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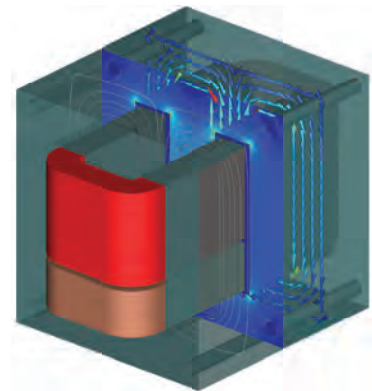
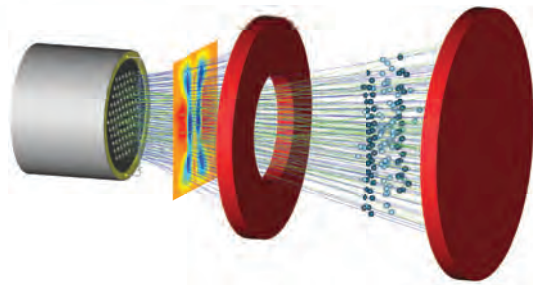
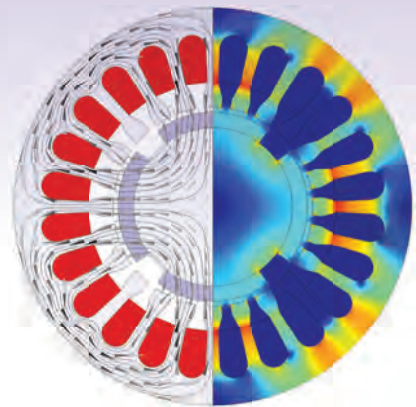
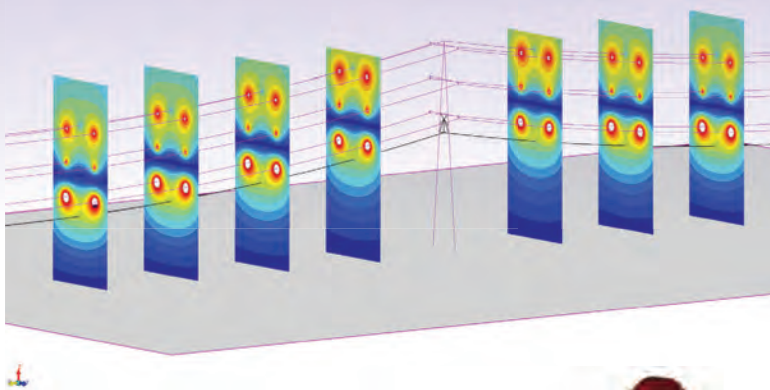
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From the Publisher's Desk

Russia-Eukraine war may give a jolt to our energy sector

The way the Russia-Eukraine conflict is intensifying, at this moment it is very difficult to ascertain the future of the world. Of course the war will have a long-term effect on the global economy and environment, however, I'm more worried that the Indian energy sector has to encounter some immediate challenges.

Although we are yet to feel the hit, the Russia-Eukraine war has already increased energy prices globally. In 2021, India imported 1.8 million tonnes of thermal coal from Russia. Also, we imported 43,400 bpd oil from Russia in 2021, which is about 1% of our overall oil imports. Yet another fact is we account for about 0.2% of Russia's natural gas exports – in fact, since 2018, GAIL (India) Ltd., has a 20-year deal with Gazprom – a Russian majority state-owned multinational energy corporation.

Isn't it a bit troublesome? In fact, in an interaction with PTI, recently, ICPPA Secretary General Rajiv Agarwal, has expressed his concern on the effect of the ongoing crisis. He expects that the situation will hamper supplies to both Captive Power Plants (CPPs) and industries from Coal India. The apparent rise in oil price will definitely increase our logistics cost, as a consequence of it, there will be a hike in prices of all commodities.

Although many of our energy-intensive industries have started installing their captive renewable power generation plants, we are still at infancy. As per the available reports, already during last more or less six months, the coal-based captive power plants are facing a big challenge as far as the supply of coal to them is concerned. The recent situation will further complicate the scenario. Thus, till we find a feasible alternative, our challenges will continue.

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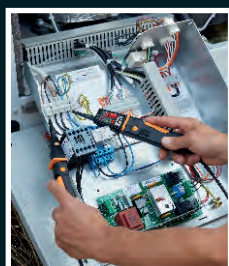


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MORE THAN 35 INNOVATORS PARTICIPATED IN THE EXPOSITION ORGANISED ON BEE'S TWENTIETH FOUNDATION DAY

Recently, the Bureau of Energy Efficiency (BEE) organised the National Innovation Conclave on Low Carbon Technologies – to commemorate its 20th Foundation Day. This conclave provided a platform to present the innovations showing benefits of energy savings and greenhouse gas emission reduction potential when deployed at a large scale in industrial and commercial sectors.

R. K. Singh, Union Minister of Power and New & Renewable Energy, Government of India delivered special address on the occasion. He emphasized that there is a need to establish a robust ecosystem for innovation. We need to help people working in this direction and fill in the gaps for bringing such technologies to market.

Facility for Low Carbon Technology Deployment (FLCTD) is a project financed by the Global Environment



BEE's poster of the event...

Facility (GEF), implemented by the United Nations Industrial Development Organisation (UNIDO) in collaboration with the Bureau of Energy Efficiency (BEE). The event showcased many low carbon technology innovations developed and validated with the support of FLCTD project. More than 35 innovators participated in the exposition organised under the

event. Since 2018, the FLCTD project has conducted four rounds of innovation challenges.

On this occasion, a compendium of the FLCTD Accelerator was released and the winners were facilitated. The conclave focused on the challenges in low-carbon innovation including the need for financing towards commercialization and scale up. The conclave had sessions deliberating on innovating technologies, investments in cleantech innovation and FLCTD's Accelerator programme.

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NHPC SETS UP NEW VERTICAL FOR DEVELOPMENT OF RENEWABLE ENERGY (RE)

Earlier in December 2021, the formation of a separate RE unit got the nod of Department of Investment and Public Asset Management and NITI Aayog...

NHPC Limited has set up a new wholly owned subsidiary company, NHPC RENEWABLE ENERGY LIMITED (NREL), for development of Renewable Energy, Small Hydro and Green Hydrogen-based businesses. The subsidiary has been incorporated with the Registrar of Companies, NCT of Delhi & Haryana. It will develop RE projects either in stand-alone mode or through formation of Special Purpose Vehicles (SPVs) with collaboration of other agencies.

Speaking on the occasion, A. K. Singh, CMD, NHPC, said "NHPC has envisaged to become a global leading organization for sustainable development of clean power. The incorporation of NHPC Renewable Energy Limited shows our deep commitment towards tapping Renewable Energy, which helps in reduction of carbon emissions and in producing

clean and green energy. The decision of setting up a subsidiary for renewable energy comes at a time when NHPC, which is predominantly a Hydro player, plans to increase the share of renewable energy in its generation portfolio."

Currently, NHPC's total installed generation capacity stands at 7,071 mega-watt (MW), which includes 100 MW of Solar/ Wind energy-based plants. Another 5,999 of Hydro and 105 MW of Solar Plants are under construction. NHPC Ltd. is expanding its RE portfolio and has taken up several projects under different modes, which are presently under tendering / development stage. Recently, NHPC signed Letter of Intent with Rajasthan Renewable Energy Corporation Limited (RRECL) for "Development of 10,000 MW RE projects or parks in Rajasthan."

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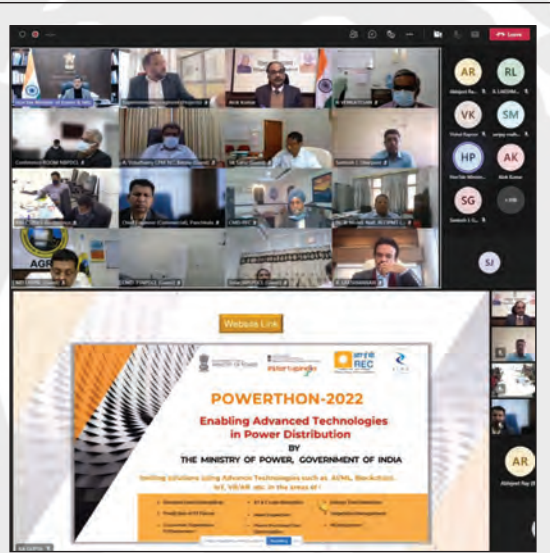
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POWERTHON-2022 UNDER RDSS AIMS TO BUILD A ROBUST POWER SECTOR

On 7th February, the Union Minister for Power and MNRE, R. K. Singh virtually launched Powerthon-2022, a hackathon competition under RDSS to find technology driven solutions to solve the complex problems in power distribution and to ensure quality and reliable power supply.

In his keynote address, Singh said that this program is much needed in the power sector. According to him, there will be a standing body and this innovation will be opened as an ongoing scheme. He encouraged technologists to come forward not only with solutions to existing problems but also with other problem statements and ideas for reliable power supply. He said that ideas and concepts will be rewarded with licence – and development of prototypes will also be fostered.



A glimpse of the virtual launch of the Powerthon-2022...

On the occasion, REC Limited in collaboration with SINE, IIT Bombay, announced that Technology Solution Providers (TSPs), start-ups, educational institutions, research institute, equipment manufacturers, state power utilities and other state and central power sector entities, shall be briefed on the current challenges or problem statements faced across the power distribution sector and invited to participate & showcase their technology-driven solutions to solve the complex problems.

The hackathon will ask participants to find innovative solutions based on advanced emerging technologies like AI/ML, Blockchain, IoT, VR/AR etc., on nine themes that have been identified after various discussions & consultations with 14 DISCOMs across 9 states and have been categorized across nine broad aspects for pilot testing. E1

INDIA TARGETS REPLACING DIESEL WITH RE IN THE AGRICULTURE SECTOR

A presentation was made by the DG BEE to deliberate about the various actions that may be taken at state levels...

Union Minister for Power and New & Renewable Energy, R. K. Singh, chaired a virtual meeting recently with the officers of Ministry of Power and MNRE, Addl. Chief Secretaries and Principal Secretaries of Power/Energy Departments of States & UTs to discuss the role of States and UTs towards Energy Transition Goals of India.

Minister Singh reiterated Prime Minister's commitment to ramp up India's fight against climate change & global warming and emphasised the need for collaboration between the centre and states to ensure Energy Transition in all potential sectors of the economy.

This meeting was organised in line with the Prime Minister's commitment at COP26, towards reducing the carbon intensity of our country. The objective of

this meeting was to ensure the state's participation in fulfilling the India's climate commitments and each state and UT can be assigned energy saving targets.

Addressing the meeting, Singh stressed on the need for collaborative efforts between the Central and State Governments towards the large-scale deployment of energy efficiency measures in potential sectors of the economy. He emphasised the need to have state specific agency dedicated for energy efficiency and conservation. He urged that the states should develop action plan to achieve the assigned targets. He further said, "We are working for a new and modern India, which cannot happen without modern power systems, and we look forward to working with all States and UTs to achieve this." E1



SHAPING THE ENERGY INDUSTRY OF TOMORROW

In the face of increasing decentralization and fluctuating power generation, the individual elements of an energy system must be linked to each other intelligently. WAGO offers a wide variety of solutions for these challenges.

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- Telecontrol technology (RTU)



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ENPHASE, SALCOMP PARTNERSHIP EMERGES AS INDIA'S LARGEST SOLAR INVERTER MANUFACTURER

Enphase Energy, Inc., a global energy management technology company and the world's leading supplier of microinverter-based solar-plus-storage systems, has recently showcased its India manufacturing unit, set up in partnership with Salcomp—a world-leading company in high precision manufacturing. The Enphase-Salcomp unit has emerged as India's largest solar inverter manufacturer with an annual capacity of more than 6 million units. Based at Salcomp SEZ in Sriperumbudur near Chennai, it produces the Enphase IQ Microinverters, which are currently being exported, thus making the unit one of the largest solar equipment exporters in India by the number of units.

The Enphase IQ microinverters are some of the most advanced solar inverters in the market that enhance solar energy output while making the entire solar energy



Sunil Thamaran, VP and MD at Enphase Energy India

system more reliable, efficient, and safer. Every microinverter is powered by semiconductor integration, predictive control, and a technically configurable architecture. And each microinverter undergoes rigorous functional and reliability testing. The one-of-a-kind, high-tech automation manufacturing unit is certified with ISO 14001, ISO 27001, ISO 45001, and ISO 9001.

Speaking about Enphase Energy's India focus, Sunil Thamaran, VP and MD at Enphase Energy India, said, "Enphase sees incredible growth potential in India and has partnered with Salcomp to provide

an impetus both domestically and export-wise for India. We have exported millions of microinverters to North America, Europe, and Asia from this plant. Besides that, about 60% of Enphase Energy's global workforce is in India."

ET

TPCODL CONDUCTS ALL-ROUND REFURBISHMENT OF ITS DISTRIBUTION INFRASTRUCTURE IN CUTTACK

To avoid mishaps to people and stray animals at open electrical establishments, the company has undertaken fencing work at 240 places...

With reliable power supply to all its consumers as its primary objective, TP Central Odisha Distribution Limited (TPCODL), a joint venture between Tata Power and the Government of Odisha, has been focusing on upgradation of existing electricity distribution infrastructure and augmentation of the same. The company has recently undertaken a number of such initiatives in Cuttack district in this regard.

TPCODL has installed over 6000 new poles replacing small heighted, old, and faulty poles across its five divisions under Cuttack electrical circle to ensure continuous and reliable power supply in this area. To ensure a safe network for electricity supply around 3700 tilted poles have been straightened and over 500 double pole structures are installed. It also

took up strengthening of mass scale power network in 169 feeders resulting in better service to the customers like 11 kV Paramhansh feeder under City Distribution Division II – where tripping was a major issue for a long time. Similarly, feeders at Nahalpur, Ramkumarpur and Ayadpur under various divisions have helped in irrigation and agriculture in a major way by supplying proper electricity to the area.

TPCODL has refurbished as many as 96 Distribution Sub-Stations and installed 67 new 11 kV AB Switches at various locations in the circle, which have proven helpful in enhancing reliability and uninterrupted power supply in various localities.

Appropriate road crossing measures have been taken at around 230 places to avoid any sort of accident.

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LUMINOUS LAUNCHES INVERTER SERIES WITH LI-ION-BASED BATTERIES, PROVIDES FIVE-YEAR-LONG WARRANTY

Luminous Power Technologies has launched a new inverter series “Li-ON”, an integrated Inverter with Lithium-ion batteries. The new series built on Li-ion batteries, touted as the future of the power storage business, aligns with the idea of an ‘integrated approach to science and technology, for a sustainable future’, the theme for this year’s National

Science Day. The new inverter series is compact, safe, efficient, and provides high-rated performance with zero maintenance.

Commenting on the launch, Vipul Sabharwal, Managing Director, Luminous Power Technologies, said, “Constantly striving towards quality and performance excellence, we are proud of our ability to create ground-breaking products that are not only innovative but



Li-ON 1250, the first in the Li-ON series...

also better for our environment. With the new series, we are also addressing the pressing needs for minimizing the carbon footprint with reduced CO₂ emissions. Our aim is to provide our customers with an experience that’s essential in the post-pandemic era, as we need to stay connected and rely on an ‘always-on’ support system. Li-ON is attractive, compact, safe, and efficient, with a long-lasting battery that requires negligible maintenance. It is certainly a game-changing power backup system.”

Li-ON 1250, the first in the Li-ON series, will be offered as a single unit with an inverter and integrated Li-ion battery encapsulated in an elegantly designed premium cabinet. With the new Li-ON battery, the Li-ON series of inverters promise enhanced performance with an extended battery life that is 3 times better than conventional battery-based inverters. E1

GUJARAT’S FIRST HYBRID PROJECT TO MITIGATE ~150,000 TCO_{2e} EMISSIONS YEARLY

Gujarat is one of the states that has aggressively supported corporate adoption of clean energy. It announced a hybrid policy in 2018...

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 tCO_{2e} (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 tCO_{2e} (carbon emission) a year (source: tCO_{2e} value calculated as per CEA database version 16).

Speaking on the project, Mayank Bansal, Chief Commercial Officer, ReNew Power, said, “As India strives to achieve net zero by 2070, large scale adoption of renewables by corporate India is key. With corporates increasingly harnessing renewable energy, ReNew aims to develop around 250 MW of wind-solar hybrid projects in Gujarat.” E1

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UNDERWRITERS LABORATORIES SELECTS REDFLOW FOR FLOW BATTERY RESEARCH PROGRAM

Underwriters Laboratories Inc. has selected Redflow ZBM batteries to carry out research to characterize the operating and safety profile of redox flow batteries under nominal and off-nominal conditions.

The Electrochemical Safety Research Institute at Underwriters Laboratories has undertaken the test program in collaboration with Stress Engineering Services Inc. (SES) and Redflow to understand key technical attributes of redox flow batteries, study their cycle life and aging properties and to understand how the batteries behave under off-nominal conditions of overcharge, over-discharge and external short-circuit conditions. Six Redflow batteries were purchased by Underwriters Laboratories in 2021 and the test program commenced in January 2022.

Commenting on test, Tim Harris, Managing Director and CEO of Redflow, informs, “Redflow’s CTO Steve



Redflow MD & CEO Tim Harris

Hickey and I were able to meet the Underwriters Laboratories and SES teams at their Texas facility last month to advise on the setup of the Redflow batteries and provide broader input on the test program.”

This research will enhance the knowledge base around the operating and safety characteristics of zinc-bromine flow batteries, enabling interested parties to better understand and compare a broad range of battery chemistries.

Detailing on the need for the test, Dr. Judy Jeevarajan, Vice President and Executive Director of the Electrochemical Safety Research Institute at Underwriters Laboratories, says, “As redox flow battery technology evolves, it’s important to determine its safety and performance limits under various conditions. Our partnership with Redflow and SES will deepen our understanding of this energy storage alternative.”

GWEC’S NEW REPORT PREDICTS POSSIBILITY OF ADDING 2.2 MILLION ENERGY JOBS

India could save an extra 229 million metric tons of CO_{2e} over the lifetime of a wind farm...

The Global Wind Energy Council (GWEC) has recently published a report titled Capturing Green Recovery Opportunities from Wind Power in Developing Economies. The report, written in collaboration with BVG Associates, highlights the vast and largely untapped socioeconomic and environmental opportunities that could be unlocked by wind energy in a group of developing economies from 2022-2026.

The report focuses on five countries – Brazil, India, Mexico, the Philippines and South Africa – each of which face particular challenges due to COVID-19, but which have significant untapped wind energy resource that could unlock rapid economic growth under green recovery measures.

The five case studies quantify a series of impacts, which would result from pursuing a green recovery

strategy, where public policy shifts towards the clean energy transition to accelerate deployment of wind projects over the next five years. This approach would not only support countries on their progress to meeting energy and climate goals, but would enable them to realise a range of socioeconomic benefits from long-term job creation to cleaner air and water conservation.

The total upside for green recovery measures across the five countries examined in the report include 2.23 million full-time equivalent jobs over a 25-year lifetime of wind projects, and nearly 20 GW of additional wind power installations – enough to power roughly 25 million homes each year from 2026 onward, and potentially save the equivalent of 714 million metric tons of CO₂ emissions over wind farm lifetimes.

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TWO MILLION PEOPLE TO RECEIVE CLEAN ENERGY FROM SENEGAL'S NEW WIND FARM

Senegal inaugurated the first large-scale wind farm in West Africa on Monday, a facility that will supply nearly one sixth of the country's power when it reaches full capacity later this year. With the wind farm, Senegal will get 30% of its energy from renewable sources, which has been a goal of President Macky Sall. The 158 megawatt wind farm was built by British renewable power company Lekela, which also has wind farms in South Africa and Egypt and an upcoming one in Ghana.

Briefing on the development, Papa Mademba Biteye, Director-General of Senelec, the national electricity company, said, "The energy mix we have today allows us to move past our dependence on petrol."



With the wind farm, 30% of all energy used in Senegal will be from renewable sources...
Representative Image Source: Unsplash/ZHANG FENGSHENG

Wind farms remain scarce throughout sub-Saharan Africa compared with solar plants, partly because they can cost more and take longer to build and because strong wind is generally less plentiful than sunshine, said Silvia Macri, an energy analyst at IHS Markit. "Senegal pushed ahead its renewables agenda quite aggressively," Macri told the Thomson Reuters Foundation.

Senegal's first solar plant came online three years ago, and the country has since built several more. Other countries in the region are following suit with solar but are much further behind in terms of wind, Macri added. In Taiba N'Diaye, 46 giant wind turbines rise over scrubland about 90 km (56 miles) from the seaside capital. One-third are operating, and the rest are due to come online by June.

UOSSM LAUNCHES FIRST ELECTRIC VEHICLE POWERED BY SOLAR ENERGY SYSTEMS

The 100% Electric Vehicle (EV) uses a lithium battery charger at health facilities powered by solar energy...

UOSSM has launched the first Electric Vehicle (EV) in northern Syria. The vehicle will be used primarily for health services including vaccine transport between cold rooms and primary healthcare facilities, and to transport patients as part of the referral system.

Over a decade of ongoing conflict has left over four million people in northern Syria without access to critical health services. Aerial bombardment has destroyed healthcare and energy infrastructure, leaving civilians and healthcare workers to rely on diesel fuel, creating a cycle of dependency, fragility, and further contributes to conflict.

To address this challenge, a humanitarian innovation by Union of Medical Care and Relief Organizations (UOSSM) has successfully launched

the EV under the new Health System Resilience program in northern Syria. The 100% solar-powered vehicle reduces dependency on fuel, while ensuring critical health services can run 24/7 in one of the most fragile settings. The expected metrics and outcomes of the pilot project will show its importance in improving and saving lives as it will be used for medical purposes and non-reliant on fuel- providing medical access in situations such as shortage of fuel in the area.

The EV is expected to result in significant savings in the long term by reducing reliance on fuel, and strengthening and localizing the health system. In remote and conflict affected areas, health systems including hospitals and ambulances rely on diesel fuel for generating electricity and running mobile ambulatory services.

O. BLUM TO TAKE OVER AS THE EXECUTIVE VP OF SCHNEIDER ELECTRIC



He is currently the Chief Strategy & Sustainability Officer at Schneider Electric...

Schneider Electric has appointed Olivier Blum as the new Executive Vice-President of its Energy Management Business, effective from April 1, 2022.

Olivier began his career at Schneider Electric in 1993 in his home country France. He has been living and working in Asia for the last two decades, where he has held lead leadership positions as the Regional Head of Strategy for China and the Regional Managing Director for India, before taking on the global role of

Executive Vice-President for the Home & Distribution Division based in Hong Kong. In 2014, he joined Schneider Electric's Executive Committee as the company's Chief Human Resources Officer.

In his new role, Olivier will be responsible for Schneider Electric's full Energy Management portfolio of world-leading technologies, software and services, championing "Electricity 4.0" as the fastest route to a net zero world that is more electric and more digital. **EE**

K. AMIN HAS BEEN INDUCTED AS BOARD MEMBER IN THE BOARD OF SIEMENS ENERGY



He currently is the Executive Vice President for the Siemens Energy Generation division...

The Siemens Energy Supervisory Board appointed Karim Amin as Member of the Executive Board, effective from March 1, 2022.

Karim served in various management positions and had experience in service operations, sales, product management and lately was responsible for the biggest division within Siemens Energy (26,000 employees). He graduated from Cairo University as an Electrical Engineer and holds an MBA from Warwick Business School in the UK. Karim has been

leading the performance improvement for the Generation Division since the establishment of Siemens Energy.

Commenting on this appointment, Joe Kaeser, Chairman of the Supervisory Board of Siemens Energy, said, "Karim is an excellent leader. His passion for customers, people and competitive edge is outstanding. I've known him for over a decade and value his experience and dedication for our industry and his relentless efforts to drive innovation and decarbonization at all levels of the value chain." **EE**

S. REESE JOINS GE DIGITAL AS CHIEF EXECUTIVE OFFICER



He has joined GE from Autodesk where he was Executive Vice President, Product Development and Manufacturing Solutions...

GE has appointed Scott Reese as Chief Executive Officer of GE Digital effective from February 22, 2022. He has joined Autodesk in 2003 with the acquisition of VIA Development Corporation and has spent nearly two decades leading product and go-to-market initiatives across a wide range of industries, while driving aggressive growth with next-generation solutions for manufacturing. Reese also established Autodesk's cloud platform, products, operations, and cyber security practices.

Revealing their future plan, Chief Executive Officer of GE's global energy business portfolio, Scott Strazik said, "GE Digital is a critical part of the new energy company planned to spin off from GE in 2024. I am thrilled to have Scott Reese join this mission with his track record of transforming software businesses and driving growth. His deep software industry experience makes him the ideal fit to partner with our customers and the GE Digital team to accelerate the energy transition." **EE**



EV CHARGING STATION BUSINESS TO WITNESS BRIGHT DAYS

The global Electric Vehicle (EV) charging station market size is projected to grow from 2,354 thousand units in 2022 to 14,623 thousand units by 2027, at a CAGR of 44.1%. Public chargers will be the fastest growing market during the forecast period...



According to a recent report published by Research and Markets, the availability of public EV charging plays an important role to purchase electric vehicles across the globe. Public charging and access to fast charging are viewed as key criteria when buying an electric vehicle. This is anticipated to bolster revenue growth for the public charging segment. The Asia Pacific region continues to install public chargers at a significant rate due to the rising number of EV users, especially in China, India, and South Korea. These countries have implemented policies to increase the usage of EVs by providing subsidies and reduced taxes.

They also encourage the growth of EV manufacturers and related industries by providing grants or implementing preferential policies for

EV-related companies to enable them to expand faster. A steady surge in economic growth, urbanization, travel demand, etc., coupled with increasing investments toward electric mobility to contribute to energy storage and environmental sustainability is anticipated to bolster the growth of the public charging station segment.

The largest and fastest-growing market

The Asia Pacific region; comprising countries such as China, India, Japan and South Korea; is the home to some of the fastest-developing economies of the world, such as China and India. The governments of these emerging economies have recognized the growth potential of the global electric vehicle charging station market, and thus, have adopted various initiatives to

attract major OEMs for the manufacture of electric vehicle charging infrastructure in domestic markets. For instance, charging network providers for EV charging stations have partnered with various OEMs to sponsor free EV charging to EV drivers. This has led to an increase in electric vehicle production in recent years, which caters to domestic as well as overseas demand. Japan and China export electric vehicles and charging solutions across the globe.

Governments in the Asia Pacific region are also focusing on the introduction of electric commercial vehicles. For instance, in September 2020, the Indian Government announced plans to offer incentives worth USD 4.6 billion to companies establishing advanced battery manufacturing facilities as part of its plans to reduce oil imports while switching to EVs. Similarly, in 2019, China undertook measures such as sales tax exemptions. It also provided preferential financing and traffic management policies for electric vehicles besides optimizing its carbon credit program, which will be reduced appropriately in the coming years.

The second-largest growth region

The major EV markets in Europe are Austria, Denmark, France, Germany, the Netherlands, Norway, Spain, Sweden, Italy, and the UK. Europe accounted for 24.78% of the global electric vehicle charging station market in 2021 by volume. Normal chargers have a higher share than fast chargers. The top five countries account for more than 83% of all chargers, and the rest is utilized in the rest of the countries. By August 2020, Europe had implemented stringent emission regulation standards to reduce the rising emission levels. Several countries in the region are promoting electric vehicles through significant incentives.

The demand for electric vehicle charging stations has increased significantly due to the focus on zero- or low-emission vehicles in the region. The region is home to electric vehicle charging station providers such as Schneider Electric, ABB, Siemens, Efacec, Engie, and various others. The UK announced plans to phase out petrol/diesel-based vehicles by 2030 and encourage the growth of EVs. Other European countries had implemented plans for the transition to EVs during the past decade. 

For further information: <https://www.researchandmarkets.com/r/mcg7dl>

Steps to Revitalise GENCOs



If we look at the mounting amount of dues that GENCOs have to collect from the DISCOMs, it's really alarming. Forget about recovery, controlling escalation of dues is the need of the hour. What is MoP doing? Is that enough?

- P. K. Chatterjee (PK)

The last month, I mean February 2022, was quite eventful for the Indian power industry considering revelations of some of the trendy outlooks and major planning decisions of the union government. In a meeting of the Parliamentary Consultative Committee attached to the Ministry of Power (MoP), it was informed that – “The government has brought about a transformational change in the power sector over the past few years. With total installed generation capacity of 394 GW including

renewable energy capacity of 104 GW as of today (17.02.2022), our country has transformed from a Power Deficit to a Power Surplus country. Adequate transmission network has been created with enhanced inter-regional transfer capacity of over 1 Lakh MW and connecting the entire country into one integrated grid running on one frequency. The country achieved 100% village electrification and universal electricity access to all the households with significant improvement in availability of Power Supply in both rural and urban areas. The availability of power in rural areas, which was about 12.5 hours in 2015 has gone up to 22.5 hours and in the urban areas it has gone up to 23.36 hours.”

GENCOs are facing big financial challenges

Power Distribution remains the most critical link in the power sector value chain. It generates cash that feeds to the entire value chain right up to power generation and fuel supply. The impact of any inefficiency of financial management within power distribution flows to all upstream players in the value chain that adversely affects their operations and financial viability.

According to the government, one of the cases to pinpoint is mounting Genco dues to DISCOMs – it has reached at an alarming level of Rs. 98,722 Cr as on 31.01.2022 for Central Generating stations, IPPs and RE Generators put together. If the dues of State GENCOs (Rs. 63,000 crores) are also included, the total outstanding dues of GENCOs would be Rs. 1.6 Lakh crores. Thus, it is high time to assess the measures and remedies being undertaken.

A presentation from the MoP

The Government of India has initiated multiple initiatives to address the issue of surmounting GENCO dues and worsening financial performance of DISCOMs. These initiatives have been designed to tackle financial and operational issues like high AT&C Losses, high ACS_ARR gap, inadequate corporate governance, poor liquidity, lack of consumer-focused approach etc., to bring in desired financial discipline in DISCOMs and State Governments.

MoP's new order

LC-based Payment Security Mechanism: The Ministry of Power has issued an order on June 28, 2019 regarding opening and maintaining an adequate Letter of Credit (LC) as a payment security mechanism under Power Purchase Agreements (PPAs) by DISCOMs. The order mandates National Load Dispatch Center (NLDC) and regional Load Dispatch Centers (RLDC) to dispatch power only after it is intimated by GENCO and DISCOM that a Letter of Credit for the desired quantum of power has been opened and copies made available to the concerned GENCO.

PRAAPTI Portal for Monitoring of GENCO Dues: The Ministry of Power (through PFC) has launched a web-portal called PRAAPTI (Payment Ratification and Analysis in Power procurement for bringing transparency in invoicing of generators) for transparency in monitoring of GENCOs dues at the national level. The portal was launched in 2018 and provides updated monthly information to all stakeholders regarding power purchase dues of DISCOMs towards Central Generation Stations, IPPs and RE providers. The PRAAPTI portal is immensely helpful for all stakeholders and also for monitoring performance on DISCOMs under Additional Borrowing Scheme, RDSS etc.

Revamped Distribution Sector Scheme (RDSS): The Government of India has launched the Revamped Distribution Sector Scheme (RDSS) to help DISCOMs improve their operational efficiencies and financial sustainability by providing result linked financial assistance to DISCOMs to strengthen supply infrastructure based on meeting prequalifying criteria and achieving basic minimum benchmarks. The main objectives of RDSS are:

- Reduction of AT&C losses to pan-India levels of 12-15% by 2024-25
- Reduction of ACS-ARR gap to zero by 2024-25.
- Improvement in the quality, reliability and affordability of power supply to consumers through a financially sustainable and operationally efficient distribution sector.

The scheme comprises two components – Part A: Financial support for Prepaid Smart Metering and System Metering and Up-gradation

of Distribution Infrastructure; and Part B: Training and capacity building and other enabling supporting activities.

Through this scheme States or DISCOMs would be able to access funds for addressing infrastructure constraints in their distribution system as well as for its further augmentation or strengthening. This scheme provides for installation of prepaid smart meters with two-way communication features for over 25 crores electricity connections under TOTEX mode, which will help in reducing AT&C losses and facilitating automatic measurement of energy flows and enable energy accounting and auditing without any human intervention.

PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Uttthaan Mahabhiyan) Scheme: PM-KUSUM Scheme was launched in 2019 with an aim to provide energy security to consumers. This scheme provides performance-based incentives or funding support to promote installation of decentralized solar energy installations for provision of electricity to Agriculture Pump-sets. Under this scheme, Central Finance Assistance (CFA) up to 30% is provided and balance 70% can be mobilized as loan through FIs/Banks/NABARD.

Additional Borrowing Scheme: In line with recommendations of the Fifteenth Finance Commission, Ministry of Finance (GoI) has launched a program in June 2021 to allow additional borrowing space to State Governments, which is conditional on them undertaking and sustaining specific reforms in the power sector. The additional borrowing limit permitted for power sector reforms is 0.5% of the Gross State Domestic Product (GSDP) of the respective state. It is expected that the scheme would help improve financial performance of DISCOMs, which will enable them to settle outstanding liabilities including GENCO dues.

As per guidelines issued, the states' eligibility would be determined through evaluation across three components:

- Entry level eligibility conditions – To be fulfilled for becoming eligible for performance evaluation;
- Performance evaluation criteria – Marking scheme;
- Bonus Marks criteria.

Revised Additional Prudential Norms for Working Capital Loan to DISCOMs/TRANSCOs/GENCOs: At the insistence of the Ministry of Power, the Power Sector NBFCs (PFC and REC) under their administrative control have introduced additional prudential guidelines for sanctioning of working capital loans to DISCOMs/

TRANSCOs/GENCOs. These essentially entail that loans to DISCOMs and other State owned utilities would be contingent to their performance against prescribed conditions. The prudential norms for DISCOMs include – timely availability of audited annual accounts; timely filling of tariff petitions; timely issuance of tariff orders; determination of full cost tariff by SERCs; timely release of subsidy by State Governments; adherence to working capital norm as a percentage of revenue; outstanding Govt. Department electricity bills; AT&C trajectory and ACS-ARR gap as prescribed by MOP/GOI scheme; no default to any FI/ bank; preparation of quarterly accounts.

Corporate Governance Guidelines: 'Guidelines for Corporate Governance of State Power Distribution Utilities (DISCOMs)' has been forwarded to States/UTs by Secretary (Power) on 11th March 2021, to enable mechanisms for performance improvement and accountability, which provides a framework drawing from Companies Act 2013, DPE Guidelines, SEBI Regulations and best practices followed by private DISCOMs, which will be an enabling mechanism for improving the performance and accountability in State Owned DISCOMs. It is anticipated that implementation of these guidelines will result in better governance of the DISCOMs leading to overall improvement in their operational and financial performance.

A few things to ponder on

Although the Members of Parliament have offered several suggestions with regard to various initiatives and schemes of MoP, those will take time to be implemented (if at all). However, the government has been trying to mitigate the loss of GENCOs for the last two years and a half. Then where is the actual problem?

Perhaps the DISCOMs or States are still not in a position to manage to generate revenue! More than governance, it is important to improve vigilance and action on the spot. As on January this year, DISCOMs had to pay Rs. 1,21,030 crores to GENCOs, the figure was Rs. 1,15,904 crores in January 2021. It is a bit more than 4% rise in a year when many industrial units were running slow.

In any case, right now when the economy is regaining its lost vigour, we have to wait and watch... But we have to continue focusing on decentralised power generation and keeping pressure on building more and more captive power plants.



Reliable Power Systems



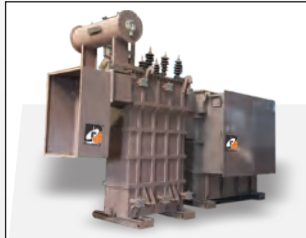
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PERFORMANCE EVALUATION OF A SOLAR MICRO PUMP

For efficient irrigation, use of solar pumps is quite prevalent these days. Here the author presents a report to establish the effectivity of using micro solar pumps...

www.electricalindia.in

Solar pumps are commonly being used for irrigation water pumping applications and the common capacity being 1 hp to 10 hp. Solar micro pumps of 0.25 and 0.5 hp are being used for drinking water application. A solar micro pump of 200 W, 24 V DC, BLDC motor, 5800 rpm, 16 lpm, 15 m total head surface pump with 250 W solar panel and controller was tested and the results are analysed in this article.

Two tests were carried out. One test through a solar array simulator for a standard daily radiation of 7.15 kWh/m^2 day with summer radiation profile. Another test directly thought the solar PV module on normal sunlight and the results are presented.

Experimentation results

Hot profile: The pump was installed over a water sump with piping and instrumentation to maintain a constant head. Through the simulator, the standard summer hot radiation profile and solar PV module parameters were applied and the resultant DC power was fed to the controller and then to the motor. The variation of input power

and water discharge from the pump for a constant head of 15 m with time is plotted in Figure 1. The hot profile ran for 9 hours and the pump ran from 60 W to 200 W

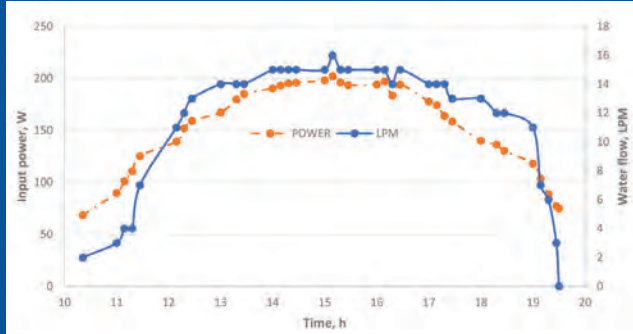


Figure 1: Variation of power and water flow with time (Summer profile).

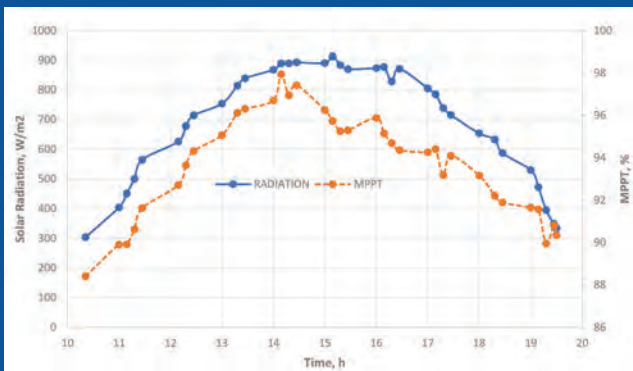


Figure 2: Variation of Radiation and MPPT with time (Summer profile).

and the flow was 2 lpm to 16 lpm. The variation of solar radiation and Maximum Power Point Tracking (MPPT) with time is plotted in Figure 2. The motor-pump operated between the radiation of 300 W/m² to 900 W/m². The MPPT varied from 88.5 to 98%. The water discharge was 6,680 litres/day.

Realistic profile: The solar PV module was kept in direct sunlight and the power generated was fed to the controller and then to the motor. The variation of solar radiation with time is plotted in Figure 3. The motor-pump operated between the radiation of 300 W/m² to 820 W/m² (available on the particular day). The variation of input power and water discharge from the pump for a constant head of 15 m with time is plotted in Figure 4. The realistic profile ran for 7 hours and the pump ran from 75 W to 180 W and the flow was 3 lpm to 15.8 lpm. The water discharge (extrapolated to 7.15 kWh/m²/day) was 6,750 litres/day.

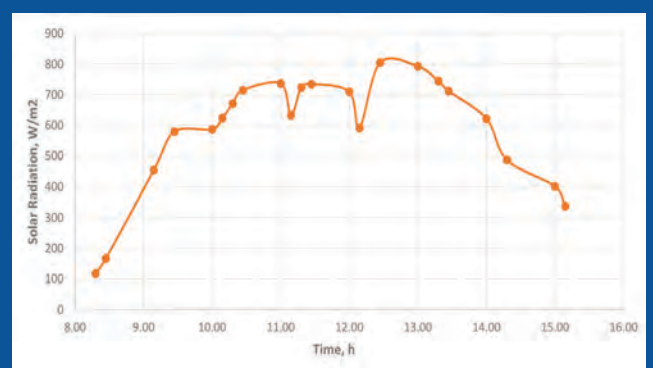


Figure 3: Variation of solar radiation (realistic) with time.

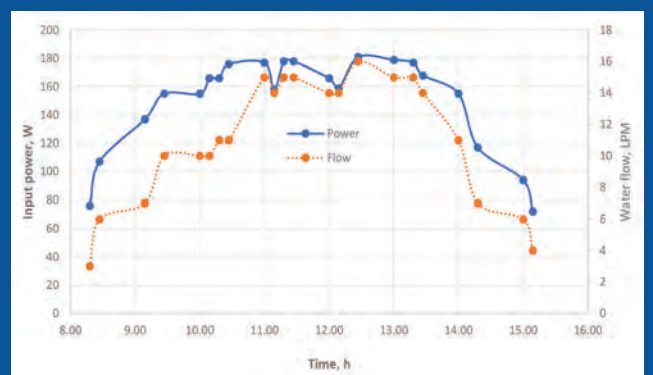


Figure 4: Variation of input power and water flow (realistic) with time.

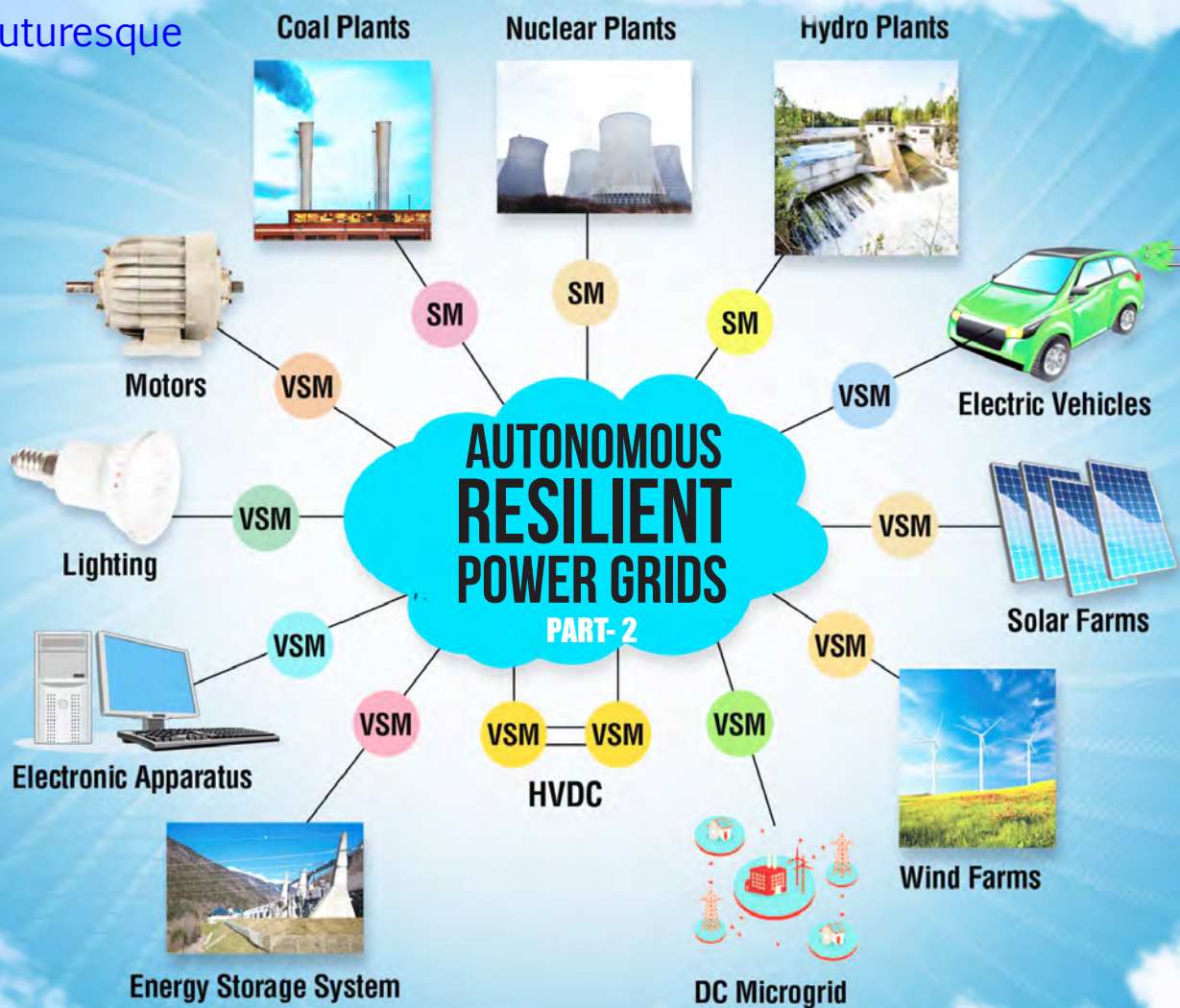
The shut off head of the pump was 26 m and the all-day water to wire efficiency was 17.8 %.

Conclusions

A 200 W solar micro pump was tested with simulation and also with realistic profile and the results are presented. Hot profile MPPT varied from 88.5 to 98 %. The water discharged per day was 6680-6750 litres at a constant head of 15 m and the all-day water to wire efficiency was 17.8 %.



S. Jothibas has B. Tech in Mech. Engg. and M.Tech in Thermal Engg. He is presently working as Joint Director with Central Power Research Institute, Bangalore. He has been taking care of Solar Pump Testing and also providing Energy Audit service to Process industries, Buildings, Hydro, Gas, DG & Thermal power stations. He has 40 technical papers to his credit. He is a certified & accredited Energy Auditor of BEE, New Delhi, and a Life Member of SEEM.



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...

Dynamic Energy Storage

A unified energy management scheme offers many advantages in terms of power quality improvement, energy time frame shifting, intermittency handling etc in renewable energy integrated power systems. The performance of a distributed energy source integrated energy system depends on the regulation of DC link voltage, power quality, real power transfer such as reactive power support, current harmonic compensation, unity power factor operation etc. When DC-link voltages are subjected to transient conditions, it results in Slow-acting of the same which leads to issues like degradation of compensation performance, maximum power point shifting from operating point on renewable source side, failure

in effective power management at DC link. That is why it is important to have an effective energy storage system which supports system operators and renewable energy producers.

Keeping in view the above perspective and issues, battery-supercapacitor units emerge as a solution for dynamic energy storage devices. In this simple energy management scheme, renewable energy source is connected with high-gain DC-DC converter. As energy storage device batteries and supercapacitors are used. They are also responsible for the required power flow in the system. And the power flow control between the utility grid and the energy storage device is done by a bidirectional buck-boost DC-DC converter. The voltage source converter is responsible for the real power exchange from renewable energy sources to the utility grid and to achieve the main function of real power transfer.

This proposed scheme has several advantages including fast DC link voltage regulation, effective energy management at DC link, inherent current limits for both supercapacitor and battery life etc. Another main feature is extended life span, less intensive and less effect of current stress on battery units.

Technical Areas

Advanced data analytics, complex system theory, optimization algorithms, and nonlinear controls are some of the technical areas to achieve an autonomous energy grid as shown in Figure 8.

The data analytics based renewable energy forecasting methods have a vital role in the modern

industrial system. Large volumes of heterogeneous data on the electric grid are collected, stored and analyzed with the help of smart meters, sensors, smart home energy management systems etc using data management techniques. Big data analytics have the ability to collect, store, manage and efficiently process these data using data mining algorithms or machine learning algorithms. The four main steps in this process are data collection, data communication, data analysis and finally data processing. Fault detection and location, output forecasting, protection, operation and maintenance are some of the major applications of data analytics. Neural network, k-means, and support vector machine are the typical data analytics methods which are widely used.

Optimization methods of the autonomous energy grid can be divided into planning, operations and interactions with ICT infrastructure. Control, optimization and monitoring have to be done in real time and decentralized manner using advanced mathematical models and algorithms. The combined operation of distributed optimization methods and information infrastructures are needed for the exchange of performance between algorithm and data volume.

From a control point of view, in AEG, decentralized control algorithms are used to control the system. But due to communication delays, losses, and synchronous control actions, these algorithms are inherently asynchronous. This leads to challenges in optimal operation and stability analysis. This can be solved by developing scalable-

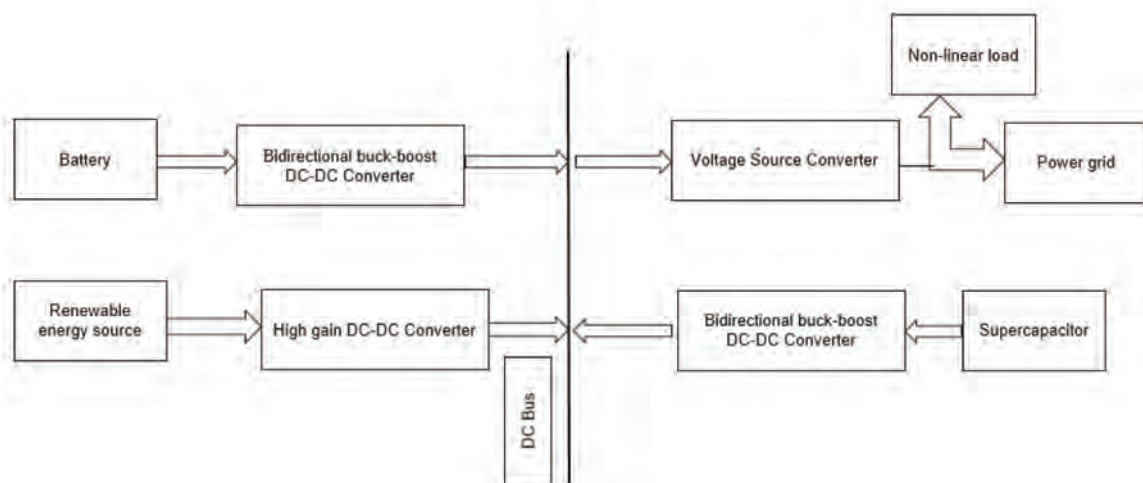


Figure 7: Dynamic energy storage system for DER integrated utility grid

control strategies which can be applied for both large and small scale grids.

Model and simulation of different energy domains are needed in AEG for real-time optimization, system and subsystem control. This is where the role of a complex control system comes in. Big data analytics provides the required information for forecasting. That information can be used as a parameter in optimization algorithms.

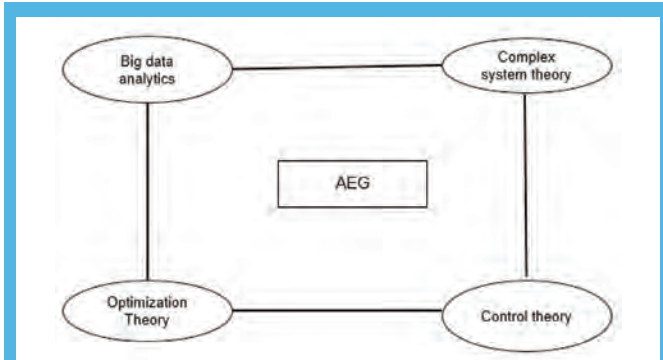


Figure 8: Technical areas of AEG

Implementation Of Virtual Synchronous Machine

Among the different models of implementation, synchronverter approach and robust droop control offers promising technical routes for the implementation of power electronics based autonomous energy systems.

Synchronverters or virtual synchronous generators are DC-AC converters in which the mathematical model of a synchronous machine is directly embedded into the controller. i.e. these inverters can be operated to mimic the behaviour of a synchronous generator. It can be controlled either by controlling the DC bus voltage or by directly controlling the power exchanged with the grid. The real and reactive power delivered by a synchronous converter connected in parallel can be controlled as well. Thus, there are two control strategies for synchronverter. Among all available options today, the synchronverter model is the simplest. It consists of two parts: one is a power part (Fig 9) which is a basic inverter (converts DC power into three phase AC) and another one is an electronic part which is responsible for controlling the switches in the electronic controller via running code in the processor with lowest number of control parameters. The electronic part consists of voltage sensors, current sensors, analog to digital converters. The power part transforms the energy through three phase inverter legs operated with

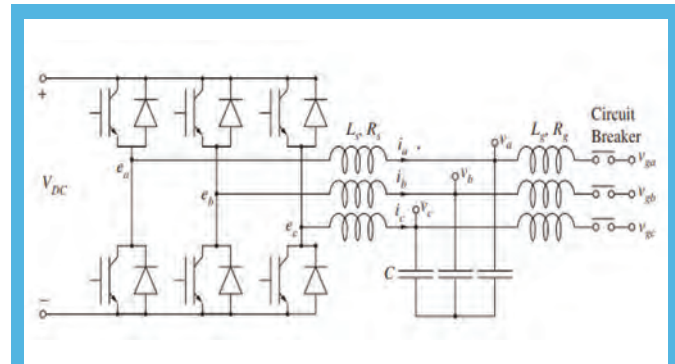


Figure 9: Synchronverter - Power part

Pulse Width Modulation (PWM) and three phase LC filters. These filter inductors and capacitors reduce voltage ripples, current ripples and hence suppress the switching noise. In addition to this, inductors and circuit breakers can be adopted to couple with the grid. The electronic part includes sensors and Digital Signal Processor (DSP) and acts as the pattern of a synchronous generator.

A synchronverter, when connected to the grid, helps in voltage and frequency regulation without even measuring the grid frequency through voltage and frequency drooping. This method also helps to achieve load sharing and power regulation. It can be easily operated in island mode or grid connected mode and hence provide epitome solutions for microgrids and smartgrids. Another added advantage is its autonomous and self-organizable property: it can automatically disconnect, reconnect and resynchronize with the grid. Grid connection of renewable energy sources, HVDC application, STATCOM, PV inverter, parallel operation of UPS, isolated or distributed power supplies etc are some of the potential applications of synchronverters.

Robust Droop Control

The robust droop control, which is based on improved droop control strategy, is another technical route to implement inverter based smart power systems. The synchronization mechanism of a synchronous machine inherently exists in drop control strategy and can be equipped with a self-synchronization mechanism which eliminates the need of Phase Locked Loop (PLL) even though the controller structurally resembles an enhanced PLL or the sinusoid-tracking algorithm for synchronization. Thus, establishing a link between droop control and PLL, this control strategy helps in voltage regulation, accurate power sharing, and is applicable

to inverters with varying impedances. It should be noted that, in this technology, the inverter attains synchronization by a droop controller, thus eliminating the need for a dedicated synchronization unit. This mitigates concerns caused by PLL such as performance degradation, increased competition, PLL tuning issues etc. Whenever voltage is higher than the rated value, the reactive power automatically gets reduced. Similarly, when the frequency is lower than the rated value, the real power gets increased. Thus, this technique helps in the automatic regulation of real power and reactive power corresponding to the variation of frequency and voltage, while controlling the output voltage within the specified range (even when it is subjected to noise, computational error, component mismatches etc).

Conventional droop control idea takes different forms for different types of impedances such as resistive impedances, capacitive impedance and inductive impedance, which makes it impossible to operate in one system. Also, conventional droop control strategy addresses the problem of parameter shifts, numerical error, disturbances and noise, inaccurate real and reactive power sharing etc, thus leading to problems for large scale renewable energy utilization. Robust universal droop controller is an ideal solution for these problems. This control can be applied to inverters having phase angle varying from $-\pi/2$ rad to $\pi/2$ rad, which is called droop control of R-inverters. This method is highly efficient for parallel operation of inverters with varying output impedances and removes all issues raised by the traditional method.

Conclusion

Autonomous energy systems facilitate the future transactive energy market. It offers solutions for many problems faced by traditional power systems. The fundamental concept behind this technology is by interfacing power electronic devices with the grid through a common law of synchronization. The mechanism and dynamics of synchronous machines are embedded in these power electronic based players, so that all individuals attain legal equality and behave as one system. These kinds of power electronic converters are termed as virtual synchronous machines. The control mechanism of VSM is done through synchronverter control strategy and robust droop control strategy which offers potential solutions for the implementation of VSM. Since all individuals in the grid are homogenized

they can interact with each other by exchanging power through a dedicated communication channel. This leads to autonomous operation of the power system. Thus this technology makes the power grid more efficient, selforganizable and resilient by utilizing maximum benefit from green energy sources.

...concluded 

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Advanced measuring solutions for electrical maintenance and safety



testo Voltage tester application



testo voltage current tester application



testo Multimeter application



testo Clamp meter application

We often find the electrical maintenance engineers and facility inspectors are trying their best to ensure uninterrupted service. Many a time they have to encounter problems like power losses, system failures and at the worst even accidents. Continuous inspection becomes a mandate & that's where Testo extends its support and expertise to the industry and its users.

Testo Electrical Measuring Instruments is a set of equipment that enables any engineer or technician to curb down any sort of electrical disorder. Thanks to innovative technologies and simplified application, the Testo measuring instruments measure electrical parameters more reliably and precisely than ever before. This complete set comes in a portable kit with:

I. testo 745 non-contact voltage tester with a voltage range of up to 1,000 V AC is particularly well-suited to fast initial checking of any suspected fault sources. It is available with a filter and is used for high-frequency interference.

- Adjustable sensitivity • Visual and acoustic signal
- Waterproof and dustproof according to IP 67
- Measuring point illumination

II. Testo 750 Voltage tester is with patented all-round LED display for visibility from all sides. They have the most essential functions for voltage testing, continuity testing and rotating magnetic field measurement.

- Clear, patented all-round LED display • Fibre-optic technology for optimum voltage indication • Anti-slip ring for secure grip • Ergonomic handle shape
- Measuring point illumination

III. Testo 755 voltage & current tester is the first of its kind that meets the latest standard, and can also measure current. It can determine voltage/de-energization, for measuring current and resistance, as well as used for continuity tests. In addition, the integrated torch enables dark spots to be illuminated. The measuring tips can be changed easily, so that the whole instrument does not need to

be replaced in the event of damage.

- Automatic measurement parameter detection
- Certified according to voltage tester standard
- Measurement result without any switching on or selection • Measuring point illumination
- Exchangeable measuring tips

IV. Testo 760 multimeter is the first digital multimeter with automatic detection of measurement parameters and selection via socket assignment. Function keys replace the traditional dial on all three instruments, which means easier operation and greater reliability.

- Easy, modern operation with function keys instead of a dial • Measurement parameter detection and selection via the socket assignment • Prevents incorrect settings • True root mean square measurement - TRMS • Large, backlit display

V. Testo 770 Clamp meter is ideally suited for current measurement in switching cabinets. It has a unique grab mechanism for easy and safe work and automatic measurement parameter detection also it ensures reliable work. It also measures multiple parameters like, power factor, resistance, voltage etc very easily.

- Unique grab mechanism makes it easier to work at tight measuring points • Auto AC/DC for current and voltage • Large two-line display • True root mean square measurement - TRMS • With additional functions, such as starting current, power and μA measurement • T 770-3 also works on Bluetooth and testo Smart Probes App

It has also been proven that an efficient and healthy electrical facility can improve total performance of any industrial, residential or commercial application. Testo provides you with the best solutions and products that not only measure the necessary parameters but also ensure longevity and minimises colossal damages. Now Be Sure with testo. 

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PHOTOVOLTAIC MANUFACTURING

OUTLOOK

IN INDIA

PART 1

As prolonged dependence on the imports raises the severity of the associated risks, India needs a sustainable, vertically integrated domestic solar manufacturing ecosystem. In addition to the PV manufacturing landscape, this article delves into other key aspects...

India has made substantial progress in domestic solar module manufacturing capacity in recent years. However, stronger impetus is needed in this regard to achieve 300 gigawatts (GW) of solar power generation capacity by 2030.

As of November 2021, India had a cell manufacturing capacity of 4.3GW and a module manufacturing capacity of ~18GW₁. These are, however, just nameplate capacities. Actual production output at any given time is significantly lower as most of Indian solar manufacturing facilities operate at a Capacity Utilisation Factor (CUF) of less than 50%. Moreover, multi-Si module technology, which accounts for the majority (60-70%) of existing domestic module production capacity, is on the verge of becoming obsolete. Local demand for these modules continues to dwindle and is expected to last for another 1-2 years. On the brighter side, new major manufacturers planning to expand or enter the market are seeking to install machinery that can handle cell sizes of up to M12 (210mm x 210mm), in both mono facial and bi-facial configuration.

India needs a sustainable, vertically integrated domestic solar manufacturing ecosystem

There is no existing manufacturing capacity in India for the initial stages of the photovoltaic (PV) value chain, namely from polysilicon to wafer. For these raw materials, Indian solar manufacturers are still dependent on imports, mainly from China. Prolonged dependence on the imports raises the severity of the associated risks. Shortage of raw materials, a power price hike in China and a surge in international freight charges have inflated module prices in 2021 by more than 25% ². This highlights the need for a sustainable, vertically integrated domestic solar manufacturing ecosystem.

Without large-scale domestic manufacturing of upstream PV value chain products, the overarching risks of logistics and commodity price fluctuations for imports will persist. The Indian PV industry also faces mid- to long-term challenges of high manufacturing expenses, inadequate Research and Development (R&D) and a shortage of skilled manpower.

Dozens Of Companies Are Vying To Make A Mark In The Indian Solar Sector

To encourage vertically integrated facilities, the Indian Government introduced the Production-Linked Incentive (PLI) scheme for 10GW capacity of integrated manufacturing of “High Efficiency Solar PV Modules” with a financial outlay of Rs 4,500 crore (US\$616 million). The PLI tender received a tremendous response (54.8GW of bids, a fourfold over-subscription) from the industry, pushing the government to increase the PLI amount by an additional Rs 19,500 crore (US\$2.5 billion) for solar module manufacturing.

The Indian government’s ambitious targets and support for the solar sector have made indigenous PV manufacturing’s prospects even more vibrant. As a result, dozens of companies are vying to make a mark in the Indian solar sector. In coming years, given the high growth potential of the domestic solar market and rising favourability of India as an alternative manufacturing hub (for geopolitical reasons), diverse stakeholders such as solar project developers, government-run organisations, PV ancillary players, etc., will strive to build their stake in the solar manufacturing market.

In addition to the PV manufacturing landscape, this article delves into key aspects such as major government initiatives, ongoing challenges and an overview of the way forward for India.

Global PV Manufacturing Landscape: A Snapshot

Of the total global solar module manufacturing capacity of 358GW, China accounts for about 61%.³ The dominance of China is visible throughout the entire supply chain of solar manufacturing. It holds the leading market share in manufacturing capacities of materials such as solar cells, wafers, polysilicon etc., which are critical to manufacturing of solar modules. In terms of worldwide production capacity (GW), China accounted for 75.2% of polysilicon, 97.9% of wafers, and 73% of solar cells in 2020.⁴

India’s manufacturing capacity share of 5% may make it one of the top five module manufacturers in the world but most of this capacity (about 10GW⁵) is either outdated in terms of cell sizes that can be handled (less than 158mm x 158mm) or not used efficiently. Also, the production output of Indian manufacturers is significantly lower than their nameplate capacities. Lower capacity utilisation in Indian production facilities adversely affects the pricing of their modules, presenting a challenge for domestic players to compete with global competitors in quality and pricing terms alike.

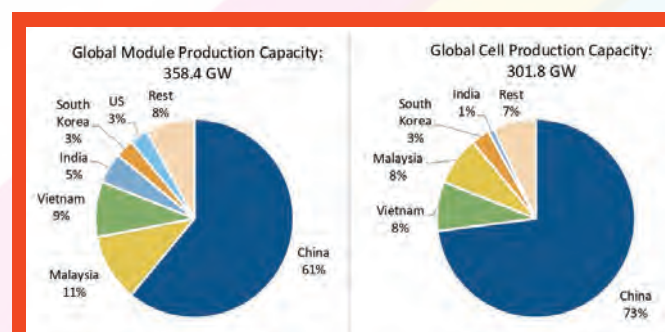


Figure 1: Global Annual Module and Cell Production Capacity (as of November 2021)

Source: Paula Mints: “Solar’s History and Future in Pictures”, SPV Market Research, November 2021.

Note the positions of Malaysia and Vietnam in the global industry (refer figure 1), these countries have become offshore manufacturing hubs for various Chinese players and are showing continuous growth in the relevant sector over the recent years.

From early 2010s, Chinese suppliers began flooding the market with cheap solar panels and in the process weakened local solar manufacturing industry in most of the relevant countries including India. In response, several countries then introduced policies to limit Chinese dominance and provided protection measures for the

local manufacturers. Some of these measures/barriers against the cheap solar imports are Anti-Dumping Duty (ADD) in the U.S. and Safeguard Duty (SGD) in India. As a result, several of the leading Chinese suppliers set up new manufacturing capacities in countries such as Malaysia and Vietnam to mitigate the international trade risks and also facilitated creation of these new solar PV export hubs in Southeast Asia. Leading Chinese suppliers such as Trina, Jinko etc have PV fabrication facilities (fabs) in China and Malaysia/Vietnam.

Favourable business environments, in terms of local government support and availability of skilled workforce, are among the key factors that led to the selection of Malaysia and Vietnam as preferred PV manufacturing destinations outside of China. Another factor is the countries' strategic location in the middle of Asia, enabling manufacturers to have their supply networks closer to the source of demand. Following suit, non-Chinese players such as First Solar, Hanwha Q cells etc have also set up manufacturing facilities in Southeast Asia.



Figure 2: Leading Module Manufacturers in the World (Basis Production Capacity)

Source: IEA PVPS National Survey Report of PV Power Applications in China 2020; BloombergNEF, 4Q 2021 Global PV Market Outlook, Nov 2021, Industry Interviews.

Of the 10 leading solar module suppliers, nine are Chinese. Most of the leading Chinese manufacturers maintain a Capacity Utilisation Factor (CUF) of more than 50%.⁶ Huge production scale coupled with their high CUF allow them to produce high-quality modules and simultaneously maintain competitive pricing. Anticipating an increase in demand globally in the post-pandemic era, many Chinese manufacturers plan to expand capacity at each level of their solar PV value chain, from polysilicon to modules.

In CY2020, JA solar announced module capacity expansion of 33GW, while Trina, Jinko and Longi have announced phased expansions of 29GW, 19GW

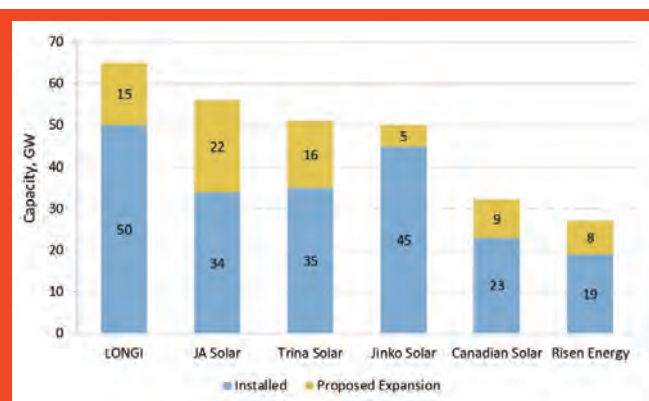


Figure 3: Proposed Module Capacity Expansions of Top Chinese PV Manufacturers, November 2021

Source: PV Magazine, IEA PVPS National Survey Report of PV Power Applications in China 2020, JMK Research.⁷

and 15GW respectively,⁸ up to CY2024. By the end of CY2021, JA Solar managed to reach 11GW of its 33GW target, while Trina and Jinko achieved 13GW and 14GW of their expansion targets. However, some analysts say achieving these targets in a timely manner would be difficult in a post-pandemic economy, owing to short-term constraints such as supply chain disruption and shortage of raw materials such as polysilicon.

The Chinese solar PV industry is also driving technology advancement. First, in early 2010s, Chinese players acted as the dominant force to bring back crystalline silicon (c-Si), specifically polycrystalline silicon (poly-Si) technology in the global market as it was losing ground to other technologies. In just a few years since the resurgence of c-Si, global PV technology demand began to shift from poly-Si to monocrystalline silicon (mono-Si) modules, chiefly driven again by the Chinese industry. Under mono-Si type, passivated emitter and rear contact (PERC) technology has become the workhorse globally. Coming technologies such as Hetero-Junction (HJT) and Tunnel Oxide Passivated Contacts (TOPCon) are already on the horizon. The unrelenting strides in technological innovation and massive scale of PV adoption across the globe have been largely promoted by Chinese players capitalising on extensive R&D, economies of scale and large government incentives.

Import-Export Trends

Undoubtedly, China has become one of the main drivers for solar PV development globally. The industry relies heavily on exports. In CY2020, from total PV production of 124.6GW in China, exports constituted 78.8GW.⁹ The leading Chinese solar export markets are depicted below.

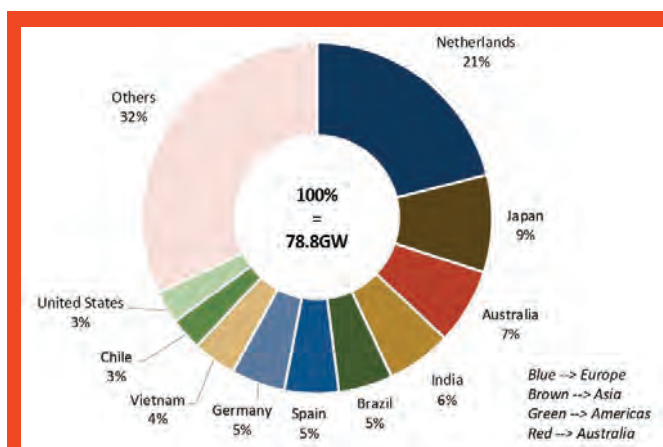


Figure 4: Leading Chinese Export Markets, 2020
Source: PV InfoLink.¹⁰

Europe is the biggest export market for Chinese modules, with Netherlands, Spain and Germany among top 10. India, with a share of 6%, is in the top five.

Considering solar PV international trade data vis-à-vis India (April to November 2021), Chinese suppliers account for 90% of India's solar imports.¹¹ The share of Chinese suppliers in net import of solar cells and finished panels is 91.1% and 89.9% respectively. The remainder comes from countries including Hong Kong, Malaysia and Singapore.

The bulk of India's PV exports (76%) is shipped to the U.S. This market accounts for 71% and 77% of solar cell and finished panel exports respectively. Other countries in India's export manifest are South Africa, Afghanistan, UAE, Turkey, Canada etc.

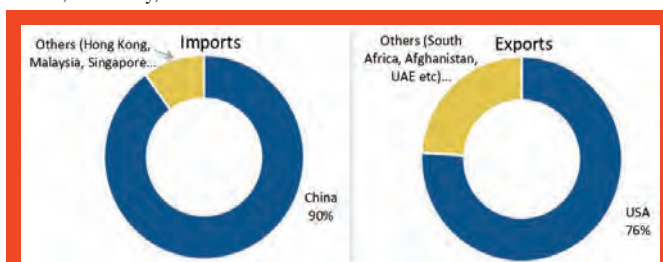


Figure 5: India Solar PV Import-Export Scenario - H1 FY2022 (April-November 2021)
Source: Ministry of Commerce and Industry.

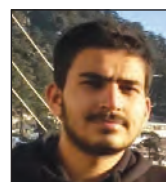
Observing the solar import statistics for India in the past six fiscal years, imports were the least in FY2021 owing to covid-induced disruptions, though imports (refer figure 7 later) were declining since FY2019. Safeguard Duty (SGD), applicable on imported solar modules from countries such as China, Malaysia and Taiwan from July 2018, is the key factor behind the downward curve between FY2019 and FY2021.

...To be continued

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JMK Research & Analytics is a boutique consulting firm for all kinds of research and advisory services for Indian and International clients focusing on Renewables, Electric mobility, and the Battery storage market. For further information: contact@jmkresearch.com



PERFORMANCE EVALUATION OF A SYSTEM

The LED street lighting systems provide illumination level >16 lux at a height of 4 m and periphery of 4 m at an energy efficiency of >90 lm/W...

Light Emitting Diodes (LEDs) are miniature bulbs with UV resistant, weather proof, unbreakable plastic or aluminium case, super-lamination. Basically, the mode of building up luminaires of a large size is through clustering of miniature sources into a lamp. An individual LED can give approximately 100 to 150 lumens per Watt.

Solid state, opto semiconductor LEDs in conjunction with solar photovoltaic (PV) have the potential for energisation independent of the grid, especially in areas of weak and unreliable power supply. It is a continuously evolving technology, becoming cheaper each day and it serves as an ideal energy saving solution in the street lighting sector. The efficacy of LEDs (laboratory) which was around 100 lumen/W in 2008 went up to 200

lumens in 2022 and the luminaire output up to 160 Lumens per Watt in 2022.

It is an ideal solution for a demand side management for minimizing the load on grid during peak time created because of lighting loads. LEDs using SPV has the added advantage of bringing down the capital cost of the SPV system as the power requirement of the LEDs are far lower than that of conventional lighting systems. Hence, the SPV-based LED lamps are emerging as the front runners for energy saving, grid Independent Street Lighting Systems. The power input of equivalent LEDs is reduced to almost 25% of their conventional Tubular Fluorescent Lamp (TFL) or Compact Fluorescent Lamp (CFL) equivalent. A typical configuration, as fixed by Ministry of New and Renewable Energy (MNRE) is a 40 W solar PV panel, 40 Ah battery and 7 W LED lamps, to give an output lighting level of over 16 lux at 4 m height and 4 m periphery.

A standalone solar photovoltaic street lighting system is an outdoor lighting unit used for illuminating a street or an open area. The Solar Street Lighting System consists of Solar Photovoltaic (SPV) module, a luminaire, storage battery, control electronics, inter-connecting wires/cables, module mounting pole including hardware and battery box. The luminaire is based on Light Emitting Diode, a solid state device that emits light when electric current passes through it. The luminaire is mounted on the pole at a suitable angle to maximize illumination on the ground. The PV module is placed at the top of the pole at an angle facing south so that it receives solar radiation throughout the day, without any shadow falling on it. A battery is placed in a box attached to the pole. Electricity generated by the PV module charges the battery during the day time, which powers the luminaire from dusk to dawn. The system lights at dusk and switches off at dawn automatically.

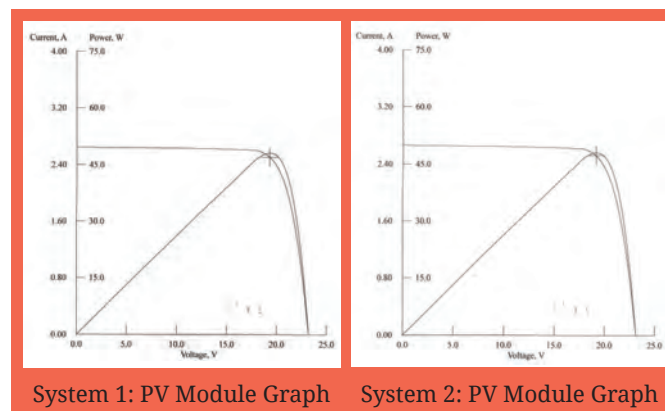
SI No	Apparatus	System 1	System 2
01	Solar PV Module	40 W	40 W
02	LED Luminaire Rating	7W LED	7 W LED
03	Battery Type	Lead Acid	LiFePO4
04	Battery Rated Voltage	12.00 V	12.80 V
05	Battery Rating	40 Ah	196 Wh

Both the systems have been tested and results are analyzed in this article.

Experimentation results

PV module: The PV module made up of crystalline

silicon solar cells, the power output of the module(s) under STC is measured using Sun Simulator. The measured results with graph are as below.



SI No	Test Parameters	Recorded Values of System 1	Recorded Values of System 2
01	Voc of PV Module	23.047 V	22.989 V
02	Isc of PV Module	2.645 A	2.662 A
03	Module Wattage at STC Pmax	48.15 Wp	48.031 Wp
04	Module Efficiency	15.304 %	15.266 %
05	Fill factor	0.790	0.785

Battery

Battery storage is becoming an increasingly popular addition to solar energy systems. Two of the most common battery chemistry types are lithium-ion and lead acid. As their names imply, lithium-ion batteries are made with the metal lithium, while lead-acid batteries are made with lead.

- System 1 : Sealed maintenance free lead acid battery with a capacity of 40 AH, at voltages of up to 12V @ C/10 discharge rate
- System 2 : 12.80V DC, 192 Wh capacity Lithium Ferro Phosphate Battery

Light source

The light source is of white LED type.

Light output

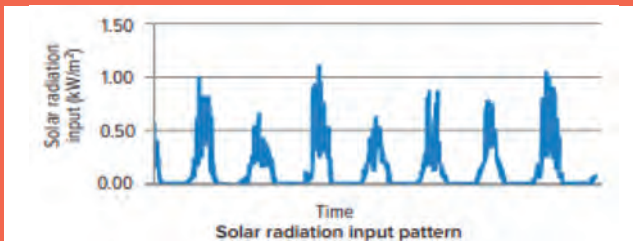
Requirement: Minimum 16 Lux when it must be measured at the periphery of 4 metre diameter from a height of 4 metre. At any point within area of 2.5 metre diameter periphery the light level should not be more than three times of the periphery value. The illumination should be uniform without Dark Bands or abrupt variations and soothing to the eyes. Higher output would be preferred.

Solar Street Lighting

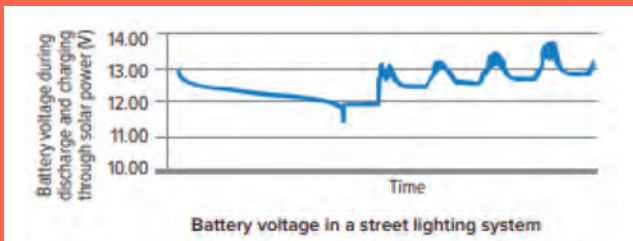
Sl No	Test Parameters	Light output (in lux) from 4 meter height : System 1	Light output (in lux) from 4 meter height : System 2
01	Light output (in lux) from 4 metre height at 4.0 metre	20.02 lx	21.55 lx

Average duty cycle: 5 hours a day under average daily insolation of 5.5 kWh/ sq.m. on a horizontal surface.

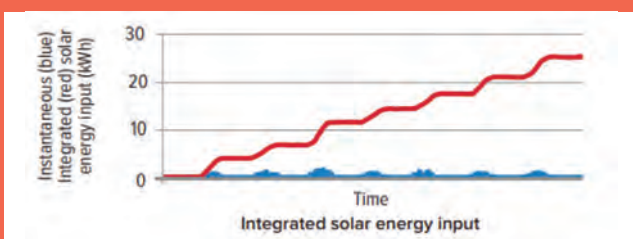
Autonomy: 3 days or Minimum 15 operating hours per permissible discharge.



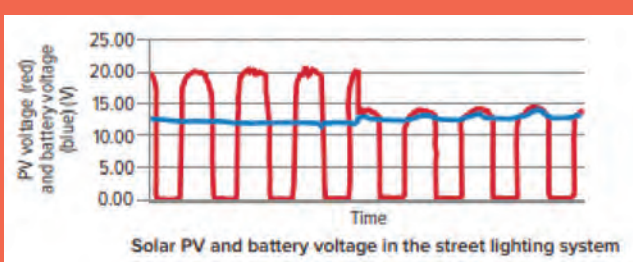
Ideal Graph of Solar radiation vs time



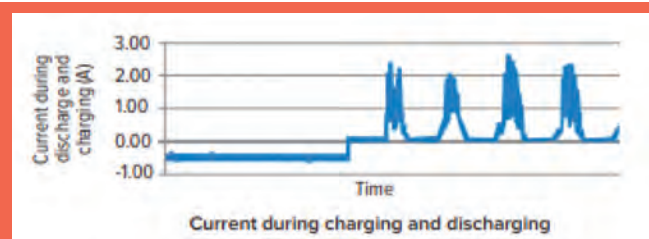
Ideal Graph of Battery voltage during discharge and charging vs time



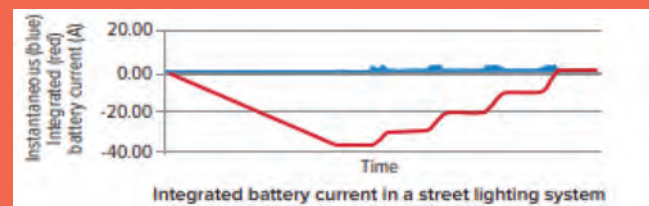
Ideal Graph of Instantaneous & Integrated solar energy input vs time



Ideal Graph of PV Voltage & Battery voltage vs time



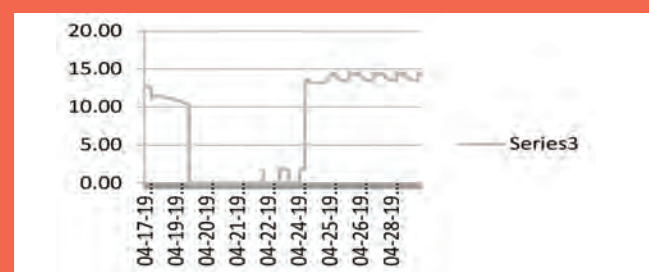
Ideal Graph of Current during discharge and charging vs time



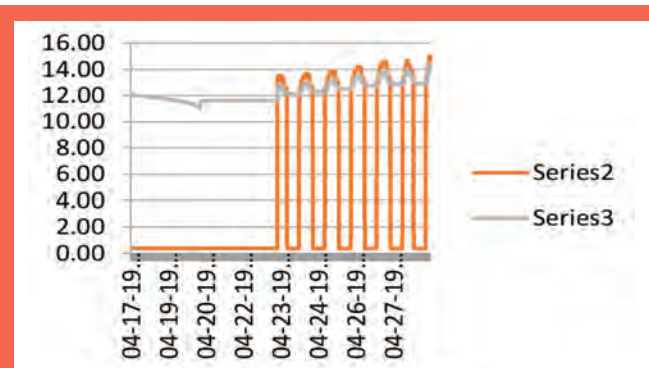
Ideal Graph of Instantaneous & Integrated battery current vs time



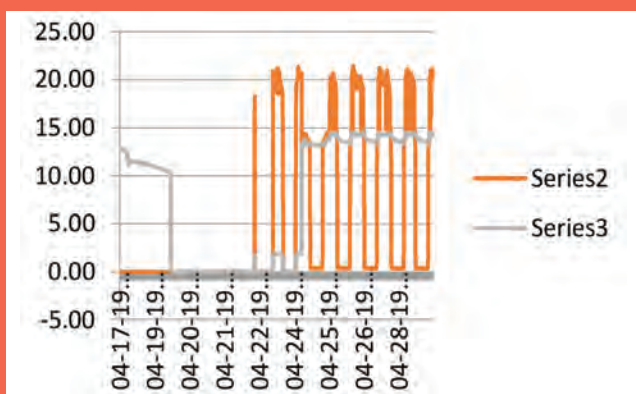
System 1: Graph of Battery voltage during discharge and charging vs time



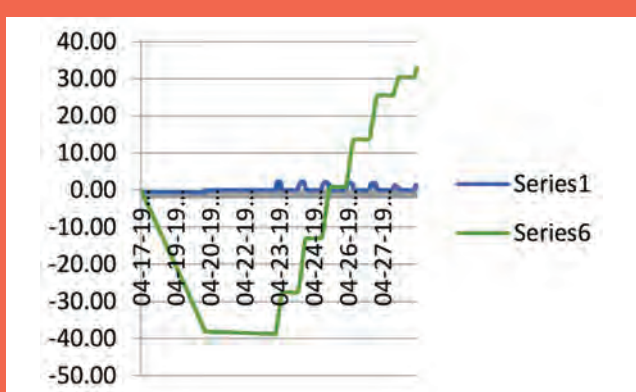
System 2: Graph of Battery voltage during discharge and charging vs time



System 1: Graph of PV Voltage & Battery voltage vs time



System 2: Graph of PV Voltage & Battery voltage vs time



System 1: Graph of Instantaneous & Integrated battery current vs time



System 2: Graph of Instantaneous & Integrated battery current vs time

Electronics (Solar charge controller)

The driver efficiency for a conventional driver is around >85% while for a well-designed MPPT or microcontroller-based driver it can be as high as 98%. Driver efficiency is highly sensitive to the cost of the power source (in the case of solar PV system where capital cost of the solar module is high). Investment in the driver cost is offset by the reduction in the cost of the PV panel.

Sl No	Test Parameters	Recorded Values of System 1	Recorded Values of System 2
01	Input power	7.48 W	6.91 W
02	Output power	6.40 W	6.20 W
03	Efficiency	85.56 %	89.73 %
04	No load current	6.37 mA	9.95 mA

Electronic protections: Adequate protection is incorporated in the system under various conditions, e.g., when the lamps are removed and the system is switched ON.

Sl No	Protections	Recorded Values of System 1	Recorded Values of System 2
01	Low voltage cut –off (V)	10.74 V	11.08 V
02	Load reconnect (V)	13.48 V	12.28 V
03	Over charge cut-off (V)	14.80 V	14.53 V
04	No Load protection	Provided	Provided
05	Battery Reverse Polarity		
06	Temperature compensation		
07	Protection for reverse flow of current through the PV Module		
08	Short circuit protection		

Conclusions

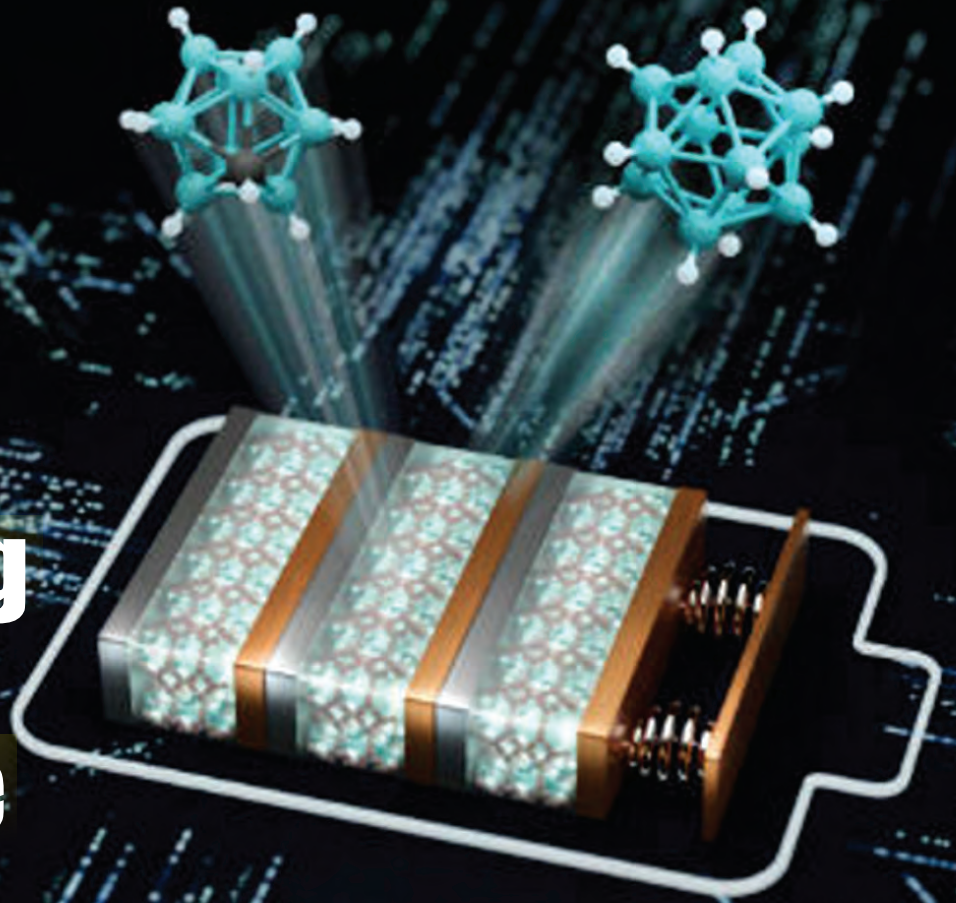
Two 40 W solar street lighting systems were tested with Lead acid battery and Lithium ion battery and the results are presented. The solar powered LED street lighting technology, addressed primarily to meet the requirements of rural areas that are weakly connected to the grid or facing power outages.

The LED street lighting systems provide Illumination level >16 lux at a height of 4 m and periphery of 4 m at an energy efficiency of >90 lm/W. The Solar Charge controller provides the electronic efficiency from 85.56% to 89.73%, indicating scope for improvement. There is further scope for improving the Illumination levels with the use of new age technology in improving total light output and light distribution.



Raghu R. is a B. E. in Electrical and Electronics Engineering. He is presently working as an Engineering Assistant at Energy Efficiency and Renewable Energy Division of Central Power Research Institute, Bangalore.

Developing A New Electrolyte



The future of battery technologies lies in sodium. A UNIGE team has developed a new material that improves the performance of solid-state sodium batteries, which is less dangerous and a more durable alternative to lithium...

Sodium is more sustainable than lithium that currently powers most of our devices and vehicles. Sodium is also abundant on the earth's surface. The only problem is that its ions do not move easily in the liquid electrolyte of conventional batteries, making it less efficient than lithium. Therefore, the solution lies in the development of a solid electrolyte. A scientific team from the University of Geneva (UNIGE) has succeeded in meeting this challenge by modifying the crystal structure of a material composed of carbon, boron and hydrogen (carbo hydridoborate). The research group also defined the ideal pressure to be applied to the battery for it to operate efficiently.

The solid electrolyte developed by the UNIGE team lets the ions move efficiently within the sodium batteries...
Copyright: Xavier Ravinet / Olivier Gaumer – UNIGE



Introduced to the market in the early 1990s, lithium-ion batteries (or 'li-ion' batteries) now power most of our electronic devices and electric vehicles. However, they have two major shortcomings. The liquid electrolyte they contain, which allows positive ions to flow between the two electrodes of the battery, is highly flammable. If it leaks, it can react violently with oxygen, posing a major hazard to users. The supply of lithium is also problematic: unevenly distributed around the globe, it is at the heart of major geopolitical issues in the same way as oil.

An alternative is sodium battery. This chemical element is abundant all over the

earth and in the sea and is cheaper than lithium. It is also easier to recycle. However, its use is still underdeveloped. "The production of this type of batteries involves a different technology from that used for lithium-based ones. Industry is still reluctant to embark on this less familiar technology," explained Fabrizio Murgia, a Researcher in the crystallography laboratory of the UNIGE Faculty of Science.

The most efficient material today

Because sodium is heavier than lithium, its ions also move less easily in the liquid electrolyte. The solution is to design a solid electrolyte that is also non-flammable. However, the electrolytes of this type developed up to now, which are composed of hydridoborates (boron and hydrogen), have not been able to achieve the performance of lithium batteries. Two recent studies conducted by the UNIGE crystallography laboratory, headed by Professor Radovan Cerny, have succeeded in solving this problem.

The first one, published in ACS Applied Materials & Interfaces, led to the development of an efficient material: sodium carbo-hydridoborate ($\text{NaCB}_{11}\text{H}_{12}$). "Originally, this material, which is used in nuclear medicine, is not conductive. By modifying the structure of its crystals, and more precisely the spatial arrangement of the atoms, we have succeeded in making it conductive, which makes it the most efficient means of transporting sodium ions currently available," explained Radovan Cerny. To achieve this result, the research team subjected the compound to high shocks, generating high temperatures, inside a ball mill. This is an energy-efficient method that is widely used in the cement industry.

Easy to produce

The second research project consisted of putting this material in situation. For a battery to work, the electrolyte, whether liquid or solid, must be in intimate contact with the positive and negative electrodes of the battery. It must therefore be contained firmly within the battery. "To achieve that, pressure must be applied by means of screws or springs. We looked for the ideal 'force' to exert on our solid electrolyte," explained Matteo Brighi, former Postdoctoral Scholar in the Crystallography Laboratory. It was shown that this should be around 400 atmospheres, equivalent to the pressure under water at a depth of 4,000 metres, which can be achieved very easily with a few turns of a screw.

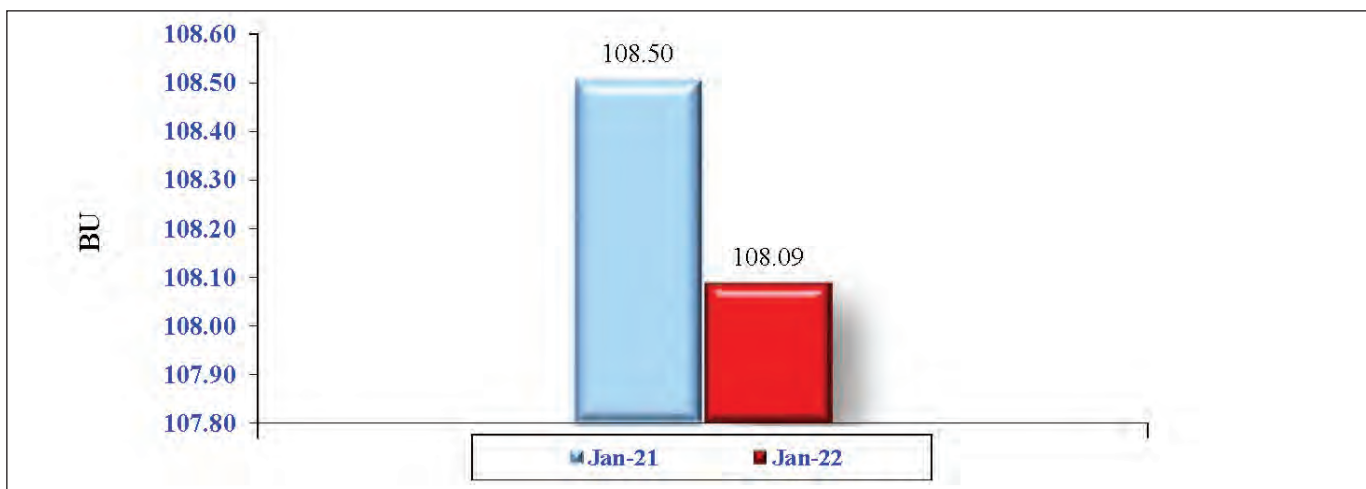
Those discoveries pave the way for easier production of sodium batteries, especially in the automotive industry. "Because of the slightly heavier weight of these batteries, they could be used primarily to power cars. The cost-effectiveness of manufacturing them has also yet to be assessed but it is now important that industry realizes that the material we have discovered is really interesting," concluded Murgia.

13

Electricity Generation for Jan-2022 (BU)

Type	Achievement	Targets	Achievement*	% Change of Achievement w.r.t. Jan-2021
	Jan-21	Jan-22	Jan-22	
Thermal	97.19	100.67	96.46	-0.75
Nuclear	3.21	3.47	3.97	23.42
Hydro	7.96	8.06	7.63	-4.18
Bhutan Import	0.14	0.23	0.03	-81.17
All India	108.50	112.43	108.09	-0.39

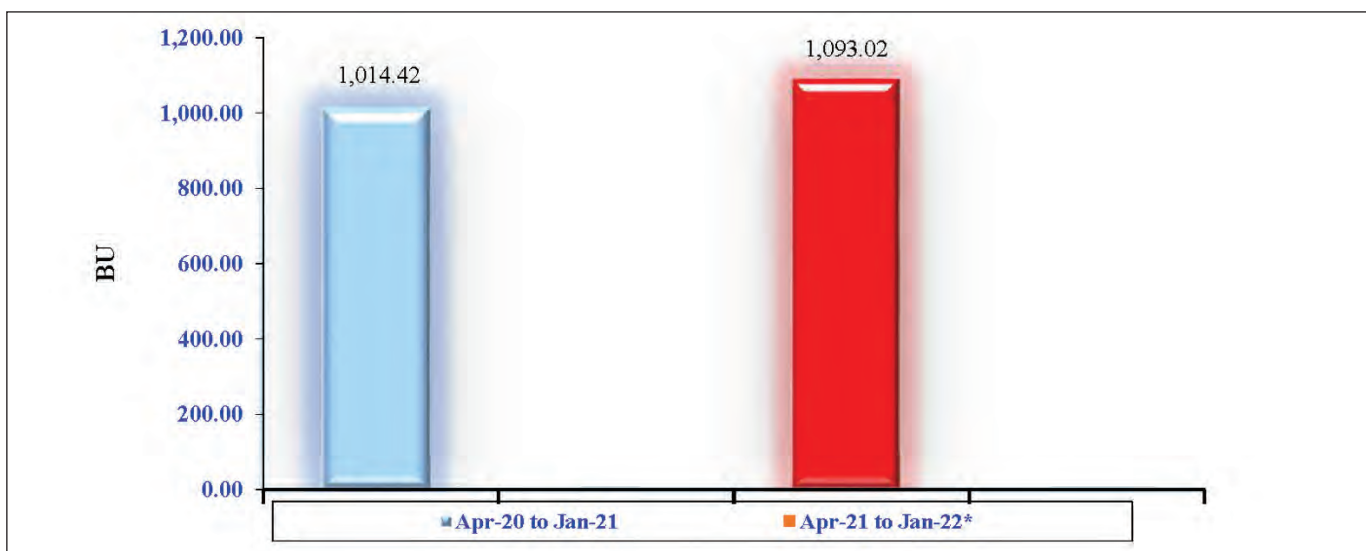
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Electricity Generation During Apr-20 to Jan-21 & Apr-21 to Jan-22 (BU)

Type	Apr-20 to Jan-21	Apr-21 to Jan-22*	% Change w.r.t Apr-20 to Jan-21
Thermal	834.11	913.19	9.48
Nuclear	37.16	38.80	4.42
Hydro	134.61	133.74	-0.64
Bhutan Import	8.54	7.28	-14.81
All India	1,014.42	1,093.02	7.75

* Provisional



Source: CEA

“Kusam-Meco” Handheld Micro Ohm Meter Model- Km 8501/Km 8502

KUSAM-MECO has added 2 New models of handheld milli ohm meters to their existing range of Micro/Milli ohm meters. These meters are light weight and easy to carry. These meters adopt latest microprocessor technology, 4-wire method for measuring the resistance. It is suitable for testing the resistance of coils, motors, transformers, cables, contact resistance of switches, connectors, relays etc. It has a wide measuring range. Model KM 8051 has range from 0.001mΩ to 300.0 KΩ Resolution 1μΩ whereas Model KM 8052 has measuring range from 10.0 μΩ to 50.00 KΩ (Resolution 0.1μΩ). The test current for model KM 8051 is 1 Amps whereas the test current for model KM 8502 is 10 Amps. Both instruments are with rechargeable Li-ion battery. They can store 500 data which can be uploaded to PC. It has a big LCD screen 72 × 55mm (model KM 8051) & 108 × 65 mm (Model KM 8052). For reading in dark places there is backlight function. It is provided with USB interface & communication Cable & Software CD. When not in use for long time (15



minutes) the meter shuts off automatically to preserve the battery.

The instrument size is 187 × 119 × 50mm (KM 8501) and 240 × 188 × 80mm for model KM 8502. The instruments are supplied with Test wire, USB cable, Charger, Software CD, Manual, Instrument box. 

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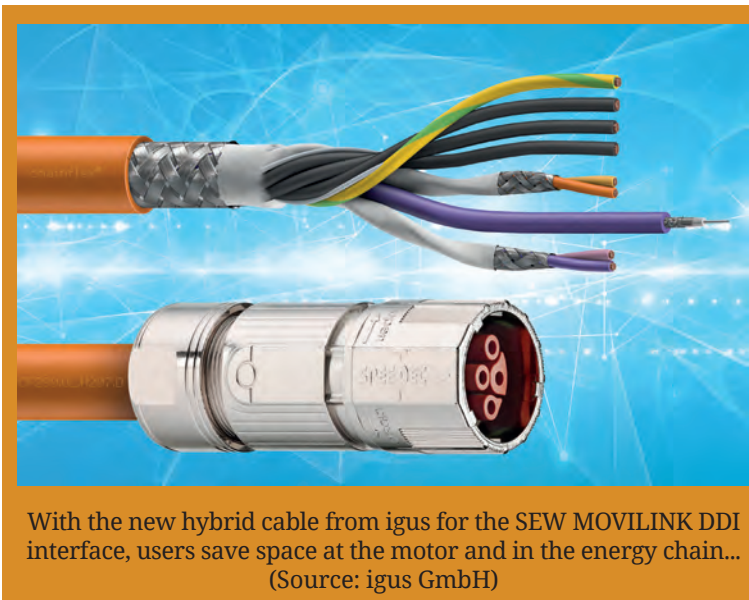
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Energy and data combined in new igus hybrid cable for SEW motors

New highly flexible chainflex cable saves 40% space in the e-chain and ensures reliable energy and data transmission

Small, compact and fast: these are the demands on the new generations of motors. To this end, more and more drive manufacturers are turning to hybrid technology to save space. Therefore, igus has now expanded its range of hybrid cables with a new cable especially for SEW motors with the MOVILINK DDI interface. Users in the material handling industry, for example, can rely on a durable cable specifically developed for e-chain applications.

Hybrid cables for drive technology are characterised by their ability to combine energy and data transmission in one cable. The result: the number of cables required is halved. In the case of the new SEW motors with MOVILINK DDI interface, the drive manufacturer relies on a coaxial element for the data transmission of motor information. In order to be able to safely supply the compact motors with energy and data while they are in motion, igus has now developed a new hybrid cable. "The challenge with cables with coaxial elements is that they quickly become susceptible to faults at high dynamics. That is why we have made it our task to develop a durable and flexible cable that also functions reliably in motion", says Andreas Muckes, Head of Product Management chainflex cables at igus GmbH. To this end, the motion cable specialist can draw on its more than 20 years of expertise in the field of coaxial cables for highly dynamic applications. For the new hybrid cable CF280.UL.H207.D, four energy cores have



With the new hybrid cable from igus for the SEW MOVILINK DDI interface, users save space at the motor and in the energy chain...
(Source: igus GmbH)

now been combined with one coaxial core and two control pairs. By merging two cables into one, users can save 40 per cent space in the energy chain. At the same time, the weight that has to be driven by the system is reduced, which means that less energy is consumed. The new cable with PUR outer jacket can be used for applications with a bending factor of up to 15xd and is

therefore suitable for a wide range of industries: from machine tools and material handling to the automotive industry.

28 cables for hybrid technology

With 28 different cable types for motors from Siemens, Beckhoff, SEW and Bosch Rexroth, igus already has the largest portfolio of hybrid cables for the energy chain from stock. With the expansion of the CF280 series, igus is following the ongoing trend of hybrid technology. The cable specialist also offers its CF280 cable series with a PVC outer jacket as CF220. In this way, additional costs can be reduced in the hybrid cable segment. The chainflex cables can be purchased harnessed or by the metre. As with all its cables, igus also provides a guarantee of up to 36 months on the new SEW hybrid cable.

More information about igus hybrid cables:

<https://www.igus.eu/info/unharnessed-cables-hybrid-servo-cables-chainflex?L=en>



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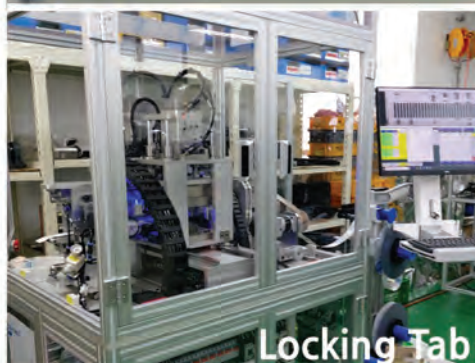
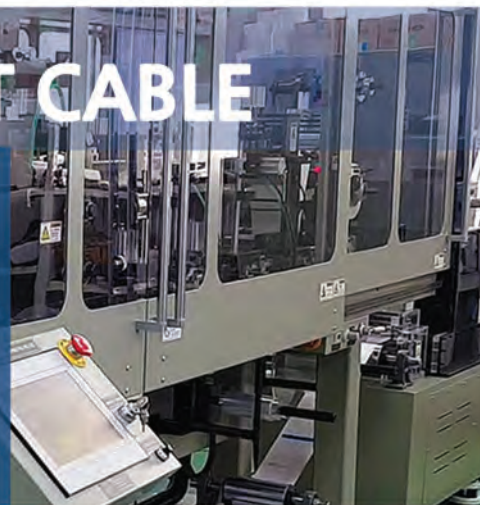
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