



# ELECTRICAL

## INSTALLATION ENGINEER

### NEWS LETTER

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

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## EDITORIAL

Dear Members, Fellow Professionals and Friends,

*Seasons Greetings to One and All!*

*Happy Tamil New Year “Vikari” and Best Wishes for Happy Times Ahead in All Economic and Social Activities!!*

Traditional Tamil New year’s Day falls on the 14<sup>th</sup> April, which is known by the name “VIKARI” this year. Though the general predictions for the year are Good with Good Crops and Prosperity etc. , there are also warnings about excess rains and floods this year too. Let there be adequate care and Let us hope for Good Times ahead.

The most important event this month is the General Elections and the Heat is already on. We can, on one hand, feel very proud about our Country which occupies the position of largest democracy of the world, but on the other, we are all aware of the deteriorations in many respects. There are lots of mutual accusations and all of them owning responsibility for all good things that have happened. The fact is that we are also one of the largest and growing economies of the World at present with all round growth in all areas and with large potentials still left to be tapped in future. There have periodically been Great Leaders at the top who laid the foundation and set directions for large scale Industrialization, large dams for irrigation and substantial Electricity Generation and so on and it is ultimately the people at the grass root level and lot of honest officials at the middle and high levels who made things happen in spite of growth of various degrees of corruption at all levels. The Green Revolution and the White Revolutions are remarkable and the growth of MSMEs with thousands of clusters focusing on specialized activities are all the result of enterprising and intelligent people of this country. The potentials in Industries, Agriculture and Renewable Energies and Service Sectors are all being tapped to make us great Economic Power. Massive digitalization which is already on, can probably help reduce corruption to a great extent, but it is very important to focus on improving the Moral Standards at individual level.

The World Earth Day is on 22<sup>nd</sup> April and a List of Tips to be remembered and implemented is published separately in this issue. An analysis of the Tips will show the importance and responsibility of Engineers in all areas as Energy, Sourcing of Energy, use of Energy and Efficiencies at all levels play very important role in caring for the Earth or the Globe. Today large scale mining for Fossils like Coal, Oil and Gas and large scale pumping of Water for all purposes are considered the Great Ills affecting the Earth and it may affect the entire Human Race of the World at large. There are theories and calculations to prove that the entire needs of Energy and Water can be met with intelligent tapping and use of all resources above the Earth like Rainfalls, Waterfalls, Solar, Wind, Biomass and Ocean Waves and so on. Efficient and adaptable Technologies are being developed in all these areas and we can certainly look forward to a Green India playing an important part in Greening the World.

***We thank all those members who have helped us by participating in the advertisement appearing for the issue February 2019 – Dehn India Pvt. Ltd., Elecexpo, Galaxy Earthing Electrodes Pvt. Ltd., Pentagon, Power Square Engineers (Indotech Transformers Ltd.), Supreme Power Equipment Pvt. Ltd., Visewham Electricals.***

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# KNOW THY POWER NETWORK - 139

## INTERFACE BETWEEN THE POWER SYSTEM AND THE DISTRIBUTION TRANSFORMERS PROVIDED WITH FIXED CAPACITORS-AN ANALYTICAL STUDY - I

### ABSTRACT

It is a well-known fact that the distribution transformers functioning in rural areas normally have their operating power factors at low level – 0.8 lag or below. The presence of predominantly agricultural pump sets and other inductive loads in the rural distribution circuit is the main contributing factor for this situation; lack of consumers awareness about the impacts of such low power factor operation plus their lukewarm response to enhance the reactive power support (VAR compensation) are among other influencing factors. As a measure to mitigate this situation, the power utilities like Tamil Nadu Electricity Board and Punjab EB have provided fixed capacitors across the LT terminals of distribution transformers on a large scale. As this step has been implemented without making detailed studies, a host of problems like the incidence of overvoltages and appearance of ferroresonance with attendant failure of distribution transformers and other LT equipment/devices have been experienced. To find solution to this pressing situation, there is a need to bring all the connected issues to the central stage. Analytical studies are also required with an objective to provide guidance values (safer values) for the provision of such fixed capacitors across the LT terminals of distribution transformers in rural areas. An attempt has been made in this paper to meet this crucial requirement.

### Keywords

Distribution transformers, fixed capacitors, rural electrical network.

### 1. INTRODUCTION

The term ‘Fixed capacitors’ conveys that the capacitors are permanently tagged on to the distribution transformers and it always works ‘in tandem’ with the transformer under all operating conditions. Moreover, deploying the Fixed Capacitors in the distribution network compensate certain amount of reactive power demand by End users. Hence it may be treated as a ‘part of the power delivery network’. This method of connecting capacitors across the transformer terminals is resorted to with an objective of providing the required reactive power (VAR) support in rural network which normally starves from inadequate flow of VARs with the consequential presence of low voltage conditions. These capacitors are compact, easily handled and erected at a small cost. Additionally, for economical choice, Fixed Capacitors are used for individual inductive load or a group of loads which have relatively relentless demand for reactive power. The estimated cost of this measure is around Rs500/KVAR. A large number of these capacitors are currently in service in Tamilnadu Electricity grid. No doubt, this corrective method has ratcheted the power factor in the rural power networks concerned to a higher level. But it has brought some unwanted operating problems in its wings. Significant amongst them are, ferroresonance, overfluxing, overvoltage, harmonics and overheating with the attendant failure of transformers and other LT equipment. In addition, nearby communication system has also been adversely impacted. All these issues demand an effective techno-economic study on the present provision of fixed capacitors on distribution transformers.

The present study covers a range of issues and provides answers to the topics like,

- Merits and demerits of providing fixed capacitors on distribution transformers.
- Internal Overvoltages, Overfluxing and ferroresonance brought by this arrangement.
- Percentage rise in the voltage levels brought at the location of the distribution transformers in point.
- Finally the guidance values for the provision of fixed capacitors across terminals of the distribution transformers.

### 2. TECHNICAL DETAILS OF FIXED CAPACITORS CONFORMING TO BIS-IS-13925-1

9KVAR capacitors are currently provided to the distribution transformers with the rating less than 100KVA; for transformer with the capacity of 100KVA and above 18KVAR capacitors are employed.

**Table 1. Specification of Capacitors**

Specification	LT Capacitor rating	
	9KVAR	18KVAR
Current (Ampere)	11.8	23.6
Fuse rating (Ampere)	32	63
Voltage rating (Volts)	440	440
Connection	Delta	Delta
Capacity (KVAR)	9	18
Impregnate	Non PCB film type	
Capacitor material	Poly propylene films	

**3. ADVANTAGES THAT WOULD ACCRUE BY THE PROVISION OF FIXED CAPACITORS (MERITS)**

- One of the corrective measures for improving the VAR flow in the neural networks. It helps to bridge the existing gap in the VAR compensation in rural networks.
- Improves the voltage profile in the LT network (enhancement is around 2%).
- Enhances the functional power factor (the improvement in power factor is around 8-32%). It helps to increase the efficiency level of connected equipment.
- Maximizes the loading on the distribution transformers.
- Increases reactive flow to the utilities concerned.
- Brings a conducive operating environment for the equipment and devices in the LT power delivery system.
- Helps to postpone the enhancement of distribution transformers with the attendant savings in system capital outlays.
- Helps to create permanent assets in the network that can be easily moved from one location to another
- Requires less space: brings more benefits at less costs.
- Attractive in financial terms- Anticipated payback on the investments made is less than one year.

**4. ADVERSE IMPACTS TRIGGERED BY THE INTERFACE OF CAPACITORS WITH THE NETWORK (DEMERITS)**

- Creates pathways for the flow of network problems like Ferro resonance, dynamic overvoltage, harmonic resonances, and introduction of noise frequencies and over fluxing of transformers. These problems have the potential to inflict severe damages on the transformers and other connected equipment.
- In sync with the inductance present in the circuit, it brings oscillations which may lead to resonance with the consequential voltage and current magnification.
- Generation of excessive voltage surges and arcs with the attendant erosion of contacts in the controlling breakers and switches. This phenomenon is generally expected during the “paralleling operation of 11kV and 22Kv feeders with that not having LT fixed capacitors distribution transformers.
- The current method of adopting one-size fits for all procedure brings several problems in its fold. It is mainly due to the fact that network conditions differ from place to place and so also the characteristic behaviour of the connected equipment.

**5. METHODOLOGY ADOPTED**

Field visits were made; reliable data were collected for analysis. The conditions of capacitors during storage and before erection were found out. Several departmental stores were inspected in this regard. A few distribution transformer locations were also visited so as to gather firsthand information. Interactions were also held with the field officers and staff concerned. Financial analysis were also performed to work out the anticipated monetary savings and payback period connected with the provision of these fixed capacitors.

## 5.1 Site inspection-Findings-In brief

The capacitors units were stacked properly and kept in well-ventilated store rooms. At the distribution transformer locations, the capacitor tanks were properly earthed; current, voltage and power factor readings were taken periodically. The recorded readings suggest that there is a marked reduction in current and line losses and the prevalence of better voltage profile. At the feeding substation ends of these distribution transformers, notable reductions in the loadings of the 22KV and 11KV feeders were noticed.

## 5.2 Interface of fixed LT capacitors with the network

### 5.2.1 Positive impacts

- Appreciable reductions in the currents drawn by the distribution transformers incident on 22KV and 11KV feeders. This enables the existing network to handle more loads with the attendant cash flows without any additional capital expenditure. It also obviates the need for the enhancement of existing transformers and other connected equipment. Simply put, it brings a small relief for transformers but a big *leap* for the system.
- It brings better voltage profile (0.2 to 2%), adequate reduction in line losses and appreciable improvements in power factor (8-32%).
- It helps to reduce the In-rush currents drawn by the distribution transformers from the mains with consequential reduction in the operational problems faced in the network.
- This arrangement also aids the quick discharge of the residual charges present in the capacitors through the core of the transformers and brings the residual voltage of the capacitor ought to a safe level quickly (less than one minute), whenever it is switched off. This is important from the safety for the operating personnel.

### 5.2.2 Adverse/Negative Impacts

- When the transformer is disconnected from the mains, the charged capacitor acts as a direct voltage source and discharge its energy through the transformer windings and thereby saturates the core (i.e.) partial demagnetism of the transformer core occurs. Sustained operation under this condition (This occurs when the transformer feeds light loads or operated under single phasing operating condition) may endanger the service life of connected distribution transformers in the long run.
- **Over fluxing of transformers:** Under single phase operating conditions (which were widely prevalent in the rural networks of Tamilnadu Electricity grid for most part of the day), the voltage level on the secondary terminals of the distribution transformer is comparatively at a higher level (5-10%) and the transformer loading is at low levels. For the distribution transformers located near the feeding substations, the voltage level is generally more than the normal level. Under this operating condition, the fixed capacitors on the LV side of transformers may trigger an undesirable operating condition called “**over fluxing of transformer**” which will bring the end of its service life quickly. This above situation normally gets aggravated during summer months. Moreover, the possibility of the over excitation of the transformer is more, when it is operated at a voltage level close to 110% of its rated voltage level.
- **Ferro resonance overvoltage:** There is a greater possibility for the generation of Ferro resonance voltage (short duration transients that brings long duration sustained overvoltages) in the series circuit formed by the saturable factor (Distributed transformer) and the fixed capacitors. This condition generally occurs when one or two of the system conductors or HG fuses open on the source side of the transformer or interwinding shorts in the transformer. It predominantly occurs during lightly loaded conditions. This problem is widely prevalent with the system containing HG cables.
- **Dynamic over voltage:** when lightly loaded conditions prevail in very long 11KV and 22KV feeders, dynamic over voltages due to Ferranti effect are be triggered. The combined effect of fixed LT capacitor and the capacitance of the line brings this unwanted operating condition.
- **Impact on the controlling breakers/switches:** Another circuit problem that demands attention is the possible adverse impact on the controlling switches and circuit breakers when the 11 and 22 KV feeders with fixed capacitors are paralleled with the one having no such capacitor units. During such paralleling operations excessive voltage surges accompanied with heavy circulating currents may be expected.

- **Harmonic resonance:** The introduction of capacitors in the network brightens the possibility of resonance conditions in which the harmonic currents flow at a greater level. Such a current flow will cause overloading and overheating. The excessive harmonic currents thus triggered by the harmonic voltages are mainly due to,
  - The operation of the transformers at higher flux densities consequent to the presence of higher voltages.
  - Higher insulator leakage currents occur during maximum voltage periods.
  - Presence of nonlinear loads like welding sets, converters, electronic devices that demand, switch mode supplies (computers and TVs), traction loads and thyristor controlled devices.

## 6. IMPACT IN FINANCIAL TERMS

- It increases the capacity of the existing network to feed more loads and thereby enhances the monetary flow to the utilities concerned.
- It results in appreciable reduction in line losses. In this study, the monetary savings that would accrue as a result of this loss reduction has been taken as Rs.537/KVAR.(approximately)
- It offers the least cost solution to line loss reduction and improvements in the voltage levels in rural networks.

## 7. ISSUES THAT WARRANT SPECIAL ATTENTION

1. *Provision of fuses:* Protective fuses are provided to safeguard the capacitors against the currents exceeding its withstand levels. It is provided either externally to the capacitor or inside the capacitors units. During the visits made at site and department stores, the technical specification stipulated in the tender documents insisted on the provision of external HRC fuses to the capacitors.

But the technical details offered by some of the companies indicated that the capacitor units were provided with internal fuses. The capacitor units thus supplied with internal fuses should not be provided with external fuses so as to shun the adverse effects of double or excess protection.

The site inspections further revealed that,

- the current rating of 9 and 18KVAR units were in the range of 12 and 24 Amps respectively.
- the rewirable fuse units provided for 9 and 18KVAR units have the current rating of 32 and 63 Amps respectively.
- the fuse links provided were external to the capacitor units.

The site inspection highlighted the following

2. If the capacitor units have built-in fuse links, then the provision of external fuse units will become redundant and lead to unnecessary expenditure.
3. If the provision of the external fuse links (HRC or Rewirable) is found necessary for capacitor units, then it should meet the following parameters.
  - It should have the current carrying capacity at 135% or above of the current rating of the capacitor units.
  - Its time current-characteristic should match with the tank rupture characteristics of the capacitor units.
  - It should withstand all in-rush, discharge transients and switching surges associated with the normal operation of the capacitor units; it should have adequate  $I^2t$  capacity.
4. While checking at site, it is essential to determine the possible increased current in the capacitor units as a consequence of,
  - Increased voltage
  - Increases in frequency levels
  - Presence of harmonic up to 7<sup>th</sup> order.



(To be continued...)  
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## EARTH DAY TIPS - WORLD EARTH DAY 22/04/2019

Here are simple and easy tips to help you go green, protect the earth, save money and make every day Earth Day. You can make a difference!

1. Join Earth Day Network's campaign to Protect Our Species.
2. Join Earth Day Network's campaign to End Plastic Pollution.
3. Reduce your carbon footprint and take our Carbon Footprint.
4. Plant a tree or donate a tree through our Canopy Project.
5. Join a local park, river or beach clean-up.
6. Use environmentally-friendly, non-toxic cleaning products.
7. Replace inefficient incandescent light bulbs with efficient CFLs or LEDs. Reduce your carbon footprint by 450 pounds a year.
8. Carpool, ride your bike, use public transportation or drive an electric or hybrid car. Reduce your carbon footprint by one pound for every mile you do not drive.
9. Keep your tyres properly inflated and get better gas mileage. Reduce your carbon footprint 20 pounds for each gallon of gas saved.
10. Change your car's air filter regularly.
11. Teleconference instead of traveling. If you fly five times per year, those trips are likely to account for 75% of your personal carbon footprint.
12. Stop using disposable plastics, especially single use plastics like bottles, bags and straws.
13. Recycle paper, plastic and glass. Reduce your garbage by 10% and your carbon footprint by 1,200 pounds a year.
14. Donate your old clothes and home goods instead of throwing them out. When you need something, consider buying used items.
15. Use cloth towels instead of paper ones.
16. Change your paper bills to online billing. You'll be saving trees and the fuel it takes to deliver your bills by truck.
17. Read documents online instead of printing them.
18. When you need to use paper, make sure it's 100% post-consumer recycled paper.
19. Set your office printer to print two-sided.
20. Collect used printer, fax, and copier cartridges to recycle.
21. Convince your school district or office building to choose reusable utensils, trays, and dishes in the cafeteria.
22. Use reusable bottles for water, and reusable mugs for coffee.
23. Bring reusable bags when you shop.
24. Pack your lunch in a reusable bag.
25. Organize to have healthy, locally-sourced food served at in your school district.
26. Buy local food to reduce the distance from farm to fork. Buy straight from the farm, frequent your local farmers' market, or join a local food co-op.
27. Buy organic food to keep your body and the environment free of toxic pesticides. Support farmers and companies who use organic ingredients.
28. Grow your own organic garden, or join a farm share group.
29. Reduce your meat consumption to curb carbon emissions from the livestock industry.
30. Compost kitchen scraps for use in your garden — turning waste into fertilizer.
31. Take a shorter shower and use a water-saving shower head.
32. Fix leaky faucets and shower-heads.
33. Run your dishwasher only when it's full to save water and energy.
34. Conserve water outdoors by only watering your lawn in the early morning or late at night. Use drought-resistant plants in dry areas.
35. Wash your clothes only when necessary, use cold water and line dry.
36. Form a "green team" at your office to find cost-effective ways to conserve resources and promote sustainability.
37. Volunteer for a local environmental group and/or make a donation.
38. Pull out invasive plants in your yard or garden and replace them with native ones.
39. Turn off and unplug electronics you're not using. This includes turning off your computer at night.
40. Turn off lights when you leave a room.
41. Install solar panels on your roof.
42. Take the stairs instead of the elevator to save energy (and get exercise!).
43. Move your heater thermostat down two degrees in winter and up two degrees in the summer to reduce your carbon footprint by 2,000 pounds.
44. Lower the temperature on your water heater.
45. Contact your utility company and find out about renewable energy options.
46. Use energy-efficient appliances and electronics.

## HYDROSTOR WILL BUILD COMPRESSED AIR STORAGE FOR THE AUSTRALIAN GRID

Australia's grid storage market isn't just for batteries any more. Canadian startup Hydrostor will build a novel compressed-air storage device in renewables-rich South Australia, the company announced last week. It plans to use the 5-megawatt project as a "showpiece" to educate customers and the public on this unusual technology. Lithium-ion batteries rule the storage market, but they don't excel at very long-duration storage. That long-duration resource is becoming more valuable in regions where a large share of wind and solar power supplies the grid, making for booms and busts of production.



Hydrostor uses surplus electricity to pump air into an underground cavern partially filled with water, which helps maintain constant pressure. It can store more energy by digging a bigger hole, or extracting water from an existing cavern to make room for more air. The company's IP revolves around how to sync up equipment developed by other industries, like mining and oil and gas extraction, into a large-scale storage plant. Compressed-air energy storage has been around for years, but failed to proliferate because it relied on specific geological features which limited potential sites. A handful of startups tried to modernize the concept, but they flopped. By excavating its own caverns, Hydrostor hopes to avoid the limitations of its forebears.

If Hydrostor can prove its technology in Australia's wide-open power market, it could lay the groundwork for megaprojects, on the order of hundreds of megawatts each, that the company says are already in its pipeline. The Australia project, located at the discontinued Angas Zinc Mine, looks like a demo project but will operate commercially.

Hydrostor made the economics work by winning \$6 million from the Australian Renewable Energy Agency and \$3 million from South Australia's Renewable Technology Fund. The company will pay for the rest of the bill itself. Government support has been common in Australia's early grid batteries. Storage supplier Fluence broke the mold by securing unsubsidized financing for a battery, announced in November, slated for a wind farm in South Australia.

That said, Hydrostor's system will operate as a full-fledged merchant asset connected to Australia's National Energy Market. It will be free to bid into a suite of grid services, or play the arbitrage game, charging up when energy prices are low and discharging when price shoot up to the market cap, as happened in January's heat wave.

“It shows every bit of IP we’ve got,” said Curtis VanWalleghem, Hydrostor’s CEO. “It’s a marketing showpiece in Australia, which is such a high-profile market for storage.”

The company is gearing up for construction, waiting on the last permits, VanWalleghem said. He plans to complete it by early- to mid-2020. The finished site will include a visitor center, and the team will document the construction process, to further promote the technology.

### **Big aspirations**

Assuming it reaches completion, Angas will become Hydrostor’s third operating project.

The first was a pilot that used underwater balloons to test the “**hydrostatically compensated**” design. Next came a fully automated 2 megawatt system for Ontario’s Independent Electricity System Operator, which is undergoing commissioning.

That system will start with 8 megawatt-hours, VanWalleghem said, but he plans to expand that to 15 megawatt-hours by suctioning more water out of the salt cavern site. The plant won a 10-year capacity contract from the IESO, and Hydrostor can also use it for ancillary services.

The Australia project will utilize an existing mine shaft with the depth and specifications that Hydrostor has identified as optimal for its technology. That saves the trouble of excavating for such a small project; it won’t be particularly long-duration, starting with 10 megawatt-hours.

The company’s ambitions go far beyond the scope of these projects. The industrial equipment comes sized for much larger scales, so that’s where the economics will really shine.

Globally, Hydrostor has more than 15 sites in its development pipeline. It already bid storage plants as massive as 200-megawatt systems with 6 hours of duration, and a 300-megawatt, 12-hour system, VanWalleghem said. That would dwarf any new storage on the market today.

At the scale of 500 megawatts with 10 hours of energy, Hydrostor can hit the \$100 per kilowatt-hour threshold, VanWalleghem said. That’s the near-mythical threshold that many a startup has targeted in the effort to unseat lithium-ion’s supremacy. The company has a massive distance to cover from what it’s achieved to what it aspires to. That gap will be easier to close if the Angas project convinces financiers and engineering, procurement and construction partners that the technology merits bonding and performance guarantees.

At that point, Hydrostor can get to work in earnest on building those mega-projects. “We get one or two scale projects, and our business makes economic sense,” VanWalleghem said, before adding, “We obviously expect to do a lot better than that.”

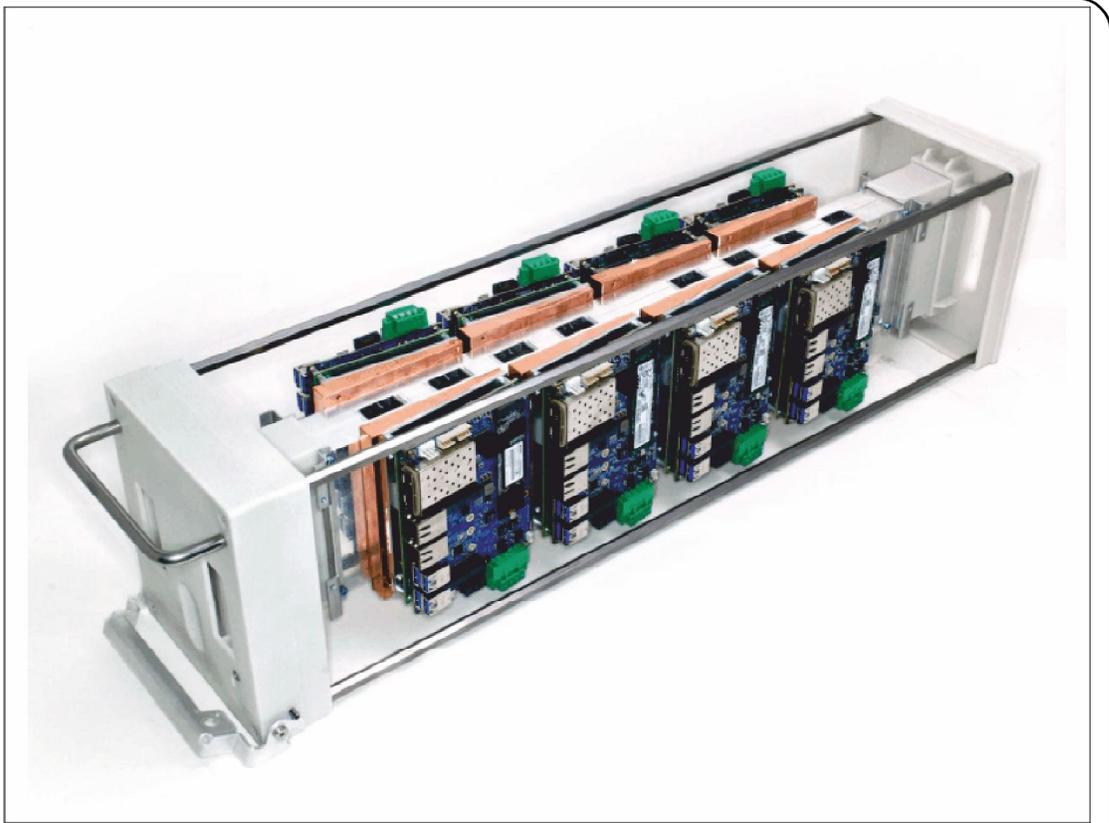
## **A COOLER CLOUD**

**A Clever Conduit Cuts Data Centers’ Cooling Needs by 90 Percent** Data centers are hungry, hot, and thirsty. The approximately 3 million data centers in the United States consume billions of litres of water and about 70 billion kilowatt-hours of electricity per year, or nearly 2 percent of the nation’s total electricity use. About 40 percent of that energy runs air conditioners, chillers, server fans, and other equipment to keep computer chips cool.

Now, Forced Physics, a company based in Scottsdale, Ariz., has developed a low-power system that it says could slash a data center’s energy requirements for cooling by 90 percent. The company’s Joule Force conductor is a passive system that uses ambient, filtered, nonrefrigerated air to whisk heat away from computer chips. In February, Forced Physics plans to launch its first on-site pilot test at a commercial facility in Chandler, Ariz., owned by H5 Data Centers. There, a rack of 30 conductors will cool IT equipment consuming 36 kilowatts, as sensors track airflow, temperature, power usage, and air pressure. Information gleaned from the one-year test will be used to demonstrate performance to potential customers. The computer equipment in a typical data center runs at about 15 megawatts, devoting 1 MW of that power to server fans. But such a data center would require an additional 7 MW (for a total load of 22 MW) to power other cooling equipment, and it would need 500 million liters of water per year. At a time when data-center traffic is expected to double every two years, the industry’s appetite for electricity and water could soon reach unsustainable levels. According to Forced Physics’ chief technology officer, David Binger, the company’s conductor can help a typical data center eliminate its need for water or refrigerants and shrink its 22-MW load by 7.72 MW, which translates to an annual reduction of 67.6 million kWh. That data center could also save a total of US \$45

million a year on infrastructure, operating, and energy costs with the new system, according to Binger. “We are solving the problem that electrons create,” he said.

In today’s data centers, circuit boards and other electronic components are enclosed in metal containers about the size of pizza boxes. Forty boxes are stacked vertically into racks. Row after row of these racks, arranged side by side in narrow aisles, fill



sprawling one-story buildings. An elaborate ventilation network blows chilled air onto the front of the racks. Small fans at the rear of each box draw the cool air over the electronics inside. Then, larger fans at the back of the rack suck out the heated air.

The Joule Force conductor is a narrow box that looks like it could hold a couple of long-stem roses. Circuit boards are not housed inside but rather are attached to the outside. It takes 40 conductors, made entirely of aluminum, to fill a standard rack. There are no small server fans—instead, four large fans at the rear of the rack suck ambient air through the conductors. The fans are the only moving parts in the system, and the air itself is never chilled. For the average data center, these large fans need just 0.28 MW—a fraction of the 1 MW that server fans generally use.

Inside the conductor, 3,000 very thin aluminum fins are lined up in two rows that form a V. The V shape moves air easily and quickly out the back. As a fan sucks air through a conductor, low air pressure draws it into the microchannels between the fins. The fins work like teeth in a comb, neatly orienting air molecules to point in the same direction and arranging them into columns. At the same time, heat from the attached electronics transfers into the aluminum fins. When air molecules contact the fins’ surfaces, they pick up heat from the metal, which prompts them to accelerate out the back.

The hotter the air is as it exits the conductor, the better. In dozens of lab tests with ambient air temperatures between 21 °C and 49 °C, the air exiting the JouleForce conductor measured around 65 °C—which is 27 °C hotter than with conventional cooling systems.

“It’s very efficient,” says Richard Madzar, head of critical systems at H.F. Lenz Co., a firm that designs data centers. Madzar, who is not affiliated with Forced Physics, has seen demonstrations of the conductor in laboratories under simulated conditions. “It eliminates the server fans and requires less power than they would have otherwise consumed,” he says. He also likes that the conductor is reusable, modular, and recyclable.

How data-center managers will respond to this new approach is unclear. Their business models are based on cooling technologies that are already widely available, says Madzar. They may have heard of other kinds of conductive cooling that rely on water or refrigerants, for instance, but these systems are primarily used in supercomputers and tend to be more expensive than conventional cooling technologies. If the JouleForce conductor is to move into everyday use, it will have to be more widely available and competitively priced.

# INTELLIGENT PRODUCTION

Transporters find their way through factory halls on their own, plants optimize their power consumption during live operation, and machines perform quality-control checks – and make the necessary adjustments – while manufacturing is still in progress. Artificial intelligence offers tremendous potential for industry. It's already making production more efficient, more flexible, and more reliable.

Industry is becoming increasingly digitalized, the digital enterprise is already a reality. Data is continuously generated, processed, and analyzed. The volumes of data in production environments are the basis on which digital representations of entire plants and systems are generated. These digital twins have been used for some time to structure the planning and design of products and machinery – and production operations themselves – and do so more flexibly and more efficiently while manufacturing high-quality, customized products faster and at an affordable price. But what would happen if the machines and processes could gather insights from these high volumes of data by themselves and optimize their processes during live operation? The potential would be enormous. The good news is that this can already be achieved, step-by-step, using artificial intelligence (AI).

## Creating new opportunities

AI has been the focus of research for more than 30 years. During this time, major advances have been made in this area of technology: for example, more powerful hardware and software and improved computing power and data transmission. Using artificial intelligence creates entirely new opportunities for flexible, efficient production, even when it comes to complex and increasingly customized products in small batch runs. The consequences will be significant, as a study by Roland Berger shows: By 2035, intelligent, digitally networked systems and process chains could account for additional growth of roughly €420 billion in western Europe alone. According to a PwC study AI can also contribute up to US\$ 15.7 trillion to the global economy in 2030.

The first real applications of artificial intelligence are already finding a place in regular industrial activities including language recognition to perform basic tasks, documenting surroundings using cameras, laser beams, or X-rays, and providing virtual personal assistants in logistics. According to the PwC study a total of 62 percent of large companies are already utilizing AI technology in 2018. Siemens has solutions in its portfolio in the area of service, as for example predictive maintenance, and other applications for engineering and quality testing. Cloud solutions like MindSphere and intelligent applications also provide support for the ongoing process optimization that improves machine efficiency and availability.

## AI and Industry 4.0

Big data and AI give Industry 4.0 a huge boost. Intelligent software solutions can use the high volumes of data generated by a factory to identify trends and patterns that can then be used to make manufacturing processes more efficient and reduce their energy consumption. This is how plants are constantly adapting to new circumstances and undergoing optimization with no need for operator input. And as the level of networking increases, the AI software can learn to “read between the lines,” which can lead to the discovery of many complex connections in systems that aren't yet or are no longer evident to the human eye. Intelligent software with sufficiently intelligent analytical technology is already available. But whether data processing is performed using a cloud solution or at the local level (for example, using Edge computing) will depend on the user's requirements. Data on an Edge platform is available more quickly and at a higher resolution, whereas a considerable amount of computing power is available in the cloud. In many cases combining edge and cloud computing is required to benefit from both worlds.

MindSphere, the cloud-based, open IoT operating system from Siemens, can be used to link products, plants, systems, and machines. It is one of the most important foundations enabling the use of AI in industry. MindSphere performs extensive analyses to make the vast amounts of data generated by the Internet of Things (IoT) useful for optimization, simulation, and decision-making.

The digital twin enables virtual testing of a variety of scenarios and promotes smart decisions in areas such as optimizing production. In the future, using a digital representation of a machine tool and the associated manufacturing process, AI will be able to recognize whether the workpiece currently being manufactured meets quality requirements. Moreover, it determines the production parameters that need to be adapted to ensure that this remains the case during the ongoing production process. As a result, production is made even more reliable and more efficient and companies even more competitive.

## **Security is the highest priority**

A precondition for both Industry 4.0 and for artificial intelligence is a state-of-the-art, end-to-end IT infrastructure, regardless of the size of the company. That's the only way a business can become part of the digital future. But this must always be accompanied by an awareness that digitalization and cyber security need to go hand in hand. The risks are huge without the right safeguards in place. According to the 2018 World Economic Forum's "Global Risk Report," business losses through cyber crime over the next five years will amount to \$8 trillion, far exceeding Germany's gross domestic product. Comprehensive protection for industrial facilities, as exemplified by the defense in depth concept from Siemens, will therefore play a key role in the future. After all, hackers are growing smarter all the time, and it is vital that companies stay ahead of them.

## **A NOVEL DESIGN FOR GALLIUM NITRIDE LEDS COULD LEAD TO BRIGHTER, MORE EFFICIENT DISPLAYS**

Small display screens, like the ones needed for AR, VR, and other head-up displays, may soon become way more efficient and yield unprecedented resolution, thanks to a new kind of transistor made from vertically oriented gallium nitride nanowires.

GaN micro-LEDs are more desirable than today's commercial designs in almost every way. For instance, each pixel on the screen of the iPhone X is created by a collection of organic LEDs, which are much bigger in size than nanowire GaN LEDs, resulting in larger pixel sizes.

What's more, to control the colour of each pixel, commercial devices rely on relatively bulky thin-film transistors (TFTs), whereas GaN LEDs can be designed to produce a color directly—and emit that color at 100 to 1,000 times the brightness and with at least double the efficiency.

The inherent properties of GaN also means that electrons can move up to 1,000 times faster than in silicon TFTs, which allows for much quicker on-and-off switching.

GaN LEDs created to date have had a horizontal design, however, with the transistor laid out next to the LED. Matthew Hartensveld, a Ph.D. student at the Rochester Institute of Technology who helped develop the new vertical GaN transistor, says its layout is analogous to building skyscrapers, instead of building multiple houses next to one another.

With the new vertical design, the transistor, or switch, resides directly below the LED, providing both dimming and switching abilities. "Without the area consumed next to the LED, additional LEDs can be placed in close proximity, creating higher pixel densities," says Hartensveld.

In a recent publication in IEEE Electron Device Letters, Hartensveld and his colleagues describe how they vertically combined a nanowire GaN Static Induction Transistor (SIT) with a nanowire LED. The LEDs use unintentionally doped GaN as a starting layer. While this type of layer is not uncommon in LEDs, here it is used to form the vertical wires that integrate the LED with the transistor. To combine the transistor and LED, the group deposited metal and insulating layers, creating the different electrical connections for the device.

The new nanowire SIT provides a 900-fold greater on-to-off ratio compared with a recently developed GaN fin SIT with a planar layout, leading to increased power savings. The compactness of these new LEDs also allows more of them to be placed within a given area, which ultimately leads to higher resolution. Their minute dimensions reduce pixel sizes by 1,500-fold compared with the iPhone X, says Hartensveld.

One of the main limitations of this design is that SITs require a negative voltage in order to turn the LEDs off, so by default the LEDs are on. Also, Hartensveld notes that commercializing the design will require some expensive photolithography in order to precisely place each nanowire.

Nevertheless, the researchers are pushing forward. The GaN material, which makes up both the LED and transistor components, is optically transparent. That means it could pave the way for the development of transparent displays, perhaps in glasses used for augmented and virtual reality.

"The remaining key component for a head-up display is integrated memory. We are actively working on a novel way to introduce memory on the same platform, and with the same material, in order to complete the device. Once the memory aspect has been performed, all the needed functions would be tied together in one system to create a transparent display," says Hartensveld.

## HERE'S HOW MANY TREES IT WOULD TAKE TO CANCEL OUT CLIMATE CHANGE

Trees are the Earth's way of soaking up our carbon.



If you wanted to plant enough new trees to absorb all the carbon people emit, guess how many you'd have to plant. Go ahead, guess.

At least, that's the number Thomas Crowther, a professor and scientific advisor to the UN, came up with. He and his colleagues used machine learning to calculate just how many trees we could plant to soak up our carbon dioxide.

"There's 400 gigatons [of carbon] now, in the 3 trillion trees, and if you were to scale that up by another trillion trees that's in the order of hundreds of gigatons captured from the atmosphere – at least 10 years of anthropogenic emissions completely wiped out," he said.

Planting trees is great, but I can't help thinking we also need to stop chopping down forests in the first place. When you chop down a tree, you destroy the entire ecosystem that depended on it. Planting a new tree doesn't bring that back.

And right now, forests are being decimated. The Amazon rainforest, for instance, is being destroyed largely thanks to the Brazilian cattle industry.

"The cattle industry is the single biggest cause of deforestation in the world and is a disaster for the fight against climate change," said Sarah Shoraka, a Greenpeace campaigner. In fact, Greenpeace found cattle ranching is responsible for 80 percent of all Amazonian rainforest destruction.

It'll take legislation to stop that, but individuals can help by doing things like eating less beef or switching to more sustainably "grown" beef (or at least not buying beef from Brazil).

**DO NOT CHOP DOWN TREES - PLANT TREES - SAVE COUNTRY**

## RISE OF BIFACIAL SOLAR PANELS LIFTS PROFITS FOR THE WORLD'S TRACKER COMPANIES

With the race on to double down on the price per Watt of solar power worldwide through the use of bifacial and other high efficiency PV panel technologies, solar tracker manufacturers are set for a bumper year, according to IHS Markit.

A research note published today by the market research company stated worldwide shipments of trackers topped 20 GW for the first time last year, with the technology incorporated into more than a quarter of large-scale solar projects for the first time.

That added up to a rise of more than 40% in global tracker shipments, with Spanish companies PV Hardware and NClave, Chinese manufacturer Arctech Solar and Italian business Convert Italia

joining NEXTracker, Array Technologies and Soltec in the gigawatt club for annual volumes.

### Profits on track

And there is more good news ahead, predicted IHS Markit senior analyst Camron Barati, who wrote: “The coming year will continue to be an exciting time for PV tracker suppliers as they continue to take advantage of tailwinds associated with the growing adoption of high-efficiency modules and bi-facial technologies, that will ultimately lower the dollar-per-Watt cost of PV tracking systems and improve the economic viability of the technology.”

With IHS predicting 74 GW of large-scale solar capacity additions worldwide this year, the research note pointed out the fastest growing tracker markets were in the Middle East and North Africa last year. The U.S. was again the world's biggest tracker market, and the Americas accounted for more than half of global shipments with Mexico bullish, but there were also significant rises in shipment volumes to Australia, Egypt and Spain.



That booming market explains why bigger concerns have muscled in on the tracker segment, with NEXTracker – acquired by U.S. technology business Flex – and Trina Solar-owned NClave prime examples. Indian steel multinational ArcelorMittal has also followed suit, by acquiring French company Exosun.

NEXTracker was the world leader for tracker shipments for the fourth year in a row, with a 29% slice of the market, ahead of U.S. peer Array. Spain's Soltec slipped two places to number five, with PV Hardware taking its place and Arctech unchanged at number four. NClave beat Convert Italia into sixth position but all the top ten suppliers – a list rounded out by Spain's STI Norland, New York-based GameChange Solar and U.S. rival SunPower – posted year on year rises in shipments.

### **What are bifacial solar modules?**

Bifacial modules produce solar power from both sides of the panel. Whereas traditional opaque-backsheeted panels are monofacial, bifacial modules expose both the front and backside of the solar cells. When bifacial modules are installed on a highly reflective surface (like a white TPO roof or on the ground with light-coloured stones), some bifacial module manufacturers claim up to a 30% increase in production just from the extra power generated from the rear.

Bifacial modules come in many designs. Some are framed while others are frameless. Some are dual-glass, and others use clear backsheets. Most use monocrystalline cells, but there are polycrystalline designs. The one thing that is constant is that power is produced from both sides. There are frameless, dual-glass modules that expose the backside of cells but are not bifacial. True bifacial modules have contacts/busbars on both the front and back sides of their cells.

The way a bifacial module is mounted depends on its type. A framed bifacial module might be easier to install than frameless, just because traditional mounting and racking systems are already adapted to framed models. Most bifacial module manufacturers provide their own clamps to mount their specific brand, taking away any installation hesitations.

For frameless bifacial modules, the module clamps will often feature rubber guards to protect the glass, and special care must be taken to prevent overtightening bolts and damaging the glass.

The higher a bifacial module is tilted, the more power it produces from its bifacial properties. Bifacial modules mounted flush to a rooftop block any reflected light from reaching the backside of the cells. That's why bifacial modules perform better on flat commercial rooftops and ground-mounted arrays, because there is more room for tilt and bouncing reflected light to the rear of the modules.

The mounting system itself can affect the performance of the bifacial modules. Racking systems with support rails usually covered by a monofacial module's backsheet will shade back rows of bifacial cells. Junction boxes on bifacial panels have become smaller or separated into multiple units positioned along the panel's edge to prevent shading, too. Mounting and racking systems specially formatted for bifacial installations take out the question of backside shading.

### **What is the outlook for bifacial modules?**

Last year, Vincent Ambrose, Canadian Solar's general manager for North America, told Solar Power World that bifacial modules were really going to take off in the next few years.

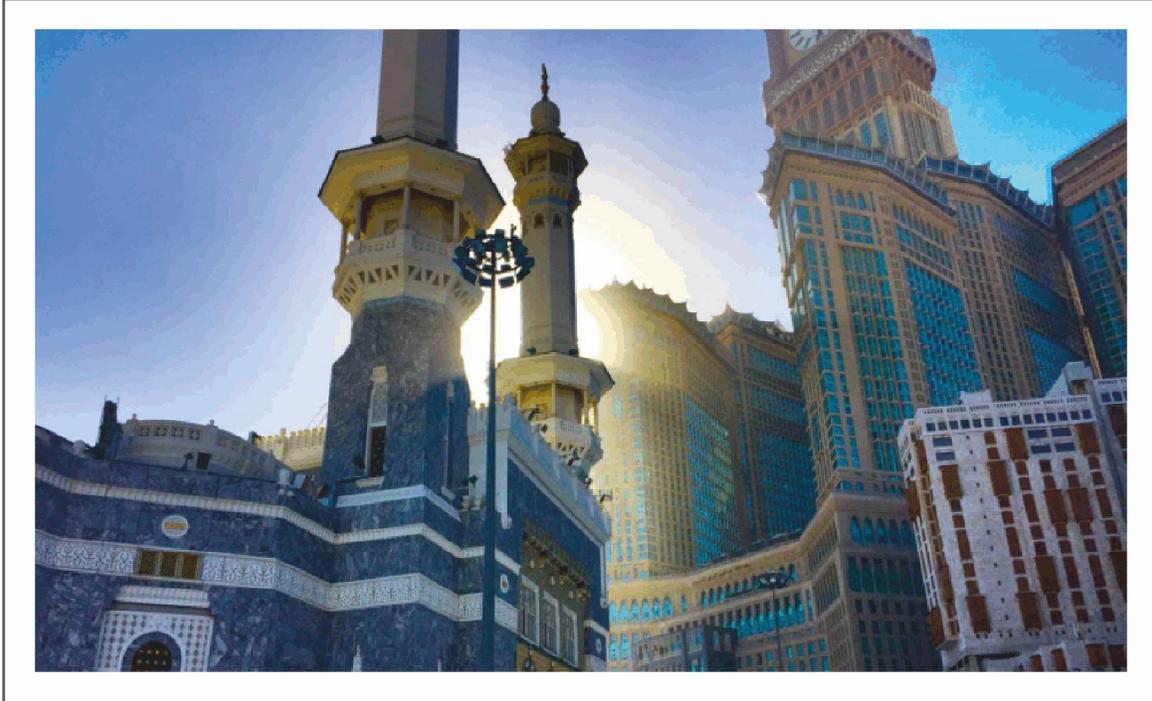
"The challenge with bifacial has always been the unpredictability of the power output because it's dependent upon the substrate behind the modules—a white commercial roof, a dark comp shingle, grass, gravel," he said "It's hard to model what the module is going to produce. The financing community is coming around on bifacial and the cost structure is coming down. We'll be hearing more about that technology in the coming two or three years."

Chinese panel manufacturer LONGi Solar believes we're entering a new era of PV, one where high-efficiency modules are supreme. Bifacial technology supports the concept of using quality materials for high-energy yields.

"Bifacial modules are the future of the industry," said Hongbin Fang, technical director of LONGi Solar. "It inherited all the advantages of mono PERC modules: high power density resulting in significant BOS savings, high energy yield with better low light performance and lower temperature coefficient. In addition, bifacial PERC modules also harvest energy from the rear side, demonstrating higher energy yield. We think bifacial PERC modules are the best approach to realize lower LCOE."

## SAUDI ARABIA PLANS 2.6 GW SOLAR PARK NEAR MECCA

The governor of Mecca Province in Saudi Arabia, Khalid bin Faisal Al Saud has signed a memorandum of understanding with the country's Minister of Energy, Industry and Mineral Resources, Khalid Al-Falih for the construction of a giant solar park in the region.



According to an official statement from the ministry, the 2.6 GW Faisaliah Solar Power Project will be built in several stages and will be developed by the ministry itself in partnership with the Development Authority of Mecca.

Only 600 MW of the project is expected to be tendered by the Saudi Renewable Energy Project Development Office (REPDO), with the procurement exercise planned to be launched this year. The remaining 2 GW, instead, will be implemented directly by the Public Investment Fund (PIF), which is a government-run sovereign wealth fund along with unspecified partners.

“The MoU is in line with the vision of the Kingdom of Saudi Arabia 2030 and the efforts of the Ministry of Energy to diversify the energy system to reach a sustainable mix that benefits from renewable energy sources, in addition to optimizing the use of hydrocarbon and mineral resources to achieve sustainable development of the national economy”, the Saudi government stated.

In early January, the Saudi Government said it intended to tender around 2.2 GW of solar in 2019, after it announced a new 40 GW solar energy target by 2030. Later at the end of the same month, REPDO launched the tender for the development and construction of seven new solar independent power producer projects with a combined potential capacity of 1.515 GW, a procurement exercise which has so far attracted the interest of more than 250 companies.

The latter and the upcoming tender for the above-mentioned 600 MW section of the new project in Mecca are part of the the second round of the Saudi National Renewable Energy Program (NREP), which this year is expected to allocate around 2.2 GW of solar capacity.

In the first round, around 700 MW of renewable energy capacity was allocated, with solar having a 300 MW slice in the form of the Sakaka PV project. This tender attracted global attention as it prompted the lowest bid for solar ever submitted, with French energy giant EDF bidding a levelized cost of electricity of only SAR 0.06697 (\$0.0178)/kWh. The record bid was rejected, however, with the successful offer tendered by Saudi energy giant ACWA, at SAR0.08872/kWh.

## WORLD RECORD PERFORMANCE FOR TRANSPARENT SOLAR CELL

Ubiquitous Energy, a leader in transparent solar technology, has certified a record transparent solar cell with 9.8% power conversion efficiency. The transparent cell based on the company's ClearView Power™ technology has an average visible transparency of 38.3% and a resulting light utilization factor (efficiency multiplied by average visible transparency) of over 3.75. This is the highest performance combination ever reported for a transparent solar cell.



“This record is a fantastic accomplishment from the team here at Ubiquitous Energy, paving the way for what is possible in the future from transparent solar technology,” said CEO Keith Wilson. “Architectural windows typically span the visible transparency range between 30% and 80%, making these solar cells ideal candidates to add to our product lineup for electricity generating windows.”

Ubiquitous Energy is currently working with global glass partners to scale up and commercialize its ClearView Power™ coatings for architectural windows. The company has spent the past years maturing previous ClearView Power™ formulations with lower efficiencies and a range of transparencies up to 80% that are already being integrated into large-area product prototypes. For more information see the IDTechEx report on Smart Glass and Windows 2018-2028.

The new certified cells are still under formulation development as part of the company's ongoing R&D program to develop future versions of its ClearView Power™ technology. The efficiency of the laboratory size cell was certified by third-party test laboratory Newport Corporation. “Laboratory efficiency and transparency are just two important milestones and we will now begin the process of optimizing the scalability and reliability of these next-generation devices,” said co-founder and Chief Technology Officer Miles Barr. “In the meantime, we are excited to begin pilot projects and commercialization activities with our earlier ClearView Power™ formulations.”

## BYE AEROSPACE'S SUN FLYER 2 COMPLETES FIRST FLIGHT WITH SIEMENS ELECTRIC PROPULSION MOTOR



Bye Aerospace's electric Sun Flyer 2 successfully completed the first official flight test with a Siemens electric propulsion motor 8 February at Centennial Airport, south of Denver, Colo.

The Sun Flyer family of aircraft, including the 2-seat Sun Flyer 2 and the 4-seat Sun Flyer 4, aims to be the first FAA-certified, practical, all-electric airplanes to serve the flight training and general aviation markets.

Siemens will provide electric propulsion systems for the Sun Flyer 2 airplane—the 57 lb. SP70D motor with a 90 kW peak rating (120 HP), and a continuous power setting of up to 70 kW (94 HP).

Sun Flyer brings the full promise of electric propulsion to the market with safe, practical and reliable electric aircraft. The all-electric



operation requires no aviation fuel and results in zero emissions and significantly lower noise pollution compared to conventional aircraft. The sleek Sun Flyer design also features enhanced speed and altitude performance with extremely low operating costs.

George E. Bye, CEO of Bye Aerospace, the developer of the Sun Flyer, said the initial flight with the Siemens motor went flawlessly.

Sun Flyer 2's program application to the FAA was accepted under FAR 23 certification criteria in the spring of 2018. The Sun Flyer 2 prototype will conduct extensive additional flight test activities in 2019 and continue to work closely with FAA representatives on certification activities.

Current flight test focus areas are propulsion system, envelope expansion and systems optimization.

Globally, Siemens eAircraft technology is helping lead the aviation industry in electrification and hybrid propulsion, system integration, service and condition-based monitoring.

The company has previously equipped European light and sport aircraft with electric propulsion systems up to 260 kW for test purposes and is also developing propulsion technology in power classes up to 10 MW to enable electrification of aircraft in the commercial air transport sector.

Siemens electric motor technology has powered aircrafts to set two speed records, achieve the world's first aero tow by an electric plane, and set a new world climb record with an altitude of 3,000 meters in four minutes and 22 seconds.

Bye Aerospace is developing the Sun Flyer family of aircraft in addition to a family of advanced, high-altitude, long-endurance solar-electric unmanned aerial vehicles called "StratoAirNet."

## **ELECTRIC VEHICLES - A GOVT INITIATIVE**

A government appointed panel led by cabinet secretary Pradeep Kumar Sinha has proposed a bouquet of incentives for makers as well as buyers of electric vehicles in an effort to push emobility in the country. The panel has recommended a lower basic customs duty on components besides a lower GST rate to encourage manufacturers to take up large-scale production of e-vehicles.

For the buyers, it has called for differential registration rates and exemption from road tax and parking charges. "A final decision would be taken at the next round of high level meeting in the Prime Minister's Office shortly" reliable source commented. Once a decision is taken, the department of revenue, the department of heavy industries and the ministry of road transport and highways will be asked to take necessary action, this person said.

The blueprint was drawn up by over two dozen top bureaucrats across all stakeholder ministries that attended the committee of secretaries meeting on total mobility chaired by Sinha last month. The NITI Aayog is acting as a nodal agency to coordinate the roll-out of the mega plan. The government is seized of the fact that India needs to adopt effective strategies to place itself as a key driver in the global mobility revolution, and this can be done only by large-scale domestic manufacturing of electric vehicles with all its components including batteries.

Prime Minister Narendra Modi had in September last year assured the country of a stable policy regime for e-vehicles. "We want to drive investments across the value chain from batteries to smart charging to electric vehicle manufacturing," he had said at the Aayog's mobility summit. "We will soon put in place a stable policy framework for electric and alternate fuel-powered vehicles. Policies will be designed as a win-win for all and will enable huge opportunities in the automotive sector."

India wants to create a robust and affordable electric mobility ecosystem comprising production facilities and a large network of charging points to achieve three key strategic goals— cutting down carbon emissions, creating new job opportunities and reducing the use of crude oil, about 80% of the requirement of which is met through imports. Though never articulated as a formal policy statement, India originally had the ambition of having all new vehicles on Indian roads powered by electricity by 2030. This, however, has been scaled down to 15% of total vehicle sales in the next five years.

## **China's participation in India's ambitious plans to go for full electric mobility**

India plans to achieve electric mobility by 2030 and welcomes Chinese industries participation and investment in the expansion of Indian Electric Vehicles (EV) Market, NITI Aayog Principal Advisor Anil Srivatsava has said. Srivastava, who led an industry delegation from India and addressed summit forum 'Global Zero Emission and All Electric Vehicle' held from January 11-13, met Chen Qingtai, President of China EV100, and invited China's participation in India's ambitious plans to go for full electric mobility.

"He mentioned that for India's ambitious objective of achieving electric mobility by 2030, we see very substantive role for the Chinese EV players," a press release from the Indian Embassy here said on Sunday.

China EV100, a private electric vehicle association of over 200 leading Chinese electric mobility industries, is organising the 5th China EV100 Forum in Beijing. The government as well as industry representatives from all over the world attended the event. China is both the biggest manufacturer and the biggest market for cars globally. But the car sales fell in 2018 by about six per cent to 22.7 million units for the first time in 20 years, sending shock waves across the industry. The drop is largely attributed to the continued slowdown of the Chinese economy, stringent measures to restrict new car sales to cut automobile pollution and the ongoing trade war with the US.

The most recent figures show that New Energy Vehicles (NEVs), a category which includes electric and hybrid models, has defied trend of slowdown, growing substantially over the past year, a recent BBC report said.

China's NEV market made a major gain this month with Elon Musk, the CEO of US electric carmaker Tesla, on Monday laying foundation to set up USD seven billion plant in Shanghai. Tesla became the first to benefit from a new C policy allowing foreign carmakers to set up wholly-owned subsidiaries in China. The new plant, Tesla's first outside the US, is located at a high-end manufacturing park in the southeast harbour of Shanghai. It is designed with an annual capacity of five lakh electric cars. In his meeting with Chen, Srivatsava said that given the market size of India and China together, there is huge cooperation potential for EV industries of both countries.

He said EV industries of both countries should have more interaction and proposed to establish a formal interaction mechanism between an Indian EV Industry association, supported by NITI Aayog, and China EV100, which can meet periodically.

He proposed to organise an industry meet of players of two sides in the first half of this year in Beijing or a suitable venue to explore cooperation possibilities between EV Industries of two countries, the release said. "Chen mentioned that India is an important country for Chinese EV players and he welcomes Chinese industries participation and investment in Indian EV market," it said.

Earlier, Srivastava spoke about the Indian government's policy for promotion of electric mobility, current state of play and future roadmap. Addressing the forum, he said EV sales were expected to be 30 per cent of total sales in 2030 with 25.36 million EVs and 59.17 million (Internal Combustion Engines) ICEs. The total automobile sales in India were expected to 84.53 million in 2030.

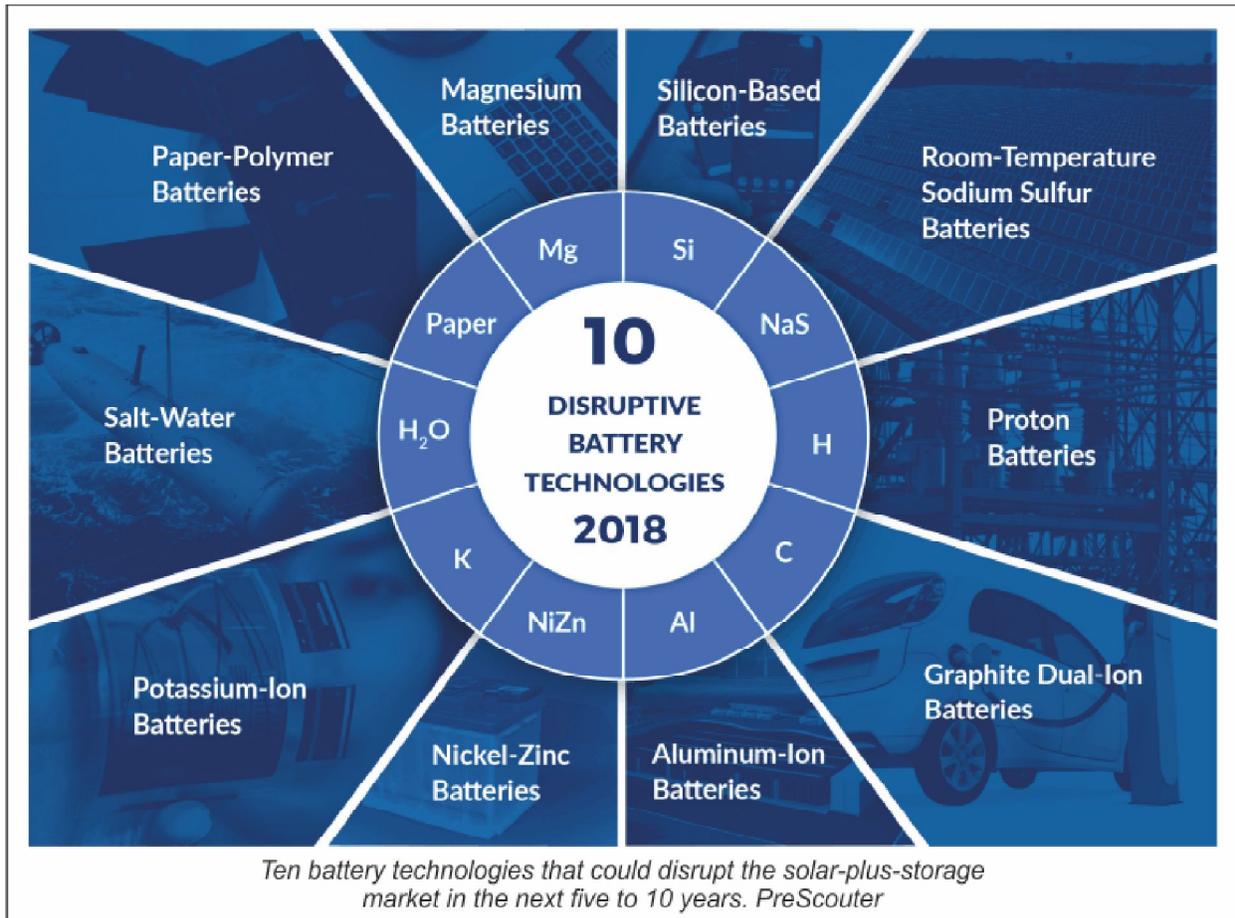
He mentioned that India is committed to global environmental commitments, and will encourage development and adoption of clean energy and new energy transportation. Leading Indian auto-makers such as Maruti Suzuki, Tata, TVS, and industry associations such as Society of Indian Automobile Manufacturers (SIAM) and Automotive Component Manufacturers Association of India (ACMA) took part in the event.

The Indian industry is looking for technologies related to DC motor, motor control systems, EV battery cells, the release added.

***Democracy is defined as a government of the people, by the people and for the people.  
Democracy is a form of government in which people are governed by their  
own elected representatives, Democracy guarantees some basic rights  
and freedom for individuals and its voters.  
These rights are known as fundamental rights.***

# 10 DISRUPTIVE BATTERY TECHNOLOGIES TRYING TO COMPETE WITH LITHIUM-ION - 1

The modern world runs on lithium-based batteries. Numerous chemistries and novel technologies are being developed to counter the limitations of Li-ion batteries though, including the high cost, raw materials sourcing and overheating. Chicago-based research intelligence firm PreScouter recently released a report detailing 10 new battery technologies poised to disrupt the market over the next decade and usher in the next wave of high-performance batteries. Here's a high-level look at the report findings, including a review of these battery technologies most valuable to solar-plus-storage.



Ten battery technologies that could disrupt the solar-plus-storage market in the next five to 10 years. PreScouter

## 1. Silicon-based batteries

Li-ion batteries have traditionally used graphite anodes, but researchers and companies are now focusing on silicon anodes. The Si-dominant anodes can bind Li-ion 25-times more than the graphite ions. However, these batteries suffer from low electrical conductivity, a slow-diffusion rate and large volumetric fluctuations during lithiation. These limitations result in Si pulverization and instability of the solid electrolyte interphase (SEI).

Two primary strategies have been used to circumvent these challenges: nanotechnology and carbon coating. In the former method, various nano-sized Si anodes are used, which have a high surface area, improved cycle life and rate stability compared to bulk Si anodes. They can also withstand lithiation and delithiation without cracking. Carbon coating uses a combination of nanosized Si with different forms of carbon materials for generation of high-performance Si/C nanocomposite anodes. Recently, doped carbon with heteroatoms as coating agents have attracted a lot of interest. The heteroatom-doped Si-C electrodes bind Li ions more strongly than carbon atoms, leading to an excellent electrochemical performance with stable electrical conductivity.

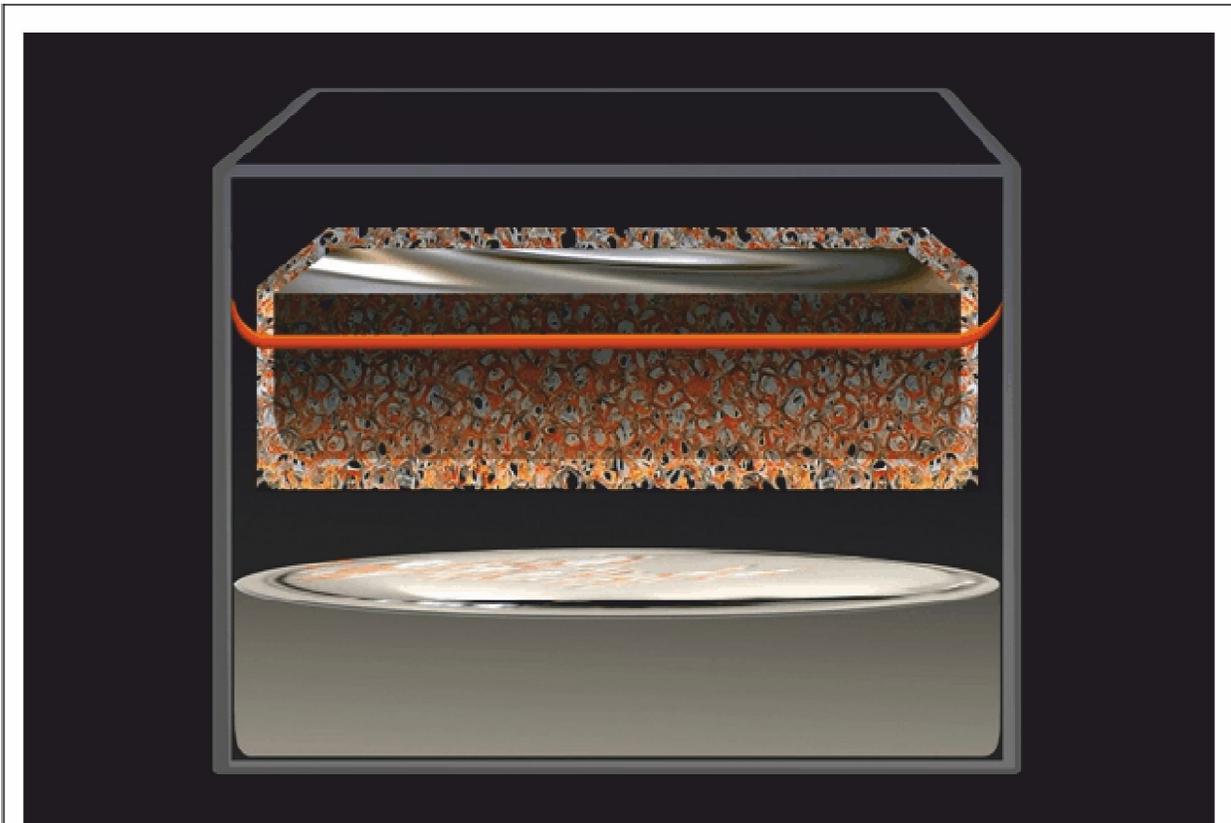
Si-based batteries have generated a lot of commercial interest due to their potential for low costs and enhanced capabilities for cars and smartphones. The competition is fierce, with many startup companies, including Sila Nanotechnologies, Enovix, Angstrom Materials and Enevate, to commercialize Si-dominant Li-Ion batteries.

## 2. Room-temperature sodium sulfur (RT-NaS) batteries

One of the most promising alternatives to lithium-sulfur batteries are sodium-sulfur batteries, due to similar physical and chemical properties of Na and Li ions. However, a high temperature ( $>300^{\circ}\text{C}$ ) is needed for battery operation. As a promising alternative, the low-cost RT-NaS battery system has generated extensive research interest for use in large-scale grid applications with enhanced safety. However, due to complex reactions within the battery, the RT-NaS batteries suffer from a lower theoretical capacity.

Various approaches have been used in 2018 to solve the problems of RT-NaS batteries.

- A team of researchers at MIT led by Dr. Sadoway focused on the membrane to solve the problem of the brittle and fragile nature of the beta alumina ceramic electrolyte membrane between the anode and cathode components of the RT-NaS. They demonstrated that a steel mesh coated with a solution of titanium nitride functions as stronger and more flexible material for industrial-scale storage systems. The approach opens up new avenues for battery design, as it can be applied to other molten-electrode battery chemistries as well.

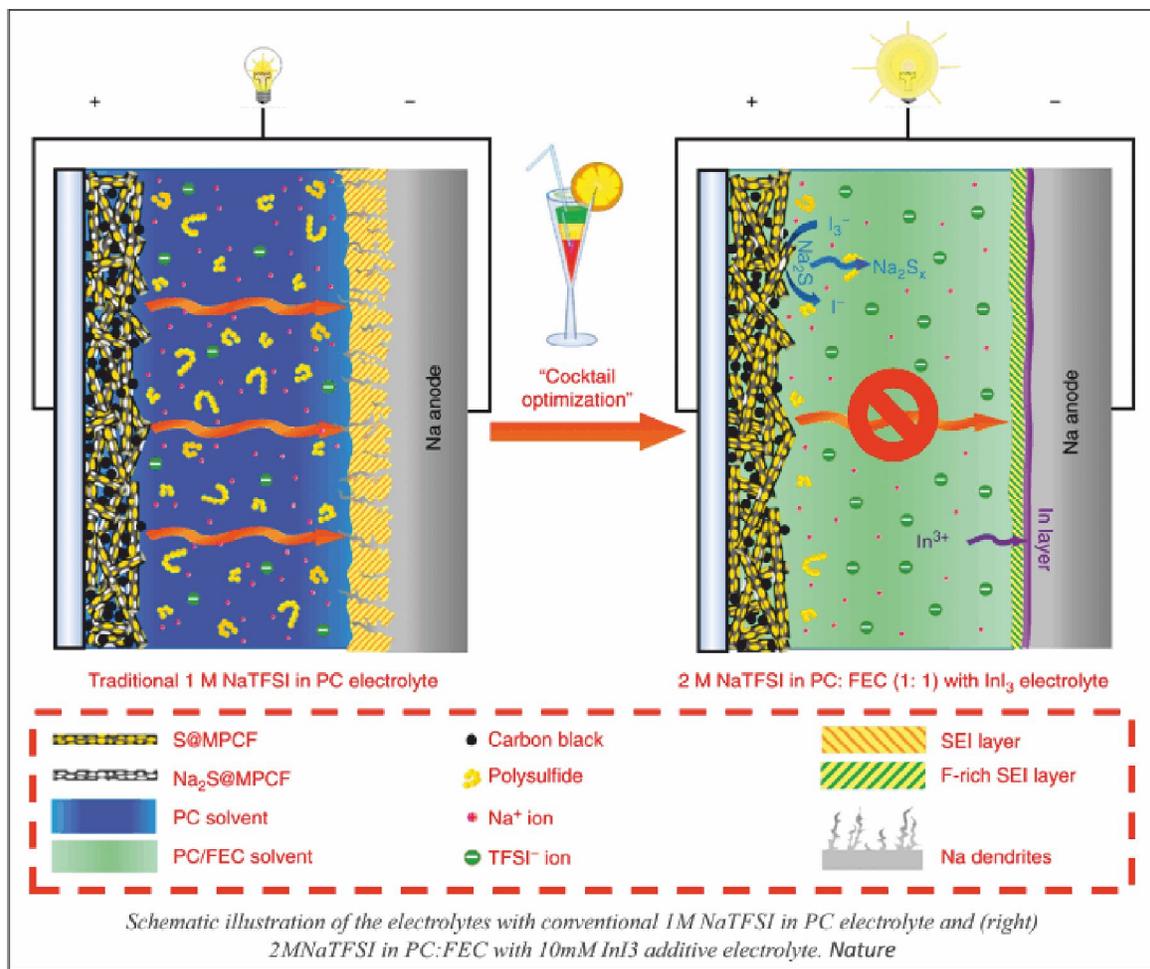
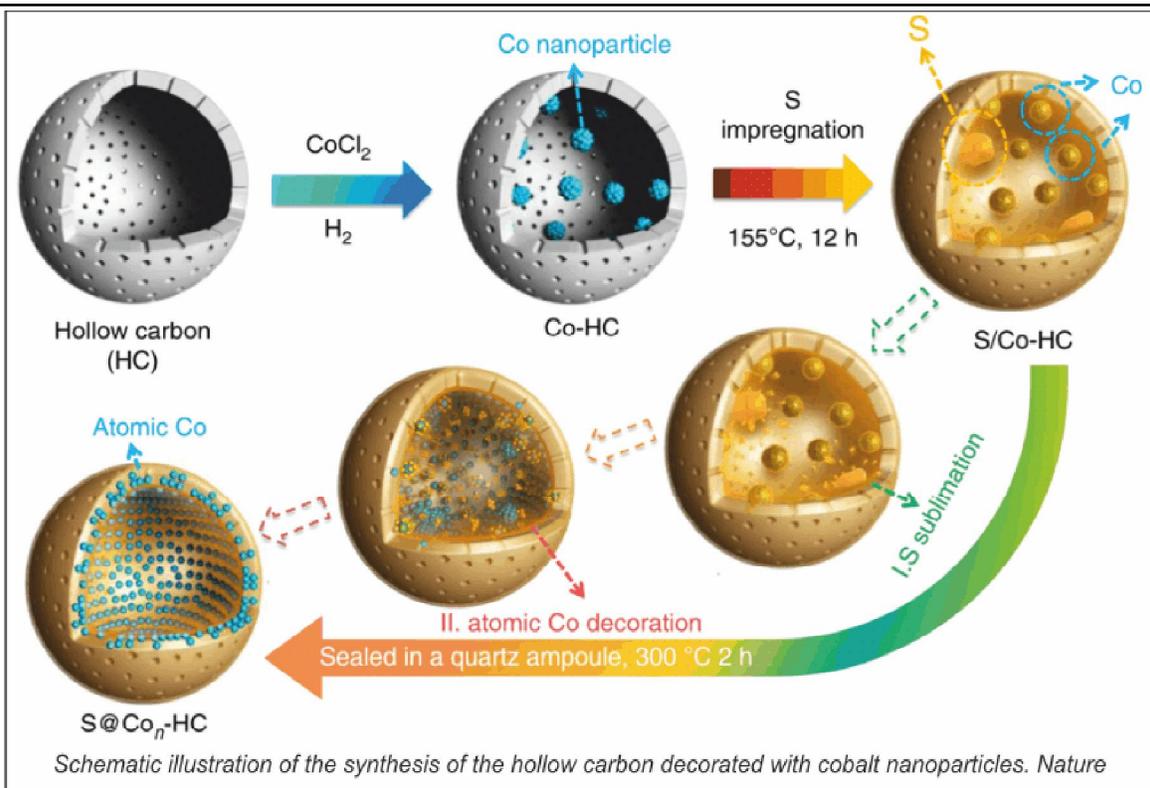


*A new approach to rechargeable batteries. RT-NaS battery with a metal mesh membrane. MIT*

- Researchers at the University of Wollongong, Australia, focused on the electrode design. They built an efficient sulfur cathode with atomic Cobalt anchored in the micropores of hollow carbon nanospheres. The synthesized cathode demonstrated excellent electrochemical performance.

In recent research published in *"Nature,"* scientists used a multifunctional carbonate electrolyte with high electrochemical performance and increased safety. This approach could be applied to a wide range of Na-based rechargeable battery systems for the advancement of low-cost and high-performance energy storage devices.

Though RT-NaS batteries are still in the early phase of development, companies like Ambri, a spin-out company from MIT led by Dr. Sadoway, is working to improve the battery design. The next generation of NaS-based energy storage technologies could soon become a reality with the ongoing research efforts and approaches discussed above.



(To be continued...)

# ENERGY, ELECTRICAL ENERGY AND RENEWABLE ENERGY – 19

## Sustainable Growth, Sustainable Electrical Energy and Renewable Energy

### Bio Diesel- Some details and status in India:

Some details regarding the present status and the future of Biofuels in general are given below to understand and to explore new technologies to suit our resources and potentials.

**Biodiesel/Renewable Diesel** - The market for biodiesel is nascent and will continue to grow if there is a strong commercially viable strategy for building a sustainable biodiesel industry. Presently, India has five to six plants with capacity to produce 10,000 metric ton to 250,000 metric tons (MT) of biodiesel per year. Biodiesel is produced through multiple feedstock technology. Unfortunately, research trials have failed to build a commercially viable biodiesel industry based on 'jatropha' (*Jatropha curcus*), and there is little indication that it can eventually succeed.

**Production** - India will produce upwards of 150 million litres of biodiesel in 2017 and will add another 10 million litres through 2018. Biodiesel producers utilize multiple feed-stocks such as 'UCO (used cooking oil), animal fats, tallow's and 'other oils' (palm stearin, sludge, acidic oils, and tree oils etc.) to produce biodiesel, thereby utilizing close to 30 percent of the installed capacity. While the use of animal fats and tallow's has remained constant, remaining feedstock use has shown steady growth, namely UCO and 'other oils'. Although there is no official regulation on supply of UCO or 'other oils' for biodiesel production, biodiesel sales have shown just incremental growth in recent years, with most of it coming from food processing industries and restaurants. Some firms claim to import smaller quantities of biodiesel and sell it locally after meeting prescribed BIS standards.

**Consumption** - Until recently, there was no excise duty on biodiesel, but with proposed GST of 18 percent, it may become costlier than conventional diesel; bulk buyers or end users may find it not to be competitive. Additionally, the excise duty concession on inputs such as palm stearin will also get replaced with a new 18 percent GST rate. Presently, no excise duty is levied on palm stearin supplied to bio-diesel producers, or for use in high speed diesel, which has 20 percent blends by volume of bio-diesel (Source: MNRE, GOI). Industry experts claim that without suitable incentives, growth of the biodiesel sector will remain flat. Biodiesel is bought by small and medium enterprises, sold to individual consumers and progressive farmers to supply energy for brick kilns, irrigation pumps, cellular communication towers, and back-up power diesel generators. Biodiesel is also sold to bulk users such as Indian Railways, State transport corporations (e.g., Karnataka State Road Transport Corporation), automobiles and transport companies (state sponsored or private trial runs); it reportedly is also retailed at select government owned outlets.

India: Biodiesel Production from Multiple Feedstock (Million Litres)

Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Production	75	99	111	121	128	132	142	148	153	161

### The future of bio-diesel in India?

Recently(2017/18), Union Minister for Road Transport and Highways inaugurated India's first refinery plant in Pune that will produce fuel oil from rice and wheat straw, cotton stalk, cane trash and corn cobs.

The preferred raw material for biofuel in India is Jatropha. This crop is often cultivated in degraded lands but requires irrigation to produce the seeds that carry the oil. The ministry has already done excellent work in producing power from municipal sewage and solid waste. It appears they want to repeat that performance with biofuels. But there is a fundamental difference between biofuel crops like Jatropha and municipal sewage. Municipal sewage is a "waste" product. We have to spend money to treat it before reusing or discharging it in the rivers. On the other hand, biofuels are produced from agricultural wastes like wheat straw which have alternative uses like cattle feed; or crops like Jatropha that lay claim on our scarce land and water resources that can be used to produce grasses and forests.

Jatropha can grow on degraded lands. It produces a poisonous seed that yields biodiesel. A friend in Dungarpur in Rajasthan runs a NGO. He started cultivating jatropha on two acres of degrade land. He is happy with the

income. Seeing his success, about 100 farmers in the area have started cultivation of this plant. The cultivation of Jatropa is good if done on lands not suitable for crop cultivation. Then it does not compete with other uses of the land such as the production of dry land crops like bajra and ragi. We must give encouragement to such cultivation. One policy hurdle is that as per our current laws the producer cannot sell biodiesel directly to the consumers. The producer has to sell the biodiesel to the oil companies, who blend it with petroleum and sell in the market. Reportedly two biodiesel plants in Kolkata have closed down, the Calcutta Tram Company and Kolkata Police stopped buying this fuel directly from the producers. Manufacturers can produce biodiesel at a lower cost than the sale price of diesel but they are not able to do this because of the intermediation of the oil companies. The oil companies have to pay taxes on the biodiesel blended with diesel, which makes it uneconomic to produce. The Government must exempt biodiesel from these taxes.

Another step to give boost to biodiesel is to invest in research on the conversion of the stems of the plant into fuel. Presently manufacturers use only the seeds of jatropa to produce biodiesel. Large amounts of cellulosic materials are available in the stems of the plant. This goes waste. Researchers are trying to find ways of converting the cellulose of the stems into biodiesel or other forms of conveniently usable fuel globally. So far, this technology has eluded them. Government should push a mission to invent this technology. Then it will become much profitable to cultivate jatropa.

Crop	Economic produce	Area (Mha)			Crop production (Mt)		
		2010/11	2020/21	2030/31	2010/11	2020/21	2030/31
Rice	Foodgrains	42.9	48.1	50.3	96.0	109.9	123.2
Wheat	Foodgrains	29.1	33.7	36.6	87.0	108.2	121.1
Jowar (Sweet Sorghum)	Foodgrains	7.4	5.2	3.4	7.0	6.0	5.7
Bajra	Foodgrains	9.6	9.3	8.8	10.4	11.4	12.3
Maize	Foodgrains	8.6	8.4	9.0	21.7	24.8	28.3
Other cereals	Foodgrains	2.9	2.1	1.5	4.6	3.9	3.8
Gram	Foodgrains	9.2	8.9	8.7	8.2	8.4	8.6
Tur (Arhar)	Foodgrains	4.4	4.4	4.7	2.9	3.1	3.3
Lentil (Masur)	Foodgrains	1.6	1.7	1.9	0.9	1.2	1.4
Other pulses	Foodgrains	11.2	12.8	13.2	6.2	6.3	6.8
Groundnut	Oilseeds	5.9	6.0	6.1	8.3	8.9	9.6
Rapeseed & Mustard	Oilseeds	6.9	7.2	7.9	8.2	9.6	11.0
Other oilseeds	Oilseeds	14.5	16.7	18.6	16.0	19.3	22.4
Cotton	Fibre	11.2	11.9	12.6	5.6	6.1	6.4
Jute and Mesta	Fibre	0.9	1.0	1.0	1.9	2.3	2.5
Sugarcane	Sugar	4.9	5.1	5.6	342.4	406.4	459.3
<b>Total</b>		<b>171.0</b>	<b>182.4</b>	<b>190.1</b>	<b>627.3</b>	<b>735.9</b>	<b>825.8</b>

Source: (MoA, 2012; Purohit and Fischer, 2014)

There is a need for caution though. The jatropa plant converts sunlight into oil. A report from the TreeHugger website, which is dedicated to promoting sustainable development, says that the plants are able to convert only 2 percent of the sunlight into the energy stored in the oilseeds. In comparison, solar panels can convert 15 to 25 percent of the sunlight into usable energy in the form of electricity. Solar panels established on an acre of degraded land will provide about 10 times the energy provided by a jatropa plantation. Therefore, it will be

much more efficient to push for the installation of solar panels on degraded lands rather than cultivation of Jatropa.

The second source of bio fuel is from crops that compete with food. Bio fuel is produced from about 40 percent of the corn grown in the United States. Soybean is also used extensively for this.

This is not viable option for India because we are unable to produce enough food and oilseeds for our own consumption. The third source of bio fuel is ethanol. Molasses is produced as a waste product during the manufacture of sugar. It contains some leftover sugar that could not be extracted. Ethanol can be produced from this leftover sugar. The amount of molasses available in the country is, however, extremely small considering our large energy requirements. Therefore, we will have to produce more sugarcane and convert it directly into ethanol to augment the supply of this biofuel substantially. Here also there is a conflict between food and energy. More production of sugarcane for the manufacture of ethanol means less production of food grains. Sugarcane cultivation also consumes a large amount of water. Reportedly certain sugar companies based in Nagpur are pushing for increasing production of ethanol from sugar cane. We have limited land and water. If we use the available land and water for the production of ethanol, then we will have to import more of food. It is better to be dependent on imported energy than on imported food. He is the custodian of the land, water and food of the people of the country. He should beware of such lobbies that have no hesitation in destroying the country for their petty commercial benefits.

It is clear that bio diesel cannot go very far in our country. Alternatively, Rice and wheat straw, cotton stalk, cane trash and corn cobs; and the large quantities of Agricultural wastes, after adjusting for other uses could be used for production of Bio Oil and Bio Crude with suitable Thermos Chemical Technologies and the Government should push for research in these areas.

Crops and Cultivation details in India are tabulated below and there are waste generation from all the crops after adjusting for other uses like fodder etc. The percentage of net wastes are calculated either based on crop production or based on total tonnage of crop are calculated depending on the type of crop. For example in case of Sugar Cane in which we are going to focus a little more in the forth coming parts of this series, 350 Million Tons is the total tonnage of the crop and the percentage of "Trash and Tops" which is calculated as 14% of 350 M Tons is the Bio mass or crop waste available for us to address.

### **Bio Oil or Bio Crude - Technology & the process**

#### **Bio Oil or Pyro Oil**

A biomass product that has long-distance transportation advantages over raw biomass and wood pellets is BioOil from fast pyrolysis, or Pyrolysis Oil.

The term "BioOil" is synonymous with oil from fast pyrolysis, while it can also reflect a much wider definition, encompassing other biomass oils such as palm oil, other vegetable and fatty oils. Here we deal exclusively with BioOil from fast pyrolysis, and thus the term Pyrolysis Oil or Pyro Oil can also be used.

Pyrolysis Oil can be substituted for heavy fuel oil (HFO), light fuel oil (LFO) or natural

Gas in a number of applications, including pulp mill lime kilns, power plants and direct heating and drying applications. Char can be co-fired with coal, and so can Pyrolysis Oil. Additional applications of Pyrolysis Oil include dry kilns, stationary diesel engines and industrial boilers.

The limekiln market is ideal for Pyrolysis Oil, since CO<sub>2</sub> neutral Pyrolysis Oil can be used with very little modification to burning systems.

Pyrolysis Oil can be co-fired in oil plants, or in natural gas plants that are already Configured to burn oil as an alternate or with coal. Pyrolysis Oil also can be used as a start up fuel or back up fuel for these facilities.

#### **Biomass for Pyrolysis:**

Analysis based on Sugar Cane alone as it is considered to be an Important Source of Biomass for Pyrolysis: Brazil is considered as an important Country in Sugarcane cultivation and Sugar Production, their Production of Sugarcane being around 420 Million Tons.

In India, Sugarcane is an industrial crop with acreage of about 4 million hectares and production to the tune of 300 million tons pa., active Sugar Producing States being Tamilnadu, Maharashtra, UP etc.. Details based on Brazil experience could be relevant and applicable to India.

Generally the bagasse is burned at sugar and ethanol plants to provide heat for the industrial processes including distillation, and electricity. This allows the plants to be energy self sufficient and reduce the cost incurred by using fossil fuels. Bagasse is also used to generate electricity, often sufficient for mills to sell surplus electricity to the grid.



It is interesting point to note that in India the surplus Bagasse or even most of the Bagasse is used for Paper Making. In Tamilnadu for example, in majority of Sugar Mills, the entire Bagasse is given away for paper making and their own Steam and Power requirements are met through use of Coal only.

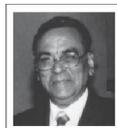
Based on the above analogy, utilizing sugar cane tops or trash can be a good lesson to be taken.

Trash is increasingly being considered for energy use. With sugar cane production at 420 MT in 2005 in Brazil, an estimated 14% or 69 MT (58.8 million BDT) of tops and leaves are burned after harvesting. As in the case with the forest industry, there is concern that enough nutrients from harvest waste are left in the forest to ensure sustainability. Specialists say that it is necessary to leave about 50% of sugar cane trash in the field. Thus 29 million BDT of trash is available for energy annually. Some quantitative estimates taken from Brazil study is given below, where the Bio Oil Production figures are very attractive. This certainly needs to be studied more deeply and explored.

Trash (Mt dry)	26	27	31
200-tpd Bio Oil plants	391	415	471
Bio Oil Production (000t)	17,043	18,064	20,538

Another interesting point is that the Trash with only around 15% moisture, looks more potential material for Pyrolysis when compared to Bagasse which has about 50% moisture.

Based on above calculations, the total quantity of Trash generated from 350 Million Tons of Sugarcane production of India, can be estimated as 49 Million Tons (42 Million BDT) and leaving 50% in the fields, the quantity available for Pyrolysis is 21 Million BDT. This can approximately yield 16 Million Tons of Pyro Oil, basing the figures on Brazil experience. This is quite substantial and needs serious considerations. Tamilnadu is one of the leading States in Sugar cane production with production of 44 Million Tons PA and the surplus trash can help produce about 1.8 Million Tons of Pyro Oil..



*(To be continued)*  
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**R.S. AGARWAL**  
*Emami*



*If There Is One Distinctive Quality That Marks Out R.S. Agarwal, Chairman, Emami, It Is Their Constant Restless Energy And Creativity.*

Blending ayurveda and modern science, Emami created a portfolio of innovative and effective products without side effects.

Agarwal, says, “My source of inspiration for shaping my life has always remained my close friend R.S. Goenka. His counsel has been-love others, listen to others, live for others.

Emami is an entrepreneurial story that would inspire employees to become entrepreneurs some day, In 1974 two childhood friends, R.S. Agarwal and R.S. Goenka, working “9 to 5” in A.C. comfort to Birla Group decided to walk on “sand” i.e. the road of entrepreneurship. With Rs.20,000 and a vision of combining wisdom of Ayurveda with modern management and manufacturing techniques, learning experiences during working in Birla group, started Emami manufacturing cosmetic products and Ayurvedic medicines in Kolkata.

Agarwal prefers to focus on strategic planning and corporate affairs, while Goenka is the perfect man for taxation and financial planning issues. The *lagan, harkat mein barkat* and management by walking around (MWA) created a pull from the market. Emami was selling “dreams” to ladies, and now to men also, and the entrepreneurship in the entrepreneurs did the rest. The entrepreneurs well understood that good advertising and sales promotion sell good products slowly and kill bad products quickly. As they were confident about their products, they then focused on marketing it on TV and radio with a helping hand from Amitabh Bachchan and Shah Rukh Khan. In Life, when a “student” is ready a “guru” appears! Emami was ready to go up, up and away.

The Company is present in more than 60 countries outside India. A new segment – rural – was created covering towns/villages with a population of less than 50,000 under ‘Project Swadesh’.

Now, the founders are preparing themselves, to “retire gracefully” and give over the reins to the next generation of Aditya and Harsh Agarwal and Mohan and Manish Goenka.

## HUMOUR - COURT JOKE

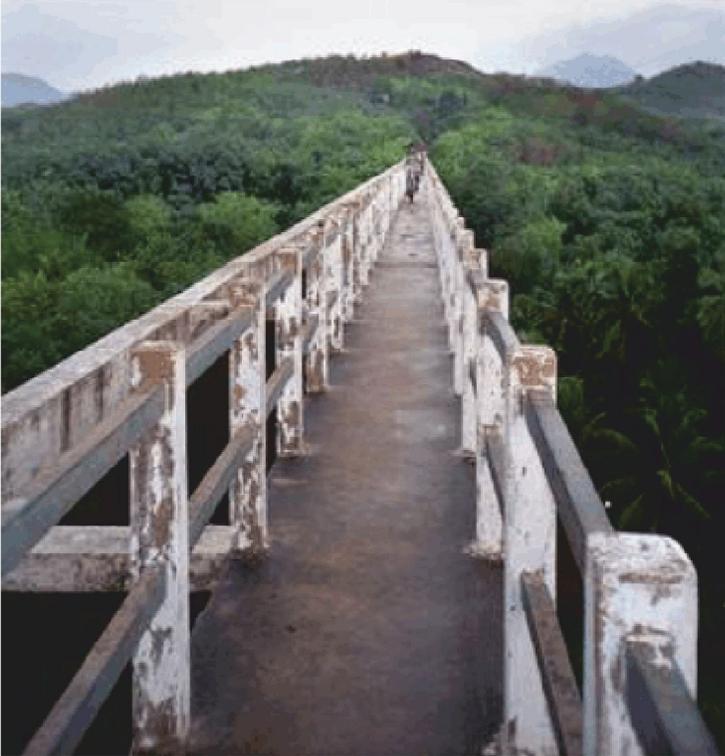
The following are some questions actually asked of witnesses by lawers during trials and, in certain cases, the responses given by insightful witnesses:

1. “Now doctor, isn’t it true that when a person dies in his sleep, he doesn’t know about it until the next morning?”
2. “The youngest son, the twenty-year old, how old is he?”
3. “Were you present when your picture was taken?”
4. “Were you alone or by yourself?”
5. “Was it you or your younger brother who was killed in the war?”
6. “Did he kill you?”
7. “How far apart were the vehicles at the time of the collision?”
8. “You were there until the time you left, is that true?”
9. “How many times have you committed suicide?”
10. Q: “She had three children, right?”  
A: “Yes.”  
Q: “How many were boys?”  
A: “None.”  
Q: “Were there any girls?”
11. Q: “You say the stairs went down to the basement?”  
A: “Yes.”  
Q: “And these stairs, did they go up also?”

## வியப்பூட்டும் இந்தியா – 16

### மாத்தூர் தொட்டிப் பாலம்

வறட்சியிலிருந்து தப்பிக்கவும் விவசாயத்துக்குப் பயன்படுத்தவும் கட்டப்பட்டது மாத்தூர் தொட்டிப் பாலம். இதைத் தொங்கும் கால்வாய் என்றும் தொட்டிப் பாலம் என்றும் கூட அழைக்கிறார்கள். கன்னியாகுமரி மாவட்டத்தில் மாத்தூர் கிராமத்தில் அமைந்துள்ள இந்தத் தொட்டிப் பாலம். தெற்கு ஆசியாவிலேயே மிக உயரமான பாலமாகக் கருதப்படுகிறது.



மேற்குத் தொடர்ச்சி மலையில் உள்ள மகேந்திரகிரி மலையில் உற்பத்தியாகிறது பறளியாறு. அருகில் இருந்த மலைகளால் இந்த ஆறு மாத்தூர் பகுதியில் பாய முடியாமல் போனது. இதனால் வறட்சி ஏற்பட்டது. கணியான் மலையையும் கூட்டுவாயும் பாறை மலையையும் ஒரு கால்வாய் மூலம் இணைத்தால், நடுவில் இருக்கும் பள்ளத்தாக்கு வளம் பெறும் என்ற எண்ணத்தில் இந்தத் தொட்டிப் பாலம் கட்டப்பட்டது.

1962-ம் ஆண்டு அப்போது முதல்வராக இருந்த காமராஜரால் ஆரம்பிக்கப்பட்ட இந்தத் தொட்டிப் பாலம், 1969-ம் ஆண்டு கட்டி முடிக்கப்பட்டது.

இந்தப் பாலத்தின் நீளம் 1204 அடிகள், உயரம் 104 அடிகள். 28 தூண்கள் இந்தத் தொட்டிப் பாலத்தைத் தாங்கி நிற்கின்றன. ஒவ்வொரு தூணும் 32 அடி சுற்றளவு கொண்டது. இந்தப் பாலம் வழியாகத் தண்ணீர், ஒரு

மலையிலிருந்து இன்னொரு மலைக்கு எடுத்து செல்லப்படுகிறது.



கால்வாய் இரண்டு பிரிவுகளாக பிரிக்கப்பட்டுள்ளது. ஒரு பக்கத்தில் கால்வாய் மேல் கான்கிரீட் பலகைகள் போடப்பட்டுள்ளதால், மக்கள் அந்தக் கால்வாய் மீது நடந்து செல்கிறார்கள்.

தண்ணீர் செல்லும் பகுதியில் பெரிய பெரிய தொட்டிகளாகக் கட்டப்பட்டிருக்கின்றன. ஒவ்வொரு தொட்டியும் ஏழு அடி அகலமும் ஏழு அடி உயரமும் உள்ளது. இரு மலைகளுக்கு இடையே தொட்டில் போன்ற அமைப்பில் கட்டப்பட்டிருப்பதால், இது தொட்டில் பாலம் என்றும் அழைக்கப்படுகிறது. இதன் வழியாக வரும் நீர் கல்குளம், விலவங்கோடு ஆகிய இரு வட்டங்களில் உள்ள விவசாய நிலங்களின் நீர்பாசனத்துக்குப் பயன்படுகிறது.

மாத்தூர் தொட்டிப் பாலத்தால் பல ஹெக்டேர் விவசாய நிலங்கள் பயன்பெறுகின்றன. தரிசு நிலங்களை, விவசாய நிலங்களாக மாற்றியப் பெருமை மாத்தூர் தொட்டிப் பாலத்துக்கு உண்டு.

பாலத்தின் மேல் நின்று எங்கு நோக்கினாலும் பசுமையாகவே காணப்படுகிறது. தென்னை, ரப்பர், வாழை மரங்களும், நெல் வயல்களும் கண்களுக்கு விருந்தாக இருக்கின்றன. பாலத்திலிருந்து இறங்க படிகள் உள்ளன. குழந்தைகள் விளையாட ஒரு சிறிய பூங்காவும் குளியலறைகளும் இருக்கின்றன.

தமிழ்நாட்டுக்குப் பெருமை சேர்க்கும் மிகச் சிறந்த சுற்றுலாத்தலமான இந்த மாத்தூர் தொட்டிப் பாலத்தை அவசியம் ஒருமுறை காண வேண்டும்.

தொடர்புக்கு: ஆம்பூர் மங்கையர்க்கரசி,  
mangai.teach@gmail.com  
Courtesy: தி இந்து, தேதி: 31.01.2018

## இரப்பர் – பெற்றோர்கள்

இரப்பரைப் பார்த்து பென்சில் சொல்கிறது, “ஒவ்வொரு முறை நான் செய்யும் தவறுக்கும், என்னை சுத்தப்படுத்தி தூய்மையாக்கி விடுகிறாய், ஆனால் என்னை சுத்தம் செய்யும் போது நீ கரைந்துக் கொண்டே போகிறாயே, அது எனக்கு வருத்தமாக இருக்கிறது” என்று.

இரப்பர் அதற்கு “அது என் கடமை, நான் படைக்கப் பட்டதே அதற்குத் தான். என்னைக் கண்டு நீ வருந்த வேண்டாம். இதில் எனக்கு முழு மகிழ்ச்சி. என்னால்

உன் தவறுகள் அழிக்கப்பட்டு, நீ திருத்தங்களுடன் முன்னேறி சென்றால் அதுவே என் வெற்றி. நான் கரைவதைப் பற்றி எனக்கு கவலை இல்லை” என்றது.

அந்த இரப்பர் வேறு யாருமில்லை. நம் பெற்றோர் தான். அவர்கள் ஆயள் முடியும் வரை நம் தவறுகளை திருத்திக் கொண்டே இருப்பார்கள்..... நம் மீது பொறாமை படாத இரு உள்ளங்கள் நம் பெற்றோர்கள்.

மரங்களை வளர்ப்போம் - தேசத்தைக் காப்போம்

## TIRUKKURAL AND FAIR AND ETHICAL MANAGEMENT - 3



On the quality of Equanimity as one of the essentials for SQ, it is said that . “Laugh over your obstacles and when you face misfortunes. There is nothing like this remedy to overcome them.” This statement is contained in Tirukkural dealing with morality, personal conduct, political rule and a variety of subjects concerning humanity. Will this quality of maintaining equanimity under adversity be possible to cultivate is the question that arises from this advice

Some of the Kurals dealt below convey the message of mental strength to maintain “Balance” which in essence is Equanimity.

*Idukkan Varungal Naguga; Athanai  
Aduththoorvathu Akhdhoppadil Kural 621*

இடுக்கண் வருங்கால் நகுக; அதனை  
அடுத்தார்வது அ.:தொப்ப தில்.

“When thou meetest misfortune; face it with thy best smile; for there is nothing like smile to enable a manto hold him on against it.”

*Inbam Vizhaiyan Idumbai Iyalbenban  
Thunbam Uruthal Ilan Kural 628*

இன்பம் விழையான் இடும்பை இயல்பென்பான்  
துன்பம் உறுதல் இலன்.

“Behold the man who loveth not pleasure and who knoweth that difficulties are a part of the law of things; he smarteth not ever under any check.”

*(To be continued)*

## HOME FESTIVALS - 5

வைகாசி - Vaikasi (May/June)



This month is devoted to the worship of Lord Murugan, who is honoured on Vaikasi Vishakham (above). He is shown at far left as Palani, the renunciate, dressed in loincloth, wearing a necklace of rudraksha beads, sacred ash covering His body

and holding the sannyasin’s staff. To the right He is shown as a prince, with His peacock, and farther to the right as the six-headed Arumugam. Devotees approach Him doing penance by piercing their bodies with small spears and carrying various offerings, including pots of milk and a kavadi, a kind of portable arched shrine. At lower right is depicted Naga Chaturthi, celebrating an ancient story in which a young boy bit by a cobra was saved from death when his sister’s prayers caused the sands of the cobra’s anthill to counteract the poison.

*(To be continued)*

*I understand democracy as something that gives the weak the same chance as the strong*

**- MAHATMA GANDHI**

## **ELECTRICAL ENGINEERING EXPO. ELECTRIC WORLD – 2019 – KELCON**

The Electrical World 2019, an electrical engineering expo, organised by Kerala A Grade Electrical Contractors' Association (KELCON) was inaugurated by Kerala State Electricity Regulatory Commission (KSERC) Preman Dinaraj at the Jawaharlal Nehru International Stadium in Kaloor here on Thursday, 28<sup>th</sup> February 2019.

The expo is an opportunity to directly understand the latest trends and technology in the electrical sector. Preman Dinaraj said steps will be initiated for speedy disposal of complaints. They can avail themselves of avenues, including the Consumer Grievances' Redressal Forums and the Electricity Ombudsman and even the Regulatory Commission, if need be, he said. The KSERC chairman said under the telescopic charging method adopted in the state, a household which consumes 250 units of electricity will be charged at the rate of '2.59 per unit for the first 50 units. After this, the charges will be levied as part of the slab rate, he said.

Joseph Basil, Electric World 2019 chairman, said biannual expo is aimed at the betterment of professionals, technicians, investors and students from the electrical field. Over the next three days- the expo concludes on Sunday -seminars on Consumer Rights, 'Introduction to Electrical System protection', 'Energy Management & Audit' and Solar Energy & Storage Systems', with a panel discussion on KSEB's Saura initiative on the penultimate day.

An e-cycle manufactured by plus one student Karthik Suresh of MKMHSS school, Piravom was the main attraction.

Seminars on Energy Management and Audit' and Solar Energy and Storage System were held as part of the expo. A panel discussion on KSEB's Saura initiative by KSEB and ANERT officials and the representative of residence associations was also conducted.

Madhulal, Executive Engineer of KSEB Saura project, N Nandakumar, Assistant Engineer of KSEB Saura project and Sumesh, Deputy Electrical inspector were the main speakers. The event was aimed at familiarising professionals and students of latest trends and technology in the electrical sector and the extensive growth the sector has undergone.

# ELECTRICAL ENGINEERING EXPO. ELECTRIC WORLD – 2019 – KELCON





# ANNUAL GENERAL BODY MEETING - PHOTOS







# SPEL



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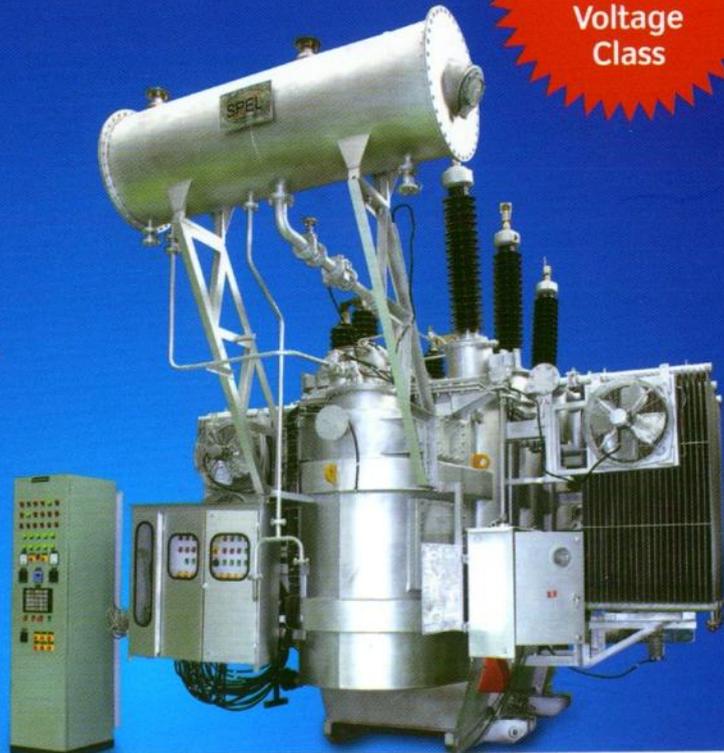
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