



# ELECTRICAL INSTALLATION ENGINEER

## NEWS LETTER

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS' ASSOCIATION 'A' GRADE (Regn. No. 211/1992)

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**KELCON**  
THE KERALA STATE 'A' GRADE ELECTRICAL  
CONTRACTORS' ASSOCIATION

  
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## EDITORIAL

Dear Members, Fellow Professionals and Friends,

*Seasons Greetings to One and All!*

*Greetings for Happy Christmas!!*

*Advance Greetings for a Happy and Prosperous 2019!!!*

The important annual event in **December** is the **Energy Conservation Day** on the **14<sup>th</sup> of December**, marked by Seminars, Rallies and many more events to remind everyone of their roles and responsibilities and concerns with regard to “Energy”, where ever they are and whatever they do, be it in Industries or Services and Commercial activities or in Agriculture or personal domestic lives, travel, transportation and communication and so on. Energy is the Fulcrum of life today and the growth of civilization is marked by galloping demand for Energy and harnessing of Energy from all kinds of sources. The World has realized now clearly that the biggest danger of the very life of humanity all over the Globe is a very large scale use of “Fossils” as source of Energy, leading to Global Warming which is a reality today. We have seen the warnings in various forms particularly the Temperature rise by 1 to 1.5 Degrees in the current decade and so on. We have also experienced recently, in many cities of India, highly increased levels of pollution disturbing the very day to day lives.

It is very clear that “Energy Conservation” has to be addressed in 3 Ways, namely, Avoiding Wastes, Using Energy Efficiently and Use of “Renewable Energy Sources”. There are vigorous and continuous activities and developments with regard to Efficient Use of Energy and the scope is very vast particularly for India as the overall National Efficiency levels are still very low, combining all kinds of activities involving all the forms of Energy like Heat, Fuel and Electricity. There are lot of initiatives in India like improved Roads and other infrastructures, more and more of Efficient and less polluting EVs (Electrical Vehicle), combined with work on “**Storage**” and “**Charging**” and plans for more and more of ‘**Water Ways**’ for Transport and so on which are all very encouraging. The work on more Efficient Equipments, Processes and Controls are also continuously on with visible achievements like LED Lights all over and Standards and Labeling etc.

In the Renewable Energy area too, the massive Solar Mission activities at present, the forth coming Bio Energy Mission and the recently announced large scale plans for ‘**Green Fuel**’ in the form of CBG (Compressed Bio Gas) and the ongoing work on harnessing Wind and Water energies are all very significant. Let us resolve to contribute our might in all the Energy activities as committed professionals.

It is very fitting that we Celebrate “**Farmers Day**” (Kisan Diwas) on the 23<sup>rd</sup> of December as it is “Agriculture” that provides Energy for all living beings, generates wastes which can be converted to Energy and also uses lot of Energy. We see concerns expressed all the time about the loss of agricultural lands to accommodate infrastructure and housing developments. A closer look will justify the needs and the necessities and the solution lies in “**Higher Yields**” in lesser areas and improved ‘**Round the year Irrigation**’. Science and Technology can help achieve these which were proved in the successful “**Green Revolution**” in our country and we need a “**Second Green Revolution**”.

**We thank all those members who have helped us by participating in the advertisement appearing for the issue November 2018 – Alfa Switchgear (I) Pvt. Ltd., Consul Neowatt Power Solutions Pvt. Ltd., Dehn India Pvt. Ltd., Elecspo, Galaxy Earthing Electrodes Pvt. Ltd., Power Cable Corporation, Power Square Engineers, Supreme Power Equipment Pvt. Ltd., Visewham Electricals, Wilson Power & Distribution Technologies Pvt. Ltd.**

**EDITOR**

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## KNOW THY POWER NETWORK -135

In line with the outline made in my last article, “**Temporary Power Frequency Overvoltages**” has been taken as the main theme for this month. This kind of Overvoltage is not new to the people of Tamilnadu, especially those who reside in Chennai, Madurai and Coimbatore cities where underground cable system is prevalent. There, this system forms the main backbone of Power Delivery system. During thunder storms and rainy days, its presence is commonly experienced.

To illustrate its significance, the following cases are given as illustration.

(i) Nearly 1300 customers lost their mobile connections in Chennai city on 11.11.18. Its cause is the failure of the feeding transformer in BSNL Building at Kellys, Chennai. It got burst due to Voltage surge (PF overvoltage) and led to a big fire.

(ii) Frequent failure of 110KV Surge Arresters experienced in the 110KV switchyard of Madras Fertilizers Plant at Manali, Chennai. This happened during the years 1981-82

(iii) Sudden loss of costly electrical equipment/devices like Televisions, Air conditioners and Fridge was experienced by the residence in Teymampet in Chennai, Tiruchengode & Kanchipuram town in the recent past, when there was an abnormal rise in the voltage fed to their premises. The affected consumers can never forget this undesirable event easily.

(iv) Similar incident had been experienced by the consumers in Khader Nawaz Khan Street in Nungambakkam, Chennai city, when it was drizzling in the month of December. UG Cable failure accompanied with very high input voltage level and a big fire were witnessed by these consumers. The irony is that till date that no reliable protection has been made against this kind of voltage oscillations, which led to the loss of electrical equipment/devices.

All these turn the spot light on the urgency of understanding this kind of overvoltage. Among the categories of the overvoltage spectrum, this type of overvoltage occupies the extreme end. It is the most dangerous one and the consumers are terrifically afraid of its incidence, way of damage to critical infrastructure and the assets of the unsuspecting consumers.

Now let us look deep on this subject (1) Origin-It is difficult to assess the losses that this overvoltage can inflict in the network by Sources that cause bring this type of overvoltage.

The main sources, that generate this type of overvoltages, are listed as follows

- (i) System faults especially L.G faults
- (ii) Intentional creation of single phasing in a three phase network
- (iii) Over speeding action of the generators
- (iv) Prevalence of the conditions that are conducive to Ferroresonance phenomenon.
- (v) Self excitation of Transformers and AC Induction Motors brought by Shunt Capacitors
- (vi) Use of salient pole machines without damper windings
- (vii) Hunting between the power sources during or after a system disturbance
- (viii) Presence of trapped charges on the transmission and Distribution lines.
- (ix) Accidental contact between HV and LV circuits
- (x) Low clearance between LV and HV lines
- (xi) Sudden loss or disconnection of neutral in a 3 phase Network.
- (xii) Ferranti effect which brings dynamic overvoltages in the receiving end

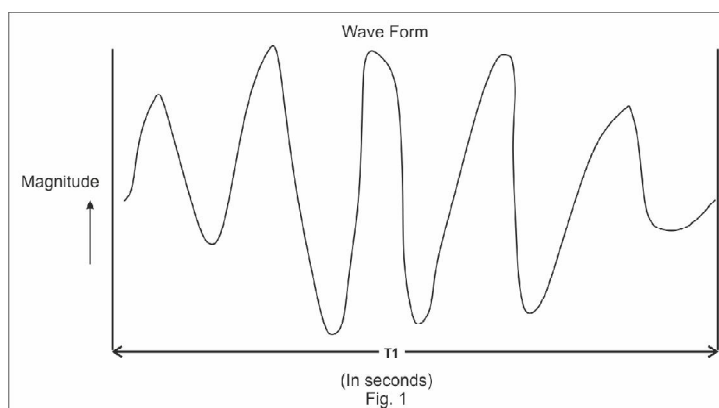
### (2) Wave Form

$$10 < f < 500 \text{ Hz}$$

$$3600 > T1 > 0.03 \text{ sec}$$

$$\text{Standardised shape – for } 48 < F < 52 \text{ Hz}$$

$$T1 = 50 \text{ sec}$$





### (3) Characteristic features of TOV

- (i) By definition it is an oscillatory/power frequency overvoltage between a phase conductor and earth or between phases in a given network.
- (ii) Its duration is long; it can either be undamped or weakly damped.
- (iii) Faults, short circuits, sudden disconnection of loads or load rejections, certain type of switching operations, ferroresonance and Harmonic effects and the presence of sustained dynamic overvoltages at the receiving end (ferranti effect) are its main sources of formation/generation.
- (iv) Its Amplitude, oscillation frequency and total duration and attenuation are stated to be its signature characteristics which reflect/ mirror its presence.
- (v) Surge arresters which are effective against VFTOS, Lightning strokes and Switching surges. It cannot offer any protection against this type of overvoltage. It is because of the high energy content of TOV. Hence the minimum protective measure to be adopted is the adequate design of the equipment like Generators, Motors, Transformers, Circuit Breakers. Similar is the case with the Insulators of OH lines and the Insulation of a UG cables.
- (vi) It acts as the main limiting factor for the selection of Surge Arresters (both Gapless and Gapped Arresters)
- (vii) It is one of the influencing factors that define/draw the conditions of Insulation coordination in a Power Network.
- (viii) Owing to its capacity to inflict severe damages (its energy content is very high) in the network, it constitutes one of the major factors for the design and erection of Power Station Switch yards and Substations.
- (ix) It's key role demands it as a factor for the design and operation of EHV and UHV Substations.
- (x) The magnitude of TOV depends upon the Earthing factor of the location Place of its origin. To get lower TOV, the ratios of  $R0/R1$  and  $X0/X1$  should be less than One and three respectively

(4) Protective Measures against TOV-Except for the good and adequate design of the network and its apparatuses, there is no other way to meet this kind of overvoltage. Failure to meet this condition, no doubt, will bring disastrous results.

This factor holds good both for the Supply side and Demand side networks connected equipment and devices. To repeat, the sources of TOV (as listed below) Warrant special attention. We have to see that these sources will not cause voltages beyond the critical levels or exceed the prescribed tolerance levels.

- (i) Single Phase Earth faults
- (ii) Events that follow/accompany the load rejection. This includes Ferranti Effect and Critical Switching Operations.
- (iii) Ferroresonance phenomena: over excitation or over fluxing of Power and Distribution Transformers.
- (iv) Harmonic Over Voltages
- (v) Overvoltages caused by Series and Parallel Resonances in the network.
- (vi) Intentional creation of Single Phasing.
- (vii) Inadvertent disconnection of the neutral of the transformers or the link between the Neutral and the Earth.

The operating people or the consumers who have witnessed the destructive power of TOV alone can Vouch Safe. We had describe its ugly (ugly facet/dimension). It is like the face off. We had with the recent GAJA cyclone in Tamilnadu facet/dimension. For others, it may be just one of the dreadful overvoltages present in the network. I hope that the readers will not like the encounters with TOV in the near future. Will you? I would like to sign off here, till we meet again. Kindly remain tuned.



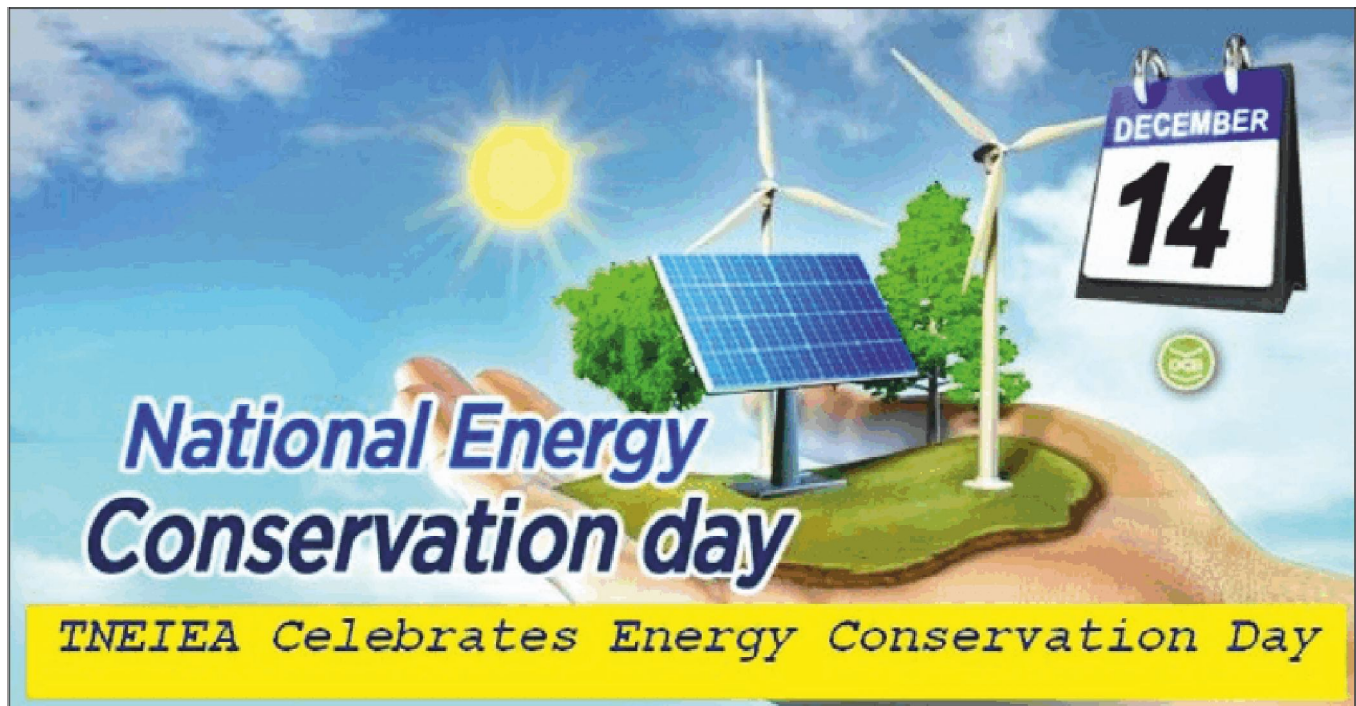
*(To be continued...)*  
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***“Democracy must be something more than two wolves and a sheep  
voting on what to have for dinner.” – JAMES BOVARD***

# NATIONAL ENERGY CONSERVATION DAY 2018

*National Energy Conservation day 2018 would be celebrated  
on Friday, at 14<sup>th</sup> of December*

National energy conservation day is celebrated every year by the people all over the India on 14<sup>th</sup> of December. The Energy Conservation Act in India was executed by the Bureau of Energy Efficiency (BEE) in the year 2001. The Bureau of Energy Efficiency is a constitutional body which comes under Government of India and helps in the development of policies and strategies in order to reduce the energy use. The Energy Conservation Act in India act aims to employ the professional, qualified and energetic managers as well as auditors who are with expertise in managing the energy, projects, policy analysis, finance or implementing the energy efficiency projects.



## WHAT IS THE ENERGY CONSERVATION?

National energy conservation day in India is celebrated to aware people about the importance of energy as well as saving or conserving the more energy by using less energy. The exact means of energy conservation is using less energy by avoiding the unnecessary uses of energy. Using energy efficiently is very necessary to save it for the future usage. Energy conservation should be rooted in the behavior of every human being to get more effect towards the plan of energy conservation.

One can save the energy by deeply taking care of it such as turning off the unnecessarily running fans, lights, submersible, heater, combining car trips or other electric things of daily usage. These are the more easier and efficient way to save extra uses of energy thus playing the great role towards the campaign of national energy conservation.

Fossil fuels, Crude oil, Coal, natural gas and etc generate sufficient energy for the use in daily life but increasing the demands of it day by day creates the fear of reducing or diminishing the natural resources. Energy conservation is the only way which helps in replacing the non-renewable resources of energy with the renewable energy. In order to aware the energy users for less energy consumption as well as to make efficient energy conservation, energy or carbon taxes has been employed by the government in different countries. Tax on high energy consumption reduces the energy use by the users as well as promotes limited energy use among users.

People must aware that bright lighting at their work places leads to the variety of problems like stress, headache, blood pressure, fatigue and reduces work efficiency of workers. Whereas, natural day lighting enhances the productivity level of workers and reduces the energy consumption.

Petroleum Conservation Research Association was established by the Indian government in India in the year 1977 to promote energy efficiency and conservation among Indian people in their every walk of life. This is a big step taken by the government of India for energy conservation to a great level. Another government organization in India, Bureau of Energy Efficiency, has also been set up in 2001 for better energy efficiency and conservation.

### **What are the Energy Conservation Measures**

Windows are the big energy conservation contributing factors other than thermal curtains, Smart windows or films.

A big amount of energy can be saved by the natural lightings and LED, Fluorescent bulbs, Linear fluorescent retrofit, Solar charged flashlight, Sky lights, Smart windows, LED lighting and Solar lights.

Water conservation also leads to the better energy conservation. There is wastage of around thousands of gallons water per year by the people which can be prevented through various means of water saving solutions like 1.6 GPM or less low flow showerheads, Ultra low flush toilet, Faucet aerator, Composting toilets and etc.

Insulation also plays big role in energy conservation by decreasing the thermal losses in winter seasons as well as thermal gains in summer seasons. For example; natural wool insulation, house insulation, cotton insulation, VOCs in fiberglass insulation, thermal insulation, cellulose insulation and etc.

### **HOW NATIONAL ENERGY CONSERVATION DAY IS CELEBRATED**

To make the campaign of national energy conservation more effective and special all over the India, variety of energy conservation competitions are organized by the government or other organizations around the living areas of normal people as they are the main target of the campaign. At many places the various painting competitions on energy conservation day is held by the student or member of the organizations at school, state, regional or national level.

The campaign of the national energy conservation is the national awareness campaign launched by the Ministry of Power to facilitate the process of energy conservation in India. Painting competitions organized for the students at many levels is one of the main activities of this campaign which helps in increasing the awareness of children about the importance of conserving energy as well as educating and involving their parents in the campaign. This competition helps the people of domestic sectors to be aware.

Every participant is provided a theme Topic such as the “**More stars, more savings**”, “**Today’s energy wastage is tomorrow’s energy shortage**”, “**Energy saved is future save**” and many more. Participants can make their painting more effective by using the Pencil Color, Crayons, Water Colour and etc.

Students, who take part in the competition and win, get participation certificate, merit certificate or cash prizes which worth Rs 33,000 per State. This amount is distributed among all the winners of a state and awarded by the Ministry of Power at 14<sup>th</sup> of December at the celebration event of National Energy Conservation day.

### **OBJECTIVES OF NATIONAL ENERGY CONSERVATION DAY**

National energy conservation day is celebrated every year using particular theme of the year by keeping in mind some goals and objectives to make more effective all over the country among people. Some of the important goals are:

- > It is celebrated to send the message of importance of conserving energy in the every walk of life among people.
- > Promoting the way of process of energy conservation by organizing a lot of events such as discussions, conferences, debates, workshops, competitions, etc all through the country.
- > Promote people for less energy usage by neglecting the excessive and wasteful uses.
- > Encourage people for efficient energy use in order to decrease the energy consumption and prevent the energy loss.

### **SIGNIFICANT ROLES OF INDIAN CITIZENS IN ENERGY SECURITY**

Each and every citizens of the India must aware about how to use efficient energy, how to save the energy for their own future safety and many more ways. They should follow all the rules, regulations and policies implemented by the Government of India in order to support the energy efficiency. Citizens of India can pay their direct contribution to the campaign of reduce energy use throughout the 11<sup>th</sup> Five Year Plan period. **Children are the big expectation and hope for the country to bring positive changes as well as to enhance the economic condition of the country.**



## ALUMINIUM AND WATER ARE FUEL FOR THIS ELECTRIC VEHICLE

**EV Breakthrough:** A single ‘refuelling’ of the battery would give a range of 1,000 km.

### **Firm develops metal-air battery to deliver higher mileage**

If you ever get stuck at a traffic signal near the verdant campus of the Indian Institute of Science (IISc) in Bengaluru and see a fellow commuter driving a white Mahindra e2o Plus electric vehicle covered with stickers, don’t mistake him for just another techie.

Chances are that he is Akshay Singhal, the 25-year-old co-founder and CEO of nanotechnology start-up Log 9 Materials, conducting trials for his car to run on water. This is made possible by the metal-air battery, developed by Log 9, fitted in the vehicle.

Log 9, an IIT Roorkee spin-off, says it is using the wonder material ‘graphene’ to make the metal-air batteries commercially viable and affordable for e-vehicles and stationary applications like power backup products.

Mr. Singhal said that traditional lithium-ion batteries stored energy rather than generating it. For instance, an e-vehicle has a mileage range of 100 km to 150 km, after which it has to be charged. This on an average takes about five hours, he said. “If you are driving from Koramangala to the airport [in Bengaluru], you can’t come back with one single charge,” Mr. Singhal said in an interview. The company aims to replace the requirement to charge e-vehicles and “instead refuel them just like gasoline, but with water,” said Mr. Singhal, who founded the company along with his IIT-Roorkee college mate Kartik Hajela in 2015. Log 9 said the initial cost of its battery was almost half of that of the lithium-ion battery. A single ‘refuelling’ of the battery which uses aluminium, besides water as fuel, would give a range of 1,000 km.

### **Wonder material**

Log 9’s secret sauce is its experience and expertise in ‘graphene’ which is one million times thinner than paper and forms graphite or pencil lead when stacked together. Log 9 said its battery enables the car to run on a simple fuel cell technology that uses electrochemical reaction to produce electricity. But there is a ‘graphene rod’ along the metal plate that generates electricity with water as its base for the chemical reaction. The electricity thus generated is sent to an electric motor that drives the car.

**Experts like Ashok Misra, an honorary energy professor at IISc, said the growth of e-vehicles requires an innovative battery solution to make it a convenient proposition for end-use customers. “Log 9 Materials has demonstrated the capability to tackle this energy-generation bottleneck... with a commercially viable solution,” said Prof. Misra, who is also on the boards of Kirloskar Electric Company and Reliance Industries.**

Investors are taking note of the potential of Log 9’s innovation and have so far invested \$1 million in the firm.

### **Present Specification of e2o Car - Mahindra e2o**

The Mahindra e2o, previously REVA NXR, is an urban electric car hatchback manufactured by Mahindra Reva or Reva Electric Vehicles. The e2o is the successor of the REVAi and was developed using REVA’s technology, and has a range of 120 km.

**Electric motor:** 3 Phase Induction Motor

**Battery:** 11 to 16Kwhr Lithium-ion battery

**Range:** 120 km (75 mi)

**Curb weight:** 830 kg (1,830 lb)

**Manufacturer:** Mahindra Electric Mobility Limited



**Length:** 3280 mm

**News : The Hindu Dt 19/11/'18**

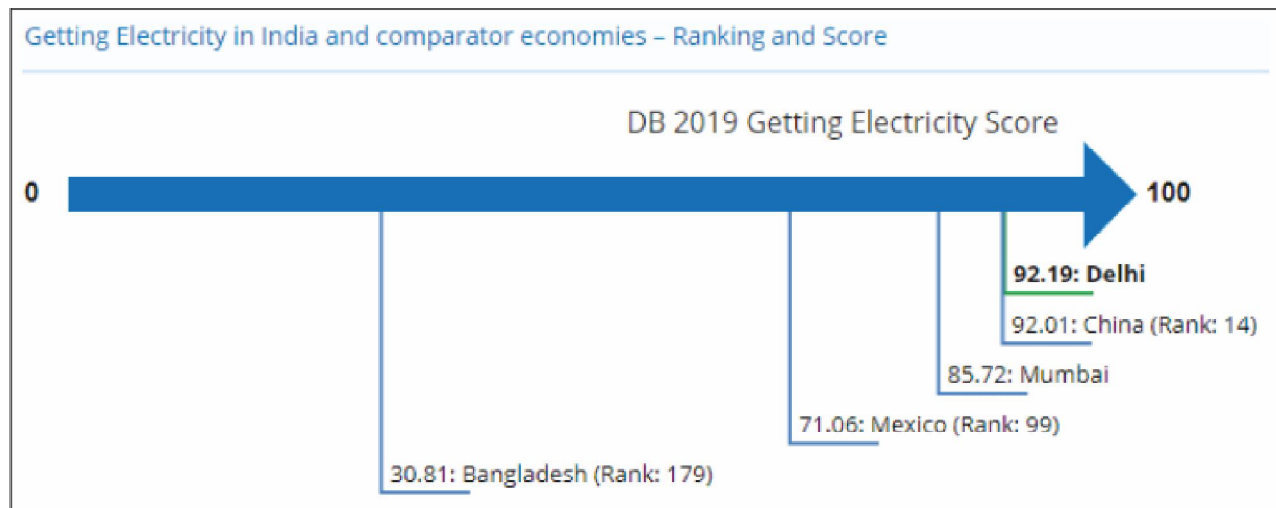
## HOW ELECTRICITY HELPED INDIA GAIN ON EASE OF DOING BUSINESS RANKING

**Overall, India has jumped 23 places to 77th rank in the rankings thanks to feedback from stakeholders that it is now significantly simpler to get construction permits and ship goods across the country's borders, among other things – Sudheer Singh**

New Delhi: The reduced cost and time taken to get a power connection in the metro cities of Delhi and Mumbai over the past year is among the main reasons why India gained in the World Bank's latest Ease of Doing Business ranking.

“Getting Electricity was made cheaper and faster in Delhi with the cost for low voltage connections reduced by more than 30 percent of the income per capita, while the time needed was reduced to 31 days, from 39 days,” the bank said in a statement on its Doing Business 2019: Training for Reform report.

The report measures progress of economic reforms in only two cities including Delhi and Mumbai. For measuring electricity reforms, it considered power supply data on Tata Power Delhi Distribution (TPDDL) in Delhi and Reliance Utilities and Power in Mumbai.



Overall, India has jumped 23 places to 77th rank in the rankings thanks to feedback from stakeholders that it is now significantly simpler to get construction permits and ship goods across the country's borders, among other things.

The report compared the time taken to get an electricity connection in Delhi – 31 days – to the average time taken in entire South Asia – 98.3 days. Also, the cost of an electricity connection in Delhi stands at 46.4 per cent of income per capita as against 1,054.7 in South Asia.

Overall, India carried out six business reforms during the past year, earning the credentials of being a top global improver for a second consecutive year, according to the report that was released today. Last year, India was ranked at 100.

The latest reforms were in the Doing Business areas of Starting a Business, Dealing with Construction Permits, Getting Electricity, Getting Credit, Paying Taxes, and Trading Across Borders. On the measure of absolute progress towards best practice, India significantly improved its Doing Business score to 67.23, from 60.76 last year.

This is the second consecutive year that India has been recognized as a top improver. India is the only South Asian country to achieve this distinction two years in a row, and only nine other countries have accomplished this since 2011.

However, the report also points out India still lags in areas such as Enforcing Contracts (ranked 163 globally) and Registering Property (166). “It takes 69 days and costs about 8 percent of the property value to register a property, compared to 20 days and 4.2 percent among high income OECD economies,” the report said. Also, it takes 1,445 days for a company to resolve a commercial dispute through a local first-instance court, almost 3 times more than the 582 days needed in high income OECD economies, it noted.

## A SOLAR CELL THAT DOES DOUBLE DUTY FOR RENEWABLE ENERGY

Now researchers at the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) and the Joint Center for Artificial Photosynthesis (JCAP), a DOE Energy Innovation Hub, have come up with a new recipe for renewable fuels that could bypass the limitations in current materials: an artificial photosynthesis device called a "hybrid photoelectrochemical and voltaic (HPEV) cell" that turns sunlight and water into not just one, but two types of energy — hydrogen fuel and electricity. The paper describing this work was published on Oct. 29 in *Nature Materials*.

### Finding a way out for electrons

Most water-splitting devices are made of a stack of light-absorbing materials. Depending on its makeup, each layer absorbs different parts or "wavelengths" of the solar spectrum, ranging from less-energetic wavelengths of infrared light to more-energetic wavelengths of visible or ultraviolet light. When each layer absorbs light it builds an electrical voltage. These individual voltages combine into one voltage large enough to split water into oxygen and hydrogen fuel. But according to Gideon Segev, a postdoctoral researcher at JCAP in Berkeley Lab's Chemical Sciences Division and the study's lead author, the problem with this configuration is that even though silicon solar cells can generate electricity very close to their limit, their high-performance potential is compromised when they are part of a water-splitting device.

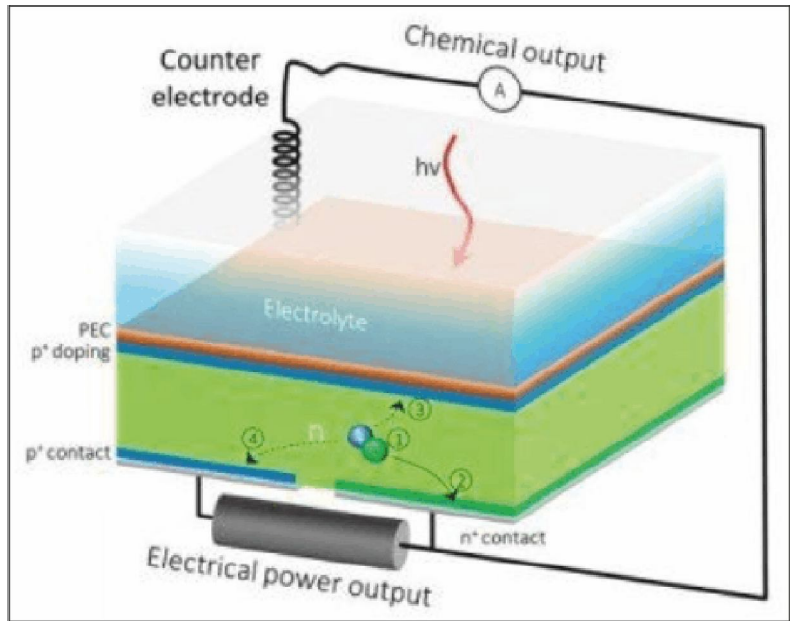
The current passing through the device is limited by other materials in the stack that don't perform as well as silicon, and as a result, the system produces much less current than it could — and the less current it generates, the less solar fuel it can produce. "It's like always running a car in first gear," said Segev. "This is energy that you could harvest, but because silicon isn't acting at its maximum power point, most of the excited electrons in the silicon have nowhere to go, so they lose their energy before they are utilized to do useful work."

The current passing through the device is limited by other materials in the stack that don't perform as well as silicon, and as a result, the system produces much less current than it could — and the less current it generates, the less solar fuel it can produce. "It's like always running a car in first gear," said Segev. "This is energy that you could harvest, but because silicon isn't acting at its maximum power point, most of the excited electrons in the silicon have nowhere to go, so they lose their energy before they are utilized to do useful work."

### Getting out of first gear

So Segev and his co-authors — Jeffrey W. Beeman, a JCAP researcher in Berkeley Lab's Chemical Sciences Division, and former Berkeley Lab and JCAP researchers Jeffery Greenblatt, who now heads the Bay Area-based technology consultancy Emerging Futures LLC, and Ian Sharp, now a professor of experimental semiconductor physics at the Technical University of Munich in Germany — proposed a surprisingly simple solution to a complex problem. In water-splitting devices, the front surface is usually dedicated to solar fuels production, and the back surface serves as an electrical outlet. To work around the conventional system's limitations, they added an additional electrical contact to the silicon component's back surface, resulting in an HPEV device with two contacts in the back instead of just one. The extra back outlet would allow the current to be split into two, so that one part of the current contributes to solar fuels generation, and the rest can be extracted as electrical power.

After running a simulation to predict whether the HPEC would function as designed, they made a prototype to test their theory. "And to our surprise, it worked!" Segev said. "In science, you're never really sure if everything's going to work even if your computer simulations say they will. But that's also what makes it fun. It was great to see our experiments validate our simulations' predictions." According to their calculations, a conventional solar hydrogen generator based on a combination of silicon and bismuth vanadate, a material that is widely studied for solar water splitting, would generate hydrogen at a solar to hydrogen efficiency of 6.8 percent. In other words, out of all of the incident solar energy striking the surface of a cell, 6.8 percent will be stored in the form of hydrogen fuel, and all the rest is lost.





In contrast, the HPEV cells harvest leftover electrons that do not contribute to fuel generation. These residual electrons are instead used to generate electrical power, resulting in a dramatic increase in the overall solar energy conversion efficiency, said Segev. For example, according to the same calculations, the same 6.8 percent of the solar energy can be stored as hydrogen fuel in an HPEV cell made of bismuth vanadate and silicon, and another 13.4 percent of the solar energy can be converted to electricity. This enables a combined efficiency of 20.2 percent, three times better than conventional solar hydrogen cells. The researchers plan to continue their collaboration so they can look into using the HPEV concept for other applications such as reducing carbon dioxide emissions. “This was truly a group effort where people with a lot of experience were able to contribute,” added Segev. “After a year and a half of working together on a pretty tedious process, it was great to see our experiments finally come together.”

## DEEP GREEN: USING UNDERWATER KITES TO GENERATE CLEAN ELECTRICITY

Marine energy developer Minesto has reached a new milestone in the development of its Deep Green technology, using the device to generate clean electricity at a commercial scale. The technology, which functions like an underwater kite, could more than double the number of regions suited to tidal energy projects. Tidal power has long been touted as a major source of renewable energy. By and large, however, it remains an untapped resource. While there are various technologies on the market, promising to harness the power of the waves, most of these are suitable only for use with fast-moving tidal streams, and have no application within slower ocean currents.



To take the most common tidal device as an example, horizontal axis turbines extract energy from moving water, much as wind turbines extract energy from air. Sitting stationary on the seabed, they typically require currents of 2.5m/s or faster to produce electricity cost-effectively.

This is useful in areas with high marine current flows. However, for tidal power to reach its full potential, it will be necessary to expand its geographic scope.

Minesto, a marine energy developer based in Sweden, is hoping to do just that. The company's Deep Green technology, currently under development, is able to cost-effectively generate electricity at sites with velocities between 1.2m/s and 2.4m/s, and depths between 60m and 120m. This could more than double the size of the exploitable tidal resource. "Compared to other marine energy technologies, Minesto's product enhances the energy conversion, making it a commercial proposition applicable to vast areas around the globe where no other known or verified technology can operate cost effectively," says CEO Dr Martin Edlund. "Most concepts target areas with very high stream flows, 2.5m/s and above. We target areas that are 2.5m/s and below."

#### A milestone for Minesto

In August, Minesto announced that it had broken new ground by verifying its technology at utility scale. By October, it had gone one step further, using this commercial-scale unit to generate electricity for the first time. The system, based at the Holyhead Deep site 8km off the coast of North Wales, is now in its second commissioning phase. Essentially, the company wants to demonstrate that the technology is performing as expected, and that there are safe and efficient handling procedures in place.

"We are engaged with demonstration of our first utility-scale device, which currently means a 500kW unit off the coast of Wales," says Edlund. "The next step of the development for that product range is to optimise it in regards to power production performance, which could mean increasing the rated power to, for example, 750kW for the next utility-scale system."

If these efforts are successful, the company will scale up the technology still further. According to plans announced last year, the Holyhead Deep site will be developed in three phases as part of a deploy-and-monitor approach. Eventually, the installed capacity will be boosted to 80MW.

It's just the latest step in what has already been a lengthy journey. In fact, the concept first arose as early as 2004, when inventor Magnus Landerg presented an early version of the technology (then called the Enerkite). "The technology was originally invented by an engineer with the aerospace company Saab within the scope of a wind turbine study where vertical-axis turbine concepts were explored," explains Edlund. "The idea was then taken to Chalmers University of Technology in Gothenburg to evaluate the technical and commercial viability."

In 2007, Minesto was founded as a spin-off from Saab, and the technology continued to evolve. Since then, five prototypes have been built and tested, first in basins and since 2011 in the ocean. It first generated electricity in 2009.

**An underwater kite** – As Edlund explains, Deep Green follows the same guiding principle as a kite, gliding smoothly through the water as a kite does through the air. "Minesto's Deep Green technology is a unique marine energy converter, a subsea kite that targets the global low-flow tidal stream and ocean current resource," he says. "It consists of a wing that is tethered to the seabed and that carries a turbine underneath. Our subsea kite technology converts kinetic energy to electricity by way of a unique principle similar to flying a stunt kite in the wind." When the kite 'flies' through the underwater current, it pushes the turbine through the water at a speed several times the actual stream flow. Electricity is produced in the on-board generator, and transmitted through the tether to cables on the seabed.

Because the speed has a cubic relationship to the power production, any surge in speed means a dramatically higher increase in electricity generation. This gives the Minesto kite an automatic advantage over stationary turbines, which lack the added step of energy conversion.

On top of that, the device weighs up to 15 times less than competing technologies, and follows a detachable design concept, which means it can be serviced on shore. Since it operates at least 20m beneath the surface of the water, there is no visual impact and the environmental footprint is kept to a minimum.

**The route to market** – As well as expanding the Holyhead Deep site, Minesto is also developing a smaller scale system (around 100kW) known as the Island Mode model. This will form a commercial product targeting off-grid applications such as island economies and aquaculture. Moving forward, its commercialisation strategy is based on site development activities in three main areas: the European Atlantic coast, the US and South East Asia. The company sees the greatest potential in South East Asia. "As we see it, the quickest route to market for our product in this emerging industry is for us to drive initial small-scale installations together with customers and partners, and then develop these sites into commercial electricity generating arrays," says Edlund. Ultimately, though, the addressable market is global, with significant exploitable areas across all continents. As Edlund puts it, since Minesto addresses a problem that no other developer is focusing on, the company is singlehandedly expanding the potential of ocean power.

## DELHI GOVERNMENT DRAFTS POLICY TO MAKE 25% OF VEHICLES ELECTRIC BY 2023, SEEKS PUBLIC OPINION

In a bid to combat air pollution, the Delhi government has proposed to make 25 per cent of all vehicles to be electric by 2023.

The Aam Aadmi Party (AAP)-led Delhi government released the draft 'Delhi Electric Vehicle Policy 2018' for public comments and feedback on Tuesday. As various reports on air pollution in Delhi cite vehicular emission as key factor, the government has come out with the electric vehicle proposal.



“Rapid adoption of zero-emission electric vehicles is, therefore, of

great importance to Delhi,” Delhi Transport Minister Kailash Gehlot said. The Delhi government has planned to create a significant corpus of funds to incentivise every vehicle segment. “All incentives are in addition to the incentive offered by the Government of India as part of the Scheme for Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles in India,” the draft report said. The policy draft states various subsidies that will be offered by the Delhi government on the use of electric vehicles.

“The Delhi government will offer a subsidy up to Rs 22,000 on purchase of e-two wheelers to ensure their cost is less than or equal to petrol two wheelers. Government Electric two-wheeler taxis will be allowed to provide last mile connectivity and Scrapping Incentive of up to Rs 15,000 on old BS II and BS III two wheelers. This policy will allow open permit system for e-autos in Delhi while Individual e-auto owners will get down payment subsidy up to Rs 12,500 and 5 per cent interest subvention and similarly the cashback for passengers using e-autos up to Rs 10 per trip will be offered through this policy,” stated the report. “Government plans to promote more e-rickshaws for mile connectivity offering individual e-rickshaw owners. They will get payment subsidy up to Rs 20,000 and 5 per cent interest subvention. To reduce carbon emission govt offers full waiver on registration fees, road tax and MCD one-time parking fee for electric cabs and cashback for passengers using e-cabs up to Rs 10 per trip.”

“Under this policy, fully electric buses will be at least 50 per cent of all new buses procured for the city fleet starting with the induction of 1,000 electric buses in 2019. The government will offer substantial incentives to private stage-carriage vehicles of all sizes to ensure that electric vehicles make up at least 50 per cent of the entire public transport system in Delhi by 2023.”

Other than public transport, government will offer subsidy up to Rs 20,000 for the first 5,000 e-Carriers with advanced, swappable batteries for electric goods carriage. Offering exemption from prohibition on plying and idle parking of lights goods vehicles during specified timings.

Under the policy, the Delhi government will set up huge cable of charging stations like of petrol pumps. “Battery charging and swapping stations to be setup across Delhi with private sector participation at existing public parking zones, bus depots and terminals, metro stations etc. Energy Operators identified for operating charging stations based on competitive bidding with Up to 100 per cent capital subsidy. Government to also provide special electricity tariff for operation of battery charging and swapping stations. This policy will provide private charging stations across the capital. 100 per cent subsidy on installation of charging point up to Rs 30,000 per charging point for the first 10,000 points at residential or non-residential buildings.”

The transport minister said the Delhi government would “amend building bye-laws to ensure both home and work place parking becomes EV ready through mandatory installation of charging conduits.”



## GW SOLAR & WIND COMPLEX FOR SOUTH KOREA

### South Korea Announces Massive Renewable Energy Complex With 4 GW Capacity On Saemangeum Reclaimed Land Area In Jeollabuk-do Province; Local Media Reports Say Solar Will Make Up 3 GW & Offshore Wind 1 GW

South Korea is planning to set up a mega solar and wind energy complex with a massive capacity of 4 GW in Saemangeum in Gunsan city in Jeollabuk-do province. Country's President Moon Jae-in said the complex will attract private investment of KRW 10 trillion on the Saemangeum reclaimed land area.

While the South Korean government's official web portal Korea.net doesn't specify details, local news portal Pulse News says, the plan consists of 3 GW of solar PV capacity on land and 1 GW of offshore wind farm near Gunsan, using 9.36% of the total reclaimed area in Saemangeum on the west coast. The entire capacity will be equivalent to power generated by 4 nuclear reactors.

The central government and the provincial government of Jeollabuk-do will start with 2.4 GW of PV and 600 MW of offshore wind power (100 MW inside and 500 MW outside of Saemangeum) by 2022.

According to the reports, government will speed up the construction of power transmission and substation and regulatory work.

"One of the world's biggest solar energy and offshore wind energy generation facilities will be built in the Saemangeum area," said President Moon, visiting the region for the second time after his inauguration. "We will raise the level of renewable energy technology by placing related manufacturers and research institutes in the new renewable energy complex. The renewable energy project in Saemangeum is the touchstone of Korea's new energy policies."

The President announced the 4 GW Saemangeum project after launching an offshore floating solar power plant in Gunsan.

Yonhap News, a news agency in the country, reported that the Moon wants to build this massive complex before his term as President ends in 2022, and that reducing country's reliance on nuclear power was one of his election promises.

Under the new energy roadmap draft of the 8<sup>th</sup> Basic Plan for Long-Term Electricity Supply and Demand announced by the South Korean Ministry of Trade, Industry and Energy in December 2017, the country plans to increase the share of renewables in its energy mix to 20% by 2030. It will aim to have renewables account for 33.7% of the installed capacity in 2030, increasing from 9.7% in 2017. Between 2017 and 2030, it plans to increase installed capacity of renewables to 58.5 GW from 11.3 GW in December 2017, with the growth coming mainly from solar and wind power.

## SIEMENS GAMESA

The Indian subsidiary of the global wind power major, Siemens Gamesa, has achieved a milestone of crossing 5,500 MW of installed capacity in India with its recent winnings of two orders for its wind turbines from the renewable energy company, ReNew Power.

Ramesh Kymal, Chairman and Managing Director of Siemens Gamesa India told BusinessLine that the company "on the threshold of signing a few more contracts" and hence the company would end the financial year 2018-19 with total sales in India of 6,000 MW. The Spanish company, since taken over by Siemens of Germany, sold its first turbine in India in 2010.

Goldman Sachs-backed ReNew, one of the larger wind and solar companies in India, recently placed two orders on Siemens Gamesa for two of its projects – 100.8 MW for a project it won in a Gujarat tender, and another 76 MW it won in the second round of auctions conducted by the central government-owned SECI. The 76MW project is to come up in Maharashtra. With these orders, Siemens Gamesa's factory near Chennai will be busy making 48 turbines of 2.1 MW of capacity each for the Gujarat order, and 38 machines of 2 MW each for the Maharashtra project.

**Auctions slowing down** – On the present state of the wind industry, Kymal observed that tendering process had slowed down after plebeian response from the industry to the 5th round of auctions of SECI. The 'SECI V' auctions, initially for 2,000 MW, was later re-tendered for 1,200 MW. There has been another

capacity auction conducted by the state-owned power producer, NTPC, for another 1,200 MW. Save these 2,400 MW there have been no auctions in the recent past, though the government has assured the industry it would put through tenders for 10,000 MW, Kymal said.

Also, the upper cap of 1 2.50 a kWhr that the government is trying to bring in is proving to be a “dampener”, he said. Many in the industry have rue the upper limit for electricity prices that could be quoted in a tariff-based tender, which is seen as one-sided in government’s favour, sitting between fixed tariffs and marked determined tariffs. “Tariffs will go up,” cautioned Kymal, noting that prices of steel and crude had gone up, impacting raw material and logistics costs. Also, the windiest sites have been taken, and the upcoming projects would be put up only on 2nd or 3rd grade lands, where with slower winds, annual electricity generation would be lower.

## EMIRATES STADIUM POWERS ITSELF FOR 90 MINUTES WITH NEW BATTERY

Arsenal football club has unveiled a new secret weapon against climate change: a battery storage system developed by UK battery pioneer Pivot Power. Arsenal’s battery system can save enough energy to power the 60,000 capacity Emirates stadium for an entire match, which is the equivalent of running 2,700 households for two hours.

The storage technology allows Arsenal to avoid purchasing energy at peak prices, instead stockpiling electricity for use when costs are up to three times more expensive, particularly during a matchday.

Arsenal managing director Vinai Venkatesham said: “This is a big step

forward for us in being efficient with energy usage and it builds on our work in reducing our carbon footprint as an organisation. We have been powered by green energy since 2016 thanks to Octopus Energy, and the battery storage system will support our efforts further.”

The 3MW/3.7MWh battery storage system is a first for UK football, and will not only assist Arsenal in reducing its electricity bills but also allow the club to earn extra funds by providing flexible capacity for the grid. Through Arsenal’s battery system, the Emirates stadium can store and sell energy back to grid, easing pressure on UK energy at peak demand, which could be vital while large-scale renewable efforts such as electric vehicles are entering the market.

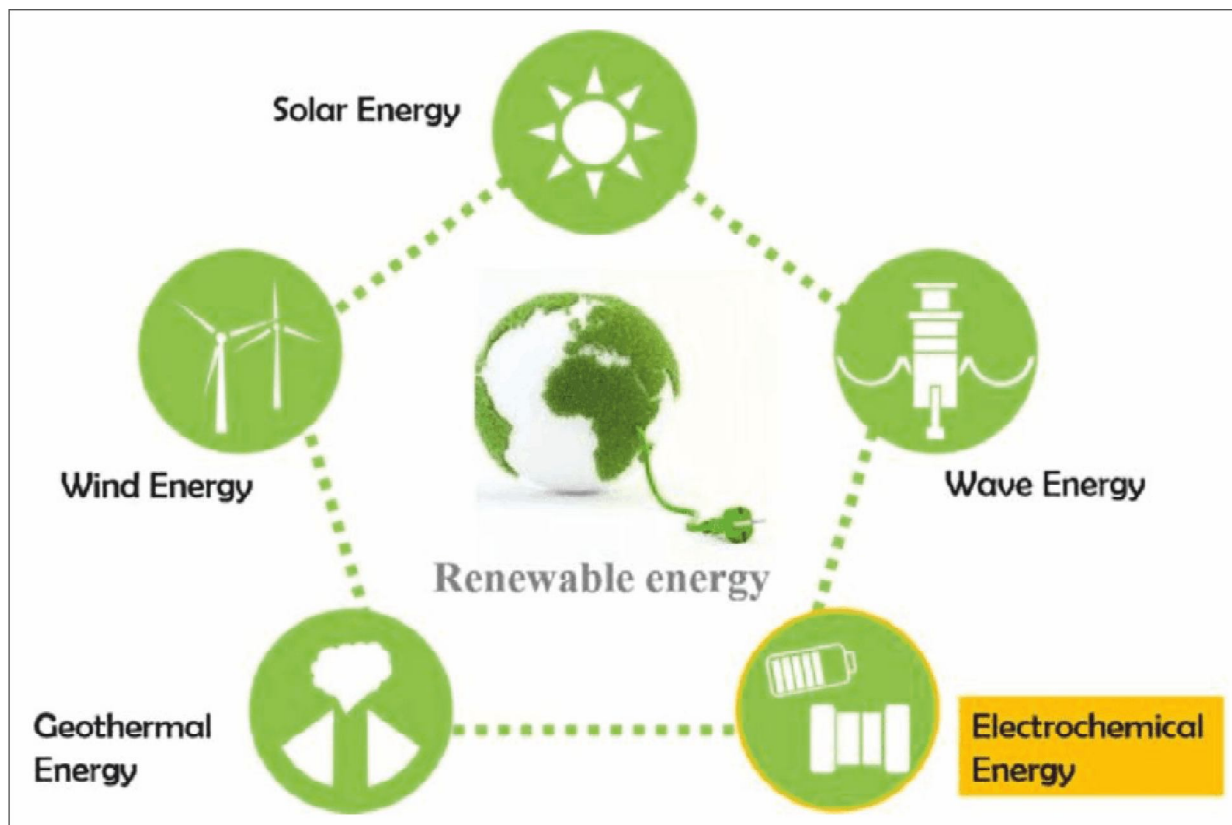
The Emirates stadium has committed to cutting its carbon footprint since 2016, when it signed a contract with solar company Octopus Energy to use 100% renewable energy. Arsenal has included installing LED floodlights that use 30% less electricity than traditional ones. The club also recycles 80% of match day waste, with all food waste sent to an anaerobic digestion plant to be turned back into energy for the club. In the past year, the football club has saved 7 million kilograms of carbon dioxide entering the atmosphere, enough to fill up the stadium almost four times.

“Arsenal is showing how football clubs and other big power users can save money and support the UK’s climate change and clean air targets,” said Pivot Power CEO Matt Allen. “Batteries are central to creating a cost-effective, low-carbon economy and we are keen to help government, local authorities and businesses seize the opportunities they offer.” Pivot Power is responsible for operating Arsenal’s battery system for the next 15 years, and there is the option to add an additional 1MW/1.2MWh of capacity next summer. Any income generated will be shared between the battery developer, Arsenal, and investor Downing LLP. Pivot Power is also developing grid-scale batteries and rapid charging units for electric vehicles.



# INDIA BECOMES LARGEST RENEWABLE ENERGY AUCTIONS MARKET IN THE WORLD

India has become the largest market globally for auction of new renewable energy generation projects and the second-largest destination attracting clean energy investments. These are the findings of the latest Climatescope 2018 report by Bloomberg NEF (BNEF).



“India’s renewable auctions market is the largest in the world. Over 11 Gigawatt (GW) of projects were awarded through auctions in 2017 resulting in the best year for solar capacity as installations jumped by 90 per cent over the year,” Bloomberg NEF said. ALSO READ: Infographic - India’s clean energy investment totalled \$7.4 bn in first half of 2018

India has secured second place in the global ranking driven by its policy thrust towards renewables and increasing investments in the clean energy sector. The country is the second-largest renewable energy investment market among all Climatescope countries, attracting \$9.4 billion in new investments in 2017.

Renewable energy installations in India exceeded those by coal power plants for the first time in 2017 as the country moved closer towards its target to install 175 GW of renewables by 2022. “India’s well-established domestic supply chain facilitated the development of clean energy projects further, despite competitive auctions putting downward pressure on profit margins across the value chain,” BlombergNEF said. India’s installed power generating capacity stood at 346 GW in June 2018, with renewables (excluding large hydro) accounting for 71 GW. With coal taking a share of almost 60 per cent, challenges with domestic coal supply are resulting in increased coal imports.

However, the government has reduced its coal capacity target for 2027 by 11 GW to 238 GW as the country seeks to replace coal with renewables through auctions. The report said India’s renewable auctions market is the largest in the world and auctioned capacity has ramped up by 68 per cent since 2017. India was the world’s fifth largest clean energy investment market in 2017, jumping up from being the sixth largest in 2016. Clean energy investment totalled \$7.4 billion in the first half of 2018, with solar power projects accounting for the majority. India’s solar market almost doubled in size in 2017, making it a record year with annual PV installations touching 9.4 GW.



## DENMARK TO OPEN WIND ENERGY RESEARCH CENTRE IN INDIA

In the last couple of years, India has been very clear regarding the country's ambitions for the expansion of sustainable energy, such as wind and solar energy – especially considering India's fast-growing electricity usage and their contribution to the Paris Climate Agreement.

Currently, India is hosting 'RE Invest', the region's largest conference regarding sustainable energy, where more than 10,000 people will be attending. Permanent Secretary, Morten Bæk, will be representing Denmark and give a lecture about the Danish experience with offshore wind. The Indians have started to notice the Danish know-how and expertise within the green sector. Consequently, Denmark will now establish a Danish-Indian



knowledge centre for the development of especially wind energy in the world's second most populous country.

**“I see great potential for cooperation with India in the coming years. The country's political ambitions for the green transition are not to be mistaken. Therefore, I am hopeful that we will be able to establish a fruitful collaboration with India. The Indians have visited Denmark multiple times to learn from us, and I believe the time is right for us to move there and bring our experience and know-how into play for the benefit of the climate, the global green change and the Danish energy companies”, said Minister of Energy, Utilities and Climate Lars Chr. Lilleholt.**

The Indian Prime minister Modi has previously stated that the country must produce 227 GW of green energy in 2022. Modi is completing an electrification of all Indian villages, but the increasing prosperity of people in India is expected to up the demand for energy significantly in the coming years. Especially wind and solar energy is in for a historic boom. If everything goes as planned, India will have a capacity of 66 GW onshore wind in four years – in comparison, Denmark currently has a capacity of 4.5 GW. Furthermore, India wants to reach 30 GW of offshore wind before 2030, which corresponds to 23 times the 1.3 GW capacity that Denmark has achieved since 1991.

The knowledge centre is to be financed under the Danish Finance Act, and the plan is to allocate EUR 7.4 million over the next five years.

### Facts:

- India is on its way to becoming one of the world's largest markets for sustainable energy. Until 2040, India will account for 30 percent of the world's increased energy demand and thereby have the largest energy growth, right in front of China (IEA).
- India is predicted to add “an EU” in energy capacity up until 2040, meaning that the Indians will expand their energy sector equivalent to the size of the EU's sector today.
- India is projected to be the world's fastest-growing economy until 2040 (5.5 percent average GDP growth)\*.
- In 2016, investments in the Indian energy sector reached EUR 76,3 billion, number four following China, the US and the EU\*\*.
- The Danish Energy Agency is starting a three-year strategic sector cooperation with Indian ministries and national institutes. Offshore wind energy and integration of renewable energy into the electrical system are the key focus areas.
- The launch of a new knowledge centre is expected to support wind and offshore wind energy especially.

## ENERGY PLAYS A VERY CRITICAL ROLE IN THE DEVELOPMENT OF ANY COUNTRY

**By the year 2030, energy demand is estimated to increase by at least 35 per cent thus creating greater demand for solutions that reduce energy consumption.** A global response is therefore needed towards the demand for products, solutions and systems that can contribute to solving energy problems. Since energy efficiency and conservation will be key elements to a sustainable future, India needs to focus a lot more on the technologies that are more energy efficient and thus sustainable.

In September 2016, the UN General Assembly adopted the Sustainable Development Goals for 2030. Narendra Modi, Prime Minister of India while addressing the International Conference on Rule of Law for supporting 2030 Development Agenda reiterated that these goals reflect our evolving understanding of the social, economic and environmental linkages that define our lives. He further elaborated that India's commitments at COP-21 underlines the Indian ethos, which aims at changing human lifestyle in the manner in which we engage in economic activity.

According to Ministry of New and Renewable Energy (MNRE), India has an installed energy capacity of more than 200 GW (gigawatt) and has set an ambitious plan to add 60 GW of thermal and nuclear power capacity, 62 GW of hydro capacity and **175 GW of renewable energy generation capacity** by 2022. To cope up with future energy demands, India needs to focus on and implement some major changes for transformation.

In order to meet India's growing energy demand, it is important to not only increase electricity-generating capacity, preferably through renewable sources but also use energy efficiently. **Though energy conservation and energy generation go hand in hand, the former is less expensive.** It is possible to achieve a better result in conservation, if commercial building, industries and communities use equipment with updated electrical standards along with practicing regular energy consumption audits.

The government now needs to step in and help push the sustainability agenda further by promoting the development and use of eco-friendly products. **Government can also encourage the environmental / energy efficiency labelling and ratings of products.** These moves will definitely open up the market for eco-friendly products making India more competitive on this front. **There needs to be a focus on demand side energy management through policy and institutional mechanisms.** It is essential that the financing of energy efficiency and attractiveness be ensured. The business model for energy efficiency needs to be strengthened by giving targets to distribution companies to reduce consumption by enhancing efficiency and reduce T&D losses. Electricity distribution companies should start promoting demand side management. Just as they sell electricity, they should pay for / incentivize saving electricity as well.

**It is important to set minimum standards of efficiency for all electrical appliances including motors. A higher depreciation for energy efficient equipment and not just for renewable energy equipment and a lower excise duty will also encourage the adoption of energy efficiency products.**

**Sustainable construction** is another important area to look at. The commercial buildings sector in India faces a series of challenges that will define the way we think of buildings in the years to come. Buildings have to comply with strict sustainability standards in order to keep energy consumption low and flexibility high. **The ESCO model of financing should be promoted for enhancing efficiency in existing buildings.** Measurement and verification protocols for existing buildings (without escalating costs) need to also be put in place.

Energy and water have a significant inter dependent relationship commonly known as the water-energy nexus. Energy is critical for water as well. For example, most water supply systems, both urban and rural require power to distribute water through pipe networks and farmers need power to run pump sets and irrigate their fields. Power is also required to take away and manage wastewater.

On the other hand, water is critical for energy. This co-dependence of water and energy leads to them interacting at multiple points. Considering that the most profligate consumer of water and also the most inefficient is agriculture, a lot of focus is required on this sector. The agriculture sector is the largest user of water and given that, it takes energy to pump and transport water they are also one of the largest users of free or subsidized energy. Around 60 percent of irrigated agriculture in India depends on pumped groundwater.

It is therefore imperative that we in India wake up to the fact that we need to approach the water-energy nexus in a holistic manner, especially as we know that the demand for water and energy will increase substantially as the country urbanizes and more people move above the poverty line.

A little less known fact is that **pumps account for a massive 10% of the world's electricity consumption – and a lot of this is wasted.** Consumers can make a drastic change in their energy consumption by taking a simple but effective step – that is by the optimal usage of energy efficient technologies. **We could save around 4% of the world's total electricity consumption – equivalent to the residential electricity consumption of 1 billion people, if people were to switch to energy efficient pumps.** We can achieve this by ensuring that the minimum standards for motor and pumps are higher than the current BIS standards. Today, intelligent pumps & solutions are widely available in our market and they allow you to control, monitor and optimize your entire system to deliver high performance in demanding applications. Typical advantages of intelligent pump solutions are energy savings, lifetime improvements and system cost reductions.

It is understandable that for the development of the country, people require an uninterrupted flow of energy. No country can therefore afford to think of not using and generating sufficient energy. But at the same time, to cope up with the rising energy demands, we are responsible to take actions to fill the gap between the demand and supply of energy. It is time to wake up to the reality and consider implementing reliable energy efficient measures to satisfy the country's appetite for energy in the coming decades.

*Courtesy :Sustainability Outlook : The article was contributed by Mahathi Parashuram. She is Regional Head – Public Affairs, Communications & Relations for the Asia Pacific Region at yGrundfos*

## LIVING ELECTRODES WITH BACTERIA AND ORGANIC ELECTRONICS

Adding bacteria to electrochemical systems is often an environmentally sensitive means to convert chemical energy to electricity. Applications include water purification, bioelectronics, biosensors, and for the harvesting and storage of energy in fuel cells. One problem that miniaturisation of the processes has encountered is that a high signal strength requires large electrodes and a large volume of liquid.

Researchers at Linköping University, together with colleagues at the Lawrence Berkeley National Laboratory in Berkeley, California, USA, have now developed a method in which they embed the electroactive bacterium *Shewanella oneidensis* into PEDOT:PSS, an electrically conducting polymer, on a substrate of carbon felt.

The researchers call the result a “multilayer conductive bacterial-composite film,” abbreviated as MCBF. Microscopic analysis of the film shows an interleaved structure of bacteria and conducting polymers that can be up to 80 µm thick, much thicker than it can be without this specific technique.

“Our experiments show that more than 90% of the bacteria are viable, and that the MCBF increases the flow of electrons in the external circuit. When our film is used as anode in microbial electrochemical cells, the current is 20 times higher than it is when using unmodified anodes, and remains so for at least several days,” says Gábor Műhes, researcher at Linköping University and one of the lead authors of the scientific article recently published in Scientific Reports.

Previous work has tested, among other things, carbon nanotubes to increase the surface area at the anode, but the results were poor. The possibility to couple biological processes with readable electrical signals is also valuable, for example for environmental sensors which require rapid response times, low energy consumption, and the ability to use many different receptors. Researchers have recently demonstrated how to use *Shewanella oneidensis* to produce electrical currents in response to arsenic, arabinose (a type of sugar) and organic acids, among others.

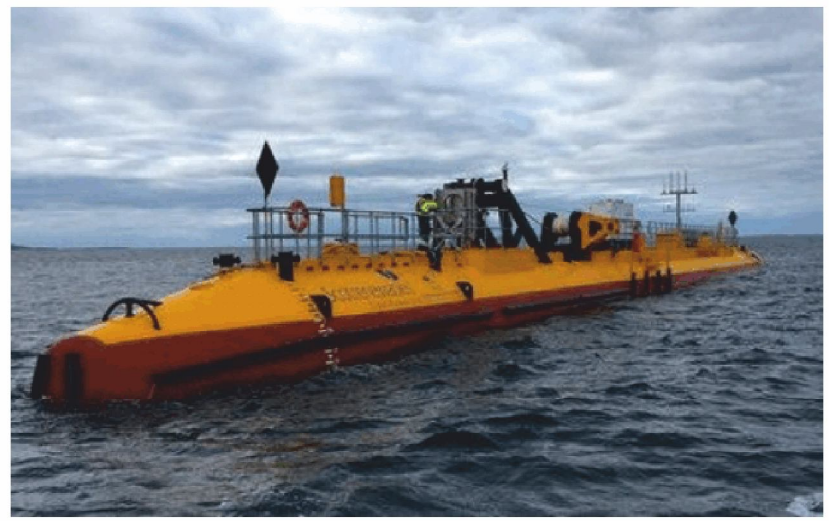
“This technology represents a type of “living electrode” where the electrode material and the bacteria are amalgamated into a single electronic biofilm. As we discover more about the essential role that bacteria play in our own health and wellness, such living electrodes will likely become versatile and adaptable tools for developing new forms of bioelectronic technologies and therapies,” says Daniel Simon, principal investigator in Organic Bioelectronics at the Laboratory of Organic Electronics.

***Learning to ignore certain people is one of the great paths to inner peace.  
Life gets easier when you delete those who make it difficult.***

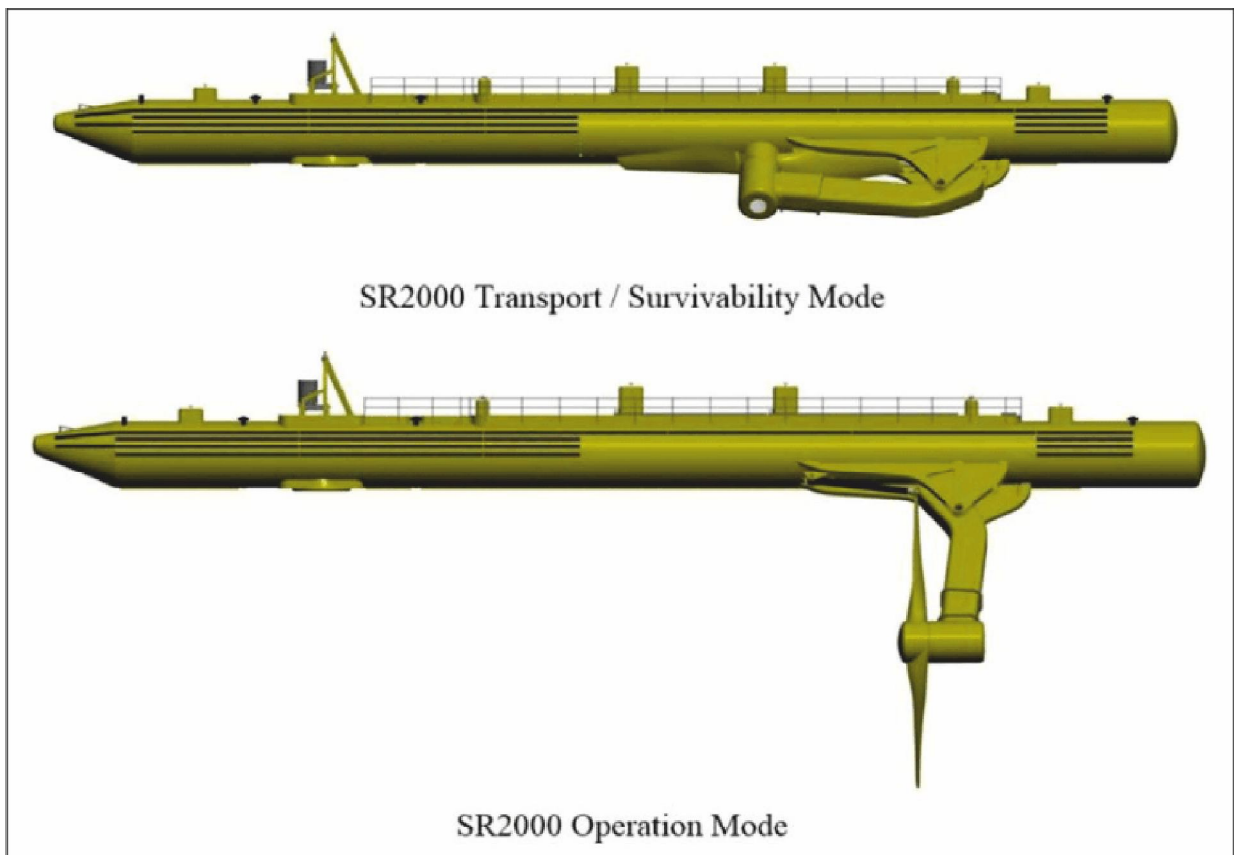


## INNOVATIVE FLOATING TIDAL-POWER TURBINE GENERATES 3 GWH OF ENERGY IN ITS FIRST YEAR OF TESTING

The floating tidal stream turbine off the coast of Scotland has proven that it can produce electricity safely and cheaply year round. Of the various renewable energy sources, tidal and wave power get less attention and fewer investments than many others. This is because of the inherent risk of any energy generating technology that has to operate in the brutal environment of the sea. Between the wear and tear from waves, the corrosive nature of saltwater and the inaccessibility of something installed offshore, the odds are often stacked against a technology before it can really get started.



So why do we keep trying? Because the potential energy from these sources could easily power the world if technologies are successful and seeing as a majority of the world's population lives with 60 miles of a coast, it puts electricity close to where it will be used.



A tidal power project called FloTEC believes that it has solved many of the problems that have faced the industry before. Its pilot SR2000 turbine is the most powerful tidal stream turbine to date and it has just finished a full year at sea continually generating electricity.

The project leaders have a goal of creating tidal power systems that are low cost, low risk and reliable and with the SR2000 turbine they've proven that this is achievable. The 2-MW turbine has been stationed off the Orkney Islands since last summer and in that time has generated 3 GWh of energy, that's equivalent to the annual electricity needs of 830 British households and is more power than has been produced by all wave and tidal energy projects in Scotland in the past 12 years.

The turbine has been feeding electricity to the Orkney Islands' grid and has supplied more than a quarter of their power needs over the year.

The turbine, which looks like a large yellow submarine, was able to weather the harsh fall and winter storms typical of the area and withstood waves over 7 meters in height. It was able to maintain continuous generation in waves 4 meters high. The team says that the improved performance over other tidal systems was thanks to bigger, more robust rotors that were able to generate energy at lower speeds.

The FloTEC project was able to keep costs down because the SR2000 was easy to access for maintenance using inexpensive rigid inflatable boats which kept costs down and also keep outages to a minimum. The crew has plans to construct a 2 MW commercial version of the SR2000 after this year's successful pilot. It should be ready by the end of the year and will be tested off Orkney before hitting the market.

## OIL RETAILERS BET BIG ON SOLAR WITH EASY LOANS

Oil companies betting big on solar energy doesn't sound ironic any more. Setting up solar power plants is not a token of commitment to the environment. Instead, it is making business sense as rising cost of running petrol pumps eat into dealer income.

No wonder India's state-run fuel retailers are persuading petrol pump owners to go green by setting up solar power units. Experiments by IndianOil, the country's largest fuel retailer, in 2015 showed running outlets on solar power costs less than burning diesel in generators to keep pumps running, especially in the hinterland.



Since then, IndianOil, which holds sway over nearly half of India's fuel retail market, has been driving its dealers to switch to green power by arranging easy loans through a tieup with SBI and other assistance. Bharat Petroleum and Hindustan Petroleum, too, have joined the bandwagon but have been slower.

"Solarisation of petrol pumps is part of IndianOil's green commitment. Our target is to run 100% retail outlets on solar power in the next two years. The focus will be on rural areas where we have Kisan Seva Kendras (low-cost, stripped-down versions of petrol pumps)," IndianOil chairman Sanjiv Singh told TOI.

"A solar plant not only ensures continuous power but it ensures quality power and prevents equipment (at outlets) from tripping due to supply interruptions or (voltage) fluctuation. Pollution from generators is also checked," Singh said.

All these result in uninterrupted operation and no loss of sales. Depending upon the size of the petrol pump, a 24 kw (kilo watt) rooftop photovoltaic system can reduce costs by more than Rs 7 lakh a year. This is nearly 50% less than the average annual electricity bill, based on commercial rates that are higher than domestic tariffs, for grid supply. There are other benefits too such as accelerated depreciation.

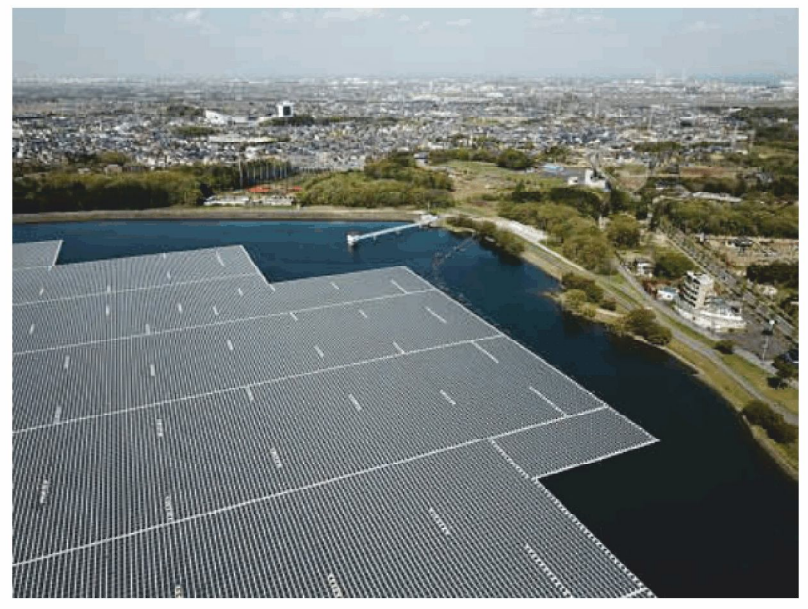
Power supply from the grid in rural areas and the hinterland still remain patchy and also suffer from low, high or fluctuating voltage. Petrol pump owners in these areas depend on generators, which pushes up running cost and eats into dealer margin.



## INDIA'S FIRST LARGE-SCALE FLOATING SOLAR PROJECT

India's first large-scale floating solar project is on its way with Shapoorji Pallonji winning the first block in Solar Energy Corporation of India's auction of 150 MW of such projects on the Rihand Dam, along the Uttar Pradesh-Madhya Pradesh border. Shapoorji Pallonji won the reverse auction for 50 MW quoting a tariff of Rs 3.29 per unit, officials said.

"This is the country's first floating solar project at such a scale," said a Solar Energy Corporation of India (SECI) official. "There are a few others but they are in kilowatts." The remaining 100 MW will also be shortly auctioned in blocks of 50 MW, the official said. "We had considered bringing out such a tender two years earlier, but our initial inquiries showed tariffs would have been in the range of Rs 7-8 per unit, and so we decided not to go ahead," the official said.



Since then, solar tariffs have fallen dramatically, with those of ground mounted projects dropping to Rs 2.50-3.50 per unit. In UP, where solar radiation is not as strong as in states like Rajasthan, the average tariff has been more than Rs 3 per unit.

Rihand Dam, also known as Govind Ballabh Pant Sagar, is the country's largest reservoir by volume and largest artificial lake, located on the Rihand River with its catchment area spread over Uttar Pradesh, Madhya Pradesh and Chhattisgarh.



A problem several solar developers face is that of connectivity and transmission of the power they produce as mostly solar projects come up in rural areas because they need vast amounts of land – around six acres per MW. The Rihand floating projects will not have any such issues, and they can use the same transmission facilities as the hydropower station of the dam.

“Floating solar is a well-established model worldwide,” said Vinay Rustagi, managing director at solar consultancy Bridge To India. “It is really great that India has also gone forward with floating solar and that too at this size.” He said the price discovered in the first reverse auction is 10% higher than ground-mounted projects in UP. “Given that transmission issues are less, the tariff is in line with expectations,” Rustagi said.

He, however, expressed concern that the timeline for the project – at just 13 months – could be a challenge. “Acquiring floating structures within this deadline might be difficult,” Rustagi said.

## **SOLAR PLANTS COMMISSIONED AT ALANDUR, ST THOMAS MOUNT METRO STATIONS**

Chennai Metro Rail has commissioned solar power plants at Alandur and St Thomas Mount metro stations with a total capacity of 1120 KW. Solar plants have been installed on rooftops at these metro stations. The plants are expected to generate around 1,51,200 units per month. They would help save around Rs 69, 49,152 lakhs per year, a release from CMRL said.



These solar plant projects were executed under zero capital investment by CMRL and based on RESCO Model under Solar Energy Corporation of India (SECI) scheme on a monthly tariff basis payment. Earlier, solar plants were launched at Koyambedu metro station and depot. Now the installed capacity of CMRL’s roof top solar power is 3.0 MW in total. Another 4.6 MW rooftop solar power installation is under progress and is expected to be completed by end of this year 2018, according to the statement.

***“But collective thinking is usually short-lived. We’re fickle, stupid beings with poor memories and a great gift for self-destruction.” – SUZANNE COLLINS***

## VFD – FUTURE OUTLOOK

Variable Frequency Drives (VFDs) are known by many names: Variable speed drives, Adjustable speed Drives, Adjustable Frequency Drives, Variators and Frequency Converters. Contrary to popular belief, VFDs are not limited to industrial settings but are in fact quite ubiquitous. Their applications range from smaller appliances to larger motors in building, agricultural and industrial settings.

### AC Induction Motors: The Geek's Gift

To learn about VFDs we must talk one of the greatest inventors of the 20<sup>th</sup> century. Nikola Tesla's contribution to the design of modern AC electricity supply systems is particularly well known.

We also know about the 3-phase AC Induction motor which he patented in 1888. The AC induction motor invented by Tesla was more efficient and reliable than (his supposed arch-nemesis) Edison's direct current (DC) motor. However, one significant weakness of the invention was that speed control in AC motors unlike DC motors was an extremely difficult task.

For DC motors, speed control could be achieved by installing a simple rheostat. However, for AC motors it requires varying the magnetic flux or changing the number of poles on the motor. Even decades after AC motors became widespread, varying the frequency for speed control in AC motors remained a concept per se.

It was only in the 1980s, almost 100 years after their introduction by Tesla, that varying AC motor speeds entered the mainstream of industry.

### Variable Frequency Drives: A century's worth of effort

The innovation that allowed for changing AC motor speed was Variable Frequency Drive technology. A Variable Frequency Drive (VFD) is a device that controls the voltage and frequency that is being supplied to a motor and therefore controls the speed of the motor and the system it is driving.

There are three types of VFDs: **Current source inversion (CSI)**, **Voltage source inversion (VSI)** and **Pulse-width modulation (PWM) VFDs**.

Of these the first two are not widely used due to issues with motor cogging, i.e. motor refusing to start even when full voltage is applied. PWM VFDs are widely used in industry because of excellent input power factor due to fixed DC bus voltage, absence of motor cogging, higher efficiencies, and lower costs.

### VFDs: How do they save energy?

A motor does not need to operate at the same load throughout the day. Depending on demand, the load required varies throughout the day. With VFDs you can control the speed of the motor according to the load. This reduces excess energy from being wasted.

This can result in tremendous savings especially for machines such as variable-torque centrifugal fans and pump applications. The load's torque and power for these two set of machines varies with the square and cube, respectively, of the speed. A relatively minor reduction in speed can thus lead to a large power reduction. For example, **at 63% speed a motor load consumes only 25% of the power it would have consumed at 100% speed.** That's some serious energy saving!



## VFD and Energy Savings: We are talking about some big numbers here

Electric motors are the single biggest consumer of electricity worldwide. According to IEA estimates, they consume about **45 per cent** of global power produced. Lighting is a distant second with 19 per cent.

Although, VFD as the go-to option for reducing energy consumption in motive loads has been around for a while, it had seen limited adoption earlier due to high risk perception. The global market penetration of VFDs for all applications is still relatively small even though the VFD market is estimated to be nearly **USD 19 billion** in 2016, according to a report by MarketsandMarkets.

The same report projects the VFD market to grow by **6.9%** to touch **USD 27 billion** by 2021.

### VFDs: They do more than just energy savings

In addition to reducing energy costs, VFDs also save costs in other ways by:

- Increasing system reliability
- Reducing downtime
- Reducing equipment setup time
- Lowering maintenance cost
- Lessening wear and tear of machine

### VFDs in India: Energy Efficiency, PAT and Climate Change

Experts believe that there is a huge untapped potential for VFDs in the Indian industry. Sectors including Iron and Steel, Cement, Aluminum and Fertilizer in particular have a sizable potential for this application in India.

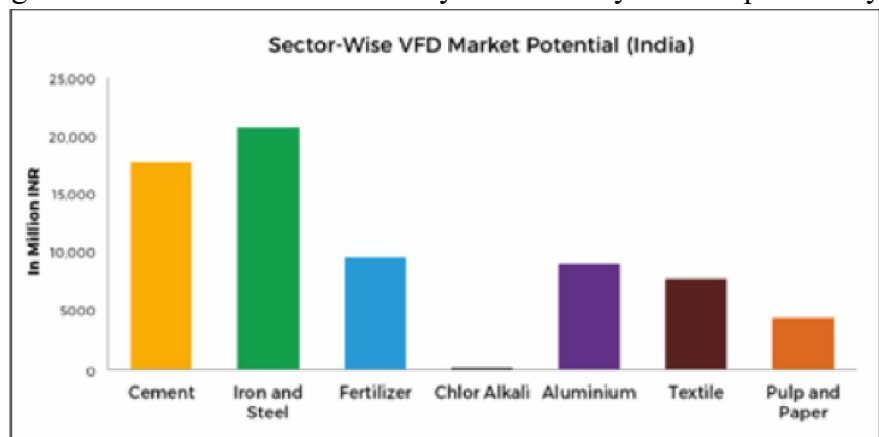
The significance of VFDs has risen in the context of the **Perform, Achieve and Trade (PAT) scheme** of the government of India launched in 2008. The PAT scheme imposes mandatory specific energy consumption targets on certain designated industries with less energy efficient facilities having higher reduction targets than the more energy efficient ones.

The scheme has acquired renewed significance in the context of India's Intended Nationally Determined Contributions (INDCs) which have pledged reduction in emissions intensity of its GDP by 33 to 35 per cent by 2030 from the 2005 level.

Simply put, India has to become more energy efficient and what better way to do so than by deploying VFDs for industrial motor applications; which as we discussed earlier are the biggest consumer of electricity globally.

Thus, VFDs would have an important role to play if India wishes to achieve its emission targets. **Sustainability Outlook in its PAT Pulse 2 Report** estimates a potential

**market size of more than USD 1 billion (INR 7 billion) for Variable Frequency Drives across sectors in India.**



**market size of more than USD 1 billion (INR 7 billion) for Variable Frequency Drives across sectors in India.**

VFDs primarily have two main market segments, namely **High Tension drives (HT)** and **Low Tension drives (LT)**, with the former having a relatively higher potential in the Indian industry and being more efficient in terms of savings per unit investment. Both the segments have seen varying penetration rates in the Indian Industry with the uptake of LT drives being relatively higher than that of the HT drives. This is because, while on the one hand there the upfront capex for LT drives **Rs.6000-7000/kW** and simple **payback is <2 years** the capex for HT drives is **Rs.15000-20000/kW** and the associated **payback period is 3-4 years**. Furthermore, the costs of LT drives have fallen in the past decade but the costs of HT drives haven't seen a similar drop.

In conclusion, VFDs hold enormous potential for energy efficiency across the globe. It is time industry leaders and policy-makers realize its importance and make the necessary efforts to attain our shared global goal of sustainable energy.

*Courtesy: Sustainability Outlook*



# ENERGY, ELECTRICAL ENERGY AND RENEWABLE ENERGY – 15

**Sustainable Growth, Sustainable Electrical Energy and Renewable Energy**

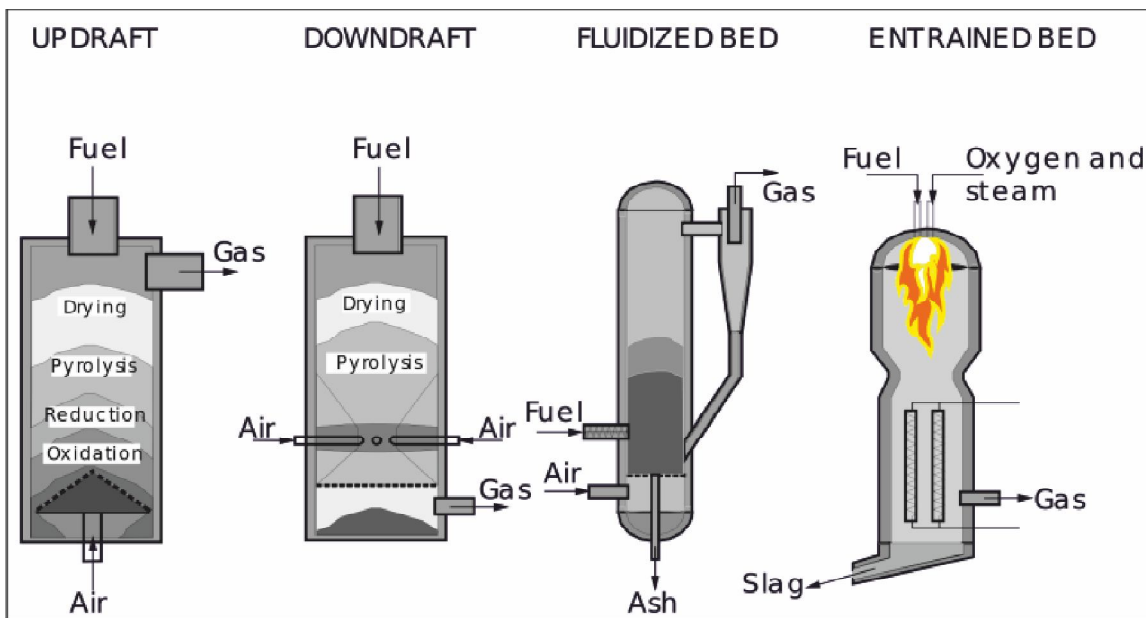
**Thermo Chemical and Biochemical Technologies**

**Bio Mass and Gas – Thermo Chemical – Producer Gas and Syn Gas:**

**Biomass Gasification – Controlled Oxygen Types**

In the popularly used Gasification units with controlled oxygen supply delivering ‘Producer Gas’, some of the difficulties commonly found are – a) varying Calorific values of the Gas depending on efficiency of control of oxygen (in plain Heat applications this does not seem to affect visibly, but in cases of Power Generation, this affects) b) In these types of Gasifiers, for sustained performance, the Biomass requires to be dried very well with moisture content very near ‘0’; the performance gets affected otherwise.

The various types of Gasifiers as shown below draw controlled Air/ Oxygen for the Gasification process and produce ‘Producer Gas’.



**Biomass Gasification – Oxygen free types:**

In principle, it is found that if gasification can be achieved in the following sequence without the requirement of air/oxygen supply from outside, the Calorific values can be much higher, Power Generation can be done with 100% Gas and the whole process can be stable and more efficient.

**Oxygen free Gasification**

1. Non Incineration Thermal Waste to Energy Solution
2. Thermal Phase Change from Solid to Gas Phase in complete absence of Oxygen
3. Produces SYNGAS FUEL. This can be used to generate electricity.

**Power Generation**

1. The Syngas uses the Gas Cycle to convert fuel to Electricity.
2. High efficiency (proven) Reciprocating Gas Engines are used.
3. Waste Heat is used efficiently to Create a viable feed-stock from wastes of different kinds, including Municipal Solid Waste.
4. Since non-incineration, it is safe to use plastics, which augment feed Calorific Value with the absence of Toxic Gases, normally associated with Plastics.
5. **The challenges are to provide sufficient Heat inside the sealed Chamber/ Reactor for Gasification to take place.**

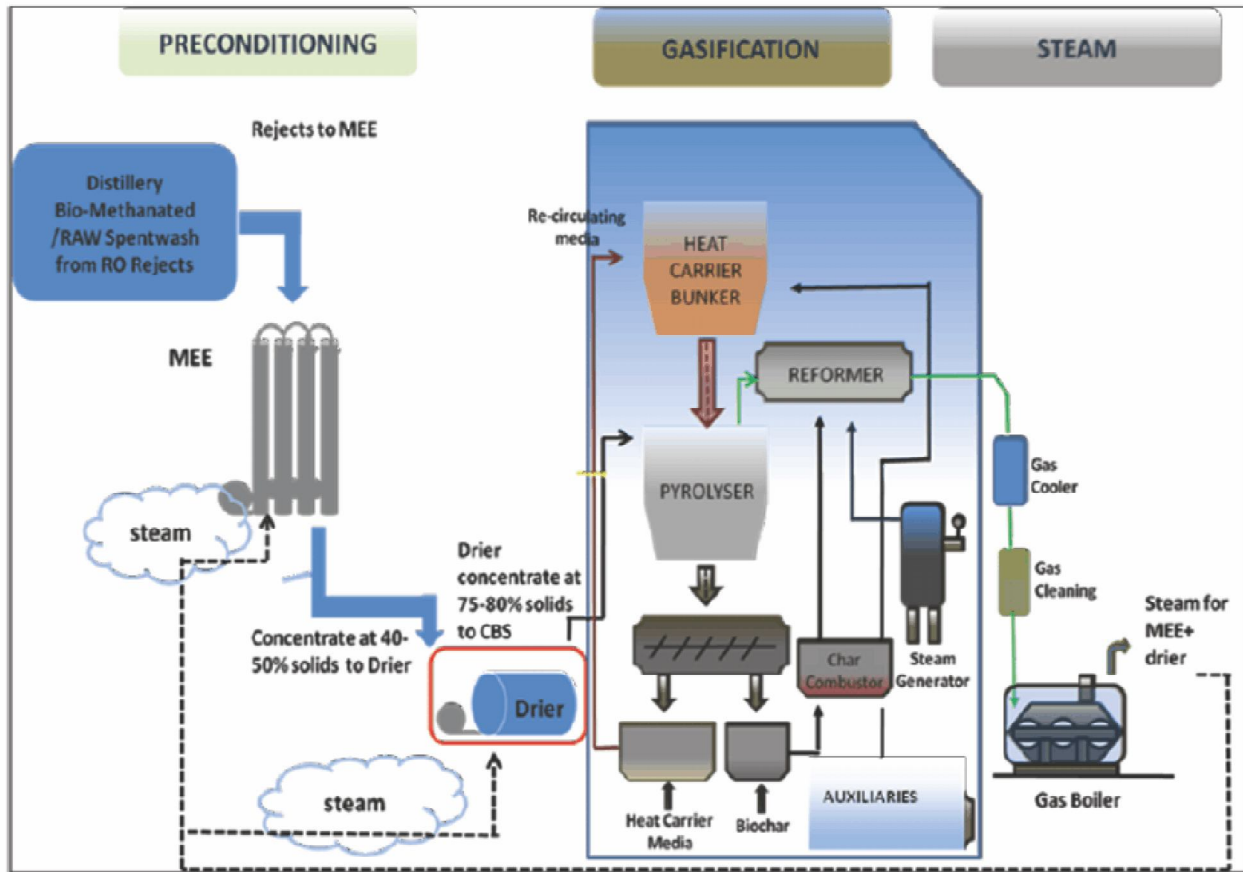
There are 2 important technologies in use now as solutions for providing/ generating heat inside the sealed reactors. These Technologies are applied particularly for large scale Power Generation. They are namely:-

- a) Oxygen Free Gasifiers using Heat Carriers.
- b) Oxygen Free Gasifiers – Using Plasma Torches.

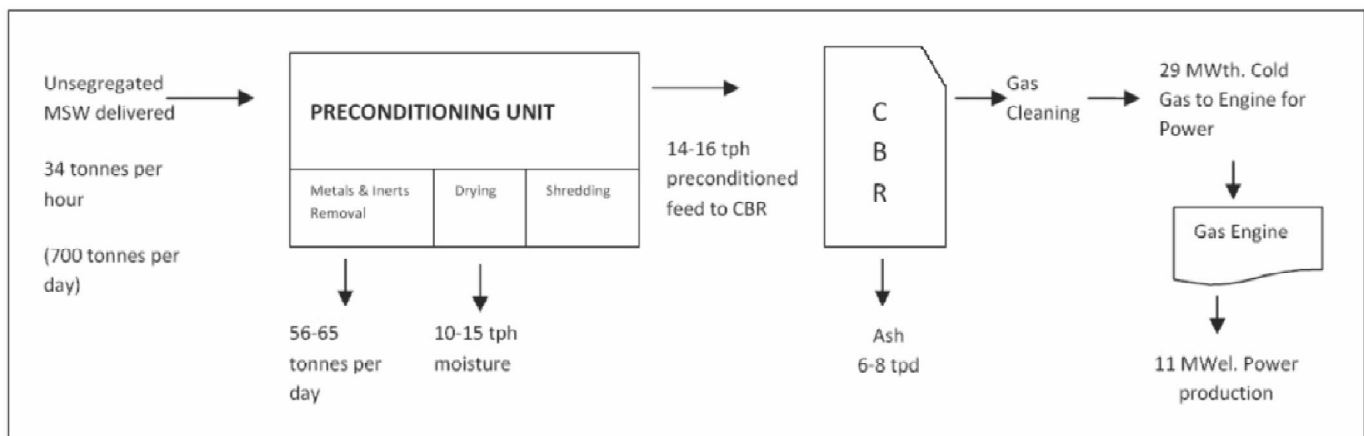
**Oxygen Free Gasifiers using Heat Carriers:**

One of the ‘Oxygen Free’ types using ‘Heat Carriers’ as shown in the Flow Diagrams G and H given below, the Heat Carriers are special Metallic Alloy Balls of diameters ranging between 5 to 7.5 mm, heated up to about 700 to 800°C and fed into the reactor synchronizing with the ‘Biomass’ feed. The ‘Gasifier’ stage in the Diagram G uses the heat carriers. The heating of the heat carriers are achieved through steam generation done by using a portion of the Gas generated once the Cycle is established.

**Diagram H**– Shows the complete Process including Power Generation with sample workings for utilisation and disposal of 700 Tons per day of Municipal Solid Waste.



**Diagram G - Preparation of Biomass Feed and Gasification. Heat Carriers used**



## **Diagram H - Oxygenfree Gasification and Power Generation working shown - to handle 700 Tons of Municipal Solid Waste per day and 11 MW Power Generation**

The complete process details in various stages of Gasification and Power Generation as given in the Diagram H are detailed below:

### **PRECONDITIONING**

- The waste is segregated in a fully automated segregation and sorting m/c Unsegregated MSW delivered to designated waste disposal site;
- Waste stored at enclosed storage facility;
- and the recyclables/inerts are separated and sold to appropriate buyers/disposed;
- The waste is subsequently dried by utilizing the waste heat from the system, and shredded to make it input ready for the Gasification and Power Generation Systems;

### **Gasification & Power Generation**

- The Preconditioned Waste is conveyed in enclosed conveyors to the Gasifier System;
- The waste undergoes a thermo-chemical degradation by high temperature heat transfer absorbing heat from the heat carriers in completely inertized chamber in the CBS Gasifier;
- This results into a Calorific Rich gas which is steam reformed to finally result into a hydrogen intensive Syngas;
- The Syngas is subsequently cooled and cleaned of pollutants and supplied to the gas engine for power generation;
- The engine processes this clean gas to produce Green Power that can be evacuated to the Grid.
- The Flue gas from the Engine is treated and the heat from therein is utilized for the captive requirements of the Gasifier System;

### **Broad Input / Output**

- Input – Unsegregated Municipal Solid Waste or any other Wastes or Biomass, with sufficient Calorific Value established with Fuel Analysis;
- Receipt of waste – 365 days a year;
- Plant Uptime (Defined as the amount of time for production of electricity) – 7500 hours/annum;
- Amount of Electricity Produced – Established with the kinds and quantities of Biomass and their characteristics and Calorific values, constant and varying;
- Rejects from the system:
  - Inerts & Recyclables - A function of the feed – estimated at APPROX 15% of the received waste
  - Ash - A function of the feed – estimated, subject to actual feed analysis.



*(To be continued)*  
*S. Mahadevan, B.E., F.I.E., M.B.A.,  
Consultant, Energy and Energy Efficiency,  
Mobile: 98401 55209*

## **10 COMMANDMENTS - TO AVOID COMPUTER VISION SYNDROME (C.V.S)**

1. Eye to Screen Distance: Keep at least 25 inches distance, preferably more.
2. Monitor Tilt: Keep top of the monitor slightly farther from the eyes than the bottom
3. Screen Colours: Use dark letters on a light background.
4. Vertical Location: Ensure that viewing area of the monitor is between 15° and 50° below horizontal eye level.
5. Lighting: Have ceiling suspended indirect lighting. Use blinds shades & curtains to control outside light & avoid reflection.
6. Neck Posture: Always use chair with arms. Note that flexion (head-tilt pose) causes less fatigue than head-erect posture.

7. Humidity & Airflow: Avoid direct flow or draft of air on your eyes. Avoid low humidity or fumes as it aggravates dry eye condition.
8. Break: Take a short visual break every 20 minutes to avoid strain.
9. Exercise: Blink your eyes few times. Close eyelids and roll the eyes behind your closed lids once clockwise & once anti-clockwise. Take a deep breath & open eyes while releasing breath.
10. Doctor's Advice: Follow your doctor's advice & use lubricating eye drops as advise.

*Issued in public interest by Centaur makers of Ocuwet eyedrops*



TULSI TANTI, Chairman & MD  
Suzlon Energy



***While Men May Come And Men May Go, The Enterprising Ones Figure Out How To Survive, And Fuel A Thousand Dreams For Fellow Citizens To Follow.***

Tulsi Tanti is the chairman and managing director of Suzlon Energy, a US \$1 billion market cap wind power based company.

Shortage of power was the spark that created Suzlon. Tulsi Tanti sold his textile business and boldly

rode into wind turbine power, becoming a global player. Many people questioned his move and ridiculed him and just shrugged off his visionary bold action. Today, Tulsi is the one whom India is counting on, India's ultimate "Wind man". He visualized the potential of wind energy and created Suzlon Energy. In 2005, when Tanti entered the Forbes list of the 40 richest Indians, not many had even noticed him. By 2007, he had created a business that was valued at Rs.57,000 crore in less than 13 years. **Tulsi got selected for Chanchlani Global India award 2009 for his outstanding contributions to promote non-conventional sources of energy. Also he has been awarded Champion of the Earth for 2009 by the United Nations Environment Program for his Entrepreneurial Vision in combating climate change and was also awarded Global Indian Award and Golden Peacock National Training Award.** Suzlon's meaning can be a good management lesson for everyone: *sujhbujhke loan lena.*

Tulsi started his first venture in textiles in Surat and later shifted to Pune. He faced the problem of escalating costs and unreliable power. Then his innate "entrepreneurship" motivated him towards wind energy. He set up two wind mills for supplying electricity to his own textile plant. Tulsi has given employment to 16000 people in 25 countries such as the Americas, Asia, Australia and Europe. He has created fully integrated supply chain with manufacturing facilities in three countries. His activities are supported by sophisticated R&D in Belgium, Germany and the Netherlands.

Suzlon Energy is the fifth largest wind turbine manufacturer in the world and the largest in Gujarat. Tulsi was worth \$930 million according to Forbes in November 2008. Suzlon reported revenues of Rs.9,397 crore for the first six months of the 2011-2012 financial year.

## HUMOUR

Three lawyers and three engineers were travelling by train to a conference. At the station, each lawyer bought a ticket whereas the engineers bought only one ticket between them.

'How are you going to travel on a single ticket?' asked a lawyer.

'Wait and watch', answered one of the engineers.

When they boarded the train, the lawyers took their seats, but the three engineers crammed into a toilet and closed the door behind them. Shortly after the train started, the ticket collector arrived. He knocked on the toilet door and asked, "Ticket, please." The door opened just a crack and a single arm emerged with a

ticket in hand. The ticket collector took it and moved on.

Seeing this, the lawyers decided to do the same thing on the return trip so when they arrived at the station they bought only one ticket. To their astonishment, the engineers didn't buy any. 'How are you going to travel without a ticket?' asked one of the perplexed lawyers.

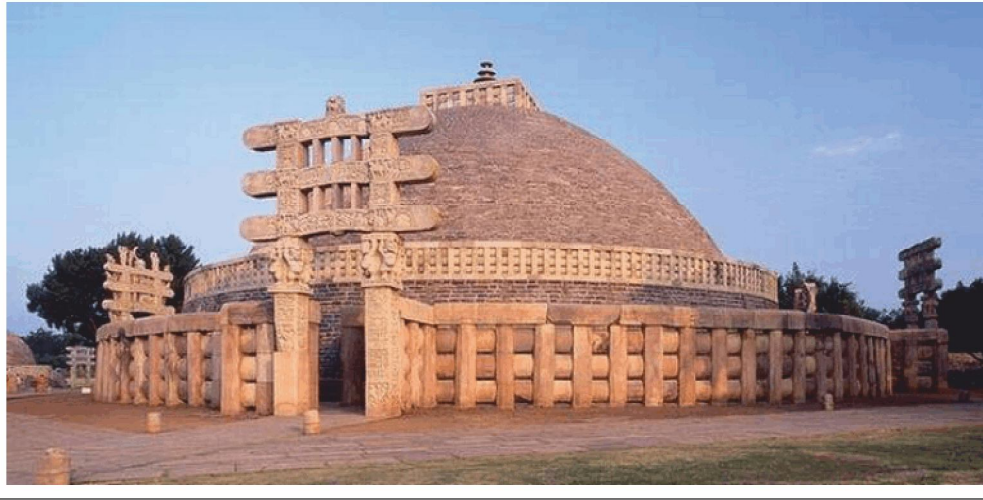
"Wait and watch", answered an engineer.

In the train, the three engineers crammed into a toilet and the three lawyers into another nearby. Soon after the train started, one of the engineers got out of the toilet and walked to one where the lawyers were hiding. He knocked on the door and said, "Ticket, please..."



## வியப்பூட்டும் இந்தியா - 12

### அழகிய சாஞ்சி



சாஞ்சி என்றதும் புத்தரின் நினைவுச் சின்னங்கள் இருக்கும் அழகிய ஸ்தூபிதான் நினைவுக்கு வரும். மத்தியப் பிரதேசத்தின் தலைநகரான போபாலிலிருந்து 46 கி.மீ. தூரத்தில் இருக்கிறது சாஞ்சி நகரம். கி.மு. மூன்றாம் நூற்றாண்டில் இந்தியாவில் பெரும் பகுதி மௌரிய அரசர்களால் ஆளப்பட்டு வந்தது. மௌரிய வம்சத்தின் தலைசிறந்த அரசரான அசோகர், கலிங்கப் போருக்குப் பின் புத்த மதத்தைத் தழுவினார்.

புத்தரின் தத்துவங்களைப் பாதுகாக்கவும் உலகம் முழுவதும் பரப்புவதற்கும் பல முயற்சிகளை மேற்கொண்டார். அவற்றில் ஒன்றுதான் சாஞ்சி ஸ்தூபி. மிகப் பழமையான கல்லில் அமைக்கப்பட்டது. யுனெஸ்கோ பாரம்பரியச் சின்னங்களில் ஒன்றாக இருக்கிறது.

அசோகரின் மனைவி தேவி, சாஞ்சிக்குப் பக்கத்தில் உள்ள ஊரைச் சேர்ந்தவர். குன்றுகளின் மேலுள்ள அழகான இந்த நகரத்தில் ஸ்தூபி கட்ட முடிவு செய்தார். அவரின் மேற்பார்வையில் முதல் ஸ்தூபி பிரம்மாண்டமாகக் கட்டப்பட்டது.

மௌரிய வம்சத்துக்குப் பின் வந்த குஷானர்களும் அவர்களுக்குப் பின்வந்த அரசர்களும் மேலும் பல ஸ்தூபிகளைக் கட்டினர். முதல் ஸ்தூபிக்கு மெருகூட்டப்பட்டது. ஸ்தூபியைச் சுற்றி மரவேலியும் நான்கு பக்கங்களில் தோரண நுழைவாயில்களும் அமைத்தனர். அதற்குப் பின் வந்த குப்த வம்சம் புத்த மடாலயங்களையும் விகாரங்களையும் கட்டி, சாஞ்சியை மேலும் வரலாற்று முக்கியத்துவம் வாய்ந்த பகுதியாக மாற்றினார். புத்தரின் சிலைகளும் மற்ற சிற்பங்களும் வடிக்கப்பட்டன. கி.பி. 7-ம் நூற்றாண்டிலிருந்து 12-ம் நூற்றாண்டுவரை சாஞ்சி மிகவும் உன்னத நிலையிலிருந்தது. புத்த மதத்தின் தாயகமாகப் பார்க்கப்பட்டது.

13-ம் நூற்றாண்டுக்குப் பிறகு சாஞ்சியின் முக்கியத்துவம் படிப்படியாகக் குறைந்தது. கி.பி. 1818-ல் ஜெரல் டெய்லர் என்ற ஆங்கிலேயர் பாதி புதைந்திருந்த சாஞ்சியைக் கண்டுபிடித்தார். 1912-ல் தொல்லியல் துறையின் பொது இயக்குனராக இருந்த ஜான் மார்ஷல் சாஞ்சியை முழுவதுமாகப் புதுப்பித்தார்.

சாஞ்சியில் நிறைய ஸ்தூபிகள் இருந்தாலும் மூன்று ஸ்தூபிகள் மிகவும் பிரபலமானவை. அசோகரால் கட்டப்பட்ட முதல் ஸ்தூபி பிரம்மாண்டமானது. 215 அடி உயரமுள்ள குன்றின் மேல் அரைக்கோள வடிவில் அமைக்கப்பட்டுள்ளது.

ஸ்தூபியின் நான்கு திசைகளிலும் மிக நேர்த்தியாகச் செதுக்கப்பட்ட சிலைகளுடன் கூடிய தோரண வாயில்கள் உள்ளன. தெற்குத் தோரண வாயிலில் புத்தரின் பிறப்பு, அவர் வாழ்க்கையில் நடந்த அதிசயங்கள் மிக அழகாகச் செதுக்கப்பட்டுள்ளன. இதன் அருகே ஒரே கல்லினால் ஆன 42 அடி உயர அசோகத் தூண் நிறுவப்பட்டு இருக்கிறது. உச்சியில் நான்கு திசைகளை நோக்கி நான்கு சிங்கங்கள் இருந்தன. காலப்போக்கில் தூண் உடைந்து விட்டது. உடைந்த பாகங்கள் அருகில் உள்ள அருங்காட்சியகத்தில் வைக்கப்பட்டுள்ளன.



கிழக்கு தோரண வாயிலில் இளவரசர் சித்தார்த்தன் அரண்மனை வாழ்வைத் துறந்து செல்லும் காட்சியும் தாயார் மாயா கர்ப்பமுற்றிருந்த போது கண்ட கனவு காட்சியும் செதுக்கப்பட்டுள்ளன. மேற்குத் தோரண வாயிலில் புத்தரின் ஏழு அவதாரங்களும்

காணப்படுகின்றன. சாரநாத் மான் தோட்டத்தில் புத்தர் பேசிய முதல் பிரசங்கக் காட்சியும் உள்ளது.

இரண்டாவது ஸ்தூபி கி.பி. 150-ல் கட்டப்பட்டது. 3அடி விட்டத்தில் 22.5 அடி உயரத்துக்கு அமைக்கப்பட்டுள்ளது. ஸ்தூபியைச் சுற்றி சிறு கைப்பிடிகள் கொண்ட சுவர் போன்ற அமைப்பு உள்ளது. அதில் பெண்கள், தெய்வங்கள், புராணங்களில் காணப்படும் இறக்கைகளுடன் கூடிய சிங்கம், குதிரைத் தலை, மீன் தலையுடன் கூடிய மனித உருவங்களைக் காண முடிகிறது.

மூன்றாவது ஸ்தூபியைச் சுங்க வம்சத்தினர் கட்டினர். புத்தருடைய சீடர்களின் நினைவுச் சின்னங்கள் இந்த ஸ்தூபியில் உள்ளன. இந்தியாவில் காண வேண்டிய முக்கியமான இடங்களில் சாஞ்சியும் ஒன்று.

தொடர்புக்கு: ஆம்பூர் மங்கையர்க்கரசி, mangai.teach@gmail.com

Courtesy: தி இந்து, தேதி: 03.01.2018



## TIRUKKURAL AND MANAGEMENT IN A 'NUTSHELL' - 68



In Management and Managers, the Characteristics of Equality and Equanimity are very important.

Equality refers to looking at all people concerned with our activities equally without any partiality and judging them and rewarding them purely based on the Merits.

Equanimity refers to looking at all events of successes and failures, rise and falls, gains and losses and the such with total balance so that the mind is clear and calm to plan ahead.

Tiruvalluvar brings out the value of these concepts in the following 2 Kurals and he has also written many more Kurals to elaborate on these.

**“Thaguthi Ena Ondru Nandre Paguthiyan Parppattu Ozhugapperin”** Kural 111

தகுதி எனவொன்று நன்றே பகுதியான் பாற்பட்டு ஒழுகப் பெறின். குறள் 111

**“The Alpha and Omega of righteous life is Propriety: and Propriety requireth that thou must give each person his due, basing it purely on performance without any partiality.”**

**“Kedum Perukkamum Illalla Nenjaththuk Kodamai Sandrorkku Ani”** Kural 115

கேடும் பெருக்கமும் இல்லல்ல நெஞ்சத்துக் கோடாமை சான்றோர்க் கணி. குறள் 115

**“Evil and Good come unto all: but his upright heart is the Glory of the man of Worth.”**

## HOME FESTIVALS - 1

தை - Thai (Mid-January/Mid-February)



At left the Sun god, Surya, is being worshipped with the outdoor cooking of a large pot of rice from the recent harvest. The overflowing of the dish is called

“pongalo-pongol”, and thus this festival is known as **Thai Pongal**. Other crops, like sugarcane, bananas and turmeric, are also offered. *Kolams* (hand-made rice flour patterns) are drawn in the form of the chariot, with the Sun and Moon in the centre. On this day cows and other animals are decorated and fed special foods, and their owners prostrate to them. Crows and other birds are offered food on leaves of turmeric. Sisters pray for the welfare of brothers, and elders bless the children. **Thai Pongal is celebrated by the poorest farmers and the wealthiest householders.**

(To be continued)

**People should not be afraid of their government,  
Government should be afraid of their People - ALAN MOORE**

## CITY FREIGHTER

CityFreighter's **modular approach** enables precisely such customization of key infrastructure components serial production of commercial vehicles, and that is a **key differentiator** compared to large OEMs and other competitors. Developing fully customized trucks for large fleet operators becomes a reality. The transportation and logistics industry faces many changes.

By 2030, 70% of all people will live in bigger cities and this growth will have an impact on urban logistics. One consequence of this is that the demand for sustainable, compact, pollution-free commercial vehicles is steadily growing. Furthermore, upcoming regulatory changes for inner city traffic will lead to a rapid increase in the sales of commercial electric vehicles for urban deliveries. We believe delivery vehicles for that "last mile" require a reach of approximately 100 miles and maximum, modular load solutions. The increasing shortage of drivers is another issue. According to the IDTechEx report "Last Mile Electric Vehicles 2018-2028", estimated that the last mile EV market will reach over **\$792 billion** by 2028.

CityFreighter is planning to present the first prototype in 2019 with the company currently expecting production to begin in Q3 2019. The company says that it has "tested different drive configurations and finalized the complete truck layout design," according to their website.

They initially expect to begin producing a model known as the CF1 Basic flatbed version model, and then expand the product lines. However, the advantage of their vehicle is that its modularity will allow users to create the end-specification of the vehicle from a wide variety of options.

The company is currently raising funds through a Title III- Regulation Crowdfunding Campaign on Startengine.

According to the company they are projecting the following set of specifications and costs for their vehicle:

- Driveable with a basic driver's license
- Up to 2300 kg/ 5070 lbs payload,
- Class 3 light duty truck
- Up to 20mi/706 cfi cargo volume
- 100 miles range with basic battery
- Add-on Clean energy provided by solar power
- Basic price below \$50,000
- Optional "Battery Select" upgrade (at purchase or later)
- Optional "fast charging"
- Regenerative braking
- Remote operations with mobile app

The company is banking on the growth of urban delivery markets that need to be served even whilst emission regulations are tightened.

"Our modular approach significantly reduces tooling costs, development time and supports our fast go-to-market plans via a quickly scalable production volume," said Michael Schoening, President CityFreighter Inc. "It will allow us to rapidly develop different designs for different customers' value-chain requirements."



**EXTRA ORDINARY GENERAL BODY MEETING 20.11.2018  
 "ESTHELL HOTEL & RESORT", THIRUKAZHUKUNDRAM TALUK**



**Inauguration of the Seminar**



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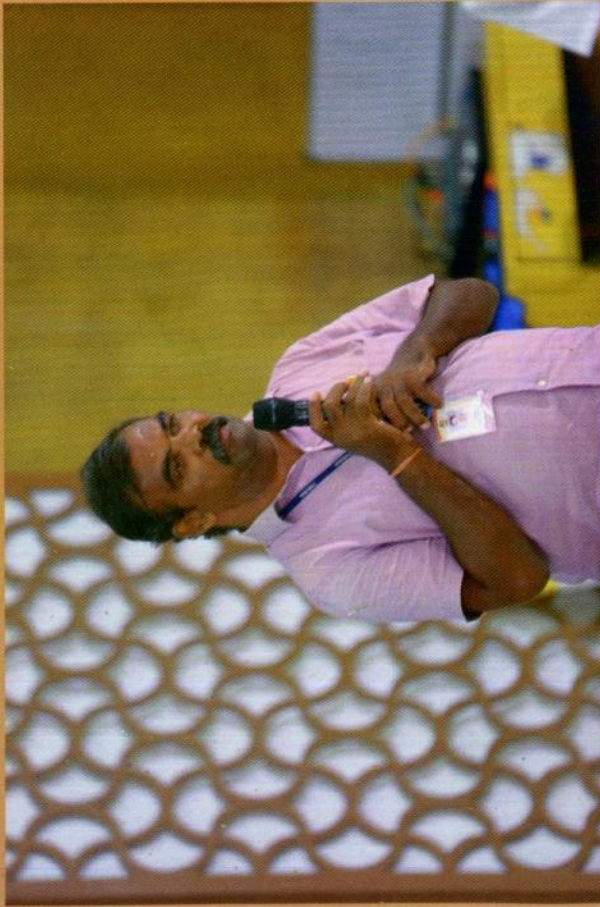


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**TECHNICAL SEMINAR TEAM**

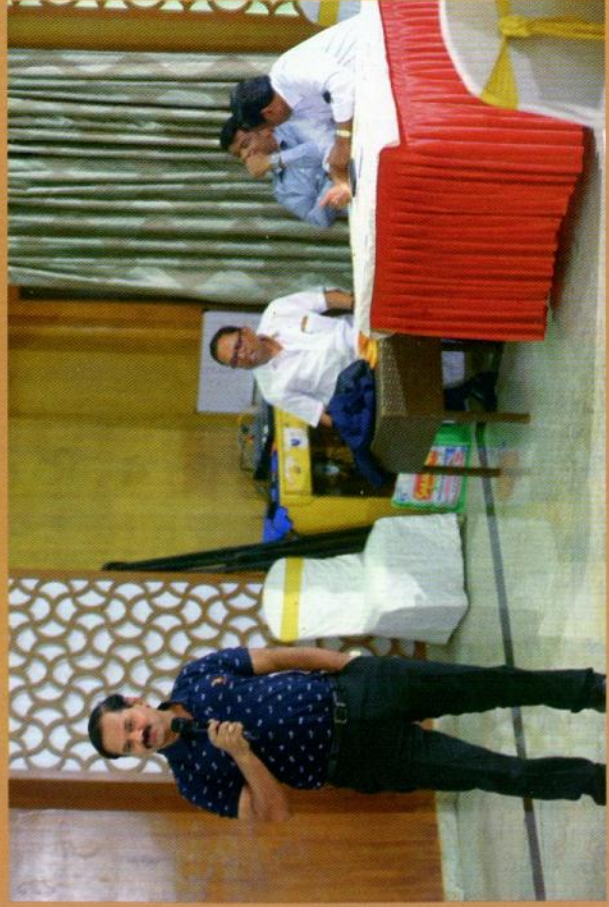




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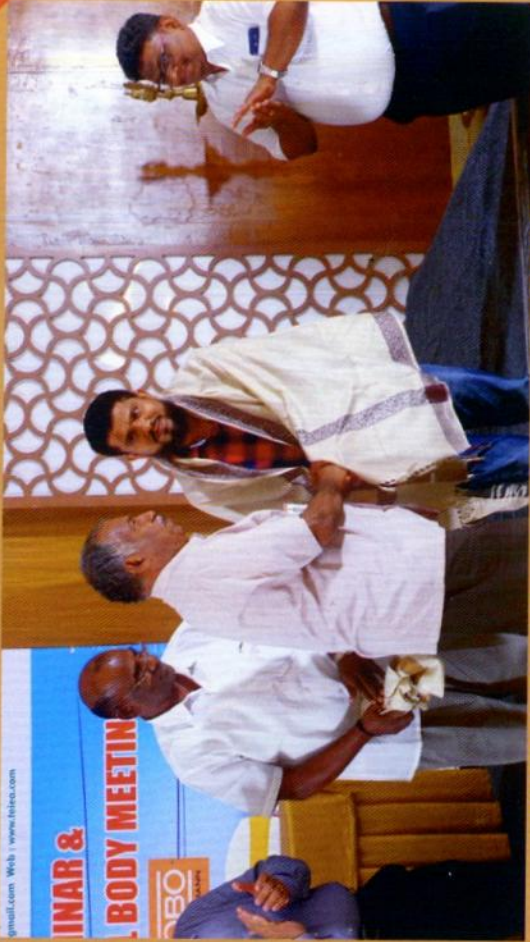


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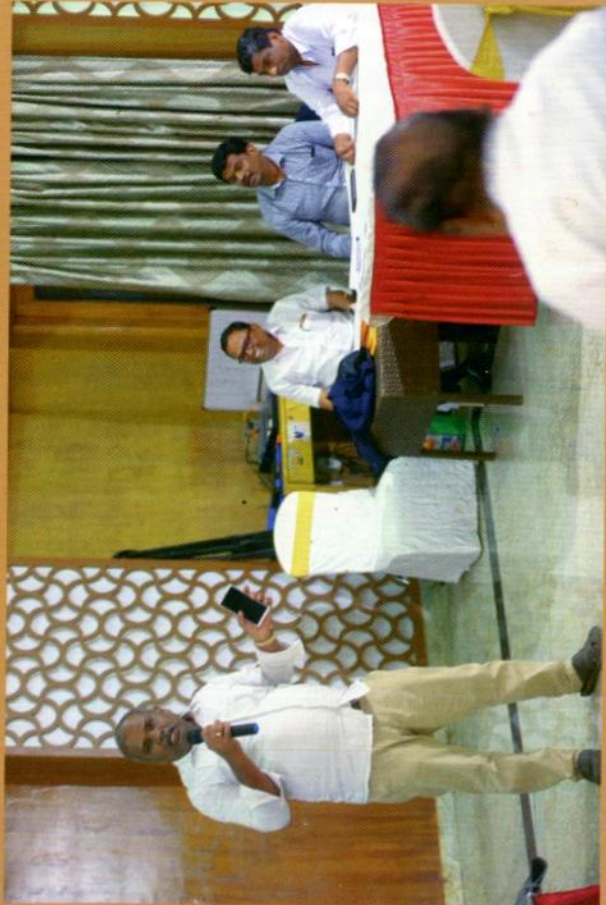
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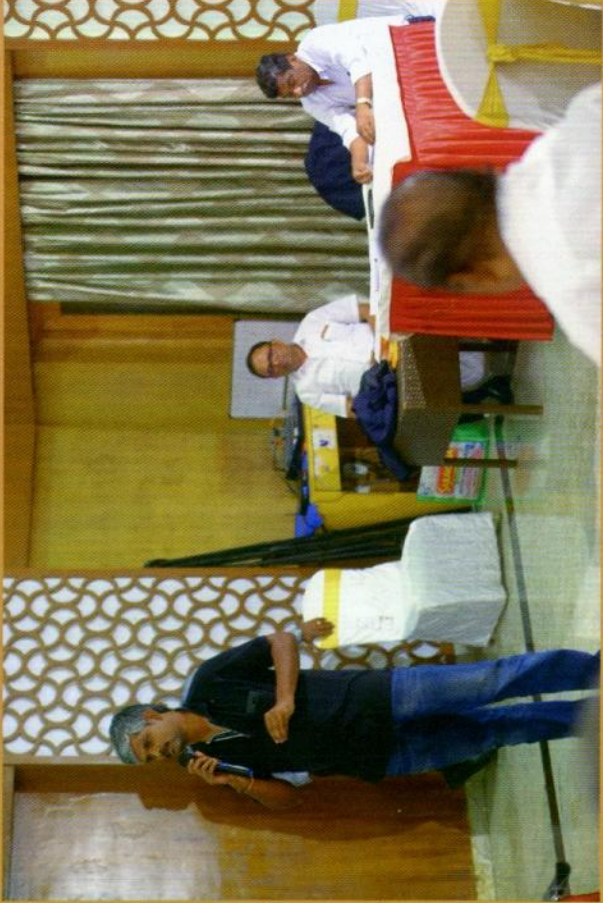


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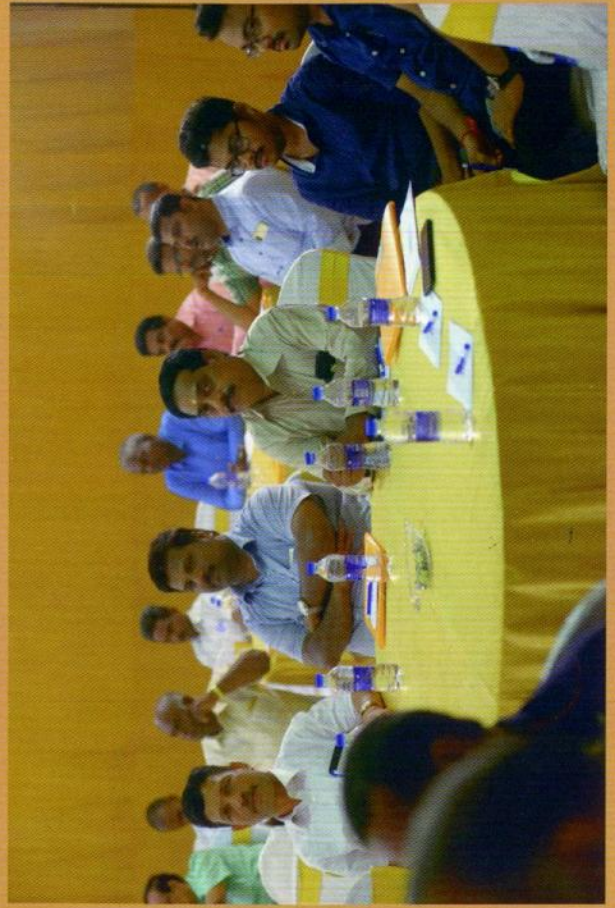




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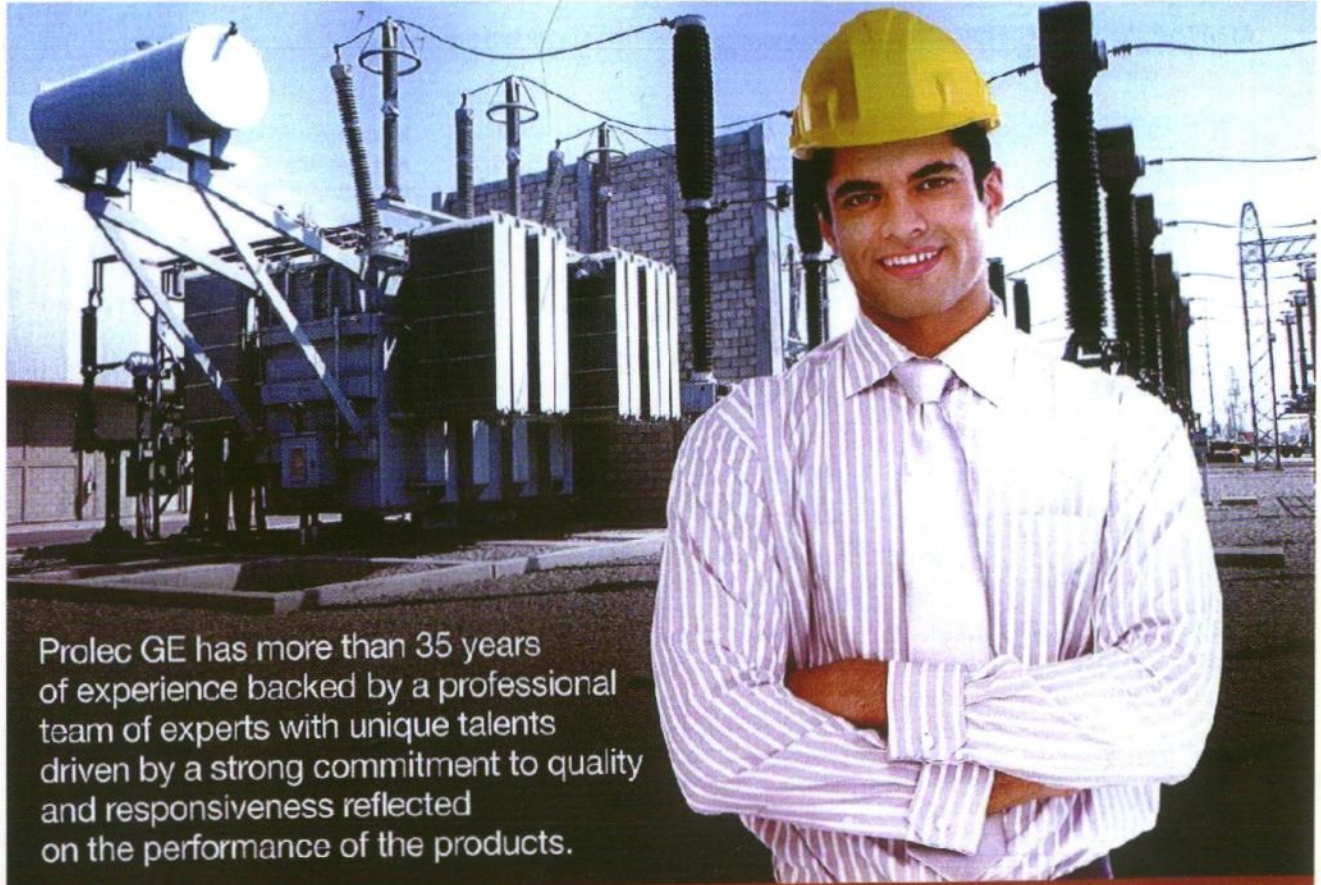


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