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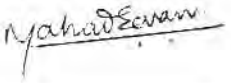
Timely funding and time-bound project execution will determine how soon we can reach the goal...

Worldwide, wind energy is accepted as one of the most developed, cost-effective and proven renewable energy technologies to meet increasing electricity demands in a sustainable manner. India has achieved significant success in the onshore wind power development, with over 23 GW of wind energy capacity already installed and generating power. Earlier, the country's wind energy potential was measured to be at around 100 GW with a tower height of 80 metres, which has recently been re-estimated by the National Institute of Wind Energy (NIWE) to be 302 GW with 100 metres high towers.

India has around 7,562 km long coast line where we have a great untapped potential for harnessing offshore wind energy. Eyeing on that, recently, the Union Cabinet, chaired by the Prime Minister, Narendra Modi, has given its approval to the National Offshore Wind Energy Policy. With this approval, the Ministry of New & Renewable Energy (MNRE) has been authorised as the Nodal Ministry for use of offshore areas within the Exclusive Economic Zone (EEZ) of the country. Also, NIWE has been empowered as the Nodal Agency for development of offshore wind energy in the country and to carry out allocation of offshore wind energy blocks, coordination and allied functions with related ministries and agencies.

The approval paves way for offshore wind energy development including, setting up of offshore wind power projects and R&D activities, in waters, in or adjacent to the country, up to the seaward distance of 200 nautical miles (EEZ of the country) from the base line. The developments are quite encouraging, and will help the country in moving forward towards attaining energy security – and achieving the NAPCC targets. However, timely funding and time-bound project execution will determine how soon we can reach the goal.

Do send in your comments at miyer@charypublications.in



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"To reach energy to the last mile, we have to ensure the decentralised power production across the country..."

P K Chatterjee (PK)

While inaugurating the National Biogas Convention, the Union Minister of State (IC) for Coal, Power and New and Renewable Energy, Piyush Goyal has recently said that the decentralisation of the power is the fastest way to provide energy access to the people of the country. It is truly pleasing to note that the Government of India has taken up the decision to encourage decentralised power supply. In a vast country like India, this decision had to be taken long back. Our population density is not uniform throughout the country, thus the demand is also different at different parts of the country. So, based on the population density at a region, local generation at required scale is always a good idea.

The minister has remarked, "There can be no two opinions about the fact that in order to reach energy to the last mile, we have to ensure the decentralised power production across the country." He has also recalled that India is already the world leader in small scale and low cost biogas purification technology. Our country has spent a lot to connect the entire country through power networking, however, local networkings are much more important. Cluster-wise development has several advantages – primarily this approach helps in efficiency enhancement and cost control of the development projects.

The union minister stands committed to the National Biogas and National Fertilizer Mission – and has assured to provide all his support to facilitate the mission. India has enough untapped resources for biogas production, the time has come when every state should focus on generating power from biogas. This is the easiest way to generate power and provide energy for cooking at remote rural areas. Several Indian universities are carrying out researches in this field. However, the outcomes of such works often do not contribute to the growth of the country. Goyal has proposed to create a framework for facilitating scientific exploration in the country. He has stressed on establishing a panel of scientists and bureaucrats – who can plan integrated research efforts of various Universities, Research Institutes & Ministry. This will definitely enrich our rural power projects.

Please e-mail me your views at pkchatterjee@charypublications.in

P. K. Chatterjee

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Larsen & Toubro announces top level management changes

The Board of Directors of Larsen & Toubro has announced the appointment of S. N. Subrahmanyan as Deputy Managing Director & President of the company. Earlier, Subrahmanyan was a Senior Executive Vice President of the company, and was appointed on the board in 2011.

It was also announced that D. K. Sen has been inducted on the board, designated Whole-Time Director & Senior Executive Vice President (Infrastructure).

Commenting on the development, A. M. Naik, Group Executive Chairman, has said, "These appointments are in line with our plans for succession and seamless transition of leadership." Both Subrahmanyan and Sen have decades of experience in the company and proven track records of performance.

Subrahmanyan has a degree in civil engineering and a post-graduate qualification in business management. Commencing his professional career with L&T in 1984 as a project planning engineer, he has over the last 30 years, played a critical role in driving many of the company's large and prestigious infrastructure and construction projects. These included EPC contracts for the construction of major international airports in India at Bengaluru, Hyderabad, Delhi and Mumbai as well as development of the Dedicated Freight Corridor. He also spearheaded major international projects including metro systems in Qatar and Saudi Arabia.

GMR Energy's plants in AP get gas allocation

Two of GMR Energy's gas based plants – GMR Vemagiri Power Generation Limited (GVPGL) and GMR Rajahmundry Energy Limited (GREL) – in Andhra Pradesh have been awarded allocation of gas through a fresh round of e-bidding conducted by the Government of India, on 15th September, 2015. This was the second round of bidding under the 'Scheme for Utilization of Stranded Gas based power Plants,' launched by GoI in March 2015. These two plants, with total capacity of 1138 MW, now can operate over the next six months starting October, 2015 at equivalent to 50% Plant Load Factor (PLF) – up from 25% PLF in the previous round.

Commenting on the development, a GMR Energy spokesperson, said, "We are happy to get gas, which will help rationalise the power tariff, and improve the power supply scenario of the state." With the current allocation of gas, operations will continue till March, 2016 – and thereafter Government of India will call for a fresh round of bidding. The scheme envisages government subsidies from the Power System Development Fund (PSDF) through a transparent e-bidding process. The government will subsidise the power distribution companies to the extent of ₹ 1.44 per unit from the PSDF for the power procured from these two plants.

GMR Energy has a portfolio of 3000 MW of coal- and 1350 MW of gas- based assets. Besides this, it also operates 25 MW solar plant, and is in the process of developing hydro portfolio of about 2000 MW.

Vikram Solar expands its U.S. presence

Vikram Solar's manufacturing facility in SEZ, Falta, WB, India...

Vikram Solar, India's tier-one, tariff-free module manufacturer, is now one step ahead of its rapid expansion into the U.S. with the introduction of new generations of high-efficiency multi-crystalline silicon solar modules and large volumes immediately available for U.S. distribution. The Vikram Eldora neo is available for commercial and residential solar installations, with a 72-cell module rated at 325 W (STC) and a 60-cell offering rated at 275W (STC).

Anticipating volume orders from the U.S. as well as its other served markets, Vikram Solar has commenced volume production at its second state-of-the-art manufacturing facility in Falta, West Bengal.

This brings the company's total capacity to 500MW, achieving goals set earlier this year. As a significant differentiator, Vikram Solar modules use solar cells with Passivated Emitter Rear Contact (PERC) technology, which enables higher efficiencies at lower cost than conventional cell technologies. PERC technology involves the addition of a dielectric layer at the bottom of each cell that allows it to respond to a broader spectrum of the sun's radiation.

U.S. deals continue at a brisk pace. A 900kW showcase project will break ground on a downtown Denver sports arena next month, and nearly 2MW of projects have been sold for school projects in the Midwest this year.

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ReNew Power commissions a unique wind project in Rajasthan

ReNew Power Ventures Pvt. Ltd., one of India's clean energy companies, has successfully pioneered the commercial installation and commissioning of India's tallest wind tower the S97 series by Suzlon.

The S97 stands at 120 m, offering 33% increase in hub height, when compared with the conventional tower design. Moreover, it is also a revolutionary on-shore installation of lattice/tubular combination towers (hybrid towers) of 120 m height.

The hybrid towers are manufactured by Suzlon, one of the leading wind turbine manufacturers from India. It has been commercially erected, for the first time, anywhere in the world. It is a part of a 100.80 MW wind farm in Rajasthan, which is being commissioned progressively with 12.6 MW currently commissioned.

Once fully operational, the farm will meet the electricity requirement of approximately 175,000 households in the area and will help offset more than 162,253 tonnes of carbon dioxide emissions annually.

With the installation of Suzlon's innovative S97 120 m hybrid tower, the gain in wind speed is 4 to 5% relatively higher in comparison with the conventional 90 m hub height. According to industry research, this is expected to increase the annual generation by 12 to15%.

Commenting on this ground-breaking installation, Sumant Sinha, Chairman and CEO, ReNew Power, said, "As a leading energy company, ReNew Power is at the forefront of adopting the most innovative and technologically advanced equipment and systems available in the market today, while at the same time partnering with and encouraging OEMs to explore new technologies and solutions."

"Industry estimates reveal that in India, approximately 400 million people do not have access to electricity. To meet the growing energy demands of the already highly strained energy infrastructure, the country requires a sustainable energy module. We are excited to be a first with this breakthrough installation in wind energy in the state of Rajasthan," he added.

Toshiba wins ₹ 3,436 crore EPC contract from UPRVUNL

Turbine for the Kudgi Super Thermal Power Project...

Toshiba JSW Power Systems Private Ltd. (Toshiba JSW), a Toshiba Group company based in Chennai, has been awarded a full EPC Contract by Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd. (UPRVUNL), a wholly owned state thermal power utility with present generating capacity of 4,933 MW. The value of the contract is over ₹ 3,436 crore (approx.USD 540 million). Toshiba JSW will carry out Engineering, Procurement, Construction (EPC) of the entire thermal power plant, including civil and boiler island package to be completed within 48 months from the contract award.

UPRVUNL's evaluation reflects the high performance and the reliability of Toshiba's ultra-supercritical steam turbines and generators, and the company's capabilities in integrating engineering and manufacturing functions.

Yoshiaki Inayama, Managing Director of Toshiba JSW said, "We have a long standing relationship with UPRVUNL. Toshiba initially entered the thermal power market by supplying two 500MW subcritical steam turbines and generators at Anpara B thermal power plant, and later cemented our association by securing another order for supplying two units of 660MW supercritical steam turbines and generators package to Meja power plant in Uttar Pradesh. We are very honoured to once again work with UPRVUNL for Harduaganj Ultra Supercritical Thermal Power Project to provide ultra supercritical thermal power plant. This takes us a step further in our endeavour to contribute to Indian's suitable power supply by its endeavour of continued innovations."

Toshiba Group is well known for supercritical steam turbines and generators in the 800 MW category in India, having won orders for ten sets in all: five for Coastal Gujarat Power Limited, a subsidiary of Tata Power Company Limited for its Mundra UMPP in Gujarat, which are now in commercial operation; three for NTPC's Kudgi Super Thermal Power Project and two for the NTPC's Darlipali Super Thermal Power Project.

Thangapandian's experience will help Neyveli Lignite Corporation in new projects

V Thangapandian
Director (Power)
Neyveli Lignite Corp. Ltd...

Former Group General Manager of National Thermal Power Corporation Limited (NTPC), V Thangapandian has taken over the charge of Director (Power) of Neyveli Lignite Corporation Ltd. (NLC). Thangapandian, graduated in mechanical engineering from Madurai Kamaraj University in July 1981. He holds 34 years of varied engineering experience in power plant erection, commissioning, operation and maintenance. In NTPC, he was a part of several projects, such as Ramagundam Project, Vindyachal and Mouda Super Thermal Power projects. He was instrumental in commissioning the 2X500 MW units NTPC-Mouda (Nagpur) as a project head. He gained vast experience in greenfield project commissioning from NTPC-Mouda, and it is expected that his experience will ease the path of NLC to expand its projects with 660 MW units across India.

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UL launches specialised solar water pump testing facility

UL (Underwriters Laboratories) has launched their highly specialised Solar Water Pump testing facility in Bangalore. Equipped with highly sophisticated and robust test equipment, the facility is approved by MNRE to conduct testing of solar PV water pumps to be used in agricultural irrigation purposes within the country.

This facility is capable of testing two pumps simultaneously at a time using Solar PV array simulators, which reduces the testing time drastically to a day's time. The facility is capable of testing both submersible (up to 10 HP) and surface pumps (1 HP).

UL Solar Pump testing facility...

UL will be adding one more set-up at this facility to expand the surface pump testing to 5 HP in coming days. UL is a global safety science organisation.

In the words of Suresh Sugavanam, Managing Director and Vice President of UL South Asia, "At UL, we are constantly evolving through our research, customer feedback and testing efforts to meet the ever growing consumer needs. This facility is a step from UL to support Indian Government's vision of implementing Solar PV based water pumps for agricultural irrigation purpose – and aims at providing our customers quality testing and certification services. This is one additional step in our growing list of services for the renewable energy industry and its applications."

CMI acquires the facility of FL Smidth

CMI Limited, a BSE listed specialty cable manufacturing company, has acquired the fully developed manufacturing facility of Danish company FL Smidth at Bawal, Haryana. The company is investing INR 200 million on the acquisition and setting up of the facility at Bawal. This investment is expected to significantly augment the production capacity of the company. The company intends to start production in the new facility within this financial year.

Commenting on the developments Amit Jain, Managing Director, CMI Ltd., said, "This is a new phase in the history of CMI. We are very bullish on the sector and are targeting a CAGR of 40% going forward for the next 3 to 5 years. The acquisition is a step in that direction, and will help CMI enhance its production capacity in order to achieve the desired growth."

CMI's products are used in many different industries. The company manufactures a wide variety of specialty cables for infrastructure, railways, oil & refinery industries, engineering companies, EPCC contractors and so on.

Bajaj Electricals wins the SEAD global efficiency medal

(L2R) R Sundarajan, Anant Bajaj and Shekhar Bajaj...

Bajaj Electricals Limited. has won the prestigious international award for India's most energy saving and commercially available Planer Luminaires class for products with 2000 lumens light output – and cool white colour temperature (4000 k).

The winning product is the LED Luminaire SKYLUX XE (BZRSQL W3) NW (2'x2'Planer Luminaire).

The Super-efficient Equipment and Appliance Deployment (SEAD) Initiative, is an international collaboration of 17 member governments and an initiative under the Clean Energy Ministerial (CEM).

Bajaj Electricals Ltd. was honoured at an awards ceremony at the International Conference on Energy Efficiency in Domestic Appliances and Lighting in Luzern, Switzerland on 26th August 2015.

On behalf of Bajaj Electricals R Sundarajan, President – Lighting Business Group and Satyabrata Chakraborty, Vice President (Technology), Luminaires BU received the award from Dr (Ms) Gabrielle Drefus, Policy Expert International Climate change Policy & International affairs, U.S. Department of Energy, Washington D.C.

Speaking on this occasion, Sundarajan said, "This is a prestigious acknowledgement for our strategic focus on lighting solutions. We are honoured to receive the 2015 SEAD Global Efficiency Medal and this recognition will further enable us to add value to our product portfolio and achieve market leadership."

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CG wins new contract for supplying smart meters to Spanish utility

The new automatic assembly lines for smart meters in CG's ZIV facility in Spain...

Avantha Group Company CG has won a Euro 24 million (approx INR 178 crore) contract to supply ZIV single and three phase smart meters to Spanish utility Iberdrola.

This order follows a significant order of Euro 17 Million from Gas Natural Fenosa (GNF) for the supply of PLC communicated smart meters, won recently. ZIV's single phase smart meter model is nowadays the reference smart meter in the PRIME PLC market segment, after the deployment of almost 4 million ZIV units worldwide.

CG in line with addressing the growing demand in the market has expanded its manufacturing plant in Zamudio, Spain, introducing new, automatic assembly lines that will be able to produce over 2 million smart meters annually.

The company is ready to meet both international and national market demands where Spanish utilities are expected to replace 70% of analogue meters by 2016 and 100% by 2018 – and is uniquely positioned to benefit from this regulation, by collaborating closely with the distribution utilities and assisting them in achieving the goal within the timeline.

ZIV smart meters have a proven track record of robust performance, backed by a string of strategic wins from some of the most relevant and innovative European Utilities such as GNF in Spain, EDP in Portugal and ERDF in France. CG also offers ZIV meters, Data Concentrator Units (DCU), Distribution Automation Solutions (DAS) and Substation Automation Systems (SAS).

Schneider Electric joins hands with research consortium

IoT

Schneider Electric has announced a multi-year collaboration with the HKUST-MIT Research Alliance Consortium as a key supporter of the consortium's research for IoT technologies for intelligent buildings and transportation. The goal of this global research, with HKUST in Hong Kong and MIT in Cambridge, is to resolve challenging problems in engineering domains such as circuits and devices, signal processing, communications and control as well as advanced data analytics, with a focus on enabling IoT technologies for better building infrastructure and enhancing transportation connectivity.

Support and collaboration in this research further shows the company's commitment to technology advancement – and will allow the company to take advantage of some of the most cutting-edge research available in the field of IoT.

"We are very delighted to collaborate with Schneider Electric in helping advance IoT solutions and adoption. The research will mainly focus on applying IoT to current architectures and technologies. Our goal is to deliver creative solutions to help address problems in building management and transportation, and eventually develop practical applications for the industry," said Prof. Enboa Wu, Associate Vice-President (Knowledge Transfer), HKUST.

IoT technologies are fundamental to Schneider Electric's focus in market segments such as water, oil and gas, data centres, mining, utilities, healthcare, food and beverage and smart cities, as a way to further maximise efficiency and sustainability for customers. Through collaborations like the work with HKUST-MIT Research Alliance Consortium, Schneider Electric is focused on developing new technologies and services that will drive intelligence, efficiency and connectivity to help customers meet these new and emerging challenges.

ABB bags big order in solar power sector from Adani Group

ABB has won orders worth around INR 119 crore (~$18 million) to provide plant electrification, automation and substation solutions for solar power plants being built as part of India's strong push for solar energy and renewables. Spread across the southern Indian states of Karnataka, Tamil Nadu and Andhra Pradesh, these projects will connect more than 850 megawatts (MW) of solar energy to the grid, and will be among the biggest solar projects worldwide.

The most significant of these projects, placed by the Adani Group, a diversified Indian multinational, is the 648 MW solar

plant in Kamuthi, Tamil Nadu. ABB will provide a turnkey solution encompassing the design, supply, installation and commissioning of the power plant electrification and automation systems, the pooling stations and multiple substations. This includes two 230 kilovolt (kV) and three 110 kV substations to connect the electricity generated to the local grid.

ABB's Symphony Plus control technology will serve as the 'unified automation platform' for the plant including the electrical systems, the solar inverters and state-of-the art software for plant performance monitoring, maximising operational efficiency and ensuring grid compliance. The IEC 61850 based automation system will facilitate local and remote monitoring and control of the plant and substation assets – and is another example of ABB technologies enabling the Internet of Things, Services and People.

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48 V architectures to increase fuel saving in automobiles

The international automotive supplier Continental is developing solutions for future 48 V hybrid architectures. The integration of a second voltage level of 48 V into the vehicle will enable significant progress in CO_2 emissions. The 48 V architecture integrates the starter generator into the engine's belt drive (Belt Starter Generator, BSG), which can be implemented at only modest expense. It has already demonstrated savings of 13% in the New European Driving Cycle (NEDC). Hybrid driving strategies make an even greater difference in inner-city traffic, where savings of around 20% are possible.

José Avila, Member of the Executive Board at Continental AG and Head of the Powertrain Division, says, "In the future, the demands on 48 V technology will increase even more. The aim will be to achieve even greater efficiency benefits with less installation space and weight while keeping costs the same. The integration architecture of a 48 V system can make a big contribution here. That is why we are developing other 48 V architecture solutions for the period after 2020."

In general, 48 V systems are about much more than just the integration of components. Decisive for the amount of fuel that can be saved is, when the energy is recuperated as well as when and how the electricity is used.

Only when all aspects of an entire system are considered – vehicle propulsion, direct CO_2 savings, partitioning of the 12 and 48 V networks including their consumers, and exhaust gas after treatment – the interplay between internal combustion engine and electrical energy can be comprehensively optimised. '48 V technology goes far beyond electric power,' is Avila's summary.

Luvata bags the Solar Industry Award

Luvata has recently won the Solar Industry Award for PV Process Excellence. The Solar Industry Awards, presented by Solar PV Management Magazine, have been created to recognise the whole value chain and those people, products and services that will develop innovative manufacturing and product approaches that have the potential to change the way we live.

Industry professionals selected Luvata as the winner of the PV Process Award, which recognises excellence in a process that improves yield management in PV manufacturing. The award has been presented during the 31st European Photovoltaic Solar Energy Conference (EU PVSEC).

"The continuous advancement of Luvata's photovoltaic wire, branded Sunwire, begins by listening to the new challenges facing PV module manufacturer. The incremental improvements made to Sunwire stem from the ongoing need for higher productivity in module manufacturing and improved efficiency of the module," says Tero Horttana, Product Group Manager for Photovoltaics with Luvata. Understanding solar ribbon is critically important to solar module efficiency and life cycle. Solar ribbon width, thickness and straightness have to be carefully adapted to accommodate the limitations of module materials. In addition, the low yield strength with high elongation, thickness and width of solar ribbon can directly influence production yields and decrease Cell To Module (CTM) losses by 20 to 30%. "Luvata is proud to be selected by industry professionals for our efforts in this regard," summarises Horttana."

Chroma, REIS Robotics develop an automated battery inspection solution

Battery Pack Auto Test System...

In order to enhance test automation and efficiency for the battery industry, Chroma has developed a lithium battery module automated test system to inspect packaging, welding and uniformity. Chroma also cooperated with Reis Robotics (Kunshan) to complete an automated battery module production and testing system that has been accredited and utilised by several battery manufacturers. This system applies to semi-finished battery modules, and performs automated testing for the synthesised measurements that generate PASS/FAIL test results. The application range includes battery modules for electric vehicles and energy storage systems.

Contextually, during the production of battery modules, a testing inspection station is often added near the semi-finished stage of processing to ensure the modules' quality, function and safety. Since battery modules may have a potential hazard for short circuits, and manual testing introduces issues like inconsistent movement, handwritten data errors, long testing hours, possible issues in shipping traceability and more, many battery manufacturers are beginning to request automated testing systems. Automated testing can avoid human errors, increase product quality, and ensure personal safety.

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Johnson Electric's second Mexico facility is operational

Johnson Electric has inaugurated its second plant in Zacatecas, Mexico on September 3, 2015. The new facility spans 8,090 square metres, adding to the existing 7,400 square metres facility. The company is well known for its motion products, control systems and flexible interconnects. The company serves a broad range of industries including automotive, building automation and security, business machines, defence and aerospace, food and beverage, home technologies, HVAC, industrial equipment, medical devices, personal care, power equipment and power tools.

Established in 1959, Johnson Electric ships its products to more than 30 countries for use in hundreds of different product applications. Its innovation and product design centers are located in Hong Kong, China, Switzerland, Germany, Italy, Israel, Japan, UK and USA. It employs more than 35,000 employees and subcontract workers in over 23 countries.

The group's business strategy is based on the twin pillars of providing 'technology leadership' and being the 'safe choice' for their customers.

Polaris Energy Nicaragua enters service contract with Iceland Drilling

© Ram Power Corporation

A demonstrative photograph of Geothermal energy plant...

Polaris Infrastructure, a Toronto-based company engaged in the operation, acquisition and development of renewable energy projects in Latin America, has announced that its wholly owned subsidiary, Polaris Energy Nicaragua S.A. (PENSA), has entered into a rig services agreement (the Rig Services Agreement) with an entity controlled by Iceland Drilling Company (Iceland Drilling).

The Rig Services Agreement relates to the drilling of no less than two new production wells and the work-over of four existing injection wells, with the option for a third new production well at the San Jacinto-Tizate Power Plant, owned and operated by PENSA.

The company anticipates a spud date on its first production well in early October 2015, and looks forward to working with Iceland Drilling towards a successful well drilling and work-over programme. Iceland Drilling has a long history in the geothermal well drilling industry, back to their founding in 1945, and brings deep drilling expertise, with in excess of 180 wells drilled in the last 10 years throughout Iceland, New Zealand, Indonesia and elsewhere. Iceland Drilling will work closely with the team from PENSA, led by the Drilling Manager.

Researchers observed new record high for superconductivity

SUPER CONDUCTOR

Researchers at the Max Planck Institute for Chemistry in Mainz and Johannes Gutenberg University Mainz observed that hydrogen sulfide becomes superconductive at minus 70 degree Celsius – when the substance is placed under a pressure of 1.5 million bar. This corresponds to half of the pressure of the earth's core.

With their high-pressure experiments the researchers in Mainz have thus not only set a new record for superconductivity, their findings have also highlighted a potential new way to transport current at room temperature with no loss.

For many solid-state physicists, superconductors that are suitable for use at room temperature are still a dream. Up to now, the only materials known to conduct current with no electrical resistance and thus no loss did so only at very low temperatures. Accordingly, special copper oxide ceramics, so-called cuprates, took the leading positions in terms of transition temperature, i.e., the temperature at which the material loses its resistance. The record for a ceramic of this type is roughly minus 140 degrees Celsius at normal air pressure and minus 109 degrees Celsius at high pressure. In the ceramics, a special, unconventional form of superconductivity occurs. For conventional superconductivity, temperatures of at least minus 234 degrees Celsius have so far been necessary.

A team led by Dr. Mikhael Eremets, Head of the Working Group "High pressure chemistry and physics" at the Max Planck Institute for Chemistry, working in collaboration with Dr. Vadim Ksenofontov and Sergii Shylin of the Institute of Inorganic Chemistry and Analytical Chemistry at Johannes Gutenberg University Mainz has now observed conventional superconductivity at minus 70 degrees Celsius in hydrogen sulfide (H_2S). To convert the substance, which is a gas under normal conditions, into a superconducting metal the scientists did however have to subject it to a pressure of 1.5 megabar or 1.5 million bar.

"With our experiments we have set a new record for the temperature at which a material becomes superconductive," said Dr. Mikhael Eremets. His team has also been the first to prove in an experiment that there are conventional superconductors with a high transition temperature.

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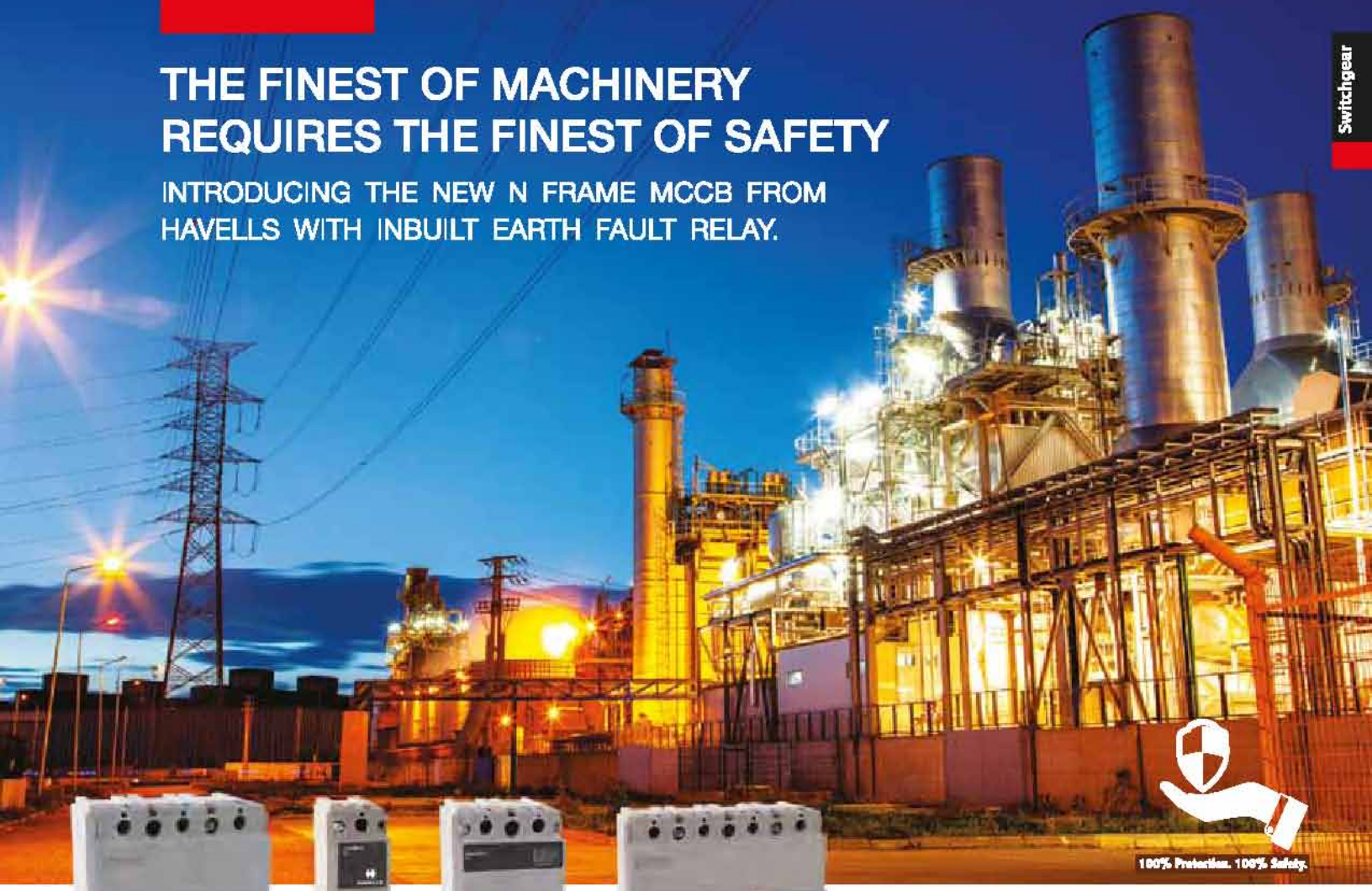

Havells introduces the new 'N' Frame Thermal Magnetic MCCB meeting varied requirements of electrical systems ensuring reliability and providing uninterupted service through out the product life cycle. The 'N' Frame MCCB uses the latest technology to enhance perfomance and safety.
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Bazmi Husain will take over as CTO, ABB

Bazmi Husain

"Bazmi Husain's unrivalled know-how will drive technological innovation across multiple disciplines," said Ulrich Spiesshofer, CEO, ABB...

ABB has appointed Bazmi Husain as Chief Technology Officer (CTO), effective from January 1, 2016. Husain, an expert in power and automation, has been with ABB for more than 30 years. He will report to CEO Ulrich Spiesshofer.

Husain is currently the Managing Director of ABB India Ltd. In his new role, he will be based in Bengaluru, India, with an office in Switzerland. His successor will be announced in due course.

As Chief Technology Officer, Husain will be responsible for overseeing all aspects of ABB's global R&D, which serves the entire company, its scientists and engineers, and for the R&D activities within ABB's divisions. Reporting to him will be the heads of R&D at Group and division level as well as ABB's venture capital arm, ABB Technology Ventures. With locations in seven countries, ABB's corporate research centres bring together an international team of highly skilled scientists across a variety of disciplines. ABB spends $1.5 billion annually on R&D and employs some 8,500 technologists.

"Bazmi Husain's unrivalled know-how will drive technological innovation across multiple disciplines to support our profitable growth ambitions – and the paradigm shifts in power and automation," said CEO Spiesshofer.

Mitsubishi Electric promotes Whitelaw to the rank of VP

Jeff Whitelaw

"Jeff is an organised and dedicated leader," said Mark Kuntz, Senior Vice President, Mitsubishi Electric US, Inc...

Jeff Whitelaw has been promoted to the rank of Vice President (VP), Product Strategy and Engineering at – Mitsubishi Electric US, Inc., Cooling & Heating Division (Mitsubishi Electric). Formerly, Whitelaw was Senior Director, Engineering Management and Testing. He reports to Mark Kuntz, Senior Vice President.

Whitelaw has worked for Mitsubishi Electric for 27 years. He is responsible for aligning and enhancing cross-functional communications and processes. He manages product planning and engineering, as well as industry and government relations, guiding the implementation of new products from ideation and development to market introduction. He monitors the HVAC regulatory landscape and oversees communication with government organisations. He directs the Engineering Center to ensure product testing and engineering operations comply with current standards.

"Jeff is an organised and dedicated leader. He's proven his ability to communicate effectively and efficiently in every role he's held. The division will be a more cohesive, well-oiled machine with Jeff in this new leadership role - a recipe for sustained success," said Kuntz.

Genevieve Cullen becomes President of EDTA

Genevieve Cullen

"We are fortunate to have a leader with Genevieve Cullen's outstanding record and unique understanding of the industry," said T Woodard...

The Electric Drive Transportation Association (EDTA) Board of Directors have appointed Genevieve Cullen to the position of President. EDTA is the cross-industry trade association promoting the advancement of electric drive technologies and transportation, including hybrid, plug-in hybrid, battery electric and fuel cell vehicles.

"As the electric drive market enters an exciting new phase, we are fortunate to have a leader with Genevieve Cullen's outstanding record and unique understanding of the industry to advance EDTA's mission," said Tracy Woodard, the chair of EDTA's Board of Directors.

Ms. Cullen previously served as EDTA Vice President, developing and leading the organisation's policy programme. As president, she is overseeing the organisation's outreach to stakeholders, policymakers, consumers and the media to accelerate the adoption of electric drive technologies.

"I am excited to lead the organisation in this critical growth phase for the industry. I look forward to working with the members and all of electric drive's stakeholders to ensure our continued success in expanding the use of secure, clean and affordable electricity in transportation," Cullen said.

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Robotics Market In Electronic, Electrical Industry To Grow

Many SMEs and cost-sensitive companies still prefer investing in traditional manufacturing processes...

Industrial robotics can be defined as the use of robots in the manufacturing processes of industries – such as electronic and electrical, food and beverage, and automotive. Industrial robots are programmed to control and automate manufacturing processes in industries. They are classified according to various technical parameters: such as number of axes, degrees of freedom, working envelope, kinematics, payload, acceleration, accuracy and repeatability.

Recently, the market research firm, Research and Markets has published a research report, titled 'Global Industrial Robotics Market in Electronic and Electrical Industry 2015-2019.' According to the report, market vendors have started developing next-generation robotic systems with artificial intelligence capabilities. This is expected to help manufacturing companies reduce product errors and consolidate their positions in the market.

The report also points out that the market is growing steadily, with the production of industrial robots for the electrical and electronics industry gaining momentum. The demand for electrical and electronic devices is expected to increase during the forecast period. Rising factory automation in the electrical and electronics industry has led to increased demand for industrial robots. Further, the report states that the high initial investment required for setting up industrial robots, however, remains a major hindrance to market growth. Industrial robots incur more operational costs compared to traditional manufacturing methods. Many SMEs and cost-sensitive companies thus prefer investing in traditional manufacturing processes. However, the global industrial robotics market in electronic and electrical industry is to grow at a CAGR of 5.43% over the period 2014-2019.

Key vendors in this market are ABB, Adept Technology, Fanuc, KUKA and Yaskawa Electric. Also, other prominent vendors are Apex Automation and Robotics, Aurotek, Axium, Baumann, Daihen, Finsar and Kawasaki Robotics.

Transformer Oil Market To Grow At A CAGR Of 7.14%

Image Courtesy: AGM Container Controls, Inc.

Mineral oil-based transformer oil is expected to occupy the major share as compared to silicone and bio-based transformer oils for the next five years...

Recently, Markets and Markets, a global research firm, has published a report on the potential of transformer oil. As per the report titled, 'Transformer Oil Market by Type (Mineral-Naphthenic and Paraffinic), by Application (Small transformers, Large Transformers, Utility & Others), & Region (Asia-Pacific, North America, Europe, ROW) - Global Trends & Forecasts to 2020,' global transformer oil market is expected to grow from $1.98 billion in 2015 to $2.79 billion by 2020 at a CAGR of 7.14% from 2015 to 2020.

The report has defined and segmented the transformer oil market with analysis and forecast of the global volume and revenue. Mineral oil-based transformer oil is expected to occupy the major share as compared to silicone and bio-based transformer oils for the next five years.

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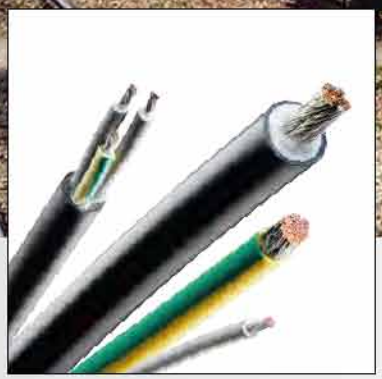

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Benefits Of BEMS

With the advent of the Smart Grid, these Building Energy Management Systems can help businesses better manage their electricity demand...

A Building Energy Management System (BEMS) is a computer-based system that automatically monitors and controls a range of building services, including air conditioning, ventilation, heating, lighting and other consumers of energy within the building or sometimes groups of buildings. The functional aim of BEMS is to manage the environment within a building, so that energy use perfectly balances the way in which the building is used.

ElMeasure provides a unique technique to integrate cutting-edge mechanical, electrical and building automation system technology into real-world solutions. The goal is to design buildings and systems that will have a smaller energy footprint and a much smaller impact on the environment.

There are a number of important benefits associated with use of a Building Energy Management system.

- It provides energy analysis, management and control information
- It enables equipment, air conditioning, lighting etc., to be switched on and off automatically
- It optimises space heating within the building
- It allows monitoring of equipment status and environmental conditions
- The amount of wasted energy is minimised. This saves money and reduces carbon emissions.

With the advent of the Smart Grid, these Building Energy Management Systems can help businesses better manage their electricity demand. With a varying price of electricity, the BEMS can program the system to turn on and turn off loads without sacrificing occupant safety, comfort and productivity.

BEMS can be used in different sectors such as:

Health Care: Health care establishments require large amounts of energy to heat and power them. Therefore, large savings can be made by installing BEMS to optimise efficiency, while still delivering the best comfort conditions for occupants.

Retail: Lighting, refrigeration and air conditions are large energy users in the retail sector. Inefficient energy use can lead to over-heating and over-cooling causing over consumption and spending.

Manufacturing: Rising energy prices and the cost of raw materials are making it hard for manufacturers to keep their production costs down and make a profit. Managing energy consumption across a manufacturing site with an effective BEMS can remove inefficiencies and reduce costs.

Educational Institutions: Private schools, academies, colleges and universities are all large consumers of power. Energy intensive equipment, such as computers, lighting and air conditioning, are often used inefficiently, e.g., they are left turned on overnight or at weekends, adding unnecessary cost to the bottom line. BEMS can be programmed with occupancy set points and calendar schedules, to ensure lighting and heating are not over-used during unoccupied times.

Commercial / Residential: Occupancy comfort and building efficiency both need to be optimised in office / residential environments. However, the desire for comfort can often reduce the efficiency of the building, due to inefficient settings and programming of the building controls. BEMS can control lighting and cooling effectively – to avoid unnecessary use of energy outside normal working hours or when ambient daylight levels are adequate.

For more information: www.elmeasure.com

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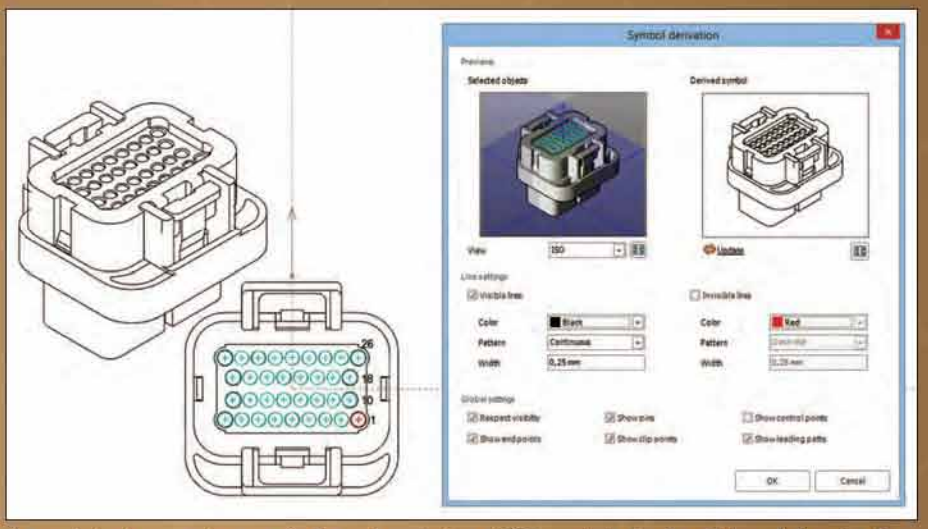
Eplan Harness proD Becomes More User-friendly

Eplan Harness proD aims to provide a user-friendly 3D system for wire harness design. Electrical engineers generally have limited experience in operating complex MCAD systems, and therefore benefit from a user friendly approach...

Version 2.5 of Eplan Harness proD will be available from October. Development has focused on optimising user workflows and a major new highlight is the coupling of the 3D wire harness engineering system to the Eplan Platform's central parts management. This represents a milestone in integrated data management. Users then have only one central parts management system that they are able to access over the entire course of a project. This significantly reduces the effort in maintaining master databases and enables continuous workflows from schematics through to production documentation.

Master data workflows have been further optimised through the derivation of 2D symbols – required for nail board drawing – from existing 3D data. This is particularly efficient because 3D component data is already required. Existing data therefore gets reused – manual creation of component symbols is unnecessary.



An assistant supports users in the extrapolation of 2D symbols for the ail board drawing from the existing 3D model...

Simple component positioning in 3D

Eplan Harness proD aims to provide a user-friendly 3D system for wire harness design. Electrical engineers generally have limited experience in operating complex MCAD systems, and therefore benefit from a user friendly approach. For example, by positioning a component, such as a connector, within the 3D space enables the selection of reference point, edges and areas. This simplifies the positioning process. A preview function helps users achieve correct positioning at the first attempt avoiding the need for subsequent adjustment. Users who use AutoCAD symbols can look forward to a much improved import function. Imported DWG and DXF drawings can be edited in Version 2.5 with all the relevant content being extracted. This greatly speeds up the process of creating parts.

Faster cable routing

Version 2.5 of Eplan Harness proD includes many new features – for example, the fixing of a 3D object's positioning, the option to position the starting point of a new bundle in a wire harness into existing bundles, and the automatic routing of cables.

To support production, wire colourings can be displayed in the connector symbol on the nailboard. Production can then use the drawing to identify the correct positioning of a wire at a connector. Searching wire lists for the necessary information is no longer required and the production process becomes faster.

Flexibility in nailboard design

There are also many new features in the nailboard design to interest users. Eplan Harness proD 2.5 has separated the 'data layer' from the 'display layer.' This might sound technical, but it gives users massive flexibility in nailboard design. Display configurations enable a drawing to be viewed differently without having to change the data – e.g., according to a company's internal drawing standards. This gives greater flexibility. Batch processing of updates has been added to project management section of Eplan Harness proD. The need for evaluation or drawing updates is detected and then batch processed to further reduce project management effort. Features such as the automated updating of library parts or the newly supported CAD formats are among the many enhancements to increase the efficiency of wire harness projects – and to speed up customer workflows.

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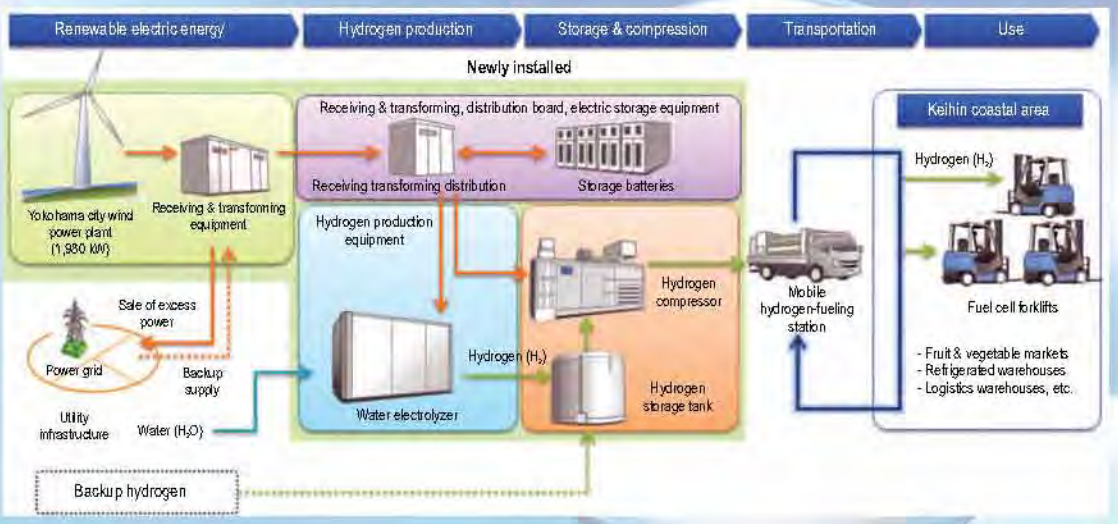
Building A Renewable CO_2-free H_2 Supply Chain

Hydrogen has the potential to permanently change the way we generate and use power. It can be created using renewable energy sources, stored, transported, and used at a later point – all with minimal environmental burden...



A new initiative that has been taken in Japan aims to trial a full-fledged carbon-neutral hydrogen supply chain powered by renewable wind energy. The trials will take place near the cities of Yokohama and Kawasaki in the Keihin coastal region.

According to the Intergovernmental Panel on Climate Change, nearly 25 gigatons of CO_2 – over half of the world's greenhouse gas emissions – come from the use of fossil fuels in electricity and heat generation, industry and transportation. Realising the importance of taking on this challenge by establishing carbon-neutral supply chains across different sectors (from power generation to vehicle fueling) as soon as possible, major corporate and public sector partners in Japan have decided to work together. Hydrogen has the potential to permanently change the way we generate and use power. It can be created using renewable energy sources, stored, transported and used at a later point – all with minimal environmental burden.

While hydrogen is most commonly created through a reaction between methane and steam, it can also be created from water through electrolysis. More often than not, this requires electricity – which is still typically produced using fossil-fuel-burning power plants.

Since the overall environmental benefit of hydrogen is only as strong as the method used to produce it, global research initiatives around the world are dedicated to developing large-scale carbon-neutral projects that use renewable energy to power hydrogen production.

Under this trial project, wind power will be used to turn water into oxygen and hydrogen, with the latter stored for use locally. Grid power will only be used for backup when absolutely necessary and excess renewable energy produced may even be sold to utility companies.

As plans currently stand, the project will involve:

- A system to produce hydrogen by electrolysing water using wind power
- A system to optimise storage and transportation of hydrogen produced
- Use of fuel cell forklifts
- A hydrogen supply chain feasibility study (hydrogen price, CO_2 reduction, etc.)

On the public sector side, the project is being implemented by the Kanagawa Prefectural Government, Yokohama City and Kawasaki City. The four private sector participants are Iwatani Corporation, Toshiba Corporation, Toyota Motor Corporation, and Toyota Turbine and Systems Inc. In addition, the project will be supported by Japan's Ministry of the Environment.

The total project duration is expected to be over four years. At this stage, the project partners are still discussing specifics. Implementation is set to begin from April 2016 onward.

A committee has been formed, with Dr. Kenichiro Ota (Prof. Emeritus, Yokohama National University) and Dr. Yoji Uchiyama (Prof. Emeritus, University of Tsukuba) participating as academic experts. The committee will discuss the direction of the project, as well as establishing a project-wide communications framework and will determine issues that require further research after the trial has finished.

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Siemens scores 90 out of 100 points in DJSI

The company has received a very positive overall assessment by scoring 90 out of a maximum of 100 points...

Siemens has been recognised as one of the most sustainable companies in its industry. Each year, the investment company RobecoSAM compiles the Dow Jones Sustainability Index (DJSI) – the world's most renowned ranking of its kind – for Dow Jones, a provider of financial market indices. In this year's DJSI, Siemens ranks among the leaders by taking second place in the Industrial Conglomerates area, which comprises 43 companies, including General Electric, 3M, Philips and Toshiba.

Siemens received a very positive overall assessment by scoring 90 out of a maximum of 100 points. The company has been represented in the DJSI every year since 1999, when the index was first published. The DJSI takes into account environmental and social factors as well as economic criteria. In addition, Siemens also received top marks in nine of the 20 DJSI categories, including customer and environmental management as well as corporate citizenship.

"Sustainability is and will remain a major success factor for Siemens and thus also for our customers. For this reason, we're very pleased to receive this honour again. By making our products even more energy-efficient and helping our customers reduce both their energy costs and their CO_2 emissions, we're driving innovation at our company," said Roland Busch, the member of Siemens' Managing Board with special responsibility for sustainability.

Globe Electric recognised for its achievements in LED lighting

"We are greatly honoured and appreciated by the recognition for the work put into developing energy efficient products for consumers...," said Globe Electric CEO Edward Weinstein...

(L2R): Adam Chaimberg VP, Product Development (Globe Electric); Stephen Harper, Prime Minister, Canada; Edward Weinstein, CEO & Jack Weinstein, COO (Globe Electric)...

Globe Electric has been awarded two international prizes for innovation in LED Lighting from ENERGY STAR and SEAD. Named the ENERGY STAR Lighting Manufacturer of the Year (Canada, 2015), this award marks Globe Electric's 3rd major ENERGY STAR win, having won Manufacturer of the Year (Canada, 2008) and Recruit of the Year (USA, 2007).

"My congratulations to Globe Electric on this great achievement. Thanks to you, Canadians have access to energy efficient lighting products and will enjoy real savings on their energy bills," said Greg Rickford, Minister of Natural Resources, Government of Canada.

In addition, Globe Electric has won the medal for greatest energy efficiency at the fourth SEAD Global Efficiency Medal competition, presented by the Super-efficient Equipment and Appliance Deployment (SEAD) Initiative at an awards ceremony at the United Nations in Paris, France. The winning LED bulb has won based on product performance and quality.

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Interview

"ELECRAMA-2016 will have more than 900 exhibitors..."

Indian Electrical & Electronics Manufacturers' Association (IEEMA), is the first ISO certified industry association in India with 800+ member organisations encompassing the complete value chain in power generation and T&D equipment. IEEMA organises **ELECRAMA** – the world's largest electrical T&D exhibition. **Aaditya R Dhoot, Managing Director, IMP Powers Ltd.**, who has been the **Chairman** of the Organising Committee of **ELECRAMA 2016**, is talking on the event with the team of **ELECTRICAL INDIA**. Excerpts...

➢ **Could you give us an overview of ELECRAMA, introducing us to its history and profile?**

From its moderate beginning in 1990, ELECRAMA has grown from strength to strength over the last 25 years, emerging as the largest stand alone Electrical T&D Exhibition in the world. ELECRAMA-2016 is the 12th edition of the event, and will be held at BIEC, Bengaluru from Saturday 13th February, to Wednesday 17th February 2016. With over 100 countries participating, tens of thousands of latest products and solutions and almost every topic of electricity covered, this edition is all set to become the WORLD ELECTRICITY FORUM.

ELECRAMA through the years has evolved along the contours of the sectoral landscape to reflect these dynamic changes in the ecosystem – and today it is poised to take a leadership position of a truly global platform for technology, product and knowledge sharing amongst all key stakeholders of the electricity ecosystem.

➢ **Please briefly introduce us to IEEMA, the organiser of Elecrama.**

IEEMA is the apex association of manufacturers of electrical, industrial electronics and allied equipment in India. Founded in 1948, IEEMA is the first ISO certified industry association with 800 plus member organisations encompassing the complete value chain in power generation, transmission and distribution equipment. IEEMA members contribute to more than 90% of the power equipment installed in India. The total combined revenue of all its members would be $ 25 Billion.

IEEMA plays a crucial policy advocacy role with government and its agencies. It works closely with standardisation bodies, R&D organisations and testing institutes for formulating Indian standards for developing energy efficient products. IEEMA evolves and operates equitable and uniform PVC Clause and due to its unbiased approach, IEEMA Price Variation Clause has gained recognition and credibility over last three decades in all utilities in India and abroad. IEEMA holds product-specific conferences, seminars and large exhibitions like ELECRAMA, which is the world's largest event for T&D equipment industry.

➢ **Could you tell us more about the structure of the event? What was the number of visitors and exhibitors in the past, and how many do you expect to see in 2016?**

ELECRAMA-2016 will have more than 900 exhibitors from more than 30 countries, spread over 6 halls with gross 80,000 sqm display area. More than 110,000 visitor footfalls from 100 countries are expected over the five days of the event.

The major highlights of the five days event are that Anant Geete, Hon'ble Minister for Heavy industries and Public Enterprises, has accepted IEEMA's invitation to visit ELECRAMA 2016 and Hon'ble Minister for Power, Piyush Goyal has agreed to grace the inaugural session. It is supported by the Ministry of Power, Ministry of External Affairs, Ministry of Heavy Industries & Public Enterprises, Department of Heavy Industry, Ministry of Commerce & Industry, Department of Commerce (For RBSM), Department of Industrial Policy & Promotion, Government of India.

ELECRAMA will for the first time feature 'WORLD UTILITY SUMMIT,' a unique global platform. This (by invitation only), event is of the utilities, for the utilities and by the utilities. CXOs of more than 50 global utilities are being invited to participate in the two-day summit to interact with CXOs of Indian utilities – and share their experiences and future of energy and its technology.

'Network to Net worth' is another new interesting and necessary addition to ELECRAMA 2016. N to N is planned for creating awareness about the huge investment and JV opportunities in the Indian electrical sector for both global and domestic investors.

ELECRAMA for the first time features unique experience pavilions displaying, 'Energies of Tomorrow' and 'Evolution of 125 years of Electricity,' in collaboration with IEEE, a coffee table book on this subject is also under preparation.

RND – Railway, Nuclear & Defence pavilion is also planned for the first time at ELECRAMA to enable interaction between industry and these critical sectors displaying their strengths, capabilities, services and plans in this specially dedicated pavilion.

Renewable energy pavilion is another addition under planning for displaying the strengths of the Indian industry in the renewable sector.

Contemporary events, which have added strength to ELECRAMA over the years will continue to feature.

The third edition of Reverse Buyer Seller Meet, supported by the Ministry of Commerce, Govt. of India will continue to generate large scale business opportunities. 8000+ meetings with 600 overseas buyers from 30 countries have been planned over the two and half days of this event.

'Engineer Infinite' in ELECRAMA 2016 will feature 50 most innovative third year student projects in the electro mechanical segment, for encouraging young budding engineers from across the country. A subset to this activity is 'Coffee with Sir,' where participating students listen and network with industry leaders over all five days. The 5 best students' projects will be awarded by an industry leader at the 'Innovation Day.'

International T&D conclave, another co-located event has been planned as a half-day event in its third edition. It will provide a unique opportunity for Indian industry and its stakeholders to listen to and interact with global experts from the energy sector.

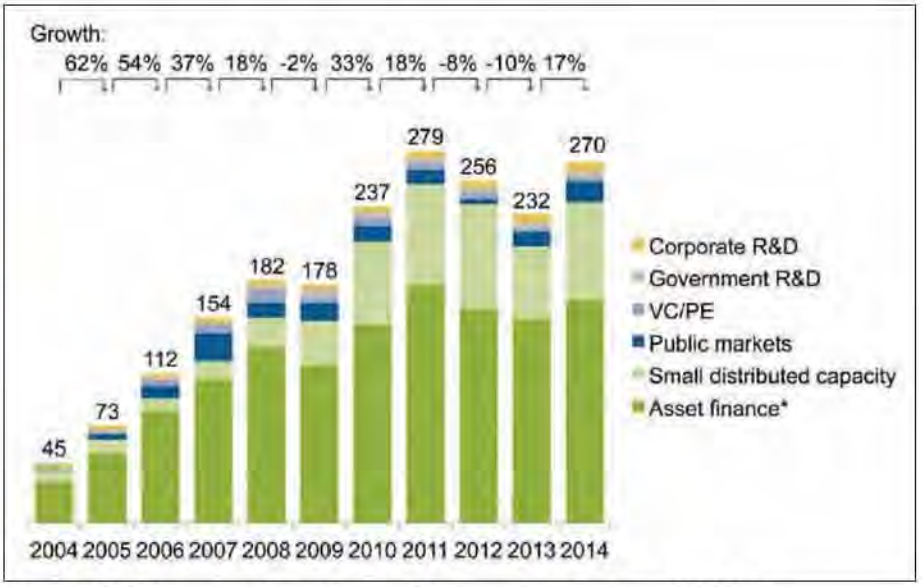
CEO Summit, which is a networking event for industry CEOs in the evening, will now have a different and more interesting format for ELECRAMA-2016. ELECRAMA will culminate with the exhibitors' nite celebrating the exhibitors.

Bosch has commissioned a 12 MW solar project for Cochin International Airport Limited (CIAL)...
Source: Bosch

GOING GREEN

To Keep The Climate Clean

Globally, installation of renewable sources for power generation is being treated with high priority. India too is not an exception. The present government is trying hard to streamline smooth financing for the renewable energy project. There are some exemplary projects that are already running with high efficiency...



Graph 1: Global new investment in renewable energy by asset class, 2004-2014...
Source: UNEP, Bloomberg New Energy Finance

With a view to rapidly arresting the fast growing carbon footprint in the power sector, globally, projects to harness renewable energy are being taken up with the highest priority. According to the United Nations Environment Programme's (UNEP's) report: 9th 'Global Trends in Renewable Energy Investment 2015,' which has been prepared by the Frankfurt School-UNEP Collaborating Centre for Climate & Sustainable Energy Finance and Bloomberg New Energy Finance, the past year (2014) brought a rebound of green energy investments worldwide with a surge of a solid 17% to $270 Billion.

Brushing aside the challenge of sharply lower crude oil prices – this sudden increase reversed the investment dip of the past two years and was mainly driven by investments in solar and wind energy. (Refer Graph: 1)

Key findings of the report include:

- China saw by far the biggest renewable energy investments in 2014 – a record $83.3 billion, up 39% from 2013. The US was second at $38.3 billion, up 7% on the year but well below its all-time high reached in 2011. Third was Japan, at $35.7 billion, 10% higher than in 2013 and its biggest total ever.
- A key feature of the 2014 result was the rapid expansion of renewables into new markets in developing countries. Investment in developing countries, at $131.3 billion, was up 36% on the previous year and came the closest ever to overhauling the total for developed economies, at $138.9 billion, up just 3% on the year. Additional to China, Brazil ($7.6 billion), India ($7.4 billion) and South Africa ($5.5 billion) were all in the top 10 of investing countries while more than $1 billion was invested in Indonesia, Chile, Mexico, Kenya and Turkey.
- Wind, solar, biomass and waste-to-power, geothermal, small hydro and marine power contributed an estimated 9.1% of world electricity generation in 2014, compared to 8.5% in 2013. This would be equivalent to a saving of 1.3 gigatonnes of CO_2 taking place as a result of the installed capacity of those renewable sources.
- As in previous years, the market in 2014 was dominated by record investments in solar and wind, which accounted for 92% of overall investment in renewable power and fuels. Investment in solar jumped 29% to $149.6 billion, the second highest figure ever, while wind investment increased 11% to a record $99.5 billion. These expenditures added 49GW of wind capacity and 46GW of solar PV, both records.
- Investment in Europe advanced less than 1% to $57.5 billion. There were seven billion-dollar-plus financings of offshore wind projects, boosting the investment totals for the Netherlands, the UK and Germany. These included, at the euro equivalent of $3.6 billion, the largest single renewable energy asset finance deal ever, outside large hydro – that of the 600MW Gemini project in Dutch waters.

Indian scenario

Under the leadership of India's dynamic Prime Minister, Narendra Modi, our country is also striding forward in the field of renewable energy. Few days back the government has launched the Indian Wind Resource Atlas at 100 metre level, which is certainly a highly useful tool for the wind energy stake holders. The government's

Our total installed capacity of renewable power is about 37,000 MW. Wind power has made a significant contribution to this achievement by way of around 24,000 MW installed capacity...

target of 60,000 MW of wind power by 2022 is highlighting the needed focus on the green power's contribution in India's sustainable development.

The union government has also raised the solar power generation capacity addition target by five times to 1,00,000 MW by 2022. The Ministry has chalked out year wise target to achieve 100,000 MW by 2022 as shown in the Table 1.

Year	Rooftop	Ground Mounted Solar Power Projects	Total (in MW)
2015-16	200	1,800	2,000
2016-17	4,800	7,200	12,000
2017-18	5,000	10,000	15,000
2018-19	6,000	10,000	16,000
2019-20	7,000	10,000	17000
2020-21	8,000	9,500	17,500
2021-22	9,000	8,500	17,500
Total	40,000	57,000	97,000 *

Table 1:
** 4,000 MW commissioned up to 31.08.2015*
Source: PIB

As on 31st August 2015, India's total capacity of renewable energy generation has been given in Table: 2 and 3. Grid connected renewable power has been a major focus area in the ministry. So far, the installed capacity of renewable power is about 37,000 MW.

Wind power has made significant contribution to this achievement by way of around 24,000 MW installed capacity, mainly in the states of Tamil Nadu, Maharashtra, Gujarat, Rajasthan, Karnataka, Andhra Pradesh and Madhya Pradesh. Wind electric generators of unit sizes between 225 kW to 2.50 MW have been deployed across the country. India ranks 5th in the world after China, USA, Germany and Spain. Necessity for energy security and caution on environmental degradation made wind as one of the non-ignorable sources in Indian energy mix.

Type	MW
Wind Power	24088.36
Solar Power	4229.36
Small Hydro Power	4146.90
Bio-Power (Biomass & Gasification and Bagasse Cogeneration)	4418.55
Waste to Power	127.08
Total	37010.25

Table 2: Grid-interactive Power (as on 31.08.2015)...
Source: MNRE

Type	MW
Waste to Energy	146.51
Biomass (non-bagasse) Cogeneration	602.37
Biomass Gasifiers 1) Rural 2) Industrial	 17.95 152.05
Aero-Genrators/Hybrid systems	2.67
SPV Systems	279.74
Water mills/micro hydel	17.21
Total	1218.50

Table 3: Off-grid/ Captive Power (as on 31.08.2015)...
Source: MNRE

Although, the figures show that as far as harnessing renewable energy is concerned, wind energy set-ups have gone far ahead of others, it's not that the government is not focusing on the other areas. With a long coast line of around 7,500 km, India has a great potential (24 X 7) for harnessing wind energy (both onshore and offshore), which is quite cost-competitive.

Also, the government has reinstated accelerated depreciation to boost wind power sector in its first budget – so that people can expand and take benefits of the same.

However, for solar energy also, internationally the cost of modules are coming down – but these parks (solar parks) need wide ground areas (lands), which are becoming costlier. Even then of late 25 big solar parks have been planned in the country. Also, off -shore projects are coming up soon.

The present government is also trying to boost the other segments of renewable energy; however, there the growth rate is still slow owing to several technological, feasibility and other restrictions. Thus, only wind and solar energies can accelerate the mission of countrywide electrification at this moment. In the words of Piyush Goyal, Minister of State (IC) for Power, Coal & New and Renewable Energy, "Union government has equal focus on various forms of renewable power and does not discriminate between solar, wind or biogas power in terms of providing support to these renewable sources."

Project finance

India needs around $200 billion to meet the targets of installing 100 gigawatts (GW) of solar power capacity and 60,000 MW of wind power capacity by 2022. In order to achieve the targeted solar capacity of (100 GW) alone, the investment required would be around ₹ 6,00,000 crores (@ ₹ 6 crores per MW at present rate) out of which about ₹ 4,20,000 crores is proposed to be debt sourced from both domestic and international financial institutions including multilateral and bilateral organisations.

During the latest 2-day visit of Narendra Modi to California, several talks have been initiated with the NRI investors on investment in the startup renewable projects, however, to further walk the talks, the govt. has to sort out the issues of tax filing, method of charging Capital Gain Tax etc. Also, the government has to redefine and ease the startup definition – the process has already been started.

A few significant projects installed in India in 2015

Suzlon Group has completed the commissioning of 100.8 MW wind power turnkey project for CLP India. The project will provide electricity to over 50,000 homes

The R&D installation is part of a test project for Vikram Solar's new floating module technology in Kolkata...
Source: Vikram Solar

and curb ~ 0.21 million tonnes of CO_2 emissions annually. The company will offer operations and maintenance for 20 years through an Integrated Service Package contract. The project is located at Tejuva, Jaisalmer in Rajasthan, which is the home to the country's largest windpark with total capacity additions pegged at 1500MW out of which over 1200 MW have already been commissioned.

Cochin International airport, the country's first airport built under PPP model, has been the first airport in the world that completely operates on solar power. Bosch has commissioned 12 MW solar project for Cochin International Airport Limited (CIAL). Hon'ble Chief Minister Oommen Chandy has inaugurated the 12 MWp solar power plant, on 18th August 2015, comprising 46,150 solar panels laid across 45 acres near the cargo complex. Now, Cochin airport's solar power plant is producing 50,000 to 60,000 units of electricity per day – that is to be consumed for all its operational functions, which technically makes the airport absolutely power neutral.

Vikram Solar has completed India's first floating solar power plant. The R&D installation is part of a test project for Vikram Solar's new floating module technology in cooperation with the Arka Renewable Energy College in Kolkata. The project aims to create a system suitable for any body of water with the possibility of being scaled up for use in any other given environment. The installation is completely flexible and consists of ten 1 kW fibreglass modules, which make up the floating platform itself. The system is firmly anchored to the bottom of the lake and is connected to the grid using a submersible cable. The overall system is designed to last for 25 years and produce a minimum generation of 14 MWh/year.

Source: Suzlon Group

Suzlon Group has completed the commissioning of 100.8 MW wind power turnkey project for CLP India, which is located at Tejuva, Jaisalmer in Rajasthan...

P K Chatterjee
Editor
Electrical India

Profile

Nanotechnology, Robotics And Artificial Intelligence (NRAI) 2015-2025

Due to the interdisciplinary nature of NRAI technologies, advancements in future industrial and space systems will experience an exponential growth cycle like that is observed in the human genome...

In recent years the industries like Automobile, Medical, Space, Communication, Space and Military have realised tremendous benefits originating from discoveries made in the fields of Nanotechnology, Robotics and Artificial Intelligence (NRAI). Advancements in space systems development have been enabled by these fields to their independent contributions, though as technological challenges present themselves, further progress will be achieved through each of these technologies going hand in hand. As researchers work to overcome tomorrow's commercial, industrial, social and military space challenges, the progressive

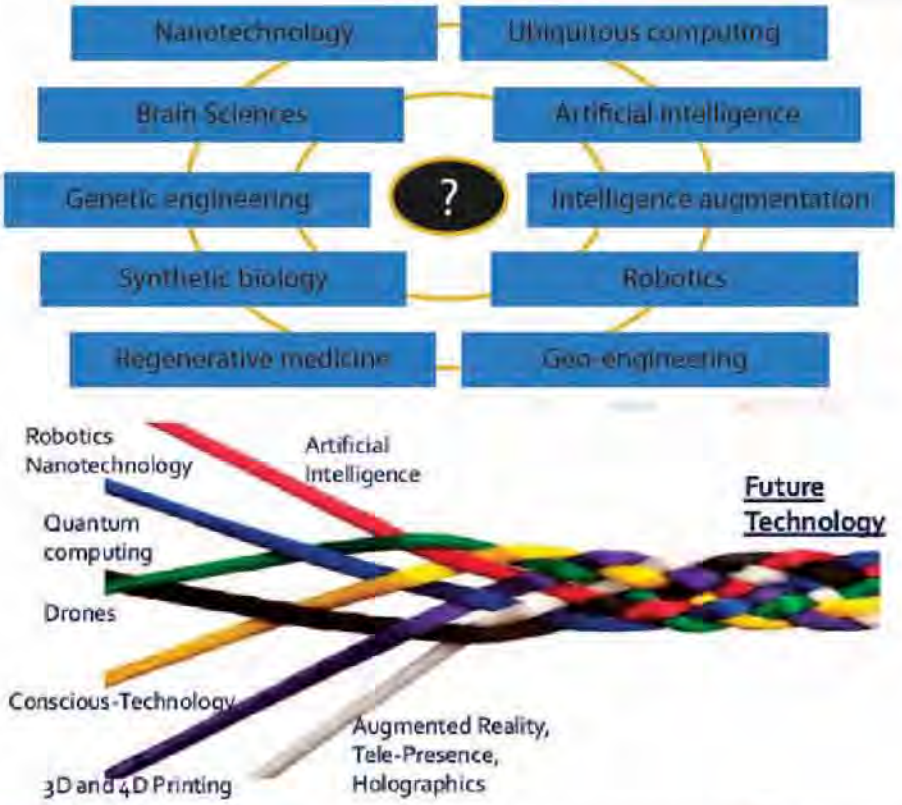
convergence of these respective fields will make possible the future development of advanced space technology, and ultimately space warfare systems. Due to the interdisciplinary nature of NRAI technologies, advancements in future industrial and space systems will experience an exponential growth cycle similar to that observed in the human genome.

Though there is tremendous potential for advances in civilian fields such as space exploration, communications and engineering through this convergence, such a process would also be the primary driver leading to advanced arms racing and evolved methods of space warfare. The convergence of nanotechnology, robotics, and artificial intelligence relative to space warfare systems as a function of time is outlined below.

In 1965 Moore's Law charted an exponential growth pattern in the complexity of integrated semiconductor circuits and data storage. The unprecedented explosion of computational potential, and in turn affordability, that Moore accurately predicted drove widespread discoveries in the field of computer science, such as the creation of the internet, complicated algorithms, and early Human Machine Interfacing (HMI).

In 2001 Kurzweil's Law of Accelerating Returns extended the growth pattern described in Moore's Law to transcend computers and reach into many other areas of science. Most remarkable is that this scientific and technological growth, which Kurzweil revealed, is not linear but exponential; and it is not limited to just the technology, as humanity accelerates its own potential as well. The way that one technology seems to reach its potential and then suddenly converges with another to become something greater was also observed with the marriage of early genetics research and advanced computer processors.

According to Kurzweil's Law, this would constitute an example of two technologies having pushed and pulled with each other, engaging in almost evolutionary fashion to become more than just the sum of their parts. The result in this case was the mapping of the genome, leading to improved health care and longer human life expectancy.



Technological possibilities, profound uncertainties, swifter change and convergence

The present concept of Human Machine Interface (HMI) in a network will be revolutionised to Brain Computer Interface (BCI). BCI will accelerate the human factor involved. This can be achieved through computational data analysis method based on architecture of the neuronal connection with in the human brain. BCI will exist parallel with a virtual world combined with a technological ability to create 3-D stereoscopic images direct to the eye, located in inter-pupillary distance of the tech-warrior. Integrating it with communication and data streaming from satellite, UAVs, UGVs etc... in a network centric warfare the tech-warrior may simply switch between various views of the war theatre.

Since the dawn of civilizations, humans have endeavoured to be in control of their environments and surroundings. This quest resulted in many discoveries and inventions, most notably among them are machines. Human used machines as an aid to make one's life comfortable, effective and efficient and aimed to develop machines capable of working like human beings, if possible. Computer is one of the most important machines, which has not only raised hopes in this regard but has also contributed significantly in every sphere of human endeavour. Human approach to problem solving is one of its kinds. It is based on abstract thought, logic, reasoning and recognising of pattern. Computers and humans are different. A computer is yet to understand all situations and simultaneously adapt to an evolving situations.

2015

Artificial Intelligence (AI): In support of cyber warfare and countless advanced military research programs, the field of Artificial Intelligence (A.I.) has been growing in importance, and this is no more apparent than in the arena of military space systems. In 2015, A.I. touches directly and indirectly upon nearly every advanced system in the space warfare toolkit. The potential inherent to these A.I. systems and the speed of their evolution will increase exponentially, driven by their own ability to learn, become cognitive and not only

New nanomaterials with revolutionary abilities will provide thermal protection, structural integrity improvements, and power generation abilities to satellites...

enhance 'their' potential, but the potential of the human war fighter as well. A.I. will enable seamless and real time responses to a broad spectrum of challenges posed at all levels of military operations. Conversely, with the increasing speed of military operations and size of operations supporting data flows, the human element will become increasingly unable to deliver effective response times in this rapidly accelerating information environment.

Cyber warfare: Cyber warfare is a daily threat, as many nations' individual systems and networks are now targeted by hundreds of thousands, and sometimes millions, of attacks per day. Such remote attacks, not only appear to originate from governments and militaries, but also from mischievous individuals, loosely affiliated international hacking organisations, and non state terrorist organisations. Such a capability is not limited to any specific nation or group, and is a method of attack that requires a constantly evolving capacity to respond to innovative challenges. Both the advanced cyber soldier and non state hacker are now well equipped to deliver compromising attacks against many aspects of space and cyber supported military functions.

As nations that are dependent on space to conduct military operations race to reduce network access points, recruit qualified professionals and identify methods to deter and respond to cyber threats, these rogue attacks are proving increasingly destructive. Furthermore, in 2015, the economic and societal effects of a large scale cyber attack against an industrialised nations' critical information infrastructure may have the potential to virtually cripple many industrial and governmental functions including those that incorporate commercial and military space systems.

Nanotechnology: Innovations in the field of lithography and multi gate processing, such as double and tri gate transistor will also contribute to dramatic increases in processing speed and efficiency when compared to the traditional and increasingly more archaic silicon chip. Both independently and hand in hand with AI, recent discoveries in the field nanotechnology, specifically carbon nanotubes and nanomaterials, are beginning to radically enhance not only traditional military space systems, but also the entire spectrum of miniaturised military technologies. New nanomaterials with revolutionary abilities will provide thermal protection, structural integrity improvements, and power generation abilities to satellites and other critical space assets. Due to the inherent and unique properties of these materials, widespread application to the structural and electronic components of space systems is inevitable.

Nanoscale applications working alone and in concert with AI will begin to move from the laboratories of the world into the theatres of war. Just as AI systems are now being wholly integrated into military decision making processes such as allowing satellites to deter attacks autonomously, in complimentary fashion, nanotechnology is providing the fabric for military space development.

2020

Artificial intelligence & cyber warfare: AI methodologies are being applied to support decision making at all levels of military operations such as assessment of force readiness, reliability and capability, complex missions planning and integration of data from multiple sources. Research in the field of AI is also addressing the challenges presented by supporting such decision making in rapidly changing environments. The use of such technology opens up endless possibilities in the military and explores AI's potential applications in military. In 2020, Artificial Intelligence (AI) and cyber warfare systems and their corresponding areas of responsibility relating to military spaces as well as civil society have fully converged. Specific combat operations are now being conducted by human and artificial operators working together in a virtual environment that delivers a real time view of the target area with semi autonomous and autonomous attack options just a blink or a voice; command away. In 2020, A.I. driven systems are supplying consolidated information and refined military options to high level decision makers, who are now unable to decipher and analyse vast data flows alone. The role of the war planner is now found to be most critical during the process of selecting war fighting strategies generated and provided by A.I. systems. The entire sphere of global military operations in 2020 has the potential to be fully interconnected for those with the means and the desire to do so, as successful military operations are decided by this complex network of systems. In the years leading up to 2020, efforts to reduce network access points into military and national security systems and to centralise individual architectures have proven to be a critical decision for many advanced military powers.

Threats posed to computer networks that support critical military satellite systems have become increasingly complex – and are occurring more frequently. Specifically, attacks targeting ground stations and command centres threaten military connectivity and the seamlessness of the Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance systems (C4ISR). Such attacks have the potential to effectively induce a systems blackout. A military's ability to adequately secure C4ISR systems and protect ground segments ensures success not only in space, but in all dimensions of warfare. If an attack were to succeed against the C4ISR supporting space systems, a self healing capability or Self Regenerative Systems (SRS) solution must be executed immediately in order to repair and secure the affected network. Such abilities to survive a debilitating space systems attack will be made possible by advances in AI.

Nanotechnology: It will be nearly impossible to find nanotechnology detractors as universal applications are benefiting industries located around the world in this multidisciplinary field. Up to this point, nanotechnology discoveries that improved military space capabilities had appeared mostly in the form of new materials that

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enhanced solar power generation, asset survivability, and structural integrity. By 2020 advances in nanotechnology have led to electrically charged based devices being replaced by non charges based devices that are non volatile. A manifested example of this leap ahead will incorporate flexible Thin Film Transistors (TFTs) that will revolutionise the way in which a human subject interacts with one's computer and related accessories. Imagine, for example, the features and capacity of a personal computer, cellular phone and Global Positioning System (GPS) integrated into a simple handheld device that is similar in size to a credit card. Garments would contain TFTs that would generate solar energy during the day and convert heat generated by the body during the evening. For soldiers on the battlefield, the benefits would include increased mobility. The next level: Molecular Nanotechnology (MNT) promises to revolutionise countless products by engineering mechanical and electronic systems including advanced materials, at the molecular scale. Such a capacity for discovery will touch upon every aspect of military technology in the realm of military space systems. This fusion process, executed primarily by A.I.

2025

The future of Nanotechnology/Robotics/ Artificial Intelligence (NRAI): As the arrival of strong A.I. draws ever closer, along with it will come the realisation that computing on such a scale and breadth is beyond our human ability to maintain and monitor even with the assistance of the machines themselves. We will begin to turn over the keys to the IT department to the computer within it, as non–biological intelligence has the ability to drive its own evolutionary cycle, with human oversight existing from afar, at specific points in the data stream.

This is the lift-off for military space systems, and our final approach towards a victory over the Turing Test. In the years leading up to 2020, we have witnessed the devices for human involvement in net centric warfare leave the point, and click mouse behind in exchange for voice command and evolved human computer collaboration, presented under the banner of HMIs.

In 2025 technology takes a step further towards Brain Computer Interfaces (BCI), also known as Brain Machine Interface (BMI) Working, but limited, examples of this technology, such as the Berlin Brain Computer Interface (BBCI) have exhibited proven results as far back as 2002. BCIs will empower and accelerate the remaining human factors involved in seamless military operations across the five theatres of combat, land, sea, air, space, and cyber space through advances in the field of neural networks, a computational data analysis method based on the architecture of the neuronal connections within the human brain. Such a system will allow human integration into the data stream and in time will not only allow interaction via one single human function, but instead BCIs will be comprised central nervous system connections, alpha and beta brainwaves, eye movement, and voice and facial recognition. The first manifestations of this technology have been dual use and have led to tremendous improvements in freedom and mobility for the severely disabled.

Additional limited civil applications are mostly in the area of video gaming. Military and national security applications of BCI in 2025 include the control of logistics, supply chains, terrestrial based weapons systems, unmanned aerial platforms, and space systems. By effectively and irreversibly fused Human Intelligence (HI) and A.I. Such a system could ultimately combine with real time, secure uplink and downlink data transmissions to a satellite in space which, in turn, could direct a small scale Unmanned Aerial Vehicle (UAV) or Unmanned Ground Vehicle (UGV) utilising advanced Nano Electro Mechanical Systems (NEMS) and Nano Opto Electro Mechanical Systems (NOEMS) derived sensors and optics delivering, for example, streaming video of the battlefield. The truly transformational role of these merged technologies will be difficult to imagine until we witness the war fighter speak, think or signal the fire command, and an enemy target is neutralised.

On a much smaller physical scale, military robotics programs have been enhanced by progress in the field of Molecular Nanotechnology (MNT), resulting in devices such as molecular motors. This development has spawned numerous concepts that are now in the research and development programs of all leading NRAI nations, such as India, China, Russia, and Japan. These robotics concepts, with molecular scale subsystems measuring less than a few centimetres, might range from miniature flying vehicles with numerous applications to ground based robots, both of which, with the help of A.I. can collectively combine their effects in a swarm like fashion.

Conclusion

Advancements in the field of MEMS driven micro thrusters would provide propulsion as reductions in the size of computer systems would allow for control of the devices, either autonomously or remotely through a ground segment. Miniaturised Unmanned Ground Vehicles (UGVs) acting alone or in swarms, will soon mimic biological entities such as insects through MNT processes and be used in Military intelligence related operations as will also be the case with aerial systems. Such systems by 2025 will be available for deployment as Military of the Shelf (MOT) systems and as Commercial of the Self (COT) systems. The role of ground segments in 2025 will continue to remain a critical area of military and national security operations. In corresponding fashion with the steps forward witnessed by many other areas of military space systems, the ground segment is reaping the benefits of NRAI as well. The vulnerabilities that weakened this bridge between earth and space based military functions have been significantly reduced, thanks to improvements in the areas of: miniaturisation, manoeuvrability, survivability and redundancy.

Profile

P M Menghal

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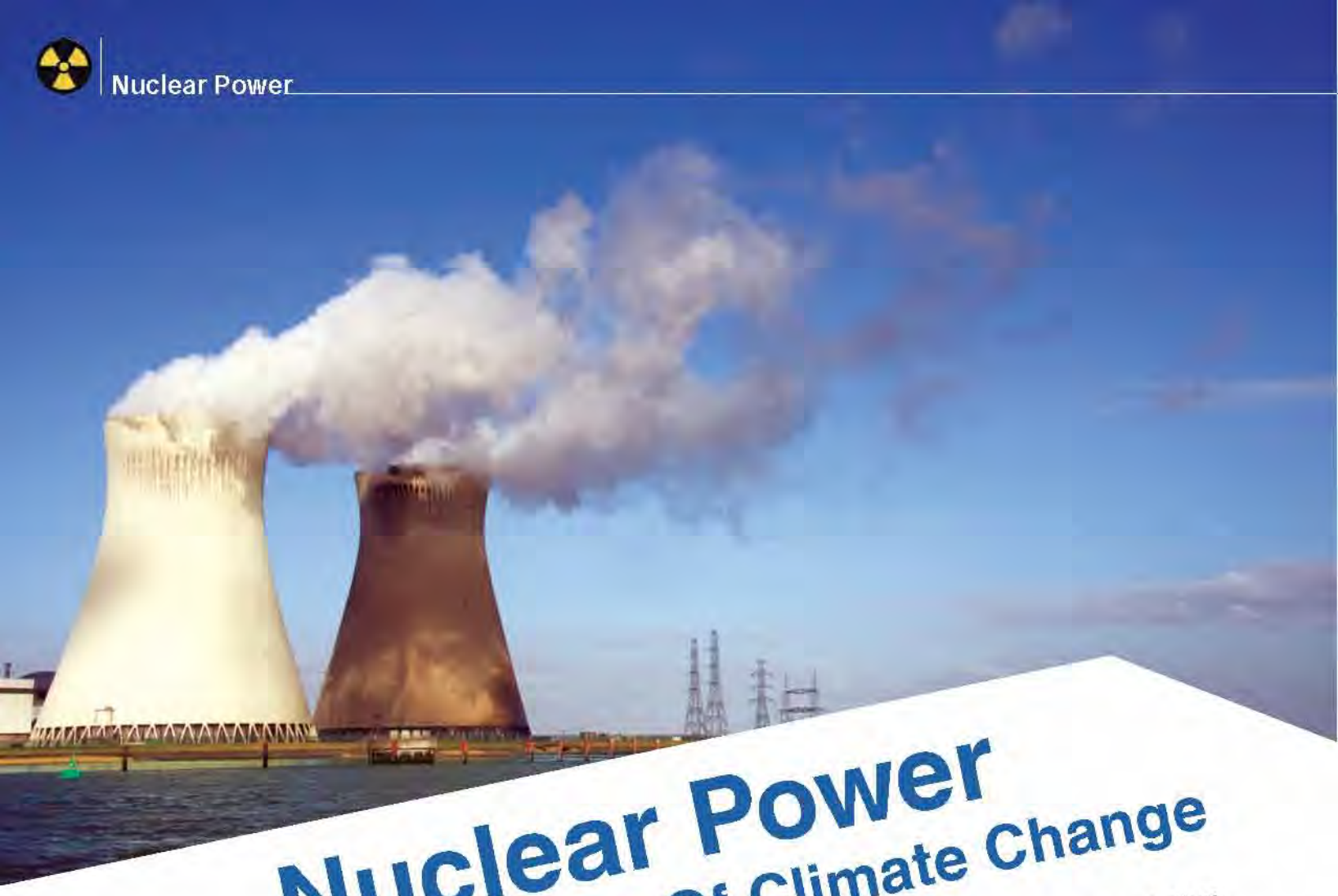


Nuclear Power
And The Challenge Of Climate Change

The challenge is that we need to reduce greenhouse gas emissions and other pollutants – and yet provide affordable power to allow for improved standards of living to the global population...

Climate change is now a universal concern. The story goes something like this:

The Greenhouse Effect: Carbon dioxide is transparent to the Sun's light, but absorbs and re-radiates the heat energy emitted by the earth.

Global Warming: The re-radiated heat warms the Earth until the net energy influx and output are balanced.

Climate Change: The additional heat energy has a complex effect on the climate and consequentially the biosphere.

This theory is not new, has been developing for a long time. Natural greenhouse effect is universally accepted. Without natural greenhouse effect, average global temperatures would be around 33°C colder. However, in recent years concentration of carbon dioxide (CO_2), methane and other greenhouse gases (GHGs) in the atmosphere has been rising. At least 80% of the world's electricity must be low-carbon by 2050 to give the world a realistic chance of keeping warming within 2°C according to the latest (5th) IPCC Synthesis report. The crux of the matter is, fossil fuel based power generation is one of the largest contributors to climate change through carbon dioxide emission.

It is also a well known fact that there is a strong direct correlation between per capita energy consumption and Human Development Index (HDI). As developing nations seek to raise their standards of living, the world will need greatly increased energy supply in the next 20 years, especially cleanly-generated electricity. Also, we need to recognise that electricity demand is increasing twice as fast as overall energy use and is likely to rise by

more than two-thirds between 2011 & 2035. The challenge is that we need to reduce greenhouse gas emissions and other pollutants – and yet provide affordable power to allow for improved standards of living to the global population.

Indian cities are amongst the most polluted cities in the world, causing immense damage to health. Also, India's per capita electricity consumption is amongst the lowest in the world. Thus, there is an urgent need to increase electricity generation, as also to clean up the environment.

So what are the options for non-polluting, carbon free power generation?

Hydro is the classic renewable but have geographical and water use limitations. Presently solar & wind are on the upsurge. But let's face the facts. Solar & wind generated electricity is intermittent. Wind's capacity factor is around is 30%, and solar is at 25%. This is not likely to improve substantially till viable energy storage devices are developed.

This leaves nuclear as a principal well established and proven alternative, particularly for bulk electricity production. There are already 437 reactors in operation world-wide, providing 11% of the world's electricity. Another 65 reactors are under construction.

Given the present scenario and severe need for electricity, in the near & intermediate term, most countries will need to have a power mix, which will need to include fossil fuels, renewables & nuclear. In the long term, fossil fuels will need to be eased out, and greater share has to be taken by renewables and nuclear. India is also following this route, the debate is how much of which?

And if we follow this pragmatic route, we find that renewables and nuclear stand on the same side of the carbon divide. The nuclear industry holds a unique place in the world economy, both in its: fundamental benefits of delivering clean, reliable, affordable energy on a large scale; and in the challenges it faces, – which range from the technological sophistication of its products, high capital cost of its plants, complexity of its supply chain, and – concerns raised by some sections of the general public over this form of energy.

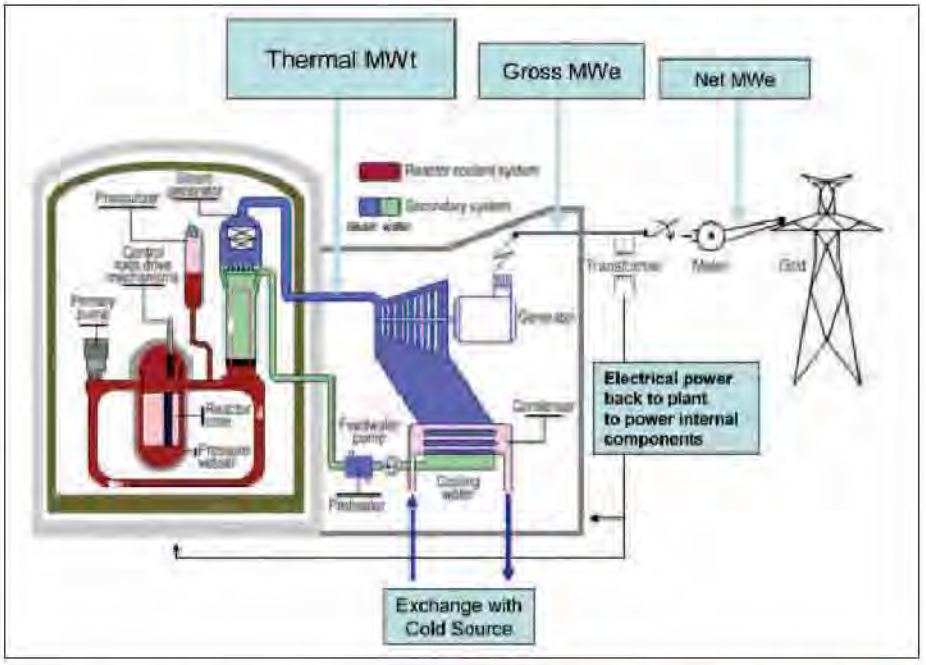
It is also important to remember that

The principles for using nuclear power to produce electricity are the same for most types of reactors. Energy released from continuous fission of the atoms is harnessed as heat...

nuclear energy also plays a vital role in other sectors too. Nuclear and radiation technology is vital for more than just providing electricity. It also has applications in medicine, industry, transport, agriculture, and it helps us learn more about our universe and can even be found inside your home.

For example, more than 30 million nuclear medicine procedures are carried out throughout the world every year. These involve the use of radioisotopes, such as technetium-99m, usually produced in research reactors. Russia keeps its shipping lanes open during winter with a fleet of nuclear-powered ice-breakers. NASA's Curiosity Rover uses plutonium as an energy source. Many household smoke detectors use the radioactive isotope americium-241. A nuclear reactor produces and controls the release of energy from splitting the atoms Uranium and a few other elements.

The principles for using nuclear power to produce electricity are the same for most types of reactors. The energy released from continuous fission of the atoms of the fuel is harnessed as heat in either a gas or water, and is used to produce steam. The steam is used to drive the turbines, which produce electricity (as in most fossil fuel plants).



Schematic of a nuclear electricity generating power plant...

I would like to add that radioactivity is a natural phenomenon and there have been many natural reactors. The world's first nuclear reactors operated naturally in a uranium deposit about two billion years ago. These were in rich uranium ore-bodies and moderated by percolating rainwater. The 17 known at Oklo in West Africa, each less than 100 kW thermal, together consumed about six tonnes of that uranium. It is assumed that these were not unique worldwide.

Any electricity generation policy will seek to deliver reliable, safe, affordable and clean power to its people. Let us see how the various power options fit into this scheme of things. Energy security and energy independence are also of concern to planners.

One measure of reliability is the Overall Plant Load Factor. The world-wide average load factors are in the range of 25% for Solar, 30% for wind, 65% for coal and 90% for

nuclear. Hydro capacities are affected by water use policies and rainfall, so the range can be very wide. This intermittency brings with it costs – economic and environmental, i.e., the need for backup generation.

Nuclear is a bulk production (base load) source suitable for industrial & process requirements, while renewables like solar and wind are more suitable for distributed loads. These high load factors also help the economics of nuclear plants. (The need of the hour for renewables is to develop bulk electricity storage systems). Indian nuclear power plants have regularly operated at 90% capacity factor.

Nuclear power plants are perhaps the safest in terms of death-rates per Terra-Watt-hours (TWh) of electricity production.

Typical values are:-

**Coal electricity – world avg	60 deaths per TWh (currently produces 26% of world energy, 50% of electricity)
**Oil	36 deaths per TWh (currently produces 36% of world energy)
**Solar (rooftop)	0.44 deaths per TWh (currently produces 0.2% of world energy - for all solar)
** Nuclear	0.04 deaths per TWh (currently produces 5.9% of world energy 11% electricity)
{*** 1 TWh = 10^{12} watt-hours = 1,000, 000 Mega Watt hours (MWh)	

One of the reasons for the above is the degree of tight regulation of the industry by national regulators, wide sharing of knowledge of safety standards & good practices encouraged by UN bodies like the IAEA (International Atomic Energy Agency) and International Industry organisations like WNA (World Nuclear Association) & WANO (World Association of Nuclear Operators).

A measure of the international confidence in nuclear power, let me state that before Fukushima accident worldwide there were 434 reactors in operation, 72 under construction and 173 were planned. As of March 2015 the figures are: In Operation-437, Under Construction-65, and Planned-165. Nuclear continues to generate 11% of the world's electricity as before. Even in Japan, nuclear restarts are now being authorised.

Fortunately nuclear accidents have been very few & far between. Though Fukushima got massive coverage press coverage, the point to note is that there have been no deaths due to radiation. In the other two major incidents, there were no deaths at TMI. In Chernobyl & 30 rescuers died (28 due to acute radiation exposure) & 100 rescuers were injured. Over 6000 children with thyroid cancers were reported, but luckily only 15 were fatal. (This was traced to intake of contaminated milk). There were no detectable cases of other cancers, incidence or mortality, that could be attributed to radiation from Chernobyl. These are the facts of the most severe of nuclear accidents.

Radiation is a big subject, but just a few words here. The energy source of our renewables is the sun, which actually is generating energy through a nuclear fusion reaction! 'The earth is the aggregate of fusion products'. Unstable fusion products undergo decay process & form stable elements. In a sense earth is the 'radioactive waste' from the fusion power plant in universe. That is why we see background radiation on earth, that is why we see natural reactors on earth, as mentioned earlier. Indian plant data shows that a nuclear power plant during normal operation adds more or less, to the background radiation; which is the typical figure internationally too.

When we talk of waste, we need to talk both about the volume of waste, our ability to handle it and the ill effects of coming into contact with this waste. The quantity of fuel needed to generate a certain amount of power depends on its calorific value, and obviously if you put in a lot of fuel you would generate a lot of waste. Typically, a 1000 MWe (Mega Watt Electrical) plant needs 2,000,000 tons of coal, or 1,960,000,000 gallons of oil, or 27 tonnes of Uranium. A coal plant will generate, on an average 400,000 tons of ash, as well as considerable amounts of particulate matter and injurious elements such as As, Hg, Cr, Cd. In addition, it will produce 4- 5,000,000 tons of CO_2 per year. {Carbon emissions impose a huge cost on society by threatening the basic elements of life --access to water, food production, health and the environment. Economists have estimated these 'social costs' at anywhere from US$8 per ton to as high as US$100 per ton of CO_2. We do need to develop clean coal and carbon capture technologies}

A typical 1000 MWe light water reactor will generate (directly and indirectly): 200-350 m^3 low- and intermediate-level waste per year. It will also discharge about 20 m^3 (27 tons) of used fuel per year, which corresponds to a 75 m^3 disposal volume following encapsulation if it is treated as waste. Where that used fuel is reprocessed, only 3 m^3 of vitrified waste (glass) is produced, which is equivalent to a 28 m^3 disposal volume following placement in a disposal canister. Safe & secure storage of these, much smaller quantities, over a long period of time is now considered feasible and practical. (India has adopted the reprocessing route, so the lower volumes will govern in the country). Another thing we need to remember that when the life cycle CO_2 balance of a plant is taken into account nothing is No-Carbon. Life Cycle Green House Gas Emission when measured as $CO_{2\ equivalent}$ per GWh (Giga-Watt-hours) is estimated to be as follows;- Solar PV- 65, Nuclear-28, Wind-26 & hydro-26!! For fossil fuel it is:- Lignite-1069, Coal-888, Oil-735 and Natural Gas-500.

The economics of nuclear power has been a point of discussion, for a long time. High capital cost of new plants requires long term financial instruments and tight project management and control of construction times. What works in favour of nuclear is high plant load factors achieved world-wide, long design life, low running costs, ready availability of Uranium & non-volatility in its price.

Structured life extension programmes have resulted in increased operating lives of plants, typically from original 40 years' design life to around 60 years; with minimal monetary investment. Such plants also deliver cheap power. India's oldest plants Tarapur Atomic Power Plant (TAPP) Units 1 &2, I understand, supply the cheapest non-hydel power! New plants are being simplified in design, have

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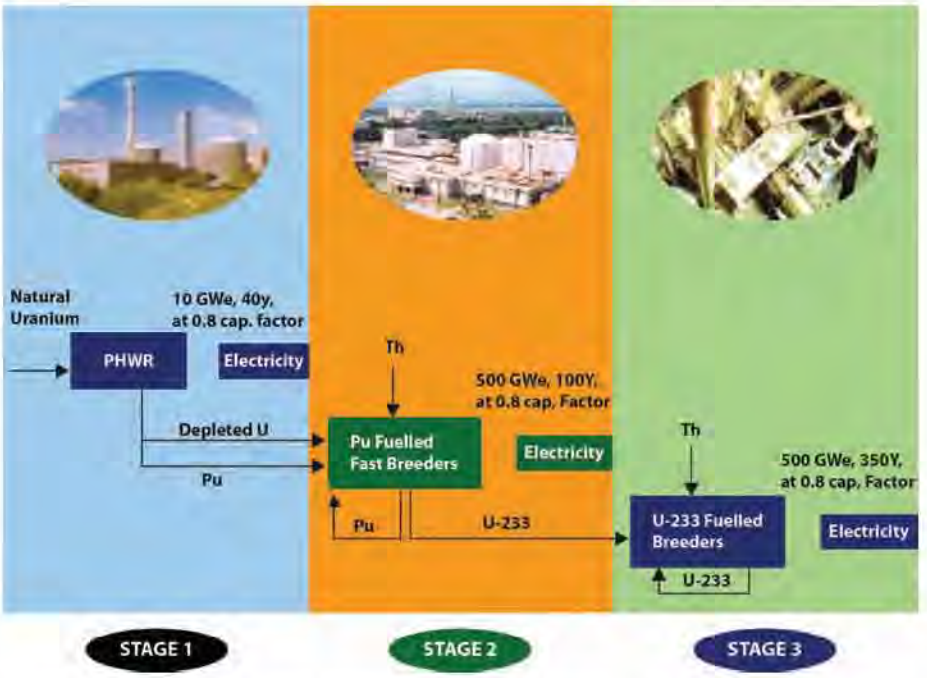
longer design life, and are modular in construction, all of which should lead to more competitive plants.

Energy security remains a high priority for all nations, and this is equally true for India. Indeed the nuclear route, envisaging ultimate use of thorium can lead to Energy Independence for India. India has about 30% of the world's Thorium and the potential for power generation is huge (See figure). The Department of Atomic Energy (DAE) has worked strenuously, and today India is a world-leader in this area. Though commercial Thorium use is some way into the future, it nevertheless holds great promise.

Thorium is not fissile; it needs to be converted to Uranium 233. Indian approach is the new classic 3 stage programme. The fuel from Stage 1 Thermal PHWR reactors is reprocessed and used in Stage 2 Fast Breeder reactors. During operation, the Thorium blanket in the reactor will be converted into fissile Uranium-233. (See figure).

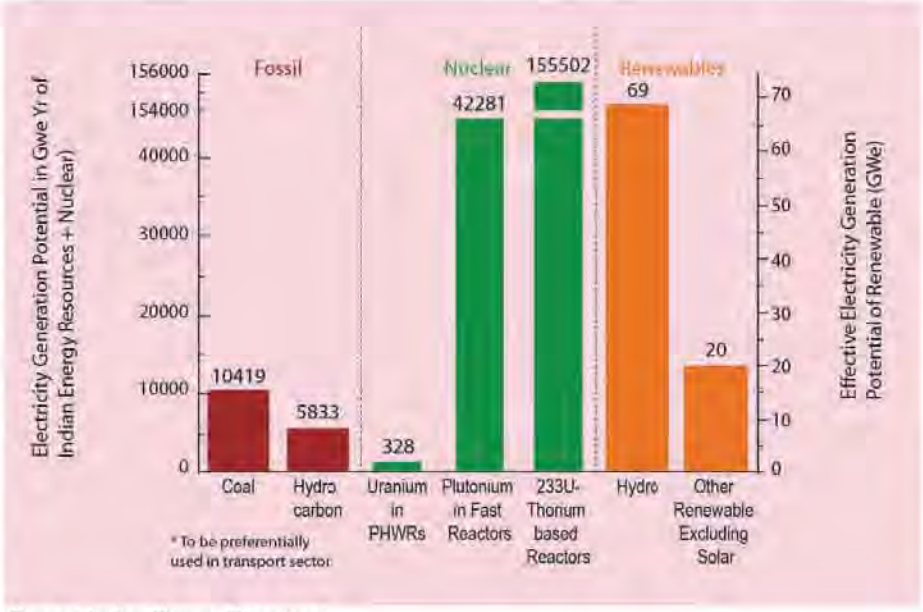
India has a long-standing, comprehensive and robust nuclear programme, which covers all aspects of the nuclear fuel cycle. Currently, India is building several 700 MWe PHWRs & one 500 MWe FBR. This is an indigenous programme, where Indian authorities have designed & constructed the reactors & operate the same. This programme is well under way.



The Manmohan-Bush deal opened the way for international nuclear commerce. In addition to the Russian reactors, India proposes to build nuclear power plants with the cooperation of France & USA. The intention is that these additional plants will increase nuclear power manifold, helping India to meet its climate commitments to a certain degree, while providing much needed electricity.

However, acceleration of the nuclear programme and introduction of these different technologies throw up many challenges. These relate to the absorption of the technology itself, building the necessary man-power, arranging finances, liability and compensation issues, becoming part of the international nuclear regime and aligning Indian laws in harmony with International agreements and conventions.

The Indian nuclear power track record, both of DAE/ NPCIL and the industry, bodes well for the success of this assimilation; but it remains a challenge nevertheless. In due course Indian entities can contribute in a significant way to international nuclear commerce. That would be a really win-win situation, for India and the world.



Current Indian Energy Resources...

Shah Nawaz Ahmad
Senior Adviser
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Profile

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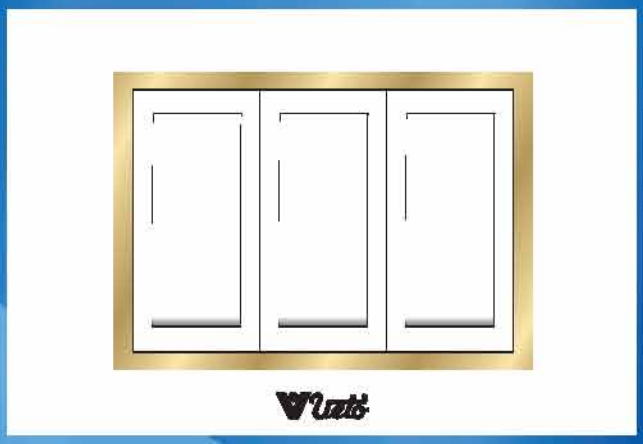

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Offshore Wind Power Generation

The Ministry of New and Renewable Energy (MNRE) has recently signed an MoU with a group of public sector undertakings and others to setup a joint venture company for an offshore wind power project in Gujarat...

Nowadays installation of submarine transmission cable interconnections around the world is a valuable asset for the offshore wind, gas and oil industry. There is a worldwide focus on environmental issues. Governments and power suppliers are supporting renewable energy sources, such as wind power, and oil/gas companies are substituting less efficient and CO_2 emitting gas-turbine generation on platforms with power supplies from the mainland. This has led to an increasing world-wide demand for submarine cable solutions with less environmental impact. Submarine cables have been increasingly used for power transmission in recent decades. Requirements are increasing regarding more effective use of available energy resources like wind power. We are equipped both with resources and skills to meet any future demands for higher voltages, higher power, deeper water and longer distances.

Indian scenario

The country's first ever offshore wind power project is set to come up in Gujarat. While on one

hand, the Central government is roping in public sector undertakings, on the other hand, Suzlon is conducting a techno-commercial feasibility study for offshore wind power project in Gujarat.

The Ministry of New and Renewable Energy (MNRE) has recently signed a Memorandum of Understanding (MoU) with a group of public sector undertakings and others to setup a joint venture company for an offshore wind power project in Gujarat. The consortium for the 100 MW wind power plant project comprises of National Institute of Wind Energy (NIWE), and consortium of partners consisting of National Thermal Power Corporation (NTPC), Power Grid Corporation of India Ltd (PGCIL), Indian Renewable Energy Development Agency (IREDA), Power Finance Corporation (PFC), Power Trading Corporation (PTC) and Gujarat Power Corporation Ltd (GPCL).

Part of MRNE's initiatives towards offshore wind power development also include announcement of draft National Offshore Wind Energy Policy and preparation of draft Cabinet note on National Offshore Wind Energy Policy. Once promulgated, the proposed National Offshore Wind Energy Policy will provide a conducive environment for offshore wind energy. In this, experts believe, Gujarat has natural advantage over other states in leveraging on its offshore wind power capabilities. India currently adds about 2,500 MW of wind energy capacity every year. The new government plans to increase annual capacity addition to as high as 10,000 MW. This endeavour would involve tapping sites that are slightly less conducive to wind energy generation and using state-of-the-art wind turbine technology to boost generation.

The government is expected to launch a National Wind Energy Mission soon to achieve this target. It needs to be mentioned here that globally around 7.5 GW of offshore wind power projects have been installed in countries like China, UK, Denmark, Germany, Netherlands, Sweden and Belgium.

Advantages

To take advantage of the steadier winds, offshore turbines are also bigger than onshore turbines and have an increased generation capacity. Offshore turbines generally have nameplate capacities between 2 MW and 5 MW, with tower heights greater than 200 feet and rotor diameters of 250 to 430 feet. The maximum height of the structure, at the very tips of the blades, can easily approach 500 feet, and turbines even larger than 5 MW are being designed and tested for future use.

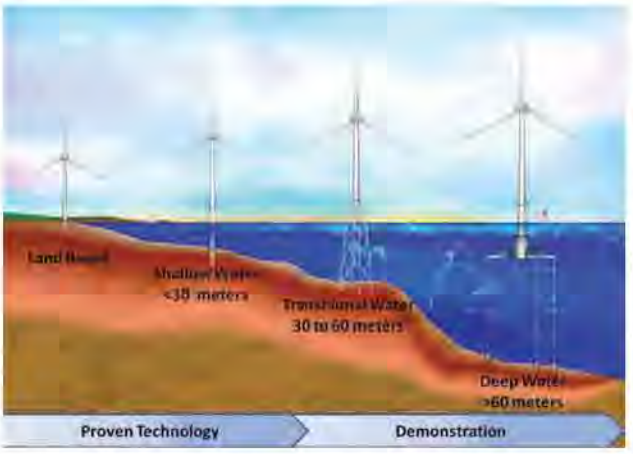
The three largest offshore wind farms currently under construction are as follows:

Wind farm	Total (MW)	Country	Completion
Gemini	600	Netherlands	2017
Gwynty Môr	576	United Kingdom	2015
Trianel Borkum West II	400	Germany	2014 (Phase 1) 2015 (Phase

Limitation

Problematic for the system stability is load shedding or a step-like increase of load by the multiphase pump. In order to investigate if there is really a problem in practice, the load characteristics of the multiphase pump have to be included into the model and simulation in more detail. It is well known that torque pulses can occur. Further, the range of load change must be defined in more detail. Using this information, the control system can be optimised.

Once promulgated, the proposed National Offshore Wind Energy Policy will provide a conducive environment for offshore wind energy...



Future scope

Another area for future investigations is the question about the quantities that are really required for system control. The current design requires the currents of all three phases into the machine as well as the rotation speed. However, the system gets simpler if some of these quantities need not to be measured.

Profile

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Wind farm, Kutch...

Climate Change And Role Of Renewable Energy

Coal–fired power stations are the least carbon efficient power stations in terms of the level of carbon dioxide produced per unit of electricity generated, and gas is the best. On an average 2.095 pounds of carbon dioxide per unit of electricity generated is produced in coal-fired power plants...

Global warming and climate change have become a worldwide issue, and these are the most debated topics among scientists and environmentalists around the world. Role of thermal power stations in global warming and climate change is well known.

The recently developed alternative sources of energy are thought to nullify the effects of thermal power in some way. The role of thermal power and renewable sources of power in climate change is described further.

Climate change

Variation in the earth's global climate or in regional climates over time is generally termed as climate change.

Climate change may be caused by the earth's internal processes or external forces such as change in the intensity of sunlight or human activities.

In the present context, the term climate change refers to change in the modern climate only, including the rise in average surface temperature, commonly known as global warming.

Effects of climate change are already felt. Glaciers are recognised as the most sensitive indicators of climate change. They advance during cooling and retreat during warming. From the last century, glaciers and ice fields have been melting all over the world. Glaciers in the Himalayas have been retreating at a rate of 25 metres per year.

Melting ice has resulted in rising sea levels. It is feared that at the current rate of melting of ice, ocean levels may rise by 23 inches by 2100.

Thermal power

World primary energy demand increases with increase in population and economic development. Within the last 25 years, the total energy consumption in the world has almost doubled. Electricity is the most conventional form of energy in today's world. It is mainly produced in power plants using conventional sources namely hydro energy, nuclear energy, and coal or other fossil fuels. However, in most of the countries, majority of plants use coal as primary energy. This is because installing a thermal power plant is in many ways more convenient than other power plants. Its gestation period is 3 to 4 years whereas in case of hydro power or nuclear power it may be 8 to 10 years or even more. So, to meet the immediate energy demand, thermal power is the best option. It can be located in any place

unlike hydro power stations, which are site specific. Further, it is free from vagaries of weather and does not depend on rainfall unlike hydro power stations. Another factor that attracts thermal power is that coal is abundantly available in many countries. Also, the thermal power technology, over the years, becomes mature, reliable and easily available. Due to these reasons, thermal power shares more than 68% of total power produced in the world today. In our country share of thermal power is 69.5% (total thermal power installed capacity is 18,9497.78 MW out of total installed capacity of 272,687.17 MW from all sources) as on April, 2015.

Thermal power & GHG production

In thermal power plant, the heat energy from coal is used to produce steam that rotates a turbine. The turbine, in turn, rotates a generator, which produces electricity. Thus, the chemical energy stored in coal is converted to electricity. The coal or other fossil fuels are carbon rich energy sources. Coal, when burned in the boiler of the power plant produces carbon dioxide, a green house gas.

Coal–fired power stations are the least carbon efficient power stations in terms of the level of carbon dioxide produced per unit of electricity generated, and gas is the best. On an average 2.095 pounds of carbon dioxide per unit of electricity generated is produced in coal–fired power plants. It is 1.969 pounds per unit of electricity in case of oil-fired and 1.321 pounds per unit of electricity in case of gas-fired power plant. With coal-fired plants generating the majority of electricity in the world, they produce the greatest share of carbon dioxide emissions from electricity generation, approximately 80% of the total. It has been calculated that thermal power plants are responsible for about 41% of U.S. man-made carbon dioxide emissions.

The emission of carbon dioxide also depends on the efficiency of the power plant. The average efficiency of thermal power plant lies between 32 to 35%. The more efficient the plant, the less amount of carbon dioxide it emits. Substantial improvements in generation efficiency can be achieved in the future through the replacement of traditional power plants with more efficient technologies, such as supercritical boilers, combined–cycle units and combined heat and power systems.

Substantial improvements in generation efficiency can be achieved in the future through the replacement of traditional power plants with more efficient technologies...

Thermal power & climate change

It is now clear that the earth is becoming warmer day by day due to green house effect. Among the green house gases (GHGs), carbon dioxide is the main culprit. At the beginning of industrial revolution, the amount of carbon dioxide in the atmosphere was 260 ppm (parts per million). After industrialisation more amount of carbon dioxide was emitted to the atmosphere by burning of coal and other fossil fuels. In March, 2015 the level has crossed 400 ppm. If we continue to use the fossil fuels at the current level, the amount of carbon dioxide in the atmosphere is projected to reach 560 ppm by the end of 21st century.

Coal is used as fuel in many industries including thermal power stations. But the emission of carbon dioxide from thermal power stations is more than other industries. This is the only reason why the environmentalists now oppose thermal power, and engineers are thinking on alternative sources of energy.

Renewable sources of energy

In the background of increasing energy demand but scarce availability and environmental threats, the search for alternative sources of energy started towards the last part of the last century. The alternate sources which have already assumed a significant importance are solar, hydro, wind and biomass.

These energy sources are renewable in nature and environmentally benign. The magnitudes of all these sources are extremely large. The very idea of accessing these energy sources gives us a kind of confidence as far as energy security and sustainability is concerned, along with assisting in mitigating the climate change by way of reduction of carbon dioxide from power plants.

The potential for renewable sources to provide clean and inexhaustible energy that is accessible to all is now universally accepted. Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report on 'Mitigation of Climate Change' has observed that technologies are available for mitigating the climate change, however these require appropriate policy and financial support. Renewable energy technologies have been identified as one of the key mitigation technologies for energy supply, transport, buildings, agriculture and waste management.

Renewable energy accounts for more than 10% of domestic energy production in the USA. According to the report the 'Energy Revolution: A Sustainable World Energy Outlook' renewable energy sources will account for 67% of the electricity produced in the developing Asia by 2050.

Solar energy

Sun is the principal source of almost all kinds of energy, both conventional and non–conventional. Although solar radiation is being utilised from time immemorial for drying, heating etc, direct production of electrical energy from it is a recent one. The solar energy that we receive on the earth everyday can produce 2500 times more power that we currently consume. But we should have the proper means and technology to harness the energy economically. Electricity is being generated from solar radiation either by photovoltaic cells or solar thermal power.

Solar radiation is directly converted into electricity by solar photovoltaic cells. The cell consists of two or more appropriately sandwiched thin layers of semiconducting material, usually silicon. When the solar cells are exposed to solar radiation, the incoming photons of radiation separate positive and negative charge carriers of the semiconducting material. This generates voltage and hence electricity. The higher the intensity of light, the greater is the flow of electricity. The electric output from a single cell is small. So a number of cells are connected in series or parallel to get the desired quantity. The module containing the cells is called a solar panel.

Solar thermal power station is like a conventional thermal power station having steam boiler, turbine and generator. In the conventional thermal power station, water is heated by coal, gas or petroleum oil to produce steam, which rotates the turbine and generator to produce electricity. But in the case of solar thermal power station, water is heated by heat derived from solar radiation. Sun rays are concentrated at solar receiver made of calcium carbide to have greater effectiveness.

To achieve this, sunrays are reflected from large mirrors, called heliostats, positioned at different positions at different angles so that the reflected rays concentrate at a point on the solar receiver. The surface of the solar receiver reaches to temperature as high as 1000^0C. In the receiver, a Heat Transfer Fluid (HTF) is heated. The HTF can be used directly in a small turbine to produce power or indirectly, to produce power when the heat is fed to a heat exchanger. The heat exchanger can transfer the heat in the HTF to high-pressure steam, which is fed to a steam turbine. Thus, although its principle is that of a thermal power station, here, no fuel is burnt, and hence there is no emission of carbon dioxide.

Wind energy

Energy obtained from a moving mass of air is known as wind energy. Wind has considerable potential as a global clean energy source, as it is abundant, and also non–polluting. Wind energy has been one of the primary energy sources used for milling grain, pumping water and so on. From the early wind mills used in India, China and Persia over 2000 years ago to the present use of wind for energy generation, wind has always played an important role in people's lives.

Wind energy has attracted many investors throughout the world. Construction of the plant is very simple. A turbine with some blades coupled with a generator is installed atop a tower. When the turbine is rotated by the wind, electricity is generated. One essential feature for this plant is that there must be sufficient minimum wind speed available in most part of the year. Global installed capacity of wind energy was 369,600 MW by the end of 2014. Installed capacity of wind power is largest in China (114,604 MW) followed by the USA (65,879 MW), Germany (39,165 MW), Spain (22,987 MW), India (22,465 MW) and the UK (12,440 MW).

Hydro power

Hydropower is currently the most common form of renewable energy and plays an important part in global power generation. Its technology is well proven and reliable. It has many advantages over thermal power. It does not aid in global warming. Worldwide hydropower produced 3,288 TWh, just over 16% of global electricity production in 2008, and the overall technical potential for hydropower is estimated to be more than 16, 400 TWh/yr.

Bio energy

Electricity is now generated from biological sources like agricultural waste, plantations, municipality waste and bagasse etc. Biomass includes straw, stalks, stems, fines and agro-industrial processing residues such as shells, husks, de-oiled cakes, and also forestry residues. The conversion technologies used are combustion/incineration, gasification, pyrolysis etc., using gas or steam turbine, either in power alone or in co-generation mode. Co-generation is the multiple and sequential use of a fuel for production of steam and power in a process industry such as sugar mills, paper mills, rice mills etc., where biomass resources are either generated or consumed in their main processing/ production process. Emission of carbon dioxide is minimal from this type of plants.

Development of RE in India

In India, the importance of the role of Renewable Energy (RE) to a sustainable energy base was recognised as early as in the 1970s. There has been a visible impact of renewable energy in the Indian energy scenario during the last few years. Renewable energy has been witnessing over 20% growth in the last five years. From the total renewable power installed capacity of 14,400 MW at the beginning of 2009, it has reached a capacity of 35,776.96 MW at the end of April 2015. This is apart from large hydro, which has an installed capacity of 41,632.43 MW as on April 2015. The potential and installed capacity of different sources of renewable energy in India is given in Table-1. Also, a total capacity of 1,174.5 MW of power plant in different renewable energy sources have been installed, which are not connected to the grid (off-grid power).

The growth of renewable energy in India is illustrated in Fig. – 1.

Apart from contributing about 12.96% in the national electricity installed capacity, renewable energy based decentralised and distributed applications have benefited millions of people in Indian villages by meeting their cooking, lighting and other energy needs in an environment friendly manner.

Renewable energy has been appropriately given the central place in India's National Action Plan on Climate Change being finalised by the PM's Council on Climate Change. India is perceived as an excellent country for developing Clean Development Mechanism (CDM) projects. As such, India has emerged as one of the most favoured destinations for CDM projects globally, with renewable energy projects having the major share.

India has achieved significantly in solar, wind, small hydro and bio energy. Wind energy continues to dominate India's renewable energy industry. India occupies the fifth position in the world in wind energy with installed capacity of 23,444 MW. India is also doing experimental studies for other renewable sources like tidal and geothermal.

Sl. No.	Source / System	Estimated Potential (MW)	Achievement (MW)
1	Biomass and gasification	17536	1410.20
2	Wind power	102772	23444
3	Small hydro power (up to 25 MW)	19749	4055.36
4	Bagasse cogeneration	5000	3008.35
5	Waste to energy	2554	115.08
6	Solar power	748990	3743.97
	Total	896602	35776.96

Table 1: Grid – interactive renewable power in India (as on 30.04.2015)...
Source: Ministry of New & Renewable Energy, Govt. of India

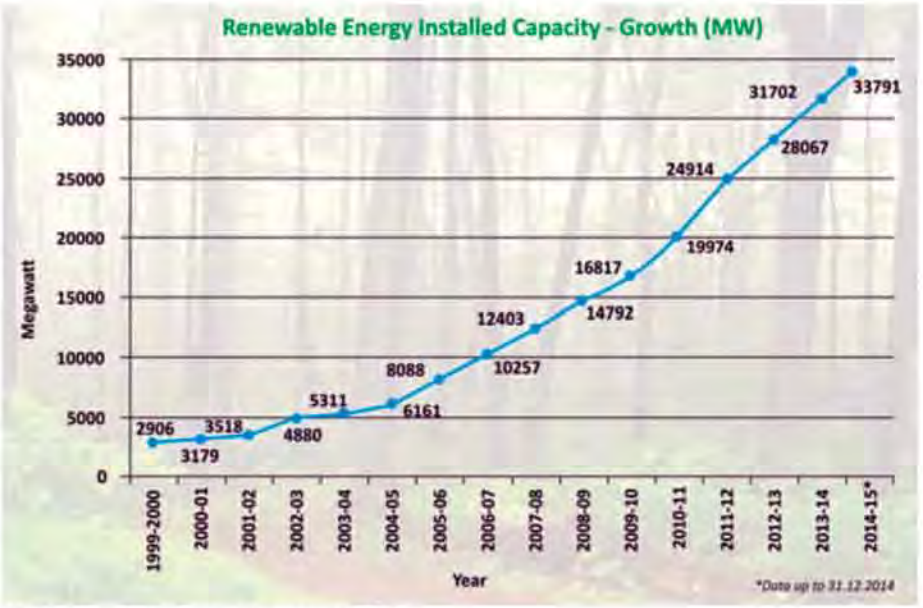

Fig. 1: Growth of renewable energy in India...

Conclusion

There is no doubt that increased concentration of carbon dioxide in the atmosphere leads to global warming and climate change. World wide concern over this has fixed targets to reduce green house gas emissions by between 25 to 40% by 2020. This will be difficult to achieve, if coal-fired plants remain in service, unless carbon capture and storage of emissions from coal fired power stations become viable. Some technology is available to limit carbon dioxide emissions, but it is extremely expensive. The extra cost means it is not economically feasible. In this situation, development of renewable power to mitigate climate change is absolutely necessary. India has taken a voluntary commitment of reducing emission intensity of its GDP by 20 to 25% from 2005 levels by 2020. The increased share of renewable energy in the coming years will contribute towards achieving this goal.

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Profile

Grid Stability Is Must

Before Ramping Up Capacity In Solar

Had the decision of high ADD imposed, there would have been severe setback to the capacity addition in solar. In fact, till the clarity on ADD came – many developers had kept their solar plans in abeyance as the projects which were awarded to them after tough competitive bidding would have become unviable...

Thanks to the National Solar Power Mission, the solar power capacity in the country is poised to increase in a rapid way in the next 4 to 5 years from the present installed capacity of around 3 GW. The new government has scaled up the target for solar capacity. The revised target is to achieve 100 GW of solar capacity by 2022 as compared to the earlier target of 20 GW envisioned by the Congress government. Though the target has been scaled many fold, how much of it would be actually commissioned – keeping in view the Indian ground reality it would be difficult to guess as of now. The Indian ground reality of topsy-turvy policies, state government priorities, land acquisition issues etc., may lead to derailment of capacity addition targets. Nevertheless, the decision of the new government on not to act on the 'Anti-Dumping Duty' (ADD) recommendation of the previous government has shown the new government's commitment and vision for solar power.

Had the decision of high ADD imposed, there would have been severe setback to the capacity addition in solar. In fact, till the clarity on ADD came – many developers had kept their solar plans in abeyance as the projects which were awarded to them after tough competitive bidding would have become unviable – with increase in the cost of solar panels on account of increase in duty on imported cells and modules. With the clarity on AAD, the developers are back on their plans to complete their on-going projects at the earliest and are also looking aggressively for new bids. India can now look forward for rapid addition of solar capacity in the grid.

Though there is clarity on the policy front, one technical aspect that has the potential to derail the development of renewables, including solar power, emerges from the unpredictable nature of electricity from these renewables. Except Bio mass/gas, 'Waste to Energy' (WTE) and to some extent Solar Thermal with storage and 'Run-of-River' (RoR) Small Hydro power plants (SHP) with pondage, electricity from all other renewables viz. Solar Photo Voltaic (PV), Wind, RoR SHP etc. is solely dependent upon the vagaries of nature. E.g. energy from solar PV is dependent upon the presence of sun light, whereas energy

Typically, the Indian grid has two peaks – one smaller peak in the morning between 9 to 11 am and a higher peak in the evening between 7 to 9 pm...

from wind project is dependent on blowing of wind. Apart from the unpredictable nature, the electricity from these renewables is also prone to variability, which means the electricity from these renewables is non-controllable, i.e., the power output would be non-steady. For example, in case of solar PV, the energy output is directly related to the intensity of sun light termed as insolation – higher the insolation, higher is the output. Therefore, in case of solar PV, electricity starts flowing to the grid after some time past sunrise and ebbs out some time before sunset – typical time of electricity generation would be from 7 to 8 am in the morning to around 5 to 7 pm in the evening, with some variations in summers and winters. Further, the electricity from solar PV typically follows a bell curve with peak levels reaching in the afternoon from 11am to 12 noon to 1 to 2 pm. The output is also susceptible to any shade on the solar panels, and therefore is negligible during rainy days.

For the stability of power grid, it is pertinent that there is a balance between the demand and supply of electricity at all point of time. If the demand is more than the supply, the frequency would dip and vice versa. In extreme cases, it may lead to tripping of the entire grid unless load shedding is carried out. Typically, the Indian grid has two peaks – one smaller peak in the morning between 9 to 11 am, when the offices and commercial establishments start functioning, and a higher peak in the evening between 7 to 9 pm when the domestic & commercial lighting demand kicks in. The demand reaches its lowest point some time in between 2 to 4 O'clock in the night. This has been the general pattern in the Indian grid, with slight variations from state to state, depending upon industrial development and also with variations in weather. For optimum, economical and efficient operation of the grid, the peak demand should be met by peaking power plants viz. gas power plants, storage/ pondage hydro power plants or pump storage hydro power plants etc. The base power which is required by the grid for nearly the entire 24 hrs should be met by base power plants viz., coal based thermal power plants, nuclear power plants – and to some extent also by large storage hydro power plants. The advantage of peak power plants is that they can be quickly turned on/off, reduce/increase output depending upon the requirements of the grid and thus the operator has control over their operations.

The generation from renewables is entirely dependent on the vagaries of nature and the operator has no control. Therefore, under the renewable power policy, energy from renewable sources is accorded a 'must flow' status to the grid and not to be backed down. Apart from environment consideration, the policy of not to back down power from renewables is also financially prudent – as the power from renewables have negligible variable cost. The danger to the stability of the grid arises from the 'must flow' status to these renewables, mainly solar PV and wind. If, at any point of time the power demand and supply in the grid are evenly matched – and at the same time the share of unpredictable power from renewables increases, then due to its 'must flow' status, power from base power plants viz., coal-based would be required to back down in order to stabilise the grid. This backing down can impact the base power plants (read coal based) by increase in their cost of generation, as the thermal power plants become less efficient on lower 'Plant Load Factor' (PLF). Variable Cost (VC) per unit and Fixed Cost (FC) per unit, both would increase – VC due to lower efficiency and FC as the fixed cost would be spread over lower units. This would ultimately increase the cost of electricity to the consumers and would amount to unintentional cross subsidising power from renewables. Backing down of base power plants (if it happens) would also point to insufficient management of the grid and lack of adequate planning.

As of now, the installed capacity of solar PV in India is around 3 GW, wind is at around 21GW and SHP around 3.8 GW, together they account for ~ 28 GW, which is ~ 11% of the entire installed capacity of India ~ 255 GW (as on Nov 2014). It is however, pertinent to note that due to low PLF (solar around 17 to 20% and wind around 20 to 26%) the energy contribution from these renewables to the grid is proportionately less than their percentage share in the installed capacity, at around 4 to 6% as against share of 11% in the installed capacity. Presently, there is not much impact on the stability of the grid on account of unpredictable power from renewables despite its 'must flow' status, though there has been state specific operational issues in some states – due to lack of adequate planning. As has happened in the state of Tamil Nadu, where due to inadequate evacuation system in areas with concentration of wind farms, the electricity from the wind farms could not be evacuated due to congestion in the evacuation lines.

Target of adding 100 GW of solar by 2022, however, may alter the present impact of renewables on the operation of the grid. Add to it another 60 GW of planned addition of wind power by 2022 and the scenario may change completely. Though, the entire target may not fructify - with the Indian ground reality, but even if 60% to 70% target of solar and wind is added to the grid – it may add additional renewable capacity of around 100 GW by 2022. In the same period, the planned

tentative capacity addition of conventional power projects (mainly coal based & large hydro) is roughly pegged at ~ 138 GW, 38 GW in the remaining period of 12th plan (2012-17) and 100 GW in the 13th plan (2017-22). With the present installed capacity of 255 GW, the total installed capacity by 2022 may touch maximum ~ 493 GW (exist – 255 + conventional planned – 138 + solar & wind planned – 100). This is with assumption that the entire capex for conventional power projects would be commissioned as planned. With some of the ageing coal based plants getting de-rated/de-commissioned by 2022, the installed capacity could be considered around ~ 480 GW.

From the present installed capacity of ~ 28 GW, the total capacity of renewables mainly representing unpredictable power i.e., Solar PV, Wind & SHP would touch ~ 125 GW (considering de-rating of some of the exiting capacity) by 2022, taking the present share of renewables of around 11% in the installed capacity to around 26%, which would correspond to around 12 to 13% in energy content. Such a high percentage of unpredictable power in the grid with 'must flow' status may not be prudent to operate the grid economically. Though some of the power planners have been indicating that the Indian grid can sustain unpredictable energy content of up to 14 to15%, the same is doubtful as the bulk of the unpredictable 'must flow' power would come to the grid at non-peak hours – solar during day time off peak and wind during night time off peak. In comparison, the unpredictable power capacity (solar & wind) in China presently amounts to ~ 109 GW, which is only ~ 9% of the total installed capacity of ~ 1247 GW.

Some may argue that part capacity of the planned solar addition would comprise small kW size roof top installations which may not impact the grid, but one should not forget the fact that most of the roof top solar installations would take place in grid connected cities and would eventually replace grid power or feed-in to the grid (due to net-metering facility), depending upon the household consumption. The end result would be the same i.e., roof top installations would impact the grid the same way as large MW size land-based solar installations would impact. Only the off-grid solar installations would not have any impact on the grid, rather they would eliminate the need to stretch the grid to far off area not considered financially viable.

Experience of solar ramp up in some of the European countries is also worth taking into account. Germany, which has installed one of the largest solar power capacity of ~ 38 GW, largely of PV, due to lucrative Feed-In-Tariff (FIT), is suffering from the issues of grid stability. In the 3 year period – from 2010 to 2013 Germany added ~ 7 GW of solar capacity every year but did not plan for storage for sucking out the day time electricity from the solar PV. As a result, to stabilise the grid during day time when the solar PV starts pumping, Germany has to resort to exporting power to the neighbouring countries at cheaper rates. Though the combined share of solar & renewable in Germany in capacity amount to around 30%, their contribution in energy terms is only around 5%. Lately, new capacities in solar has started going down due to tightening of government policies – reduction in FIT and limit on the maximum installed capacity of solar utilities. In Spain, which at one point of time was at the forefront of the solar energy movement, the government has gone one step ahead and reduced the solar tariff from retrospective date. The reason for such drastic steps were a growing deficit – as the government didn't pass to the consumers the high tariff being paid to the solar power developers resulting in ballooning deficit that needed emergent action in order not to derail the economy of the country.

The debate on the capacity of Indian grid to withstand the unpredictable energy/power content, it would be prudent to plan for sucking out the unpredictable 'must flow' power from the grid during off peak hours by suitable storage mechanism in order to utilise the same during peak hours. Different storage mechanisms available for storing bulk electricity are:

- Battery storage
- Pump storage hydro power plants
- Solar thermal with storage

Battery Storage: The conventional bulk storage batteries are not environment friendly and would also require change every 3 to 4 years. Life cycle cost would be higher – and therefore suitable only for smaller capacity off-grid utilisation. Recently there has been advancement in rechargeable bulk storage batteries wherein energy would be stored in liquid eliminating solid state interactions in conventional rechargeable batteries. The manufacturers are claiming life of 10 to 15 years and even of 20 years. However, they are very costly as of now and would add around ₹ 12 to 14 in per unit of electricity and thus financially prohibitive. Till this technology matures and the cost comes down, it would not be financially viable for large scale adoption.

Pump Storage Hydro Power Plants: Pump Storage Hydro Power plants (PSHP) can be one of the techno-economically viable solution for storing bulk excess unpredictable power. Though it would consume around 25 to 30% of the power to be stored, it would still be cost effective. However, a number of PSHP are already commissioned in India and a study would be require – whether their full advantage as pump storage plants is being reaped or not. Further, as the existing PSHPs in India are combination of conventional (or natural) hydro power plants and pump storage, pure pump storage hydro plants can be planned to utilise the excess unpredictable power being fed in

the grid. In pure PSHP there is no need for natural gradient in a river, water can be pumped from a river or a water body to a water reservoir planned at a higher altitude in nearby hills by utilising electricity during off-peak hours. During peaks hours the water stored at higher altitude can be utilised for generating electricity. Such pure PSHP of smaller capacities in the range of ~ 100 - 200 MW can be located nearer to the cluster location of Solar or wind farms in order to avoid transmission losses. As the implementation period for PSHPs is very high as compared to other power projects, the action plan for such storage should start immediately.

Solar Thermal with Storage: Till date solar thermal power plants were not being looked as financially viable proposition in India due to various reasons ranging from technical to high cost. For the same capacity, as compared to 'solar PV' the 'solar thermal' units require more land and are costly. Solar PV units are modular and therefore can be set up in discrete units at the same location as compared to solar thermal – which requires construction of the entire plant capacity in one go. Implementation period for solar PV ranges between 6 to 9 months for a medium size plant whereas it takes 28 to 36 months for a solar thermal to be commissioned. Solar thermal requires a minimum threshold capacity of ~ 50 MW for Indian conditions, to be viable as compared to solar PV – where even a one kW capacity plant can be viable. Solar thermal requires boiler and turbine to generate electricity and thus issues of O&M are similar to coal based thermal power plants as compared to simplicity of O&M in solar PV. Availability of water is another issue, as most of the ideal location for solar plants – thermal or PV is water scarce areas. Solar PV doesn't require much water apart from cleaning of the panels, which is not the case with solar thermal, which is heavily dependent on water for steam generation/cooling purpose which is akin to coal based thermal power plants. Despite many disadvantage vis-à-vis solar PV, solar thermal plants can be designed with storage which means that the excess electricity generated during off-peak can be stored and used during peak hours. Though the capital cost of solar thermal with storage would be higher but the life cycle cost would still be cheaper than other options for bulk storage of electricity. With increased focus on unpredictable renewables in India especially on solar PV, solar thermal with storage option definitely requires a serious look.

(The views expressed in this article are of the author and not of the organisation he belongs to.)

Vijay Singh Bisht
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Profile

Charge controller

For Standalone PV System

Depending on the application and type of battery used, different charge controller configurations are used which either completely disconnect the array from the battery or allow a regulated current to flow through the battery to maintain the battery voltage...

Though abundant, solar insolation is an unreliable source of energy. It fluctuates as a function of time, and is not available during the nights or in cloudy sky. Therefore, when the PV systems are used for stand-alone applications, a backup source of energy is necessary to compensate for the balance power demand of the load. Batteries are, generally, used as a backup source in such applications. To reduce the cost of the system, the ratings of the batteries are designed optimally.

Battery feeds the load when the PV output power is less than the load demand – and is charged when the PV output power is more than the load demand.

In applications, where batteries are used, it is critical to prevent overcharging or deep discharging of the batteries to preserve their life and to ensure good performance. This is achieved by what is called charge controllers. The block diagram of a stand-alone PV system with battery backup and a charge controller is shown in the above figure.

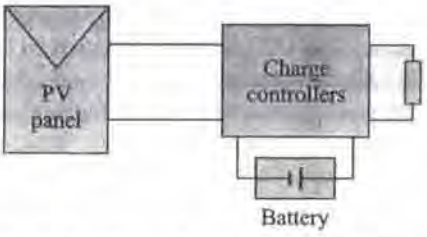

Fig. 1: Basic block diagram of a stand-alone PV system with battery backup and charge controller...

Commonly used set points

Charge controllers regulate the charging and discharging of battery. A charge controller senses the voltage of the battery [or 'state of charge' (SoC)] and decides either to disconnect it from the source (PV array in this case) to prevent it from overcharging or to disconnect the load (from the battery output) to prevent deep discharging.

Such controllers are mainly used where loads are unpredictable and the batteries are optimised or undersized to minimise the initial cost. The charge control algorithm has set points (threshold values) depending upon which it takes decisions. The commonly used set points are briefly described further and are shown in Fig 2.

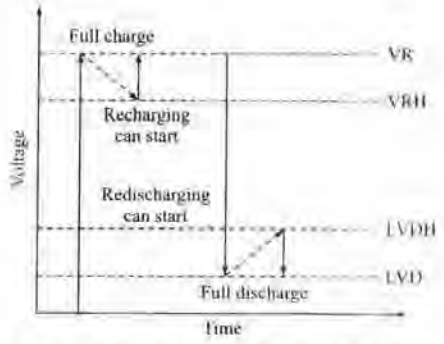

Fig. 2: Commonly used set points and their behaviour in charge controllers...

- **Voltage Regulation (VR) set point:** It is the maximum voltage up to which a battery can be charged (without getting overcharged). If this threshold is reached, the controller either disconnects the battery from the source or starts regulating the current delivered to the battery.
- **Voltage Regulation Hysteresis (VRH):** It is the difference between VR and the voltage at which the controller reconnects the battery to the PV source and starts charging. If VRH is too small, it will result in tighter voltage regulation but the control will be oscillatory and may deteriorate the battery life. At the same time, a large value of VRH may lead to 'slight' overcharging of battery during every cycle. So, in practice, there is a trade-off. VRH also determines how effectively the controller can charge the battery.
- **Low Voltage Disconnect (LVD):** It is the minimum voltage up-to which the battery can be allowed to discharge, without getting deep discharged. It is also defined as the maximum Depth of Discharge (DoD) of the battery. The charge controller disconnects the load from the battery terminals as soon as the battery voltage touches LVD to prevent it from over-discharging.
- **Low Voltage Disconnect Hysteresis (LVDH):** It is the difference between LVD value and the battery voltage at which the load can be reconnected to the battery terminals. LVDH is not kept too small, or else the load will be switched on and off more frequently, which can adversely affect battery and the load.

Types of charge controllers

There are four types of charge controllers used in the circuits involving batteries. Those are as follows:

- **Shunt type charge controller:** The basic block diagram of a shunt charge controller is shown in Fig 3. In this type of charge controller, a switch S1 is connected in shunt with the PV panel, which is turned on when the battery voltage reaches its overvoltage limit (VR). The PV array is short-circuited and it no more feeds the battery. The blocking diode prevents short-circuiting of the battery. The blocking diode also prevents the battery to discharge through the PV array during nights and low insolation periods. The switch S2 allows the battery to discharge through the load. When the battery voltage reaches the threshold value (LVD), the switch S2 is turned off to prevent deep discharging of the battery.
- **DC-DC converter type charge controller:** The series and shunt type of charge controllers discussed are able to safeguard the battery, but do not result in an efficient and optimum use of PV source. Instead of the series or shunt controllers, if a DC to DC converter is used to interface the battery and load combinations with PV array, it provides a smoother control with efficient and optimum use of the PV source.

A buck, boost or buck-boost type DC to DC converter can be used to regulate the output of the PV array to feed the load. A typical configuration is shown in Fig 5 The DC to DC converter offers the following advantages:

- There are no additional losses due to the conduction of switches such as S_1 and S_2.
- The regulation of battery charging current and battery voltage is superior.
- The output voltage of the PV array and the battery voltage need not be identical now.

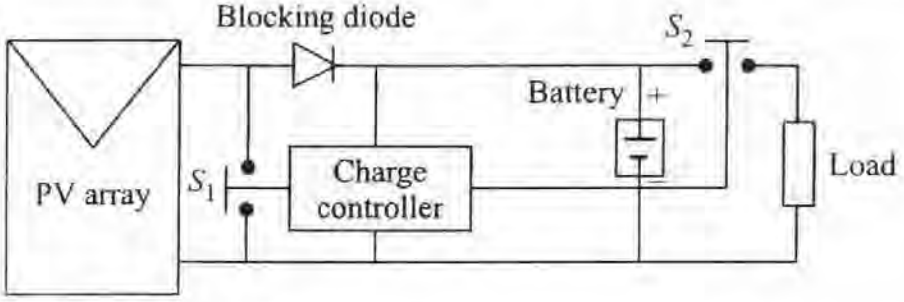

Fig. 3: Shunt charge controller...

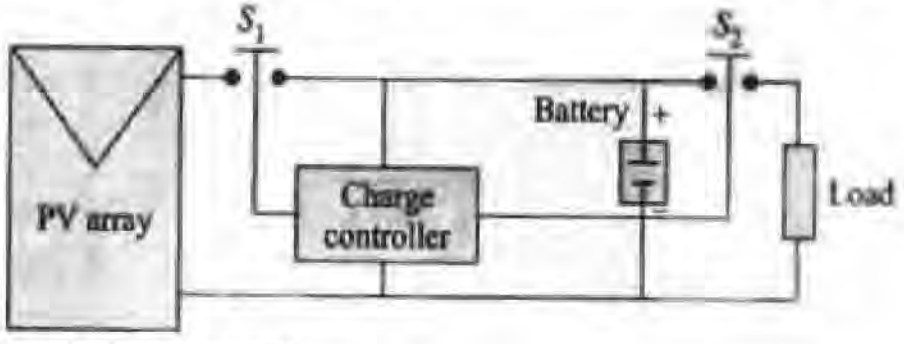

Fig. 4: Series charge controller...

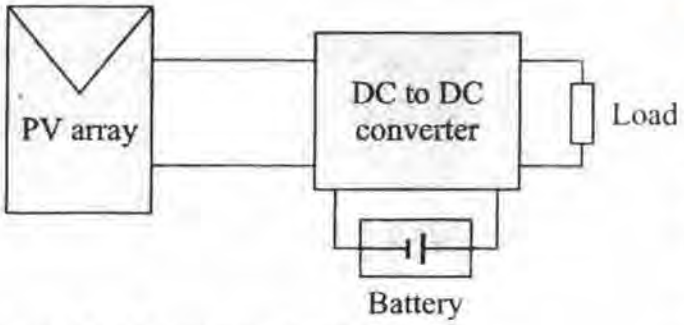

Fig. 5: DC to DC converter type charge controller...

So the PV can be operated at the maximum power point.

- **MPPT charge controllers:** To charge battery in a more efficient manner, the PV array is operated at a point where the PV output power is maximum. The output power of the PV array changes with the change in voltage across it. To extract maximum power from the PV array, a DC to DC converter is used between the PV array and the battery. The duty cycle of the DC to DC converter is controlled to impose optimum voltage across the PV array which corresponds to maximum power point.

Project prototype

A prototype model which is implemented for charging a 7Ah 12V battery with the help of 40 Watt solar PV panel is shown below:

Conclusion

A solar charge controller for standalone solar photovoltaic using microcontroller AT89C2051 has been successfully designed and implemented in this referred project.

The controller designed can be modified to be better if some of the electrical components are upgraded and improved.

The theory and concept of the photovoltaic solar charge controller designed in this work is based on shunt regulation. When the sufficient panel voltage is present it is used to charge the battery.

One of the benefits of this work is that the load can be turned on in day and night, if terminal voltage of the battery is sufficiently present.

The power available from the solar panel can be used for charging the battery and at the same time the load can also be turned on.

Due to its charging methodology this controller is good for only small scale standalone PV systems.

For large scale systems, MPPT or PWM technology can be applied, which uses DC-DC converter for operation.

Both MPPT and PWM adjust charging rates depending on the battery's charge level to allow charging closer to the battery's maximum capacity as well as monitor battery temperature to prevent overheating of batteries.

A PWM controller is less expensive than an MPPT, so it is a more economical choice for a small system. An MPPT controller is much less efficient in low power applications. For higher power rating system MPPT controllers are the best choice.

The charge controller designed in this project has features like, it prevents overcharging of battery which can reduce battery performance or lifespan, and may pose a safety risk. It also prevents complete draining ('deep discharging') of battery by performing controlled charging.

Profile

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Prof. Dr. Eicke R. Weber, Director, Fraunhofer Institute for Solar Energy Systems (ISE), Germany

Krishna Pallasana, Executive Director, The Climate Group, India

Dr. S.N. Srinivas, Programme Officer, United Nations Development Programme (UNDP), India

Douglas Wicks, Product Manager Off Grid and Battery Based Inverter Products, Schneider Electric, Canada

Rajaram Pai, Business Leader, DuPont Electronics & Communications, India

Tanveer Mohammad, Chief Operating Officer, Uninor, India

Ivan Saha, President & Chief Technology Officer, Vikram Solar Pvt. Ltd., India

Harshita S. Kumar, Cluster Operations Head-Solar Business, L&T Construction, India

Brian O'Hanlon, Director BD, RE and Sustainable Dev.; Overseas Private Investment Corp., U.S.

Basant Jain, Chief Executive Officer, Mahindra EPC Services Pvt. Ltd., India

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Solar Energy

An Investment That Can Skyrocket Into Profits

Malpani Group's solar park in Rajasthan. The 33 MW plant intends to offset 47520 tonnes of CO_2 every year...

Around 300 million Indians, i.e., roughly a quarter of the country's population, do not have access to electricity. With an installed electricity generation capacity of 245.393 GW at present, achieving parity between supply and demand seems to be a distant dream...

Electricity starved India is primed to be the next red hot market for solar energy generation. Since it is blessed with clear sunny weather up to 250 to 300 days a year, the total theoretical solar power reception, on only its land area, is about 5000 trillion kilowatt hours per year. The daily average solar energy incident over India varies from 4 to 7 kWh/m^2 with about 1500 to 2000 sunshine hours per year, which is more than the current total energy consumption. Considering the huge potential that the country holds due to its advantageous location, landslide profit in solar energy generation is but a vision away.

India accounts for more than 17% of the world population. It required an estimated 968658.543 GWh of electricity during 2011 – 12, which is projected to go up to 1392066.048 GWh by 2016 – 17 and 1914508.233 GWh by 2021– 22. According to International Energy Agency, around 300 million Indians, roughly a quarter of country's population, do not have access to electricity. With an installed electricity generation capacity of 245.393 GW at present, achieving parity between supply and demand seems to be a distant dream.

Despite being located on the equatorial belt and receiving abundant sunlight, solar energy contributes less than 1% towards the total demand. Given the insatiable demand for electricity, a strong business case can be made to invest in solar electricity generation technologies as they have a promising payback. As this sector is largely untapped even now, it provides tremendous advantage to the first movers to reap maximum benefits.

The question which we therefore must ask ourselves is why hasn't solar energy captured the fascination of India Inc and foreign investors till now? The major stumbling point for the investors in the past has been the high payback period of 15 to 18 years. Today, however, a far rosier picture for investors can be painted. With improvement in technology and reduction in prices of PV systems due to growing competition, the payback period has reduced by one third to 10 to 11 years and is projected to go down even further in the coming years. Following is a snapshot of anticipated cost per MW of setting up a solar power plant.

PV equipment for generation of 1MW electricity costs almost ₹ 6,14,00,000. The civil

Cost Area	Estimated cost / MW (INR)
PV System	6,14,00,000
Civil and commissioning (considering ground mounted)	94,50,000
Land (₹ 3,50,000/acre and assuming a requirement of 5 acre/MW)	17,50,000
Miscellaneous	80,00,000
Interest (assuming 60% debt and 40% equity, rate of interest as 13% p.a. compounded monthly and time period as 8 years)	2,56,00,000
Total Cost	10,62,00,000

and commissioning cost, along with land and miscellaneous cost, works out to ₹ 1,92,00,000. Taking an interest of ₹ 2,56,00,000 for every MW of installed capacity, the total cost per MW of setting up a solar power plant works out to ₹ 10,62,00,000.

The estimated payback period, returns and lifecycle cost for a 10 MWp solar power plant have been tabulated assuming the average life of PV modules to be 25 years. From the previous table, the cost of setting up a 10MWp solar power plant is ₹ 1,06,15,00,000. The O&M cost for the estimated life of PV cells has been worked out to ₹ 61,34,72,340, which has been calculated assuming an escalation of 5.72% in O&M cost every year.

Cost Area	Estimated Value (INR)
Installation Cost	1,06,20,00,000
O & M Cost (over the complete life)	61,34,72,340
Lifecycle Cost	1,67,49,72,340
Net earnings (assuming an average yearly output of 1400 kWh for every kW installed capacity and feed – in tariff of ₹ 8.5/kWh with a possible variation of a max of 40%)	2,97,50,00,000
Estimated Profit (over complete life)	1,29,95,27,662

The estimated payback period, considering all the above stated factors, works out to 10.25 years, which is substantially less than what it used to be a few years ago.

How can India Inc and foreign firms capitalise on the vast ocean of opportunities that solar energy generation presents in India? The government, under the aegis of National Action Plan on Climate Change, has started Jawaharlal Nehru National Solar Mission, which aims to increase the country's grid - connected solar power generation to 20,000 MW by the end of 2022 – and to formulate policies aimed at reducing the cost of generation through increased research and development. However, this target was recently revised and the Prime Minister of India, Narendra Modi has set an ambitious target to achieve 100 GW of solar power generation by the end of 2022.

According to the government's calculations, if this plan hits the ground, India would need investment to the tune of around $110 billion, including transmission capacity. Also, the government, through National Tariff Policy 2006, has instituted Renewable Purchase Obligation (RPO) mechanism, which makes it mandatory for State Electricity Regulatory Commissions (SERCs) to purchase at least 3% of their total electricity purchase from renewable sources. Plans are afoot to modify the policy to compulsorily include a minimum percentage of solar energy in the purchase. Central Electricity Regulatory Commission (CERC) has stipulated that Power Purchasing Agreements (PPAs), which the state utilities sign with the solar power developers be for a period of 25 years. Apart from this, various states have their own targets under Renewable Purchase Obligation and individual policy of Power Purchase Agreements. For example, Government of Karnataka plans to achieve minimum of 3% solar energy out of total projected electricity consumption and proposes to install 2000 MW solar power by 2021. Moreover, the government is looking at the possibility of raising solar bonds to boost investment and helping foreign firms raise rupee bonds to cut costs.

Although the financial factors affecting solar energy investment are being taken good care of, several other factors impede the penetration of more investors into this sector. First and foremost is the difficulty in finding land where solar farms can be set up without opposition from the locals. Since India is an agrarian economy, due care has to be taken to ensure that the land being acquired is infertile and unsuitable for agricultural purposes. This leads to delay in acquiring land and affects the scheduled implementation of the projects. Another problem affecting solar plants set up in remote areas is lack of infrastructure to ensure evacuation and transmission of generated power to sub – stations and grid. Yet another problem is lack of single–window clearance for projects due to which investors and developers have to approach various government departments to get the required clearances, leading to further delays in the project. Bureaucratic red tape compounds the problem further and deters investors from putting their investments in the projects in India.

To combat these problems and to ensure that more and more investors are attracted towards investing in this sector, the government has taken steps to ensure hassle – free acquisition of non–arable land. It has also started strengthening infrastructure near areas where solar farms are proposed to come up. Companies interested in setting up solar power plants in the country can claim the benefits of Accelerated Depreciation Benefit mentioned in Section 32 of Income Tax Act. It allows companies to claim 80% depreciation of its assets (plant and machinery) in the first year and 20% depreciation in the next year, thereby avoiding taxes and leading to savings. There are also plans to require new thermal plants to have 10% renewable mix, which they can generate or buy from solar companies as credit.

Additionally, all the states have been asked by the government of India to come out with their individual solar policies in a time bound manner so as to bring more clarity for investors and enable easy flow of capital

The opportunities and participation in solar energy sector are bound to increase manifold in the near future. Slowly but steadily, solar energy generation is gaining traction...

towards development of both solar farms and rooftop solar projects in the country. Also, RE – Invest summit was recently held in New Delhi to showcase Government's commitment to the development and scaling up of renewable energy in India – and bring all the existing and potential investors on a common platform and connect them with renewable energy stakeholders in India. Since solar energy forms a major part of India's renewable energy ambitions, the opportunities and participation in this sector are bound to increase manifold in the near future.

Slowly but steadily, solar energy generation is gaining traction and various corporations are coming forward and investing in solar power generation. As the Indian policy makers announce big ticket projects and set ambitious targets, the investors are shedding their inhibitions and becoming a part of India's success story. Adani Power plans to invest ₹ 3000 crore in two years to add 160 MW of solar power to its existing capacity. Moser Baer India has commissioned a 30 MW solar power plant in Gujarat at a cost of ₹ 465 crore and further plans to add 150 MW in the coming years. Goldman Sachs, which invested about $375 million in Sumant Sinha promoted ReNew Power, is looking to make more such new investments in the clean energy space. Other financial investors such as Morgan Stanley, IFC and Standard Chartered also plan to make investments in the solar space in India, particularly in projects over 100 MW.

With a platter of benefits on offer, corporations need to leapfrog and grab the opportunity with both hands and ensure they do not miss the bus. It is evident that despite the requirement of huge capital in the beginning, the solar energy sector has a lot to offer in terms of both money and ensuring energy security of the country in the long run.

The challenge remains to create awareness among the corporations about the opportunity, and time slipping by and to provide necessary assistance in planning and advice on adopting strategies that can help them identify viable solar technologies and plan their investment in the right direction.

Profile

Anuj Mahajan
Green Building Analyst
Environmental Design Solutions Pvt. Ltd., New Delhi

CFA Release Status as on 04.06.2015

Scheme: Pilot-cum-Demonstration Projects for Development of Grid Connected Solar PV Power Plants on Canal Banks and Canal Tops.

States	Project Capacity (MW)	CFA Released by MNRE (₹ Crores)	CFA Released by SECI (₹ Crores)	Remarks
Andhra Pradesh	1 MW Canal Top & 5 MW Canal Bank	4.2	-	State has changed Implementing Agency. CFA will be released soon.
Karnataka	10 MW Canal Top	12	-	State is changing Implementing Agency. CFA will be released soon after finalization of Implementing Agency.
Kerala	3 MW Canal Top	3.6	1.2	First 20% released for one project
Punjab	20 MW Canal Top	24	12.0	First 20% released.
Uttrakhand	20 MW Canal Bank	12	-	Project Proposal awaited
West Bengal	10 MW Canal Bank	6	3.0	First 20% released.
Uttar Pradesh	6 MW Canal Top	7.20	1.6344	First 20% released for one project
Gujarat	10 MW Canal Top & 15 MW Canal Bank	-	-	
TOTAL		**69.00**	**17.8344**	

Source: Ministry of New and Renewable Energy (MNRE)

40% CFA, released by MNRE to SECI, has been divided into two blocks of 20% each and which are being released as: 1) 20% on Tendering by the Implementing Agency, 2) 20% on Start of work.

Growth Indices for Electrical Industry

Cumulative Growth (2015-16) Compared to the Same Period of Previous Year (2014-15)

Product	Weightages for 15-16	1st Qtr. 2015-16 over 1st Qtr. 2014-15
LT Motors	2.9	-3.7
HT Motors	1.4	24.1
Alternators	2.1	0.5
FHP Motors	1.8	4.5
Rotating Machines	**8.2**	**3.9**
Power Contactors	3.4	-7.7
LT Circuit Breakers	5.8	3.0
MCB	4.8	34.2
S/F & F/S Units	0.4	-5.8
LV Switchgear	**14.4**	**10.7**
HV Switchgear	4.1	-5.3
Switchgear	**18.5**	**7.1**
Power Cables: PVC	20.5	11.3
Control Cables & other Special Purpose Cables	10.4	36.2
Cables	**30.9**	**19.7**
Power Transformers	5.1	6.4
Distribution Transformers	8.3	27.1
Transformers	**13.4**	**19.2**
HT Capacitors	0.2	8.1
LT Capacitors	0.5	-18.0
Capacitors	**0.7**	**-10.5**
Energy Meters	3.7	37.8
Energy Meters	**3.7**	**37.8**
T.L.T.	11.6	-25.6
Conductors	13.0	47.3
Transmission Lines	**24.6**	**12.9**
Total	**100.0**	**14.81**

Source: Indian Electrical & Electronics Manufacturers' Association (IEEMA)

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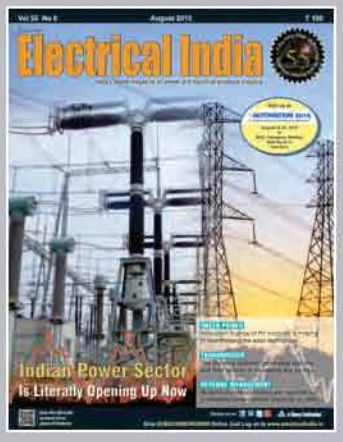

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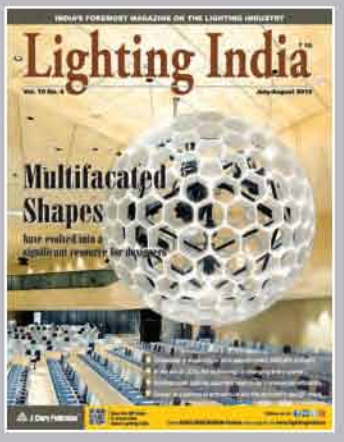

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3 years	36	3600	2500	7200	3750
5 years	60	6000	4000	12000	6000
Lighting India					
1 year	6	750		1500	1125
2 years	12	1500	1350	3000	2025
3 years	18	2250	2000	4500	3000
5 years	30	3750	3000	7500	4500
Medical Equipment & Automation					
1 year	6	750		1500	1125
2 years	12	1500	1350	3000	2025
3 years	18	2250	2000	4500	3000
5 years	30	3750	3000	7500	4500

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DEIF's Big-bang Entry
Into Solar Segment

Actual images of the projects...

DEIF with its experience and expertise in the field of power generation control solutions introduced the Automatic Solar Controller (ASC), which provides integrated solution for systems with utility, diesel and solar power source...

DEIF India Pvt. Ltd. – a subsidiary of DEIFA/S, has installed its solar solution – the Automatic Solar Controller (ASC) in the northern and western parts of India. Recently, DEIF has completed a 3.6 MW project of India's largest integrated solar company that has commissioned EPC projects of 175 MW till date. The project is spread across three different client sites, namely: Pune, Rohtak and Kasna for India's largest and Asia's third largest paint company, with a turnover of 141.83 billion rupees and a global presence.

DEIF's role in the project

DEIF's scope of supply included concept designing, engineering, getting it approved, manufacturing and supply, FAT, commissioning, SAT, training and documentation, working closely with EPC, inverter supplier, vendors and end customer, thus providing a comprehensive solution – that exceeded the customer's expectation.

Application challenge

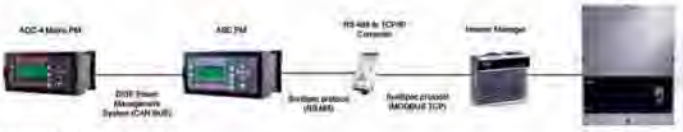
The customer was keen to use solar power even in the absence of utility supply. The back up power was delivered by diesel genset and the solar systems were to be designed to supply power along with the diesel genset and the load had to be shared between the two groups. An inappropriate design could cause burning of excess diesel by the genset or a varying load could cause an inadvertent reverse power in the genset.

Project highlights

- 3 sites at different locations, total installed solar PV capacity 3.6 MW
- Maximum solar penetration, fast ROI
- Intuitive and user-friendly Advanced Graphical Interface system
- Display of single line diagram of the Solar PV system with status of breakers and bus bar condition
- Display of real time kW reading of the Solar PV, Mains incomers
- Real time graphical view of the Active Power (kW), Reactive Power(kVAR) and Apparent Power
- Monitoring of alarms and source of alarms
- Less diesel consumption, reduced emission leading to decreased maintenance and operation cost.

The DEIF solution --- first of its kind

DEIF with its experience and expertise in the field of power generation control solutions introduced the Automatic Solar Controller (ASC), which provides integrated solution for systems with utility, diesel and solar power source.

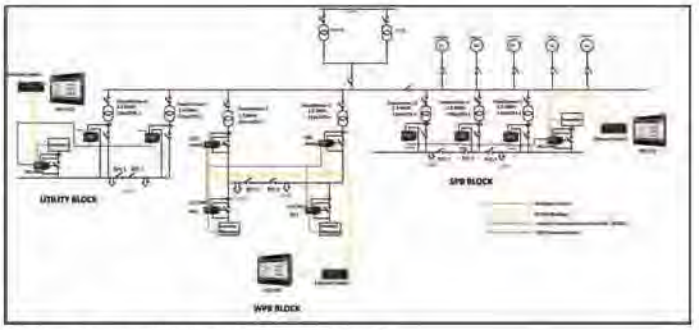


Solar block diagram...

The Automatic Solar Controller serves as an interface between solar and the diesel/gas genset controllers/Utility Power, namely Advanced Genset Controllers AGC-4, over the CAN bus to adjust power output to meet the load requirement – such that the solar system takes the maximum load share. This solution enables to share the load between solar PV group and diesel genset with or without presence of utility power with maximum solar penetration, thus resulting in maximised savings even during utility failure.

The system uses power management features of DEIF viz., fixed power mode and mains power import/export mode to achieve relevant operation philosophy. If the solar power output decreases due to bad sunlight, the deficit will be met by diesel genset through the CAN bus communication between ASC and AGC-4, thus ensuring reliable supply of power to the paint plant in all conditions.

A graphical interface solution to each of the ASC and the AGC mains is provided by connecting the same to DEIF'sAGI-110. All the TCP/IP output of the ASC and AGC mains is connected to an Ethernet switch and from the Ethernet switch AGI is connected to monitor the ASC. A case diagram for one of the plants is depicted below.



Case diagram (2 MW solar power plant)...

Empowering 'Make In India'

Indian electrical equipment industry has not been faring so well for quite sometime. But with government's emphases on 'Make in India' coupled by 'Ease of doing business,' the industry is expecting sunny days ahead...

Babu Babel, President Elect, IEEMA

Vishnu Agarwal, President, IEEMA

Sunil Misra, DG, IEEMA

At the Indian Electrical and Electronics Manufacturers' Association's (IEEMA) Annual Convention and 68th AGM, IEEMA applauded the vision of Government of India's ambitious campaign 'Make in India.' The whole industry is bullish about the fact that the government of India is thinking big.

With the government's emphasis on 'Make in India' and related programmes, there is a sense of heightened expectations from industry and other stakeholders. Within the power sector, the ambitious schemes of 'Deen Dayal Upadhyaya Grameen Kaushalya Yojana' and 'Integrated Power Development Scheme' coupled with emphasis on renewables, the emerging business opportunities seem to be very promising.

The government has also been on the right direction by making efforts towards 'Ease of Doing Business.' Against this backdrop, IEEMA organised its annual convention on the theme of 'emPOWERing – Make in India.' The annual convention was inaugurated by Anant Geete, Minister for Heavy industries and Public Enterprises and Kalraj Mishra Minister of Micro, Small and Medium Enterprises.

Vishnu Agarwal, President, IEEMA, said, "Electrical equipment industry has not been faring so well in the recent past but with emphasis on 'Make in India' coupled with 'Ease of doing business,' we are hopeful to see some revival. In our sector, recent positive policy changes in coal will have a positive impact in sometime. Ministry of Power has launched an ambitious scheme for making '24 x 7 power' available in rural and urban areas through conventional means as well as through renewables. We at IEEMA are committed to support and assist the government initiatives whereever required."

Babu Babel, President Elect, IEEMA is of the view: "There has been an overall increase in power generation by 8.4% since last year. The government had done well to untangle supply side issues by augmenting coal supply – as well as taken efforts to boost transmission & distribution. 'Make in India' is perhaps one of the most important programmes that is being pursued by the Government of India. The central theme is about transforming India into a manufacturing hub with world class technology on the pattern of China, Japan, South Korea etc. IEEMA being one of the proud partners of the 'Make in India' campaign has been vigorously pursuing with the policy makers to promote made in India products with state-of-the-art technology." In the words of Sunil Misra, Director General, IEEMA, "The electrical and industrial electronics industry has witnessed a 14.81% growth in Q1 of FY 2015-16. The growth in exports is helping the industry grow especially in Distribution Transformers, Cables, Tr. Line Towers, Energy Meters, Capacitors etc. Policy changes and various initiatives undertaken by the industry and government are eventually showing signs of revival for the sector."

Highlighting the status quo of the country's power scenario, he said, "The government has also set a target of generating 60,000 MW in wind power capacity. Currently, renewable energy accounts for only 31,692 MW of India's power generation capacity of 267,637 MW. But still the power sector is facing predicament, and this is due to the losses faced by the Discoms. The combined debt of power distribution companies (Discoms) stands at over Rs 3 lakh crore. Faced with acute financial stress, many of these are unable to buy power."

"The power generation companies are scheduling their production in accordance with the demand of electricity, which has come down as Discoms are unable to buy due to fund crunch," he added.

Event Calendar

INDIA

Redefining Electricity Conference
Venue: The Ashok in New Delhi, India
Date: 26 to 27th October, 2015

Industrial Supply INDIA 2015
Venue: Bombay Exhibition & Convention Centre, Mumbai, India
Date: 24 to 26th November, 2015

INDICON 2015
Venue: Jamia Millia Islamia, New Delhi, India
Date: 17 to 20th December, 2015

ELECRAMA 2016
Venue: Bangalore International Exhibition Centre, Bengaluru, India
Date: 13 to 17th February, 2016

INTERNATIONAL

Electrical Power System Fundamentals
Venue: Auckland, New Zealand
Date: 15 to16th October, 2015

IEEE- ISGT Asia 2015
Venue: Bangkok, Thailand
Date: 4 to 6th November, 2015

EWEA 2015 Annual Event
Venue: Paris Expo – Porte dee Versailles, Pavilion 1, Paris, France
Date: 17 to 20th November, 2015

ICPES 2015
Venue: Lisbon, Potugal
Date: 23rd to 25th November, 2015

FLIR T1040 offers outstanding image performance

FLIR Systems has released the FLIR T1040, also known as the FLIR T1K, a premium thermal camera for use in a multitude of industrial and building diagnostics applications. As per the company, the T1K is a high definition handheld instrument featuring exceptional measurement performance, outstanding image clarity, and a highly-responsive user-interface. The T1K allows users to find hot spots quickly, measure them precisely, and streamline their entire work process.

The T1K features high image quality due to the 1024 x 768-pixel uncooled infrared detector that offers twice the sensitivity of the industry standard for uncooled sensors. This resolution is further boosted by the addition of FLIR VisionProcessing, which combines FLIR's unique UltraMax super resolution process with FLIR's patentedMSX image enhancement software that overlays important visual details and perspective, such as numbers and labels, over the full resolution thermal image. The advanced image processing features provide the highest quality images available in a compact system.

High definition imaging requires high precision optics and the T1K's lenses deliver best-in-class performance. The T1K features FLIR's OSX Precision HDIR optics, which deliver superior image quality and range performance – and allow for accurate temperature measurements from twice as far away compared to the industry-standard lenses. The T1K also features a new focusing system that offers continuous autofocus as well as a dynamic manual focus.

Website:
www.flir.com.hk/t1k

KOSTAL offers string inverters

KOSTAL Solar Electric GmbH, product family of PIKO: 3.0 – 20.0 kW Solar PV Inverters are suitable for residential to commercial on-grid installations. They incorporate the latest inverter technology with improvements with respect to flexibility, communication and practicality. They have many features such as:

- Smart connections
- Integrated electronic DC switch
- Broad input voltage range
- 3 MPPTs ensure greatest degree of flexibility, so that even difficult roof surfaces can be used optimally
- Standard integrated communication package with data logger, webserver, solar portal and the following interfaces: 2xEhernet, RS485, S0, 4xanalogue inputs, 2 Lan interfaces
- Integrated switch contact for self-consumption optimisation.

The new, future oriented design, fulfills the current requirements of the photovoltaic markets and reflects the corporate philosophy of 'Smart Connections' in terms of visuals.

E-mail:
info@avrelectronics.com

Plastic guide for harsh application areas

igus has launched a new modular guide trough system, which is entirely made of tribo-optimised plastic: guidelite plus. The system is very light, easy to install, cost effective and is also suitable for use in harsh environments.

Guide troughs, usually made from aluminium or steel, ensure correct operation and a long service life for energy chains in gliding applications with long travels. The new guidelite plus from igus is a guide trough that is made entirely of plastic and is easy to assemble. Individual elements made of

abrasion-resistant high-performance plastic can be connected together very quickly – and without tools by hand due to a locking mechanism specially designed for this system. The low weight of the plastic parts helps with installation, but is also advantageous where lightweight solutions are needed. A special expansion joint, which is provided in every second link of the trough elements, guarantees flexibility and adaptability especially in case of large temperature variations. Thus, the product can also be used without restrictions in outdoor applications.

Website:
www.igus.in

Motwane 's 5 kV digital insulation, continuity tester

Are you still using hand crank, cumbersome and analog insulation resistance testers? Switch to digital.

It's time for testing with your most compact SPOT insulation resistance tester: The IT250G SPOT. The IT250G SPOT is a 5 kV voltage selectable digital insulation tester measures digitally, and also in analog. It is a battery operated device made to give stable and reliable performance in energy intensive area.

Its 'auto power off' function enhances battery life, and pleasant 'amber backlit' allows users to work in dusk environment also. The maximum resistance range of the product is up to 250G, which is primarily suitable for Distribution Transformers, Instrument Transformers, Motors, Cables, Pumps etc.

Auto discharge facility, internal data storage to guard terminal for eliminating surface leakages; the IT250G is loaded with features, which make easy onsite testing for testing service providers. The programmable timer allows PI and DAR measurements manually.

E-mail:
sales@motwane.com

Rishabh rolls out a clamp meter

Rishabh has launched its new Power Clamp Meter, which is not just another power meter but an irreplaceable product combining functions of a clamp meter, power quality meter and multimeter – which makes it an ideal tool in high current & power quality maintenance applications. It can be used to make sure that all 3-phases on feeders are pulling identical current.

Highlights of the clamp meter:

- Inrush/ peak value measurement
- Inbuilt three phase power measurement
- Energy measurement
- Active, reactive and apparent power
- Horse power measurement
- Up to 49th harmonics
- Phase angle
- THD
- Power factor
- Crest factor
- Ripple content in DC
- Non-contact voltage detection
- AC/DC volt/current up to 1000 V/A.

Website:
www.rishabh.co.in

HARTING eases the product ordering process

The HARTING range of products and solutions comprises connectors, device connection technology and network components. HARTING products connect machines and facilities via data, signal and power.

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The samples requested are shipped within 24 hours of ordering and are free of charge.

Website:
www.HARTING.com

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GE launches new gas turbine in Thailand

GE has launched its latest aeroderivative gas turbine, the LM6000-PF+ in Bangkok, employing technologies from across the GE Store to bring power online faster and more efficiently than in the past.

The LM6000-PF+ (PF+) already has seen success with a six-unit order from Thailand's Gulf Energy Development (GED) with Mitsui Corp (Mitsui) under EPC contract with TOYO Engineering Corp (TOYO), making it the largest Thailand deal for distributed power applications in GE's history.

The PF+ is GE's latest gas turbine technology through increased performance, flexibility and installation speed. To maintain its outstanding reliability, the PF+ shares more than 90% commonality with previous LM6000 models, and it employs modern technologies from the GE Store of solutions to create a more-efficient gas turbine with faster installation. In fact, the upcoming LM6000-PF+ package is expected to incorporate technologies from four GE businesses, including: GE Aviation for the gas turbine, GE Energy Management for controls, GE Oil & Gas for gearbox equipment and GE Power & Water for the overall package design and engineering. As a result of GE's cross-business collaboration, the PF+ offers higher gas turbine output (52-58 megawatts) and combined-cycle efficiency (56%) than other products in its class. Some of the latest technologies include super polished compressor airfoils and an upgraded dual-fuel Dry Low Emissions (DLE) combustor.

"We have faith in GE and believe that by choosing the LM6000-PF+, which is recognised for its increased performance and flexibility; it should serve our requirements fittingly for the specific project conditions. Moreover, it is a bonus for us to be the first market in the world to get this product," said Ravi Kurmahorita, GED's EVP for Business Development.

GED, one of the largest Independent Power Producers (IPP) in Thailand, has selected the PF+ for three combined-cycle power plants (two units each) to be installed within 300 km of Bangkok. The new plants will utilise the PF+'s high exhaust temperature to help increase efficiency and generate additional power—approximately 90 Mega Watts (MW) of power generation from each plant will be dispatched to the national grids. GE's local team in Thailand has worked closely with GED and its partners since 2014 to ensure the LM6000-PF+ was an ideal solution for customer's needs, and GED has also signed a 25-year Multi-Year Agreement (MYA) with GE for long-term upgrades and maintenance on the six units. The units are expected to be shipped in 2016.

Website:
www.ge-distributedpower.com

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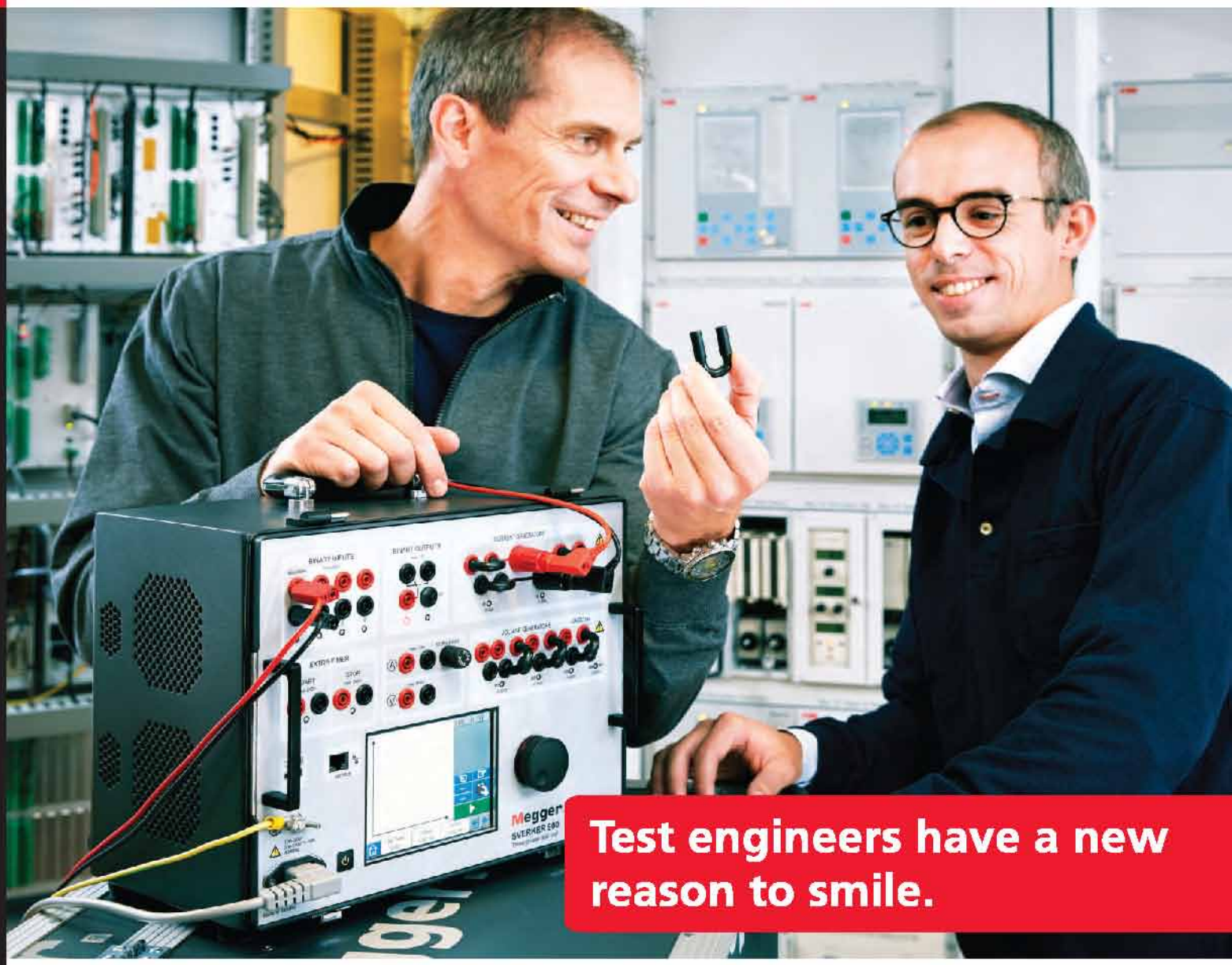

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