perspective as shown in figure 1. This ensures economic and reliable performance while systematically integrating energy in all forms.

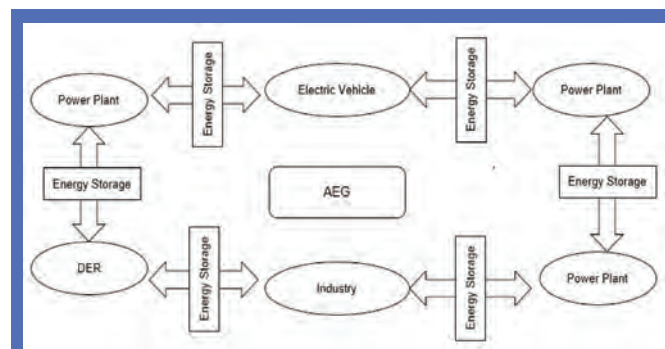


Figure 1: Self optimizing cells of AEG

Role Of Power Electronics In Grid Modernization

Given the present scenario of the electric grid, power electronics have a vital role in the ongoing process of grid modernization. Power electronics-based players already exist in several stages of generation, transmission and distribution. On the supply side, most of the renewable energy sources such as wind, solar etc., are connected to the grid through power electronics converters. These converters are necessary to control the generated power and to make it compatible with the grid. For example power electronic inverters are used in the conversion of DC electricity generated from solar panel to AC electricity. Similarly, electric vehicle and storage systems also require power electronics devices to interact with the grid. In the transmission and distribution network, flexible power transfer is done through power electronic converters such as high voltage DC links (HVDC) and Flexible AC Transmission System (FACTS). These devices improve controllability and help to reduce power losses. Also, if we look at the different load types such as variable speed motor drives, internet devices, lighting loads etc, are also equipped with power electronic rectifiers at the front end, which enhances operational capability. Putting all the above together, the deployment of power electronic equipment in the power system enhances reliability, efficiency, controllability and can respond much faster than conventional synchronous machines. If these electronic-based players possess

the synchronous mechanism of a synchronous machine, then they automatically interact with each other. i.e., to harmonize and unify future energy grids including DERs and loads, all heterogeneous players should be homogenized with a common law of synchronization.

Proposed Solution Approach

As it is well known, the transient grid stability and organic growth of a power system is due to the synchronization mechanism of a synchronous machine, they can independently synchronize with each other or with the power supply, without any external communication. This mechanism could be adopted for the future autonomous power system to unify the interaction and integration of incompatible distributed renewable energy sources that need power electronics converters to interface with the grid. Thus, from an implementation perspective, by operating these power electronic converters to imitate the inherent benefits of a synchronous machine paves the way for autonomous operation of the future power system. But these power electronic-based players do not possess any rotating inertia, damping response or islanding operation, which is inherently feasible with a synchronous machine. And this leads to deviation in grid frequency and rapid power fluctuations due to which these power converters need control strategies to preserve controllability and stability. As a solution to this, several control strategies such as reactive power control, emulation of rotating inertia with power electronic converter, damping of oscillation etc., are explicitly designed to mimic the behaviour of a synchronous machine for providing virtual inertia and damping to the grid. This concept leads to Virtual Synchronous Machines (VSMs), in

which the dynamics and behaviour of conventional synchronous machines are embedded in power electronic converters, thus providing a unified interface for grid-connected, converter-based distributed energy resources. The concept of VSM is an alternative method for electrical grid feeding and a solution towards stability improvement of the energy system.

The Virtual Synchronous Machine (VSM) is a power inverter with a built-in energy storage and proper control mechanism, as shown in Fig 2. This technology implements a control system and provides virtual inertia in order to combine three phase inverter with synchronous generator behaviour. The capacity of the energy storage unit depends on the power imbalance between the DC and AC side. To implement VSMs, different technical routes are available in literature. Among those available methods, the synchronverter based approach and robust droop control technology offers a promising technical route for the implementation of VSMs.

Overall Grid Architecture

In this grid architecture, as shown in Fig 3, all traditional power stations such as coal fired thermal plants, hydro power plants, nuclear power plants etc., are connected to the grid through synchronous generators, as normally done, whereas the power electronics converters, which are present at the supply side, inside the network and at the demand side of the energy grid can be controlled to behave as virtual synchronous machine. To be more specific, all renewable energy sources and energy storage systems, which are connected to the grid through power electronic converters are controlled to behave as virtual synchronous generators. This is done by setting the mathematical model of synchronous generators for

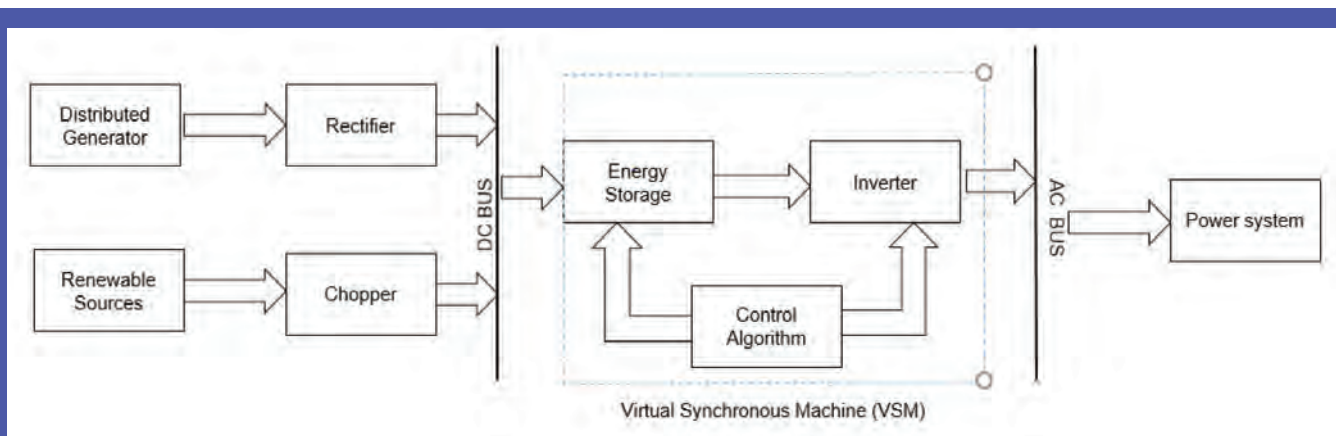


Figure 2: Virtual Synchronous Machine

the inverter controller. As for loads that have rectifiers at the front end can be controlled to behave as virtual synchronous motors. And for HVDC links, these power electronic based players can be controlled as virtual synchronous generators as well as virtual synchronous motors at both sides respectively. By homogenizing

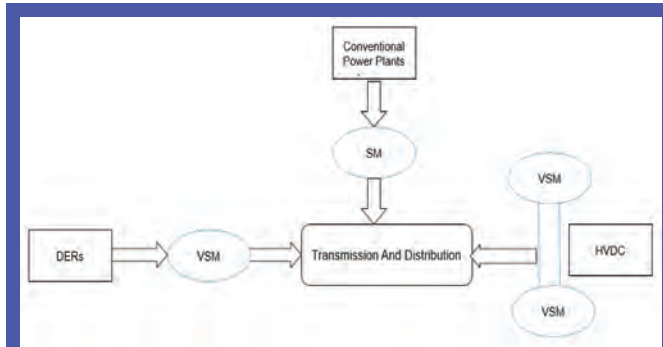


Figure 3: Overall Grid Architecture

all grid-connected converters with a common law of synchronism presents a unified, harmonized and scalable architecture for future power systems.

In this new technology, since all SM and VSM are equipped with synchronization mechanisms, they achieve legal equality and autonomously interact with each other by exchanging power via the electric network. This mechanism is the core concept behind the autonomous operation - which does not require a physical operator and can self-optimize to ensure economic and reliable performance. System autonomy is enabled when all players in the grid could directly participate in the regulation of system stability while integrating energy in all forms, as shown in Fig 2. Moreover, the deployment of this grid architecture also eliminates the need to depend on an additional external communication infrastructure, at the same time, having the ability to get reference set-points and instructions if needed. This eliminates the concern of cyber attack, which is one of the systemic flaws in the current grid system. In addition to this, the scalable grid architecture provides the foundation to achieve self-organizable grid structure. That means, it allows small scale grids to merge and form large-scale grids and vice-versa. Another advantage is in terms of resiliency - it automatically senses the fault and isolates faulty parts of the grid; once the fault is cleared, it can be reconnected. It is fair enough to say that in future it will be possible to power homes with distributed

renewable energy sources ; without relying on the utility grid. From this, it can be further extended to support neighboring grids, and then to grids and regional grids. The interconnection between different regions can be done with the help of circuit breakers, transformers, power electronic converters etc. Thus, this architecture can be applied from a single node system to multiple node systems.

Artificial Intelligence In Energy Management

Artificial Intelligence (AI) techniques are extremely powerful tools which have gone through fast evolution during the last several decades. The current electric power industry faces few challenges due to the global transition to decentralized renewable energy. From a sustainability point of view, distributed renewable generation has transformed the industry, but it does add complexity to the energy grid. AI in sync with IoT and big data could help address the challenges by processing vast amounts of data, which makes an important contribution in the fight against cyberattacks, perform predictive grid modeling, dynamic grid control and thus managing decentralized grids. In the energy industry, typical areas of AI application are virtual power plants, electricity trading, smart grid and for power consumption. When deployed correctly, AI has the ability to control and synchronize the grid with renewable sources and end-user loads in real time. With the help of AI software, any excess electricity produced by renewable sources can be sent to the grid, while utilities efficiently route energy to where it is needed. It can also help with energy storage by optimizing battery performance and battery - inverter system operation using real time load and market data which is an AI based intelligent controller. This optimization helps the control of individual battery energy systems, maintain and extend battery life. To receive and interpret energy storage, sensor data on edge devices are used. When demand is low, this excess energy is stored in industrial facilities, office buildings, homes etc, hence utilizing this power when generation is inadequate. To attain this, a lot of optimization, forecasting and coordination is required. To make accurate predictions, AI methodologies and techniques analyze both real time and historic data to find weak spots on the grid and power fluctuations using machine learning and deep learning algorithms. By analyzing real-time weather data, AI techniques

automatically attain optimal economic dispatch. In the energy operation and predictive maintenance sector, AI with thermal drone technology helps to boost solar power system production, alerts the field operators whenever solar panel maintenance is required thus eliminating the traditional trial and error method. Another particular focus of AI in the energy industry is electro mobility. The large-scale deployment of electric vehicles offers opportunities and challenges. AI based solutions facilitate energy arbitrage through vehicle to grid, vehicle to market services. These services include voltage regulation, demand response etc. With specialized algorithms, AI can perform particularly well by constantly forecasting load, grid needs, generation, electricity sale - maximizing customer benefit while meeting load and grid needs. AI power autonomous energy grid is shown in Figure 4. Large sets of datas are collected from weather satellites, edge device receivers, power generation levels, storage capacities, which are sent to the forecaster that analyzes these datas. The optimizer and controller helps in maintaining the grid stability. To ensure more accurate instructions and forecasts, all these data sets are finally fed back into the AI.

AI solutions offer real-time data processing, real-time control to determine optimal balance of electricity supply and demand to reduce energy wastes and ensure uninterrupted electricity delivery. Machine learning algorithms are used to determine energy supply and demand. Application of AI in AEG will help the operators avoid grid outages, improve operation and reduce cost. By this it ensures secure, reliable and low-carbon

electricity. Thus, AI is a key technology for renewable power grid resilience which enables faster grid analytics, better grid asset management, forecasting and control in seconds even after network disruptions.

Service-based, Segmented, 5G Network-based Distributed Energy Storage

The combination of energy grid and 5G networks will reduce the impact of cyberattack and improve performance, availability and reliability of the whole system. 5G networks will bring better bandwidth experience, address cybersecurity concerns, facilitate fine-tuned control for DER, create isolated islands and micro networks that helps provide resilience in the grid. Network slicing provides agile and customizable capabilities and helps in the integration of DER to the grid with 5G. 5G based Internet of Things (IoT) can control demand-side resources and effectively provide regulation services for smart grids. 5G network slicing facilitates wireless communication, which will be required for millisecond-level precise load control, intelligent distributed feeder automation, distributed power supply, information acquisition of low voltage distribution systems. The three defining characteristics of 5G slicing architecture are Extreme Mobile Broadband (eMBB), Massive Machine Communication (MMC), Ultra-Reliable Low-Latency Communication (URLLC). These classes for the 5G NR network as shown in Figure 5, represent the various types of communication required to enable low latency, high speed data, and mass deployment of connected devices from the

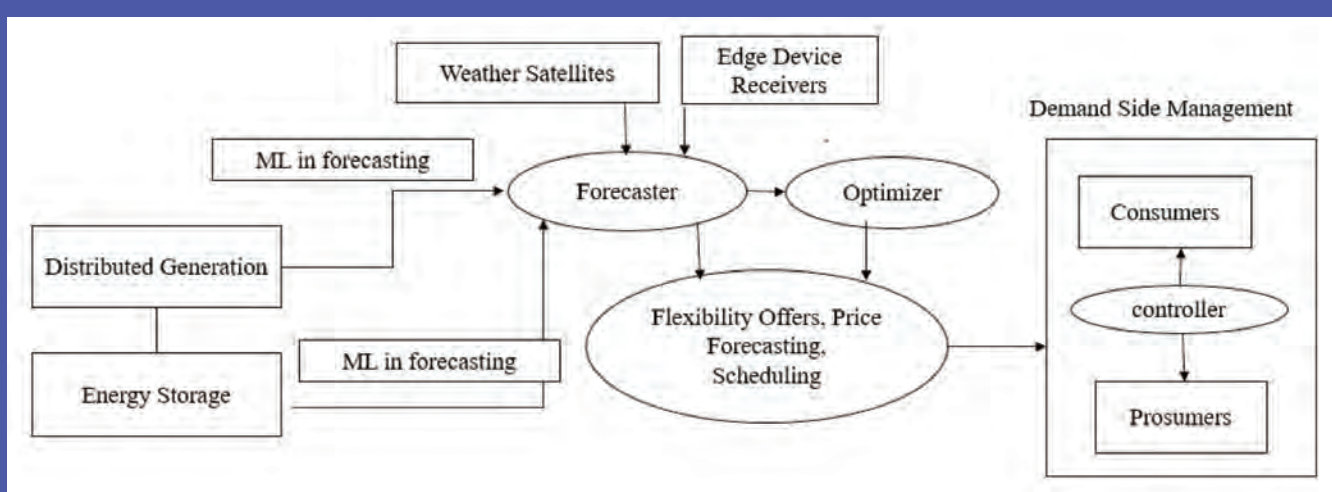


Figure 4: Autonomous grid Management using AI

network. These three categories together satisfy all the technical needs for the futuristic use cases with billions of connected devices. These generic services can be accommodated by network slicing, which can be isolated from one another. The architecture of software defined networking (SDN) supports the core technology of network slicing. Applying the SDN architecture, an SDN controller for management and orchestration provides individual slices. The controller's client context provides control logic for constituting a slice, isolated from each other and continuously optimized by global policy functions.

From an operational perspective, 5G network slicing generates virtual network topologies, a series of virtual network functions, for the different functionalities of microgrids such as monitoring, diagnosis, operations etc. This new generation wireless communication technology meets ultra-low latency requirements of industrial control services of the energy grid. 5G network slicing characteristic in DER domain proactively mitigates the

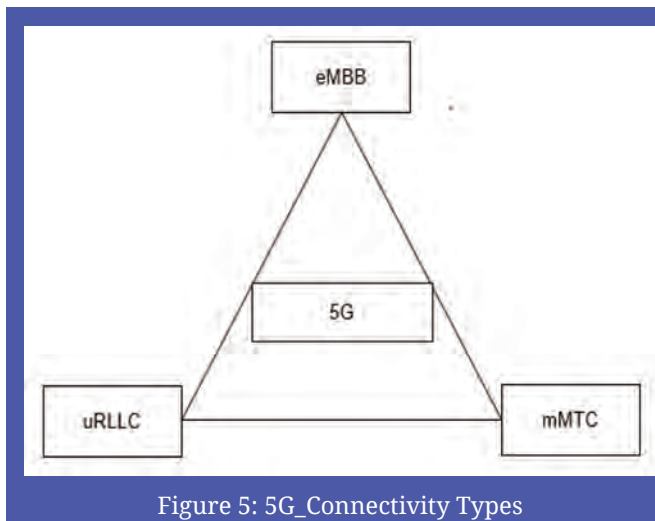


Figure 5: 5G_Connectivity Types

Dos attacks on a DER system. Integration of DER to the grid with 5G network slicing architecture is done through slice alignment strategy as shown in Figure 6. DER monitoring and diagnosis, distributed control for DER, distributed automation, DER application based network configuration are some of the use case scenarios that can be enabled by this technology. Communication Service Management Function (CSMF) is the first step to slice design in the end to end network slicing architecture. It meets service system requirements, converts into end to end network slicing requirements and finally transfers to the network slice management function (NSMF) for

network design. NSMF is responsible for generating slice instances and then combining, dividing and transferring the deployment requirement to the Network Slice Subnet Management Function (NSSMF). The NSSMF implements autonomous deployment, manages and designs slices of subnets. The collaboration of CSMF,

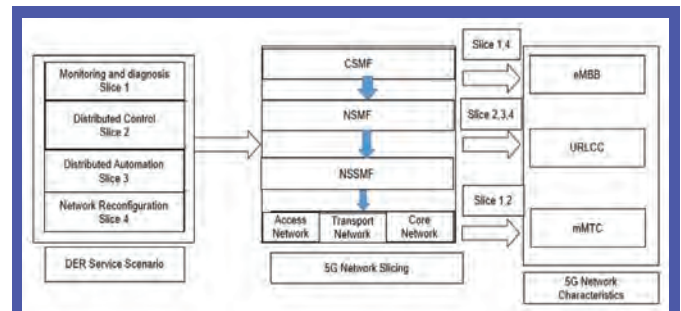


Figure 6: 5G slicing characteristic in DER

NSMF AND NSSMF completes the network design and deployment of end to end slice network.

Emerging 5G capabilities reduces the capital expenditure, increases the speed of network opening and automatically triggers network redesign to improve network service capabilities. The evolving new age 5G constitutes both licensed and unlicensed frequency bands, which are expected to implement very high service quality. Thus, some of the benefits of a 5G network in an autonomous power grid are reduced power consumption, more connectivity among devices, data transfer at high rate per area, increased scalability, cost effective, high data rate and low latency. From an effective energy management perspective, this effective communication system in smart grid provides two way energy trading and dynamic energy pricing.

...To be continued 



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CHALLENGES & THEIR MITIGATION

PART 2

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

NETC is regularly assessing health of its assets through its risk management mechanisms mentioned before. NETC is in process of formulating health index of its assets. Further to manage lifecycle of assets more effectively, getting higher return with the assets and to reduce the total cost of risk, NETC is actively considering certification of ISO 55001.

Asset management

The asset is being managed by a group of highly experienced personnel with a

Corporate Office headed by a Chief Executive Officer designated as Managing Director. For convenience of maintenance, the Transmission System is divided into three line sections with intervening power substations and each line section is further divided into a number of sub sections (2/3) with placement of maintenance teams comprising experienced fitters/foremen. The team leaders report to the concerned line in-charges and carry out patrolling as per the advance planning done. In the vulnerable & most vulnerable stretches of the transmission system having history of component failure, the tower top patrolling is being carried out along with ground patrolling almost on regular basis during adverse climatic conditions. The defects identified during patrolling are categorized as of shutdown and non-shutdown nature. The defects of non-shutdown nature are attended during regular patrolling and defects of shutdown nature are attended by obtaining shutdown of the respective transmission line or during opportunity shut down being availed by others depending upon the severity of the defects. Safety drill is a regular feature before starting any maintenance activity.

The entire maintenance activity is suitably aided by different protection mechanisms including disturbance recorders, event loggers, phase measuring units etc., put in place in the connected power sub stations and the grid and well supported by the grid operators.

Availability of transmission line corridor

NETC has achieved availability factor of transmission corridor above 99.89% under severe environmental conditions since last five years. Table 3 exhibits annual availability factor of last five years. As per Central Electricity Regulatory Commission (CERC) regulation [Reference 6], Normative Annual Transmission System Availability Factor (NATAF) is calculated as per following formulae:

$$\frac{\sum_{i=1}^o W_i(T_i - T_{NAi})/T_i}{\sum_{i=1}^o W_i}$$

AVo (Availability of 'o' no. of AC line elements) =

Where,

o = Total number of AC lines.

Wi = Weightage factor for ith transmission line i.e. number of sub-conductors x ckt. km for an AC T/L.

Ti = Total hours of availability of ith AC line excluding time not attributable licensee.

Table 3: Availability of transmission line corridor...
Source: NETC Inhouse Data

Sl. No.	Year	Availability
1	2015-16	99.92%
2	2016-17	99.89%
3	2017-18	99.90%
4	2018-19	99.97%
5	2019-20	99.98%

Tnai = The non-availability hours attributable to licensee.

Conclusions

NETC has been successful in maintaining availability of transmission corridor by adopting various innovative and sustainable mitigation measures after identifying the constraints. To reduce the down time, NETC is focusing on new methods of aerial patrolling, remote monitoring, use of modern O&M instruments, advance information about cyclones, earthquake & lightning etc. Use of 400 kV TLAs is one of the measures for future depending on its success in Indian Grid coupled with various state-of-the-art techniques for continuous strengthening of foundations & towers. NETC views human resources as the most precious asset of the company and therefore stresses high importance on mandatory and advanced training programs for upgradation of skill and knowledge.

...concluded

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Satyajit Ganguly (Main Author) is the Managing Director of NETC (North East Transmission Company Ltd.). Co- writers; Ashwani Kumar Srivastava, D. K. Sarma, Robin Kumar Sarkar and Harshal Radheshyam Malewar; are also from NETC.

A new method for producing H₂ from water

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

As a fuel, hydrogen has a critical role to play in driving the paradigm shift towards a green and sustainable economy. In addition to having about 3-fold higher calorific value compared to non-renewable energy sources such as coal and gasoline, the combustion of hydrogen to release energy produces water and is thus completely non-polluting. Due to the extremely low abundance of molecular hydrogen in the earth's atmosphere (350 ppbv), electric-field driven breakdown of water is an attractive route for production

of hydrogen. However, such electrolysis requires high energy input and is associated with slow rate of hydrogen production. The use of expensive platinum- and iridium-based catalysts also discourages it for widespread commercialization. Therefore, the transition to 'green-hydrogen-economy' demands approaches that lower the energy cost and material cost and simultaneously improve the hydrogen production rate.

The research work

A team of researchers from IIT Bombay led by Prof. C. Subramaniam have come up with an innovative route that provides viable solutions to all these challenges. It involves electrolysis of water in the presence of an external magnetic field. In this method, the same system that produces 1 ml of hydrogen gas required 19% lower energy to produce 3 ml of hydrogen in the same time. This is achieved by synergistically coupling the electric and magnetic fields at the catalytic site.

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



The experimental set up used for the research...

Involvements

The electrocatalytic material -- cobalt-oxide nanocubes that are dispersed over hard-carbon based nanostructured carbon florets, is of prime importance to achieve this effect and was developed with the support of the Department of Science & Technology's Material for Energy Storage program at Technology Mission Division. It was put to use for magneto-electrocatalysis through the DST-SERB grant.

The interface between the carbon and cobalt oxide is key to magneto-electrocatalysis. It is advantageous

as it forms a system that does not require the constant presence of the external magnetic field and is able to sustain the magnetisation for prolonged time periods; the magnitude of the enhancements achieved (650% increase in current density, 19% lowering of energy required and a 3-fold increase in volumetric hydrogen production rate) is unparalleled, the intermittent magnetic field required is similar to what a fridge magnet can provide. This route can be directly adopted in existing electrolyzers without any change in design or mode of operation and one-time exposure of magnetic field for 10 minutes is enough to achieve the high rate of hydrogen production for over 45 minutes.

Researchers' voice

Detailing on the experiment, Prof. Subramaniam said, "The intermittent use of an external magnetic field provides a new direction for achieving energy-efficient hydrogen generation. Other catalysts can also be explored for this purpose."

Jayeeta Saha and Ranadeb Ball, the students who were supported by the DST funding, informed, "A basic electrolyser cell of 0.5 nm³/h capacity can be immediately upgraded to a 1.5 nm³/h capacity by replacing the catalysts and supplying the magnetic field."



“KUSAM-MECO” High Performance High Voltage Insulation Resistance Tester Model- Km 5305In / Km 5310In / Km 5315In



KU S A M - MECO has introduced a new range of High Voltage Insulation Resistance Testers suitable for indoor & outdoor (400KV switch yards) application. They are available in 3 Voltage Ranges: Model KM 5305IN (5 KV / 10 TΩ),

Model KM 5310IN (10KV/20TΩ), Model KM 5315IN (15KV/30TΩ). All models have output Short Circuit Current $\geq 7\text{mA}$. The instruments can also measure Polarization Index Test (PI) & Dielectric Absorption Ratio Test (DAR). It also provides for Ramp Test Mode. It can also measure AC/DC voltage 0-1000 Volts. Current 0-9mA & Capacitance Test 10nF~25μF. It has an adjustable Test timer range 0-9999 seconds. It can store real-time data with test date, time, total 1000 groups. It has USB port and by help of USB cable can upload the data to PC. It has “Low battery” indicator to remind the user to charge the battery. It also has APO function to shut the Power after 15 minutes of no activity. Suitable voltage rated coloured Test leads for line, Earth & Ground are provided with the instrument. Also provided is USB communication cable, software CD, Tool Bag.

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Managing the Menace of Voltage Variations

Voltage variation is a very common phenomenon. In India, all electrical equipment is designed for 230/400 volts single/three-phase. The input voltage is generally low during day time and high during night hours. Voltage variation is everywhere, at some places it is high/low or sometimes even both (fluctuating).

Effects of high or low voltage

At the high Voltage condition, current of electrical/electronic equipment increases accordingly. This high current increases the losses of equipment resulting overheating the insulation of electrical/electronic equipment and becomes the cause of pre-mature failure of electrical/electronic equipments. It also increases the power consumption & MDI etc.

At low voltage condition, the electrical/electronic equipment does not work/operate properly. Repeated tripping of the system ultimately leads to wastage of time/loss of production.

Automatic Voltage Controller (AVC)

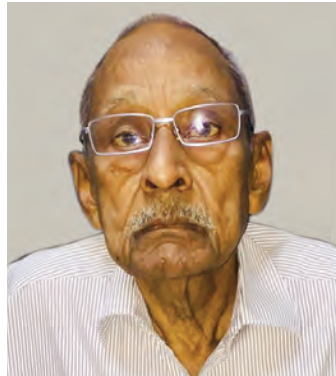
To solve the challenge of voltage variation, Automatic Voltage Controller (AVC) is required. The main part of AVC is the Voltage Regulator.

There are two technologies of Voltage Regulator available in the world:

- **Dimmer Type** Torroidal wound with copper wire and sliding contact carbon brush assembly un-suitable for continuous load with higher losses up to 8% at rated current.
- **Linear Type** Vertical Wound with cooper strip and have compensating winding Carbon Rolling Contact Assembly Rolls over the Regulator Coils both side for plus minus purpose for continuous current having trouble free working life more than 15 years with losses less than 1% at rated current.

In 1990 we developed the linear regulator

This is suitable for continuous load with lesser losses i.e. 1% maximum at rated current. The material used in linear voltage regulator i.e. copper, lamination and size is three times the conventional type voltage regulator.



B. B. Jindal
Founder, Jindal
Electric &
Machinery Corp.

Energy Audit

Any power consumer can do Energy audit or check the voltage variation in their premises with the help of digital power analyzer, which is easily available in the market at a very nominal cost (approx. Rs. 6,000/- with accessories & Software). It records the data after every 15min. interval for 7 days as shown in the chart below:

Date & Time		System Voltage (Volt) in each phase			System Current (Amps) in each phase			Power consumption
Date	Time	Rn	Yn	Bn	Ir	Iy	Ib	kW
xx/xx/xxx	00.00	234	235	240	85	90	90	50

According to the voltage variation / current pattern, a consumer can decide whether he/she needs the Automatic Voltage Controller or not.

The payback period

1. The benefit of installing an Automatic Voltage Controller is to reduce the failure rate of costlier electrical/ electronics' equipment.
2. The Automatic Voltage Controller is not a power saving device. This is added advantage at high voltage.
3. The input voltage increases payback period decreases accordingly may be 4-12 months.

Due to not reliable technology of Voltage Regulator available the voltage correction system could not become popular. 

For more information:

contact at E-Mail: jemc@jindalelectric.com

igus is the world's first manufacturer to receive UL approval for halogen-free TPE cables

The long service life of chainflex high-end TPE cables convinces inspectors and gives customers certified security...

As the world's first manufacturer, igus has received UL AWM certification from the well-known US organization Underwriters Laboratories (UL) for its high-end TPE cables that do not use fire-retardant halogens as additives. This is the first time that the testing organisation has recognised that halogen-free TPE cables can also meet the fire protection requirements in industry.

The independent organisation Underwriters Laboratories (UL) is one of the most important authorities in the USA in terms of product safety. It has been testing components of machines and systems since 1894 to see whether they are suitable for industrial use. Their seal is one of the prerequisites for a successful market entry in North America. Fire protection is a key decisive criteria. This is because, according to the US National Fire Protection Association (NFPA), machine fires are the fourth leading cause of fires in industrial environments in the USA, closely followed by fires caused by electrical factors. "That is why we are particularly pleased that igus has now become the world's first manufacturer to receive a UL seal for halogen-free TPE cables," says Rainer Rössel, Vice President and Head of the chainflex cables business unit at igus. "The approval demonstrates to our customers that they have the safety aspect with chainflex high-end TPE cables."

Fire protection can also be achieved without halogens

For this certification, the igus engineers had to do a lot of persuading. Up to now, the flame retardancy of cables has been the key factor in obtaining UL certification for fire protection. Approval is therefore only granted to products containing flame retardants such as chlorine, fluorine or bromine. These additives increase the flame retardancy. However, so far it has not been taken into account that the flame retardants generally change the chemical structure of the jacket and reduce the mechanical load-bearing capacity. Therefore, igus starts much earlier



in the process: The cable specialist focuses less on preventing a fire from spreading, but rather on how the cable itself caused the fire. The TPE jacket compounds from igus are extremely resistant to mechanical loads as well as external influences. They can therefore be used in a wide range of applications: in small installation spaces of up to 4xd, on

highly dynamic, short travels with accelerations of 100m/s² or on long travels in a temperature range from -35°C to +100°C. At the same time they are extremely media resistant, even with special organic oils. In all of these energy chain applications, the halogen-free TPE jacket compounds from igus minimize premature aging of the outer jacket by a factor of up to 10; when compared to the same materials containing flame retardants. A decisive cause of fire is reduced. This is because if the jacket does not break the cable cannot cause a fire because a reduction in the cross section of the cores is impossible due to the non-existent jacket break. An argument which finally convinced the UL.

Flame retardancy of TPE cables is no longer the measure of all things

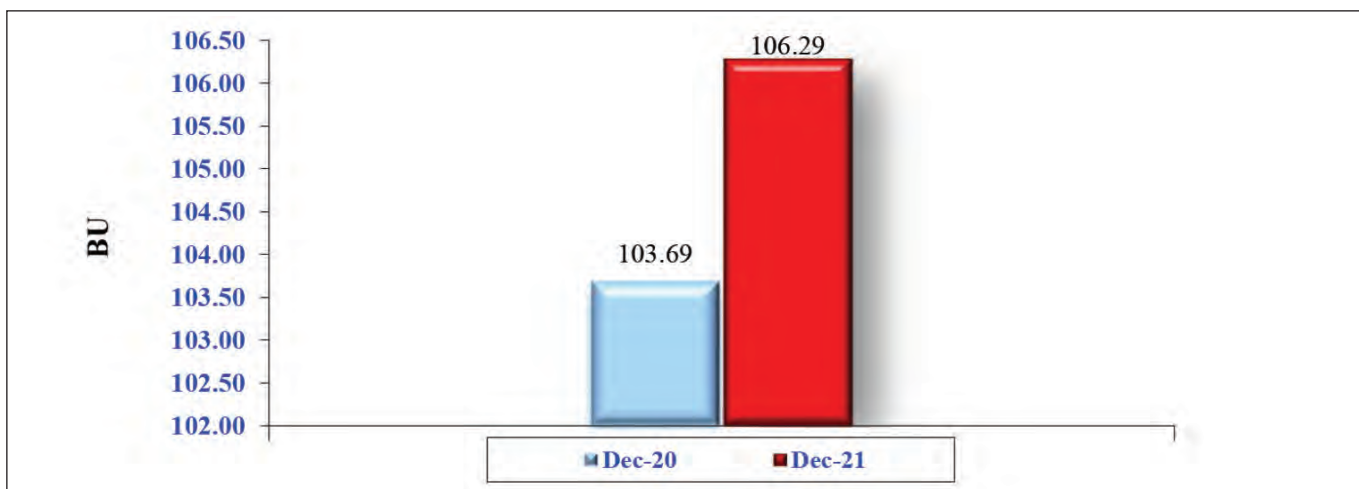
With these measures, igus makes a significant contribution to increasing machine safety. The long-term flexural strength and service life of chainflex cables in the e-chain have been proven by numerous practical tests in the in-house igus test laboratory - and not just for TPE cables. "So far, customers have already had the opportunity to choose from 1,044 chainflex cables with UL approval," Rainer Rössel points out. "With the new certification, there are now more than 200 TPE cables, so we can offer an almost complete UL certified product range." Customers in Europe benefit from this by being halogen-free, as do those who build machines for the North American market, where UL certification of the individual components is the required rule. 

For further information: E-mail: ralloli@igus.net
Website: www.igus.in

Electricity Generation for Dec-2021 (BU)

Type	Achievement	Targets	Achievement*	% Change of Achievement w.r.t. Dec-2020
	Dec-20	Dec-21	Dec-21	
Thermal	91.41	97.55	93.35	2.12
Nuclear	3.89	3.87	4.38	12.49
Hydro	8.16	8.55	8.35	2.32
Bhutan Import	0.22	0.27	0.21	-8.04
All India	103.69	110.23	106.29	2.50

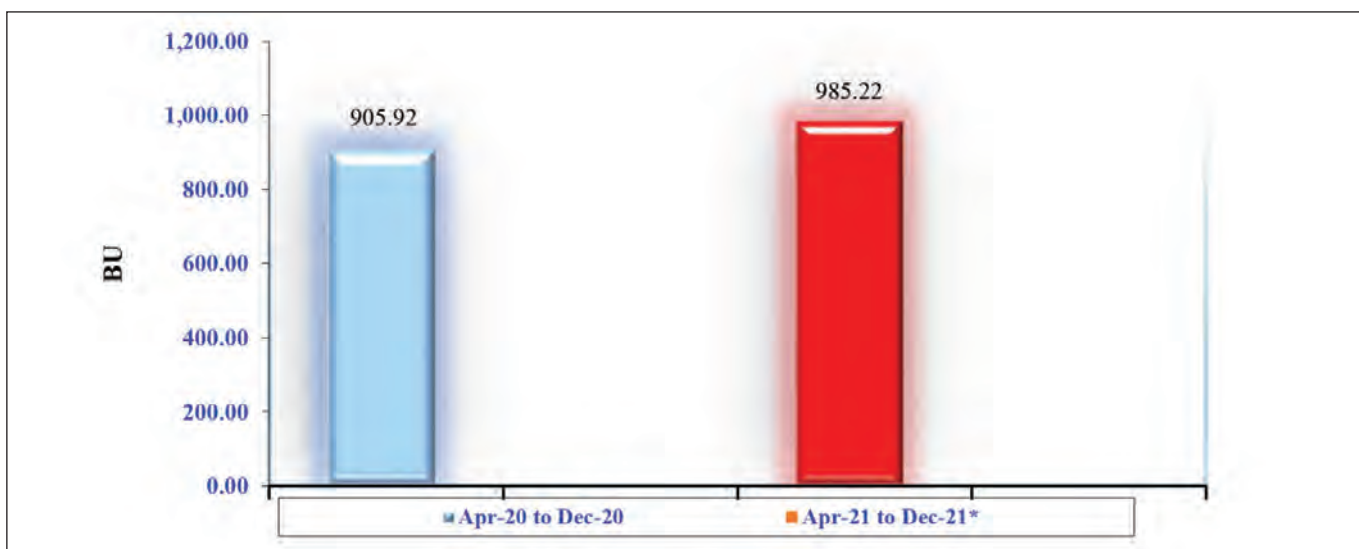
*Provisional



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

Type	Apr-20 to Dec-20	Apr-21 to Dec-21*	% Change w.r.t Apr-20 to Dec-20
Thermal	736.92	816.78	10.84
Nuclear	33.95	34.77	2.41
Hydro	126.64	126.39	-0.20
Bhutan Import	8.41	7.28	-13.43
All India	905.92	985.22	8.75

* Provisional



Source: CEA

ALL INDIA INSTALLED CAPACITY (IN MW) OF POWER STATIONS
(As on 31.01.2022)

Region	Ownership/ Sector	Mode wise breakup					Nuclear	Renewable		Total	Grand Total
		Thermal						Hydro	RES * NRE)		
		Coal	Lignite	Gas	Diesel	Total					
Northern Region	State	17979.00	250.00	2879.20	0.00	21108.20	0.00	5888.25	731.35	6619.60	27727.80
	Private	22425.83	1080.00	558.00	0.00	24063.83	0.00	3061.00	23672.57	26733.57	50797.40
	Central	15787.48	250.00	2344.06	0.00	18381.54	1620.00	11484.52	379.00	11863.52	31865.06
	Sub Total	56192.31	1580.00	5781.26	0.00	63553.57	1620.00	20433.77	24782.92	45216.69	110390.26
Western Region	State	21290.00	900.00	2849.82	0.00	25039.82	0.00	5446.50	571.48	6017.98	31057.80
	Private	31947.17	500.00	4676.00	0.00	37123.17	0.00	481.00	31272.33	31753.33	68876.50
	Central	20354.10	0.00	3280.67	0.00	23634.77	1840.00	1635.00	666.30	2301.30	27776.07
	Sub Total	73591.27	1400.00	10806.49	0.00	85797.76	1840.00	7562.50	32510.11	40072.61	127710.37
Southern Region	State	20592.50	0.00	791.98	159.96	21544.44	0.00	11819.83	597.88	12417.71	33962.15
	Private	13272.00	250.00	5340.24	273.70	19135.95	0.00	0.00	45235.00	45235.00	64370.95
	Central	11835.02	3390.00	359.58	0.00	15584.60	3320.00	0.00	541.90	541.90	19446.50
	Sub Total	45699.52	3640.00	6491.80	433.66	56264.99	3320.00	11819.83	46374.78	58194.61	117779.60
Eastern Region	State	7450.00	0.00	100.00	0.00	7550.00	0.00	3537.92	275.11	3813.03	11363.03
	Private	5553.00	0.00	0.00	0.00	5553.00	0.00	209.00	1439.07	1648.07	7201.07
	Central	14643.38	0.00	0.00	0.00	14643.38	0.00	1005.20	10.00	1015.20	15658.58
	Sub Total	27646.38	0.00	100.00	0.00	27746.38	0.00	4752.12	1724.18	6476.30	34222.68
North Eastern Region	State	0.00	0.00	466.36	36.00	502.36	0.00	422.00	233.25	655.25	1157.60
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.00	160.88	160.88	160.88
	Central	770.02	0.00	1253.60	0.00	2023.62	0.00	1522.00	30.00	1552.00	3575.62
	Sub Total	770.02	0.00	1719.96	36.00	2525.98	0.00	1944.00	424.13	2368.13	4894.10
Islands	State	0.00	0.00	0.00	40.05	40.05	0.00	0.00	5.25	5.25	45.30
	Private	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.66	27.66	27.66
	Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.10	5.10	5.10
	Sub Total	0.00	0.00	0.00	40.05	40.05	0.00	0.00	38.01	38.01	78.06
ALL INDIA	State	67311.50	1150.00	7087.36	236.01	75784.86	0.00	27114.50	2414.31	29528.81	105313.68
	Private	73198.00	1830.00	10574.24	273.70	85875.95	0.00	3751.00	101807.51	105558.51	191434.46
	Central	63390.00	3640.00	7237.91	0.00	74267.91	6780.00	15646.72	1632.30	17279.02	98326.93
	Total	203899.50	6620.00	24899.51	509.71	235928.72	6780.00	46512.22	105854.13	152366.35	395075.06

Figures at decimal may not tally due to rounding off

Source: CEA



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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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3 YEARS	18	3200.00	4100.00	4700.00	3200.00	5100.00	5700.00
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FPL expands its product portfolio to support E-mobility

Formulated Polymers Limited (FPL) is all set to address the emerging challenges related to safety, reliability, weight reduction, aesthetics etc., of E—mobility product developers. The company is progressing with a strong determination to mitigate carbon footprint menace to build a sustainable world...

The quality and performance of materials used in applications for moving electricity safely and reliably has been a challenge and critical for performance – whether to power a manufacturing robot, drone, electric vehicle, or the circuitry behind a smart home equipment.

There are customised polymer engineering plastics, which are proving to be ideal materials for the interior components of a car, as they are not only light weight, durable and aesthetically pleasing but also reduces Noise, Vibration, and Harshness (NVH) levels of an electric car.

Increasing concern for reducing the level of carbon footprints, increasing government support, and reduction in the overall weight of the electric cars are the factors facilitating the growth of electric vehicle (car) polymers market in India.

From large-scale electrical to miniature electronic applications, FPL provides a full range of engineering polymers solutions portfolio to keep circuits operating reliably and safely under diverse conditions using STARFLAM® & FORMPOLY® grades with reliable solutions & good electrical and mechanical properties (especially impact resistance) at low & high temperatures,



excellent CTI and arc resistance values, UL94 V0 at 0.45 mm certification. These high-performance compounds support miniaturisation without compromising on strength and torsional rigidity.

With a unique mix of properties, including best-in-class electrical insulation and flame retardancy that meets the highest international standards, STARFLAM® & FORMPOLY® grades are the ideal materials for e-mobility applications.

FPL grades of polyamides allow for appealing designs due to good surface aesthetics and for colourful designs due to good colourability even in grades having halogen-free flame retardancy compliant to new regulations. Material convinces with significantly improved aging properties than existing systems currently available on the market. Due to the versatile application possibilities, we can provide large production volumes at economically attractive conditions.

FPL has expanded its product portfolio of polyamides for the high-temperature range with the development of the heat-stabilized FORMPOLY® polyamide, reinforced with glass reinforcement, excellent thermal aging performance, high temperature welding properties and laser markability.

The new compounds offer a unique heat resistance and prevent corrosion on electrical components. 

For further information:

E-mail: vp-development@formulatedpolymers.com

Website: www.formulatedpolymers.com

Dr. Rashmi Bhardwaj, Vice President – Development of Formulated Polymers Limited (FPL), possesses a PhD in Polymer Technology and an MBA in International Business.



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IN THE MARCH 2022 ISSUE

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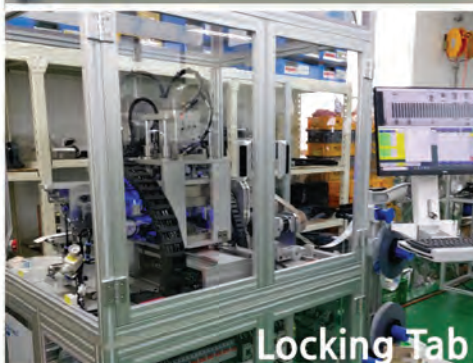
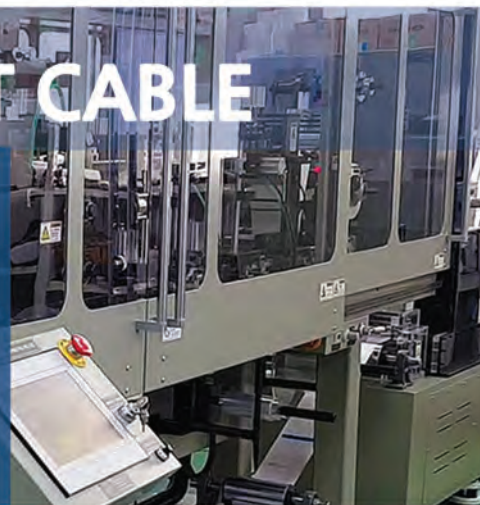
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