# 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!

India as a large and vibrant Democracy of the World will be completing the process of General Elections this month with the announcement of the results. There are lot of expectations from all the political parties and whichever way the results come, we are all confident that India will continue as a stable democracy and continue to march forward with all round progress. We have witnessed lots of ups and downs in the past including an emergency in the mid-seventies, but we have remained stable and growing. The reason is indeed our glorious culture and the vast majority of intelligent and enterprising population. Growth has been steady since independence which is indeed galloping in the past 30 years.

The month of May reminds of "May Day" or the Workers Day and these are decades of "Knowledge Workers" and continuous Knowledge and Skill Development activities as priorities to keep pace with the developments.

This is also a month when **India Celebrates National Technology Day on the II**<sup>th</sup> of May. A write up on the history and pride of Technology Day is published elsewhere in this issue. It will be very appropriate to ponder on some of the priorities for our country in the areas of Technology Development needs apart from keeping pace with the Global Developments as our 'Knowledge Workers' are spread all over the Globe.

Agriculture is one of our priority areas and we need to go fast on technologies for the Second Green Revolution. As rightly propagated by our former President Abdul Kalam, the agricultural areas are bound to shrink by a small percentage due to our population and civilization growth and a second green revolution is a necessity. With the first green revolution and adaptation of the same by the whole country, we are more than self - sufficient at present with only one crop per annum, on an average, in the cultivable area at present all over the country. With National Level Plans for Water and Irrigation and adaptation of better technologies and allocation of sufficient resources, it will be possible for us to think of 2 or 3 crops per annum to even become a leading exporters of food to the whole world. We are indeed blessed with sufficient resources to make this possible.

Energy is one other area where working with advanced technologies can help us achieve great heights. With the vast Solar and Wind potentials only, we are galloping fast today but there is one other important area of "Bio Energy" where again India has huge potentials, and the progress so far is very meagre. With huge lots of Agriculture and Plantation residues which are largely burnt away at present (creating even dangers of pollution), development and adaptation of technologies already developed in large scale, India can work to replace the entire "Fossils" meeting the present and future requirements. Let the Government that takes charge this May realize and fix priorities for "Technologies for Growth"

We thank all those members who have helped us by participating in the advertisement appearing for the issue April 2019 – Dehn India Pvt. Ltd., Dhandapani & Co., Elecxpo, Galaxy Earthing Electrodes Pvt. Ltd., Power Cable Corporation, Power Square Engineers (Indotech Transformers Ltd.), Supreme Power Equipment Pvt. Ltd., Visewham Electricals.

EDITOR

## **CONTENTS**



	PARTICULARS	PAGE NO
President :	Editorial	3
S.D. POONGUNDRAN	Contents	4
Secretary :	Know Thy Power Network – 140	5-6
P. SUYAMBU	National Technology Day	7
Treasurer :	Solar Panels – Quality on the Line	8-9
M. BALAMURUGAN	Researchers figure out how coffee can boost (some) Solar Cells	10
	Batteries are a scalable Energy storage technology	11-13
Editor : G. VENKALESH	Plastic	13
Advisor: S. MAHADEVAN	NEC ES completes 18 MW, 7.5 MWH storage project for	
Printer : M. VENKATARAMAN	EKZ in Switzerland	14
No part of the material protected	Renewable Stadiums of the Future	15-16
by this copyright notice may be	Niti Aayog seeks ministry help for EV charging infra	16
reproduced or utilised in any form	at petrol pumps	16
or by any means, the electronic	India to Install 54.7 GW wind Energy capacity	17
or mechanical including	by 2022: Filch solutions	1/
photocopying, recording, or by	Fuents	18-22
any information storage and	Events Einnich commony hoosts hottomy recycling to over 80 nercent	20
retrival systems, without prior	10 Disguntive bettery technologies trying to compete	27
written permission from the	with Lithium-Ion	28-32
copyright owner.	TANGEDCO onts for GPS to get Wind Power generation real time	33
	Brand gozero mobility rolls out E-bikes in India	34-35
YOUR CONTRIBUTION	Trichy Airport Solar	35
TOWARDS NEWS LETTER	New Sensformer® advanced with applications based on digital	55
(A) FOR BLACK &	twin simulation of Transformers	36
	Japan's space agency teams up with Toyota to develop Moon rover	37
WHITE ONLY	Solar Roadway opens in China	38
1. Full Page (Per Issue)	Energy, Electrical Energy and Renewable Energy – 20	39-42
Be 2500	Entrepreneur – Ramesh Agarwal	43
	Humour	43
(B) FOR FOUR	சர்க்கரை வியாதி உள்ளவர்கள் ஏன் பட்டை நீர் உட்கொள்ள	
COLOUR PRINTING	வேண்டும் என உங்களுக்கு தெரியுமா?	44
	உடலின் மூலை முடுக்குகளில் தேங்கியுள்ள சளியை	
1. Full Page (Per Issue)	வெளியேற்றும் சில அற்புத வழிகள்!	45
Rs. 5000	Tirukkural and Fair and Ethical Management – 4	46
Same Size Positives	Home Festivals – 6	46
CD/Zip		
to be supplied	ADVERTISEMENTS	PAGE NO
by the Advertiser	Dehn India Pyt I td	48
	Elecxpo	23
Demand Draft be drawn in	Galaxy Earthing Electrodes Pvt. Ltd.	25
favour of the "Tamilnadu	Power Square Engineers (Indotech Transformers Ltd)	2
Electrical Installation	Supreme Power Equipment Pvt. Ltd.	- 1
Engineers' Association 'A'	Visewham Electrical	24
Grade" payable at Chennai	Indo Swiss	47
		• •

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4

**Electrical Installation Engineer - Newsletter - May 2019** 

## KNOW THY POWER NETWORK - 140 INTERFACE BETWEEN THE POWER SYSTEM AND THE DISTRIBUTION TRANSFORMERS PROVIDED WITH FIXED CAPACITORS-AN ANALYTICAL STUDY - II

#### 8. RISE IN VOLTAGE LEVEL AT THE LOCATIONS OF LT FIXED CAPACITORS.

The approximate rise in the voltage level at the terminals of the distribution transformer where fixed capacitors are provided is given by the equation.

KVAR Rating of the capacitors

Fault level in KVA at the corresponding = x 100

transformer locations

(e.g.) Assumptions Fault level at the transformer = 2MVA

Capacitor = 9KVAR`

$$=\frac{9}{2000} \times 100$$

Therefore, voltage rise in percentage = 0.45%

In the case of 18KVAR capacitor provided to a 250KVA transformer.

= <u>18</u> 2000 x 100

The percentage potential rise = 0.9%

9. SELF-EXCITATION OF TRANSFORMERS

The self-excitation of transformer can happen when capacitors are connected directly to its terminals. Troubles caused by this self-excitation may lead to the failure of capacitor and transformer insulations under certain adverse conditions.

When the transformers and capacitors are connected together and if the supply is suddenly interrupted, there

5

are chances for the self-excitation of the transformer. This occurs where the magnitude of the capacitor current exceeds that of the transformer magnetizing current which normally remains around 30% of the transformer no load current. This can happen when the operating level of the transformer moves closer to the intersection of the two excitation curves. Hence it is always desirable to have the capacitances at the low level (10-15%). In simple terms, it is always safer to keep the capacitor KVAR in the



order of 10-15% of the related transformer KVA.

To cite an example 10-15kVAR capacitors are preferred for the direct connections to the transformer with the rating of 100KVA or less. The present practice of providing capacitors in the range of 18 to 30% for these transformers is found to be exceeding this safe level (Fig 1).

## 10. CONCLUSION

This study provides an interesting perspective on the application of fixed capacitors on LT power network focusing on the two ends of the spectrum viz. network performance to economics. No doubt, the provision of fixed capacitors on the LT terminals of distribution transformers is a cost-effective measure since it brings both monetary and operational benefits. But the manner in which it has been implemented in the field needs a clear focus and further refinements. One-size fits for all is not an accepted remedial measure as the ground realities always demand a different treatment. Hence careful analytical studies need to be performed before the placement of Fixed LT capacitors in service. Similar probing studies may be made before the provision of external fuse units to the capacitor units at site. Though the provision of fixed capacitors in LT network is a beneficial investment, its potential to create unfavorable operational problems in the power system always calls for careful attention and caution. In view of this, it is recommended that,

- The performance of these capacitors and their tagged distribution transformers and units concerned subjected to periodical health checks.

- As a safer level, the provision of capacitors may be kept at level of 10-15% of distribution transformer rating (10-15KVAR capacitor units are suggested for 100KVA transformers). It opportunely exists, the exciting characteristics of the distribution transformer and its related capacitor may be plotted before installation. Under no circumstances, the related characteristics of these two equipment cross each other.

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## NATIONAL TECHNOLOGY DAY

National Technology Day is observed every year on 11<sup>th</sup> of May in India, acting as a reminder of the anniversary of Shakti. Shakti is the Pokhran nuclear test which was held on 11<sup>th</sup> of May, 1998. The day highlights the important role of Science in our daily lives and encourages students to embrace Science as a career option. Various events are organized in different technical institutes and engineering colleges to mark the day. Competitions, quizzes, lectures, interactive sessions and presentations of various aspects of Science are managed globally. The day is crucial for engineers, planners, scientists and others who are engaged in nation building and governance.

## WHY NATIONAL TECHNOLOGY DAY IS CELEBRATED

On 11<sup>th</sup> of May, 1998, India victoriously test fired the nuclear missile – Shakti-I at the Pokhran Test Range of Indian Army in Rajasthan in an operation administered by late president and aerospace engineer Dr. APJ Abdul Kalam. After two days, the country victoriously tested two additional nuclear weapons. Following this, Prime Minister Atal Bihari Vajpayee announced India as a nuclear state, making it sixth country in the world that has joined the nations "nuclear club" and the first country that was not party to the Non-Proliferation of Nuclear Weapons Treaty (NPT). NPT is a global treaty signed by the UK, Russia, China, France and the US which has the objectives to prevent the increase of nuclear weapons and attain nuclear disarmament.

Becoming the sixth nuclear state of the world was not the sole thing India attained on that day. Hansa-3, India's foremost indigenous aircraft was flown in Bengaluru when the nuclear tests were being organized in Rajasthan. Hansa-3 was developed by the National Aerospace Laboratories. It was a two-seater, light general aviation plane which is utilized in the flying institutes for sports, pilot training, aerial photography, surveillance and projects related to the environment.

That is not all. On 11<sup>th</sup> May, 1998, the Defense Research and Development Organization (DRDO) also accomplished the last test-fire of the Trishul missile, which was then introduced into service by the Indian Air Force and Indian Army. A surface-to-air, quick-reaction, short-range missile, Trishul was a unit of the Integrated Guided Missile Development Programme of India which has resulted in the formation of Prithvi, Akash and Agni missile systems.

Based on these immense breakthrough accomplishments by the engineers, scientists and technicians of the country, Atal Bihari Vajpayee announced 11<sup>th</sup> May as the National Technology Day.

The theme for the National Science Day 2019 is 'Science for people and people for science'

This year's theme for National Technology Day celebrations in New Delhi is 'Technology Enablers of Startup India'.

## SOLAR PANELS - QUALITY ON THE LINE

It's a tactic employed by a number of manufacturers in the PV module market today: 'Thanks to stringent internal quality assurance, our modules have an industry leading low rate of product warranty claims'. But is there more to the claim than pure marketing?

A typical warranty today covers around 80% of a module's initial performance for a period of 25 years, often including specifications for performance loss in the first year of installation and each year thereafter. As manufacturers continue to compete

#### **KEY FEATURES** Guaranteed positive tolerance 0/+5W ensures output reliability. Strong aluminum frames can bear show loads up to 5400Pa and wind loads up to 2400Pa. Excellent performance under low light environments (morning evenings and cloudy days). 12 years for product defects in materials and workmanship and 25 years for 80% of warranted minimum power. Certifications and standards: IEC61215, IEC61730, conformity to CE. Manufactured according to International Quality (ISO9001). ISO (E IEC

on quality, and their customers benefit from lessons learned through losses resulting from light-induced degradation, potential induced degradation, microcracking and more, comprehensive warranty cover is very much a standard for the industry.

One manufacturer making big claims about its low warranty claim rates is Norway headquartered REC Group, which operates 1.5 GW of module capacity in Singapore. Cemil Seber, REC Group's Vice President Global Marketing & Product Management told pv magazine that the company sees fewer than 100 valid warranty claims per million modules produced.

"We measure our warranty claims rate very precisely on a continuous basis," he explains. "We like to make sure that that is transparent and clear in the market. But we see this [as being] very opaque in the industry."

Chinese manufacturer Wuxi Suntech Power Co. also recently issued a statement that the proportion of complaints received by third party insurance providers regarding its products also amounted to only around 100 modules for every million produced. Both manufacturers attribute their low rate of warranty claims to stringent testing standards, both on their own manufacturing lines and those of their suppliers.

"We have good traceability of our BOM [bill of materials] in the value chain and we qualify and test that all perform at the same stringent level," says Seber. "Any BOM that fails our level does not make it into our portfolio of raw materials."

#### Assurance through technology

In production lines, manufacturers are increasingly deploying additional testing and quality assurance procedures at multiple stages in manufacturing. "Every Suntech solar module is subjected to a series of rigorous tests on the production line. Of particular note is the EL test," said MR Fei, Manager of the Quality Assurance Department at Suntech. "Based on the EL of crystalline silicon, a high-resolution infrared camera takes near-infrared images of Suntech's solar modules. Cracks, poor soldering, broken grates, and other defects that cannot be seen with the naked eye are detected, allowing hidden dangers to be removed from the beginning."

But EL is hardly the highest of tech. The latest inline testing equipment is characterized as Automated Optical Inspection (AOI). AOI is more common in a number of industries outside of PV and generally involves high resolution cameras and fault detecting and reporting software. AOI can detect some faults using an algorithm, and while the equipment doesn't come cheap, it can give manufacturers far better control over their processes.

Isra Vision, a Berlin-based company that supplies inline measurement systems, says it sees interest for such solutions from module manufacturers at present. "We are talking with a lot of customers in China right now, and they want to get rid of manual inspection, especially in module assembly," says Tom Thieme, Business Unit Manager for Solar at Isra Vision. "Driving forces can be different. One is cutting labor costs, another is digitalization."

Thieme continues that many of these manufacturers are interested in fully automating quality assurance in their production lines, which is leading to some interesting discussions. Module manufacturers, he says, are interested in fully automating their quality approval procedures, but still uncertain as to putting all of their trust into software.

8

Another trend in quality assurance is the integration of testing at an increasing number of stages in both cell and module production. This again leads to more capex investment, but can allow manufacturers to more precisely pinpoint where optimization is needed and make adjustments before a faulty cell or module has been produced.

"End-of-line testing only can select for quality and not produce it," says Richard Moreth, Head of PV Sales at Vitronic, a German-based provider of solar cell inspection systems. "To fulfill future quality requirements in the PV industry we see the necessity of inline automated optical inspection directly at each process step."

#### 'Smart' PV

Automating inline testing and adding further inspection stages to production fits in with many manufactures



Fast thermal shock test chamber for Solar panel testing

roadmaps for 'Smart manufacturing', where collecting and analyzing huge amounts of data at every stage is key to improving performance and quality – principles referred to as Industry 4.0. "Testing can create long-term insights when the generated test data is used and set into relation with the performance in the field over time," explains Moreth. "Unforeseen performance losses can then be related to possible production inconsistencies and generate learnings for future production set-up. A track and trace system for the individual cell is also necessary for a consistent follow up of cell performance in the field."

And though it may be early days for large scale and multi-stage AOI deployment in PV, equipment suppliers report increasing interest from tier one PV manufacturers. "We see a change right now in the industry, the big Chinese players are changing their minds from 'we don't care, we just do inspection and sorting at the end to' to 'we want to supervise our entire process chain and collect data from each step, to see where we have the most optimization potential," says Isra Vision's Thieme. "This is a slow but growing trend."

Thieme notes that some manufacturers have an interest in the 'Smart PV' trend, but a reluctance to be first to take the plunge. "Ensuring quality, in a self-learning environment, where based on certain data sets etc., the tools, the machines can learn for themselves – this is really a vision at the moment," he says. "We are not there yet [in PV], but we have developments in the direction of AI, big data and smart learning algorithms."

For REC Group, a high level of automation in manufacturing is essential to its quality assurance, and Seber says the company has measures to minimize human intervention during manufacturing for things like moving components between stations, and has integrated 100% EL testing, pre and post lamination, and automated recognition of EL cracks into its production lines. However, the company still sees a need for 'eyes on a module' in its inspection procedures. "We believe that both machine and human are complementary," says Seber. "You won't see EL cracks on a manual inspection, but scratches on glass or on a frame etc. are better spotted visually."

#### Post production

While these sophisticated inline testing methods can provide manufacturers and their customers with some assurance that what's rolling off a production line is in line with promised standards, these modules often have a long way to go before reaching their installation site. REC's Seber points out that a great deal of quality issues can also occur during transit. "In general, you see a lot of transportation and packaging issues, things like broken glass, scratched frames and backsheets," he explains. "The customer won't care if it was production or transport that caused the problem."

There is consensus among the solar sector for 'the more data the better'. But what's done with the data remains an issue. A better understanding of the processes in manufacturing, in combination with how these products perform in the field, will surely contribute to better quality solar all round. "The more individual data you have about a module and how it was processed, the more reliable and trustworthily you can discuss with your customer any complaint or warranty issue," says Thieme of Isra Vision. "I think this can be a driving force for collecting more data about individual process steps."

9

## RESEARCHERS FIGURE OUT HOW COFFEE CAN BOOST (SOME) SOLAR CELLS

Researchers at the University of California, Los Angeles (UCLA) and Solargiga Energy in China have tried to perk up solar panels with coffee. It worked. The team reports that caffeine can help improve the efficiency with which perovskite solar panels convert light to electricity. The finding could help them a more competitive and cost-effective alternative to silicon solar cells. The authors have previously worked on improving the thermal stability of perovskite materials — the blue compounds with a particular crystal structure that forms the light-harvesting layer certain solar cells — to make them more efficient at harvesting sunlight. Part of that work involved trying to strengthen the material with additives such as dimethyl sulfoxide, an approach which showed some success in the short term, but wasn't stable over longer spans of time. Caffeine, however, is an alkaloid compound whose molecular structures could, the team suspected based on their previous experience, interact with the precursors used to make perovskite materials.



One of the Solar cells the team made using the new method

So, they set out to add caffeine to the perovskite layer of forty solar cells and used infrared spectroscopy, an approach that uses infrared radiation to identify a sample's chemical components, to determine if the materials bonded. They had.

Further infrared spectroscopy tests showed that carbonyl groups (a carbon atom double bonded to an oxygen) in caffeine tied to lead ions in the perovskite layer to form a "molecular lock". This lock increases the minimum amount of energy needed for the perovskite layer to react to sunlight, boosting the solar cell efficiency from 17% to over 20%. This lock stood firm when the material was heated, which suggests that caffeine could also help to make the solar cells more thermally-stable.

Currently, perovskite solar cells are the cheaper and more flexible option available on the market. They're also easier to manufacture, as they can be fabricated from liquid precursors — their silicon counterparts are cast from solid crystal ingots. Wang believes that caffeine might make them even easier to fabricate on a large scale, in addition to making them more efficient.

The team plans to continue their efforts by investigating the chemical structure of the caffeine-infused perovskite crystals and identify what materials would best serve as a protective layer for the solar cells.

The paper "Caffeine Improves the Performance and Thermal Stability of Perovskite Solar Cells" has been published in the journal Joule.

"A lot of companies have chosen to downsize, and maybe that was the right thing for them. We chose a different path. Our belief was that if we kept putting great products in front of customers, they would continue to open their wallets." - STEVE JOBS, Apple

## BATTERIES ARE A SCALABLE ENERGY STORAGE TECHNOLOGY

The non-dispatchable nature of renewable energy hinders widespread adoption due to economic and volatility issues driven by congestion and a reliance on fluctuating resources. In the past, these difficulties have made achieving a 100% renewable grid very challenging. However, energy storage and battery technology are improving and increase the feasibility of mass renewable integration.



Batteries provide a significant opportunity for the renewable energy industry. Other forms of energy storage such as pumped-hydro and thermal are already fairly prevalent for utility uses such as load balancing. However, these technologies are difficult to scale.

Pumped-storage and thermal facilities generally consist of massive industrial systems that are roughly the size of a traditional power plant. They also require, for example, large-scale water reservoirs, which aren't feasible for a more distributed grid of the future. In contrast, batteries are a reasonably scalable storage technology because they are comparatively small and easy to manufacture.

Mass utilization of these technologies presents an important opportunity for grid operation. As storage and batteries reach scale, it becomes no longer necessary to use electricity as soon as it's produced. Energy generation and load have always maintained a nearly constant equilibrium. Renewables have never been thought of as viable as the foundation of energy systems because they are unable to provide a constant power supply.

**Batteries Reduce Renewable Integration Challenges** 

Traditional power systems address load fluctuations using peaker plants and their dispatch capabilities. Storage provides renewables with this functionality, which reduces the congestion and resource fluctuation concerns. Batteries can provide this for distributed and residential renewables, which traditional storage systems cannot due to their size.

Batteries allow renewable generation facilities to store energy when a resource is available and supply it to the grid later. This reduces congestion because operators are able to store energy when lines are at capacity and distribute it once supply and the associated congestion decrease.

In the past, power would immediately flow into the grid causing congestion in areas with an abundance of renewable generation. Without a way to manage this overflow, it simply hasn't been possible to develop a 100% renewable grid. Even today, there is a long way to go before a fully renewable grid is an optimal solution, but we are beginning to see the technologies that will at least make such a grid viable. Batteries provide renewable sites flexibility in dispatching energy to the grid and allow operators control over congestion issues.



## **Batteries Reduce Renewable Volatility**

Obviously, renewables rely upon proper weather conditions to generate power. In other words, solar farms don't generate electricity at night and wind farms are only effective on windy days. Reliance upon constantly changing weather patterns creates volatility in the grid when compared to non-renewable energy sources. Batteries provide a solution to this problem. They allow renewables to generate power when weather conditions are favorable and automatically dispatch it as resource availability fluctuates.

This allows renewables to provide more stable power flows into the grid as weather changes on sub-hourly time intervals due to clouds or other weather changes. It also allows for time-shifting of production and usage to address recurring fluctuations in supply and load for scenarios such as the "duck-curve."

Ultimately, battery technology solves two of the main problems that fully renewable electricity grids face. Batteries reduce congestion and volatility from changing weather patterns by providing renewables with dispatch capabilities. This significantly enhances the stability of renewable energy and, in turn, makes a 100% renewable grid possible.

#### Batteries And Storage Still Aren't Perfect

It's easy to read this overview and think that utilities can simply build countless batteries and immediately move to a 100% renewable grid. While battery and storage technologies are promising, there are a still significant hurdles that the industry must address for mass integration to be feasible.

**Cost:** Batteries are still expensive. There are many instances where they are financially viable, but this is not always the case.

**Supply:** Battery manufacturing is improving but there still isn't enough capacity to support mass grid adoption.

**Planning & Modeling:** Since energy storage and batteries are still fairly new, developers are still determining best practices to optimize the size, placement, and grid impact.

**Dispatch Schedules:** Aside from modeling batteries, it is still difficult to determine ideal battery operation and dispatch strategies.

## Moving Forward

As renewable generation reaches a fairly mature state, storage and batteries are experiencing rapid, growth given their ability to address some of the associated drawbacks. Despite this, large-scale thermal and hydro storage are difficult to scale, and batteries are still not fully viable at scale.

## PLASTIC

So this happens to me quite a lot.

I'm hungry, I buy a croissant, I put it in a plastic bag ... I pay for it ... and I remove it from the plastic bag to eat it.

Both the croissant and the plastic bag served their purpose.

But the croissant is gone and the plastic bag will still be around for a few centuries.

I used it for about ... seconds.

If I throw it away, the plastic bag can either end up on a landfill.

It can be burned with all the other trash. Or it can be blown away into the water ... and return to me in the fish I eat 25 years from now. It takes at least 450 years for one plastic bottle to decompose. If you accidentally lose your empty bottle in the woods ... you can still pick it up in the year 2400. However, most petroleum plastic does not biodegrade.

It just fragments into tiny microplastics not visible to the naked eye. So, on the upside, you can't break your teeth on this kind of plastic. This is me doing grocery shopping. It's almost impossible to buy anything that is not wrapped in plastic.

As a result we throw away a lot of plastic packaging. 140 million tons a year to be precise.

Most of it ends up as landfill.A smaller percentage gets burned.And only a really tiny part gets recycled. What happens with the other third?

We know the images of birds with plastic in their stomach. We have become accustomed to the idea that even on the remotest of all islands ... This one, where nobody lives, the beaches look like this. If I tell you that every minute ... we throw one garbage truck full of plastic stuff in the ocean ... you won't be surprised. How about recycling? If we would recycle all our plastic you would think we would end up with a cleaner planet right? But ... According to this study, our use of plastic will be four times higher by 2050. So, even if we recycle everything we use, it won't be enough. We would still have to produce a lot more plastic. More importantly: new plastic is cheaper than recycled plastic. That means that, even if you are a model citizen who recycles their plastic ... Most companies won't even use it. Producing this much plastic is plain dumb.

Surely we can think of packaging that is reusable, refillable or just not plastic?

We are human beings. We invented helicopters, iris scans and Tetris. We can surely invent our way out of this, this and this. When you buy your take-away coffee you can bring your own thermos. You don't need a bottle around your shampoo. And you can bring your own bags to the supermarket. But we won't get there easily. Not with recycling alone, not with cleaning up alone. **It's time to stop using plastic and invent a hell of a solution.** 

AVOID PLASTIC BAGS - USE COTTON BAGS - SAVE COUNTRY

## NEC ES COMPLETES 18 MW, 7.5 MWH STORAGE PROJECT FOR EKZ IN SWITZERLAND

Elektrizitätswerke des Kantons Zürich (EKZ), one of Switzerland's largest power distributors, owns and runs the GSS, which NEC Energy Solutions (NEC ES) says is the European country's biggest installed storage project. EKZ is using the system to provide stability to the grid by mitigating frequency deviations. However, the GSS could also be used to provide additional ancillary services, with a payback of five to seven years, according to an online statement.

![](_page_12_Picture_2.jpeg)

The system has been installed close to a substation in Volketswil, just outside of Zurich. It can provide enough electricity to cater to the daily needs of about 600 average households (families of four).

"Battery storage is a vital part of future energy supply," said Marina González Vayá, an EKZ storage specialist. "The now-completed storage system contributes to the stability of continental Europe's power grid."

Earlier this month, NEC ES — which produces and integrates storage solutions for the grid and behind-the-meter applications — commissioned a 2 MW, 2 MWh lithium-ion storage system for ENGIE Energía Chile in northern Chile. And in January, it installed two independent 280kW/340kWh distributed storage systems and the NEC group's proprietary AERO controls software for Consumers Energy in the US state of Michigan.

NEC ES was particularly active throughout 2018. In November, it won contracts for 19 MW of storage capacity at two sites just outside of London. In September, it revealed plans to work with Key Capture Energy on a 20 MW storage project in New York state. It also started offering a new DC-coupled storage solution for the solar+storage market.

Last April, it agreed to supply a 20 MW GSS to Ørsted UK, to provide services for the UK's national grid. And in January 2018, it commissioned 50 MW of energy storage capacity in the UK with VLC Energy and VPI Immingham.

## **RENEWABLE STADIUMS OF THE FUTURE**

Sports stadiums require a huge amount of power, in particular on match-days when lighting, air-conditioning and video screens all electricity, along with a vast multitude of other energy-intensive demands. Even when not in use, stadiums and other sporting arenas need large amounts of power for maintenance.

The possibilities for incorporating renewable energy technology into stadiums and the surrounding areas provide a huge opportunity for reducing greenhouse gas emissions. This can include placing solar panels on roofs and on the roads leading towards the arenas.

Best stadiums for renewable energy: A focus on the future

As energy-smart stadiums increasingly become the norm, we take a look at those sports arenas giving us a glimpse of the stadium of the future.

## Lusail Stadium, Qatar

The Lusail Stadium in Qatar, will host the 2022 World Cup Final. When completed it will have a capacity of 80,000 seats according to architects Fosters+Partners.

The stadium will be solar powered, which in particular will be used to maintain temperatures inside the stadium. Air-conditioning will be used to reduce the temperature to 27°C at a time when the actual temperature outside is 40°C plus.

Solar energy will also be generated from the car park canopies, this will initially power the stadium and the surrounding areas when the ground is not in use. The solar power will lower the stadiums  $CO_2$  emissions by 40%.

## Antalya Stadium, Turkey

Antalya Stadium is the home of Turkish football team Antalyaspor. The stadium was built in 2015 in the hope that Turkey would secure the 2024 European championships and has a capacity of 32,000 people. The stadium is Turkey's first solar-powered stadium.

The roof is 16,000 square meters, and 75% of this area is covered with solar panels. In total there are 6000 panels, enough to generate 7,200-kilowatt hours (KWh) of energy a day. When the stadium is not in use, the power is offset elsewhere.

## Tokyo Olympic Stadium, Japan

The Tokyo Olympic Stadium will host the next Olympic Games in 2020. The Japanese government has already stated that it will be a carbon neutral games and will apply the UN's 17 sustainable development goals.

Solar panels are being incorporated into the design of the stadium. According to the architect Kengo Kuma, the solar panels will be attached to the roof and visible to spectators as they are "looking to make this environmental technology very visible as part of the design." It will also power the watering of the plants and greenery that surrounds the stadium.

## Mercedes-Benz Stadium, America

The remarkable Mercedes-Benz arena cost \$1.6bn when it was constructed in 2017, for American football team Atlanta Falcons and Major League Soccer team Atlanta United FC.

In collaboration with Georgia Power, over 4,000 solar panels were installed at the stadium and surrounding area. The panels were installed above car parks at the arena, at the stadium entry gates and on the Georgia World Congress Centre, which forms part of the complex

The project was developed over the course of three separate phases and should provide 1.6m kWh of electricity per year once complete.

## Stadio della Roma, Italy

The Stadio della Roma is the long-delayed new stadium for Serie A side AS Roma. Having suffered from innumerable delays and allegations of bribery, the stadium is now expected to be completed by 2023.

The stadium is being built according to the international standards set by LEED and GBC. According to the stadium website, solar panels will be installed on all roof areas, of all of the buildings involved in the project including the stadium roof. The project exceeds local and national targets for renewable energy generation.

## Ashton Gate Stadium, UK

Ashton Gate has been the home of Bristol City FC since 1904. The ground underwent significant renovations in 2016, which included the complete rebuilding of two stands and the renovation of another.

As part of the modernisation of the ground, solar panels were installed in the roof of the stadium. Funded by Bristol City council via a power purchase agreement 460 Vikram 255W panels have been installed, which generate 96MWh of energy a year and save 44,038kg of CO<sub>2</sub> a year, reducing its carbon emissions by 20%.

#### Bankwest Stadium, Australia

The new Bankwest stadium in the Parramatta suburb of Sydney will be completed this year and be home to A-League football side Western Sydney Warriors and Rugby League team Parramatta Eels.

Once again built to LEED and GBC standards, the stadium will be powered by renewable sources. It will also be lit by the latest LED lighting technology to significantly reduce energy use.

The Bankwest stadium is part of the New South Wales government policy of rebuilding major venues in order to 'climate proof' them from extreme weather conditions.

## T-Mobile Arena, America

The T-Mobile Arena is a multi-purpose venue in Las Vegas that has been the location for Floyd Mayweather vs Conor McGregor, UFC 200 and ice hockey team Vegas Golden Knights.

The arena uses high-efficiency LED lighting throughout to reduce energy usage, alongside high-efficiency heating systems. Other improvements include a reduction in the use of water and cooling energy used in the building.

Because of these measures the arena has been recognised for its efforts in sustainable energy by winning Leadership in Energy and Environmental Design (LEED) gold certification by the US Green Building Council (GBC), the first in Las Vegas to win the honour.

## NITI AAYOG SEEKS MINISTRY HELP FOR EV CHARGING INFRA AT PETROL PUMPS

New Delhi: Government think-tank NITI Aayog has asked the oil ministry to help set up electric vehicle (EV) charging infrastructure at 1,000 fuel stations across the country, but industry executives said any such move will require redesigning of stations and a viable business model.

Easy access to charging facility is key to making EVs popular in India where cities are choking with vehicle emissions, prompting the government to think of new ways to create an ecosystem favourable to green vehicles. Since the talk of EVs got louder globally a few years ago, Indian oil marketing companies have been exploring possibilities of being relevant in a future probably dominated by EVs. Now the government order can accelerate their transition.

For EV charging to take off at traditional pumps, companies will need to come up with a viable business model as well a design tweak of filling stations, company executives and petrol pump dealers said.

Current design allows vehicles to enter from one end of the pump, receive fuel from dispensers and exit within minutes from the other end. Replacing one dispenser or a set of dispensers with electric chargers would stop the free flow of traffic at pumps since charging takes much longer than filling liquid fuel, said NITIn Goyal, treasurer at All India Petroleum Dealers Association. This would inconvenience customers and slow down business.

The turnaround time for a petrol or diesel car refuelling is 2-5 minutes, but for electric cars even fast charging would require at least 20 minutes. Slow charging could take much longer. This means fewer customers could be serviced in a day. "Today we don't know the kind of margin EV charging can offer. But before setting up a charging point, a dealer will evaluate if the business is as profitable as the liquid fuel business," Goyal said.

Setting up charging stations at fuel pumps could be effective preliminary steps toward popularising EVs, though after a while charging points will proliferate to almost all places that can park a car or bike, Balwinder Singh Canth, a former marketing chief at IndianOil, said.

Information technology and business are becoming inextricably interwoven. I don't think anybody can talk meaningfully about one without the talking about the other. – BILL GATES

## INDIA TO INSTALL 54.7 GW WIND ENERGY CAPACITY BY 2022: FITCH SOLUTIONS

New Delhi: India is likely to install 54.7 GW of wind capacity by 2022 against the 60-GW target set by the government, Fitch Solutions Macro Research has said in a report.

The country has set an ambitious target of installing 175 GW of renewable energy capacity by the year 2022, which includes 100 GW from solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro-power.

![](_page_15_Picture_3.jpeg)

"We remain cautious on India meeting its ambitious 2022 targets for wind power capacity growth, as land acquisition issues and grid bottlenecks will lead to delays to project implementation in the sector... We forecast India to install 54.7 GW of wind capacity by 2022, compared to the 60 GW government target," Fitch Solutions Macro Research, unit of Fitch Group, said in its outlook for the country's renewable energy sector.

The agency also said it believes that concerns about the economic viability of low tariff projects from India's wind capacity auctions raise the risk that investor appetite will weaken and auctions will be postponed.

"The combination of several challenges in the country's wind power sector will hit near-term growth momentum, including land availability hurdles, grid access bottlenecks and concerns over the viability of low tender bids. This informs our view that India only will add on average 4.5 GW of wind capacity annually between 2019 and 2022, with the aforementioned risks highlighting further downside risk," the report said.

According to an year-end review released by the Ministry of New and Renewable Energy (MNRE) in December 2018, the country seeks to tender a total 20 GW of wind capacity by March 2020, with two year implementation deadlines, in order to facilitate enough growth to meet the expansion targets.

However, delays to the implementation of tendered projects and more muted interest in new auctions will present a substantial hurdle to fulfilling these envisioned expansion plans, the report said.

"Of a total of 2,943 MW tendered by the Solar Energy Corporation of India (SECI) in Gujarat and Tamil Nadu over 2017 - where 42 per cent of total installed wind capacity is located in India as of end-March 2019 - only 825 MW was commissioned as of March 2019," it noted.

Concerns over the viability of low tender bids and land acquisition issues in Gujarat were key contributors to the slow implementation of the projects, which initially were expected to be commissioned within 18 months, Fitch Solutions said. Further, the grid connection issues have been also plaguing developers of wind power projects.

"In addition, should the facility not be able to sell electricity, the project's loan interest could start to pile up and alter project economics. As such, grid connection bottlenecks represents a key risk to project developers.

"In particular, the expectation for developers to launch low bids, despite substantial project implementation challenges, is set to remain a hurdle to India deploying enough renewables projects to meet ambitious expansion plans," the report noted.

## THE WORLD'S BIGGEST UNDER-CONSTRUCTION POWER PLANTS BY CAPACITY

The top ten power plants under construction: Ranking the ten biggest

- 10. Patratu Super Thermal Power Project
- 9. Shandong Shenglu Coal-Fired Power Project
- 8. Fujian Luoyuanwan Power Project
- 7. Shin Kori Nuclear Power Plant Units 4, 5 and 6
- 6. Dasu Hydropower Project
- 5. Barakah Nuclear Power Plant
- 4. Leizhou Thermal Power Project
- 3. The Grand Renaissance Hydroelectric Project
- 2. Wudongde Hydropower Project
- 1. Baihetan Hydropower Station

## 10. Patratu Super Thermal Power Project, India – 4,000MW

![](_page_16_Picture_13.jpeg)

The world's biggest under-construction power project. The coal-fired Patratu power project has been under construction since 2018 in Jharkhand, India. The project is being developed by Patratu Vidyut Utpadan Nigam Limited (PVUN Limited), which is a joint venture (JV) between NTPC (74%) and Jharkhand Bijli Vitran Nigam Limited (JBVNL, 26%).

The super thermal power plant is being developed in two phases, with three 800MW units being installed in the first phase and two more similar units in the second phase.

The contracts for first phase plant construction were awarded to BHEL in 2018. The project is expected to be commissioned in 2022.

9. Shandong Shenglu Coal-Fired Power Project, China – 4,000MW

The coal-fired Shandong Shenglu power project in China's Inner Mongolia region has been under construction since 2016. The project is being built by Shenglu Power Company as part of the Shanghai Temple Coal Power Support Base Demonstration Project.

![](_page_17_Picture_0.jpeg)

The plant is being built in two phases, with the first phase comprising two ultra-supercritical air-cooled units each rated at 1,000MW. Estimated to cost RMB6.5bn (\$967m), the first phase features desulphurisation, denitrification and dust removal systems.

The first phase construction works are in the final stages and expected to be completed by the end of 2019.

#### 8. Fujian Luoyuanwan Power Project, China – 4,000MW

The Fujian Luoyuanwan power project is also a coal-based power plant under construction since 2015 in the Lianjiang Kemen economic development zone in Lianjiang County, China. The project, which is approved by the National Development and Reform Commission, is being jointly developed by the Shenhua Energy Company and Henglian Group.

The RMB20bn (\$2.97bn) project is being developed in two phases with two 1,000MW power plants developed during each phase. The power plant features ultra-supercritical thermal power generating units.

ZK-link Technologies supplied PLC intelligent lighting control system for the project. The power generated by the plant will be supplied to large companies in the region.

#### 7. Shin Kori Nuclear Power Plant Units 4, 5 and 6, South Korea – 4,200MW

![](_page_17_Picture_8.jpeg)

Shin Kori, the second phase of the Kori nuclear power plant in South Korea, is planned to include a total of six reactors, out of which three were operational by 2016. Unit four will be commissioned in 2019, while the construction of units five and six is in progress.

Units four, five and six will add a gross capacity of 1,400MW each to the plant. The start-up of unit four was originally scheduled for 2017, but delayed due to the decision to implement additional safety tests and measures. The Nuclear Safety and Security Commission (NSSC) finally approved the start of operations at unit four in February 2019.

Shin Kori unit three features the first commercial APR 1400 reactor. The units five and six are planned to be operational in 2021 and 2022 respectively but expected to be delayed. Construction on the two units was halted briefly for three months from July 2017 but resumed in October the same year.

## 6. Dasu Hydropower Project, Pakistan – 4,320MW

![](_page_18_Picture_4.jpeg)

The Dasu project is a run-of-river hydropower plant under construction since May 2015, on the Indus River in the Khyber Pakhtunkhwa (KPK) Province, Pakistan. Water and Power Development Authority (WAPDA) of Pakistan is the development authority for the project.

The project will include the construction of a roller-compacted concrete (RCC) gravity dam featuring an underground power station, which will house a total of 12 turbine units. Six units are being constructed during the \$4.3bn first phase of the project, which runs from 2015 to 2022, with financial assistance from the World Bank. The remaining units will be installed during the second phase.

The contractors associated with the project are China Gezhouba Group Corporation (CGGC), National Transmission & Despatch Company (NTDCL), Korea Electric Power Company (KEPCO), China Civil Engineering Construction Corporation (CCECC), and Power China.

5. Barakah Nuclear Power Plant, United Arab Emirates – 5,600MW

![](_page_18_Picture_9.jpeg)

The \$32bn Barakah nuclear power plant (NPP) in the Al Dhafra region in Abu Dhabi will consist of four 1,400MW units that will generate enough electricity to meet approximately 25% of the UAE's needs when fully operational. The plant will also offset 21 million tons of carbon emissions a year.

The plant is owned by Emirates Nuclear Energy Corporation (ENEC) and being constructed by Korea Electric Power Corporation (KEPCO). It has been under construction since 2012 and will be operated and maintained by Nawah Energy Company. KEPCO was awarded the \$20bn prime contract to design, build and provide operational support for the project, in 2009.

Unit one of the Barakah NPP is expected to be operational by the end of 2019, while the remaining units are scheduled to be completed by 2020. All the units will feature the Advanced Power Reactor (APR) 1400 light water reactor supplied by KEPCO.

## 4. Leizhou Thermal Power Project, China – 6,000MW

The 6,000MW Leizhou thermal power project has been under construction since 2015, in the Guangdong Province of China. Leizhou Power Generation Company, a subsidiary of Datang International Power Generation Company, is the owner of the project.

The coal-fired power plant will consist of six ultra-supercritical coal-fired units rated at 1,000MW each. Two 1,000MW units are being installed during the first phase of the project. A 100,000t coal unloading dock and a 3,000t heavy cargo dock are also being constructed.

The current project will replace small capacity units present at the site. The company plans to construct each of the new units in one year and ten months.

#### 3. The Grand Renaissance Hydroelectric Project, Ethiopia – 6,450MW

![](_page_19_Picture_8.jpeg)

The Grand Renaissance Hydroelectric Project, also known as Millennium Project of Ethiopia, has been under construction on the Blue Nile River in Beneshangul Gumuz, Ethiopia, since April 2011. At the time of the launch, it aimed to increase Ethiopia's power generation capacity by four times.

The RCC dam of the project will feed two underground powerhouses installed with 16 Francis turbine units rated at 375MW each. The civil contract works for the project are being carried out by Salini Costruttori Group, while Metals & Engineering Corporation (METEC) performed hydraulic and electromechanical works. Alstom and Tratos respectively provided turbines generators (eight units in the first phase) and cables.

The \$5bn ambitious project, however, faced hurdles at various stages as the construction progressed. The Ethiopian Government revoked contracts awarded to METEC in August 2018 due to numerous work delays by the contractor. The project will produce 15,000GWh of electricity a year when completed.

#### 2. Wudongde Hydropower Project, China – 10.2GW

![](_page_20_Picture_1.jpeg)

Under construction since 2015, the Wudongde hydroelectric project is located on the Jinsha River covering Yunnan and Sichuan provinces. It is part of China's West-East power transmission project, which is aimed at transmitting energy to China's eastern regions from western regions.

Jinsha River Yunchuan Hydropower Development Company is developing the RMB100bn (\$15bn) project. China Three Gorges Corporation (CTG) holds a majority share (70%) in the project, while the remaining 30% is equally shared by the Sichuan and Yunnan provincial governments.

The project will feature a double-curvature retaining arch dam and an underground power station housing a total of 12 Francis turbine units. The turbines generator units are being supplied by Voith Group and GE. The project is expected to generate first power in 2020.

#### 1. Baihetan Hydropower Station, China – 16GW

![](_page_20_Picture_6.jpeg)

The Baihetan hydropower project, under construction since 2012 on the Jinsha River, will be the fourth Chinese hydroelectric power facility to produce more than 10GW after the Three Gorges Dam (18.2GW), the Xiluodu Hydropower Station (13.86GW), and the Wudong-de Hydropower Station (10.2GW).

The concrete double-curvature arch dam of the plant will house eight 1,000MW turbine generators in each of its right and left bank underground stations. China Yangtze Power Corporation is developing the project, while Dongfang Electric Machinery will supply the turbine generators in collaboration with China Three Gorges Corporation.

The megaproject features the world's first 1,000MW turbine generator rotor, which was installed at the site in January 2019. The project is expected to be fully functional by December 2022.

Electrical Installation Engineer - Newsletter - May 2019 22

## FINNISH COMPANY BOOSTS BATTERY RECYCLING TO OVER 80 PERCENT

Finnish recycling company Fortum has achieved the high recycling rate for electric vehicle (EV) batteries of 80 per cent with a low- $CO_2$  hydrometallurgical recycling process. The number of EVs on the road will increase from 3 million to 125 million by 2030. Current battery manufacturing casts a shadow on the overall sustainability of electric vehicles. A new innovation in recycling resolves the sustainability gap by making over 80 per cent of the battery recyclable, returns the scarce metals used back into circulation and thus resolves the sustainability gap by reducing the need to mine nickel, cobalt, and other metals.

![](_page_21_Picture_2.jpeg)

"There are very few working, economically viable technologies for recycling the majority of materials used in lithium-ion batteries," said Kalle Saarimaa, Vice President, Fortum Recycling and Waste. "We saw a challenge that was not yet solved and developed a scalable recycling solution for all industries using batteries".

#### The process

The batteries are first made safe for mechanical treatment, with plastics, aluminium and copper separated and directed to their own recycling processes. The chemical and mineral components of the battery form a 'black mass' that typically consists of a mixture of lithium, manganese, cobalt and nickel in different ratios. Of these, nickel and especially cobalt are the most valuable, but also difficult to recover.

Fortum has developed a unique battery recycling process, involving chemical precipitation methodology that allows these minerals to be recovered and delivered to battery manufacturers to be reused in producing new batteries. This technology was developed by the Finnish growth company Crisolteq.

#### Second life batteries and a cleaner word

Fortum is also piloting so-called 'second life' applications for batteries; in these applications, the EV batteries are used in stationary energy storages after they are no longer fit for their original purpose.

If the forecasts on the increase in the number of EVs by 2030 hold true, it would mean an 800 per cent increase in the demand for nickel and manganese and a 150 per cent increase in the demand for cobalt for the production of new batteries. These scarce metals are mined from very few locations, and mining them would increase the greenhouse gas emissions from their production by 500 per cent.

Using recycled battery materials reduces also the CO<sub>2</sub> emissions from battery production up to 90 per cent.

Achieving a truly circular economy for batteries depends on synergic partnerships with battery manufacturers, the car industry, recycling companies and start-ups. The EU can also play a significant role in setting ambitious recycling targets for batteries. Fortum's invitation to "Join the change for a cleaner world" goes out to everyone committed to solving the sustainability challenges related to using, manufacturing and recycling batteries.

## 10 DISRUPTIVE BATTERY TECHNOLOGIES TRYING TO COMPETE WITH LITHIUM-ION - 2

## 3. Proton batteries

Many research efforts have been devoted to the generation of high-performance proton exchange membrane (PEM) fuel cells. However, the viability of PEM fuel cells has been a challenge due to their high cost, transportation and storage of hydrogen gas.

A team of researchers at RMIT University recently reported the technical feasibility of a proton battery for the first time. It consists of two parts: a carbon electrode to store hydrogen or protons from water and a reversible PEM fuel cell to generate electricity from the hydrogen. The battery design is innovative, as it uses activated carbon for the electrode, which is cheap, abundant and structurally stable for hydrogen storage and a small volume of liquid acid inside the porous material that conducts protons to and from the membrane of the reversible cell. With this battery, a voltage of 1.8 V is achievable.

![](_page_22_Figure_4.jpeg)

Though a tremendous step for efficient hydrogen-powered energy production, the commercialization of this technology is still a long way off. The team estimates the availability of the battery to be within five to 10 years. ABB Marine and Sintef Ocean are also testing a megawatt-scale propulsion plant to power commercial and passenger ships using hydrogen fuel cells. As these batteries do not require Li-ion at all, aside from using platinum as a catalyst, the remaining materials are inexpensive and abundant and therefore could be a leading contender to the current Li-ion batteries.

## 4. Graphite dual-ion batteries

Dual-ion batteries (DIBs) that use metals other than lithium have attracted a lot of interest in recent years for large-scale stationary storage of electricity. Research efforts are on to increase the energy density of the DIBs by increasing the ionic content of the electrolyte and the ability of the electrodes to store charge.

- Researchers demonstrated a new Li-free graphite dual-ion battery using a graphite cathode and a potassium anode, known as graphite dual-ion battery (GDIB). The findings were published in "*Nature Communications*." The team identified Li-free electrode-electrolyte combinations for DIB to increase the energy density of the cell. They used a concentrated electrolyte solution that demonstrated energy efficiency at par with Li-ion batteries.
- Using aluminum salt electrolytes, a research team has developed graphite-graphite dual-ion batteries (GGDIB) for the first time. The battery is inexpensive, environment-friendly and shows a superior cycle and rate performance for future energy storage applications.

• In another promising approach to DIBs, researchers at the South China University of Technology have reported the development of a Zn/graphite dual-ion battery. Due to the many attractive features of the ionic electrolyte, including suppressing dendrite formation on the Zn surface, low volatility, noninflammability, and high thermal stability, high-performance and safe Zn/graphite-ion batteries for industrial applications could become a reality soon.

#### 5. Aluminum-ion batteries

Abundant, inexpensive, readily available and cheap, aluminum is being investigated as a potential replacement for Li-ion batteries. Swiss researchers from ETH Zurich have come up with two new technologies that are a stepping stone to the commercialization of Al-based batteries.

- The first is a corrosion-resistant coating material, titanium nitride (TiN) ceramic, for use in these batteries. The excellent oxidative stability of TiN-coated materials enabled these batteries to attain a high energy density, high coulombic efficiency, and high cycling ability. Due to the excellent corrosion resistance of TiN current collectors, they could even be used as high-voltage cathode materials in Mg-, Na-, or Li-ion batteries.
- Another promising solution is the use polypyrenes as a high-performance cathode material for Al-ion batteries. These batteries typically use a graphite-based cathode, which gets distorted due to the chloroaluminate anions. Using a custom-made cell, the researchers tested polypyrene and its derivative poly(nitropyrene-*co*-pyrene) as cathode materials and found that it stores the same amount of energy as a graphite cathode. Moreover, polypyrenes offer numerous other possibilities for developing rechargeable Al-ion batteries, including low cost, high abundance, production scalability, and compositional and structural tunability.

![](_page_23_Figure_5.jpeg)

These research efforts show great promise towards commercializing Al-ion batteries for use as an inexpensive storage solution for the industry.

## 6. Nickel-zinc batteries

Nickel-zinc batteries are cost effective, safe, nontoxic, environment-friendly batteries that could compete with Li-ion batteries for energy storage. However, the main barrier for commercialization has been their low cycle life.

To address this problem, Chinese researchers from the Dalian University of Technology have developed a breakthrough in-situ cutting technique to improve the performance of Ni-Zn batteries by solving the issue of Zn electrode dissolution and suppressing the formation of dendrites. The team developed a novel graphene-ZnO hybrid electrode with the in-situ cutting technique, which can cut graphene directly into short nanoribbons. The strong interatomic interactions anchor Zn atoms onto graphene surfaces. This approach thoroughly fixes the issues of Zn electrode dissolution, dendrite formation, and performance.

With the ongoing research and approaches taken by companies, these batteries show immense potential for widespread commercial applications of electric vehicles (EVs) and energy storage.

## 7. Potassium-ion batteries

There have been a lot of recent breakthroughs to improve the electrochemical performance of potassium-ion batteries (KIBs). Three worth noting are listed below.

- A team of researchers from various institutions discovered a novel family of honeycomb-layered compounds with a general formula of  $K_2M_2$ TeO<sub>6</sub> (where M=Ni, Mg, Co, etc. or a combination of at least two transition metals). These honeycomb structured potassium-based tellurate compounds are suitable for high-voltage cathode materials and are capable of inserting K ions into ionic liquids, making them excellent candidates for the development of high-energy KIBs.
- Similarly, another team at the University of Wollongong developed a high-performance KIB with a composite of few-layered antimony sulfide/carbon sheet (SBS/C) anode.
- Other promising approaches include focusing on the synergistic combination of the electrolyte and the electrode as well as developing suitable anode materials to design a high-performance KIB.

These novel approaches will help circumvent the limitations of the suitable host substrates for intercalating K ions and are a promising step towards attracting industrial investments for commercial applications.

## 8. Salt-water batteries

Water can conduct ions and be used to form rechargeable batteries. However, the chemical stability of water lasts up to 2.3 V, which is three times less than Li-ion batteries, limiting its use in EVs. These batteries could be suitable for stationary power-storage applications. To achieve the potential, researchers at the Swiss Materials Testing and Research Institute (Empa) used a specific salt called sodium bis(fluorosulfonyl)imide (FSI), which is very soluble in water. The salt-containing liquid has all the water molecules concentrated around the sodium cations in a hydrate shell, resulting in hardly any unbound water molecules present. This saline solution shows superior electrochemical stability of up to 2.6V, which is twice as high as other aqueous electrolytes. The prototype has shown promising results in the lab and can stand multiple charge-discharge cycles.

Similarly, researchers at Stanford have developed a low-cost, durable salt-water battery for solar- and wind-energy storage. These batteries are easy to develop, as they only need manganese sulfate, water, cheap industrial salt, and electrodes for the catalytic reactions. Moreover, the chemical reaction stores electrons as hydrogen gas for future use, illustrating its suitability for grid-scale applications. The performance of the prototype manganese-hydrogen battery could be scaled up and shows a solid performance of up to 10,000 cycles and an extended life span. The battery is in the process of getting patented by the researchers before commercial applications. It has generated a lot of industrial interest, and companies including Aquion Energy are working to make cheaper batteries for grid-level storage. BlueSky Energy uses Aquion's salt-water technology for residential solar storage.

Although the current applications of the salt-water batteries are limited, they still offer several advantages, including safety, low cost and nontoxicity, for use in stationary storage systems.

#### 9. Paper-polymer batteries

Paper-based microbial bio-batteries have generated widespread interest, as they are inexpensive, environment-friendly, and self-sustainable. They could have enormous applications in biosensors and future electronic devices. However, the main limitation is the low performance.

Recently, Seokheun Choi and a team of scientists developed a high-performance microbial battery engineered from a biodegradable paper-polymer substrate. The pores of the paper contained freeze-dried electric bacteria capable of exporting electrons as a by-product of respiration. To further improve the electric performance, the team incorporated a biodegradable polymer mixture into the paper. These hybrid paper-polymer microbial fuel cells show an enhanced power-to-cost ratio, with a shelf life of about four weeks without needing any additional conditioning or microorganisms. The technology is under patent application, and the team is seeking industrial investments for commercialization. Further improvements in design optimization could offer more versatility in the use of these batteries for numerous other applications.

![](_page_25_Picture_1.jpeg)

Researchers harnessed bacteria to power these paper batteries. Seokheun Choi

## 10. Magnesium batteries

Mg-based batteries could compete with Li-ion in theory, due to a higher energy density capacity. However, Mg-based batteries are not rechargeable, as the reversible reaction requires a corrosive electrolyte that creates a barrier for  $Mg^{2+}$  ions.

For the first time, scientists at the Department of Energy's National Renewable Energy Laboratory (NREL) presented a prototype of a rechargeable Mg-based battery. They generated an artificial  $Mg^{2+}$ -conductive interface on the Mg anode surface. The interface protects the surface of the Mg anode while enabling the reversible cycling of an Mg/V2O5 fuel cell in a water-containing, carbonate-based electrolyte. The strategy significantly improves the battery performance of Mg-based batteries.

In another approach, a team of researchers at MIT, Berkeley and Argonne National Laboratory developed a solid-state material that conducts Mg ions faster, especially in the ternary spinel chalcogenide framework. This battery design requires further testing and research to enter the commercialization phase.

## Top featured technologies for solar applications

Batteries used for solar applications require several characteristics beyond low cost. Capacity and power ratings for solar batteries will depend on energy and power density characteristics of the batteries. Additionally,

metrics like the depth of discharge, overall lifetime, and efficiency of the battery will be crucial in determining which chemistries end up working for which specific niches/applications.

![](_page_26_Figure_1.jpeg)

Though a lot of the batteries featured above are in the early phase of development, they could offer low-cost alternatives to Li-ion batteries for solar applications with a longer lifetime and a wide temperature range. Ni-Zn, Mg, Al-ion, NaS, graphite DIBs, KIB, proton and salt-water batteries could all play an important role. These are recyclable and are the subject of much research investigating how to optimize the chemistries with no undesirable side reactions. As such, they offer great promise for renewable-power storage. For example, BlueSky energy has already started using salt-water batteries for residential solar storage, with prices comparable to Li-ion batteries.

Battery Type	Phase	Cost	Performance	Capacity	Rechargeable
Proton	Research	+	++	+	Ś
Graphite Dual-Ion	Research	+	++	+	S
Room-Temperature Sodium Sulfur	Research	++	++	+	Ś
Aluminum-Ion	Research	+	+++	+++	Ś
Nickel-Zinc	Prototype	+	++	+++	Ś
Potassium-Ion	Prototype	+	+++	+	Ś
Salt-Water	Prototype	++	+	++	S
Magnesium					
Mg-Metal	Prototype	++	+++	+	Ś
Solid-State Mg	Research	+++	+++	+	*

# TANGEDCO OPTS FOR GPS TO GET WIND POWERGENERATION REAL TIME

CHENNAI: Tangedco has started measuring wind power generation real time with the help of GPS over the last few months. GPS system has been installed in all windmills across the state and discom has been able to measure the power generation from a windmill without going to the spot.

![](_page_27_Picture_2.jpeg)

Till now an assessor with the help of an equipment was recording the generation and there were several lacunae in such measurement, causing losses to the discom. Tangedco has also set up smart meters in all high tension consumers and this has prevented assessors from visiting the consumer and recording the consumption.

"After installing GPS in all windmills, we are able to get the bill from the wind power companies for selling wind power within 5 days of a new month, as against a delay of over a month earlier. There is also transparency as the bill is digital and no assessor is involved," said a senior Tangedco official.

Tamil Nadu is the first state to have used GPS in windmills. Other states like Karnataka, Gujarat and Maharashtra are also likely to opt for this route shortly.

Tamil Nadu has a total wind power capacity of 8,322 MW. "With the new billing scheme, it is easy for us to know the wind power generation in a real time. We depend on forecast for power schedule, but with GPS we are able to know the wind generation real time," said the official. The GPS scheme will also help the discom to know how many windmills are actually generating power during the wind season, as many are old and not generating at all.

In the coming months, the GPS system will be installed in solar, biomass and even in thermal plants there by ruling out malpractises in billing. This will help lower discom's expenditure too.

Meanwhile, the discom has also changed all digital meters with smart meters for high tension consumers. High tension consumers are mostly factories, IT offices and other companies, which consume large amount of power. "We have a software for the smart meters and through this the bills are sent to the consumers on the first day of a month. Here too we have stopped sending assessors to collect the data on how much power has been consumed," said the official.

The bills will be sent through SMS or email to the companies. "There are a total of 9,160 high tension consumers in the state. Through the smart meter, the billing will be uniform," he said.

## BRAND GOZERO MOBILITY ROLLS OUT E-BIKES IN INDIA

British electric bike and lifestyle brand GoZero Mobility announced its foray into Indian market with the launch of two electric bikes Mile and One priced at Rs 29,999 and Rs 32,999 respectively. The Birmingham-based firm has tied-up with Kolkata-based Kirti Solar to develop and manufacture current range as well as future products. As a part of the association, the latter has invested US \$ 250,000 in GoZero Mobility. Manufacturing is going to take place from Kolkata, West Bengal with an initial capacity of 20,000 units per annum. The partnership is for the global market & aimed to make India as an export hub for global sales of GoZero E-Bikes.

![](_page_28_Picture_2.jpeg)

![](_page_28_Picture_3.jpeg)

we see this as an appropriate time for us to be here," GoZero Mobility CEO Ankit Kumar told reporters while unveiling the products. Both the products are meant for India, Africa and South-East Asia, he added. On sales target, he added, "We anticipate selling 3,000 units in the first year and scale up to 75,000 in the next five years." In domestic market, the company would come out with premium retail outlets to sell its products, he added.

![](_page_28_Figure_5.jpeg)

While GoZero One is powered with 400Wh lithium battery pack optimized to provide 60 Kms of range on single charge, GoZero Mile is powered with 300Wh lithium battery pack which provides 45 kms range. The company has claimed in its release that both the products are specialized performance e-bikes providing optimum stability and comfort and come with multi-modes of operation giving users freedom to choose the way of riding – Throttle, Peddle Assist, Cruise Mode, Walk Mode and Manual Peddle. It is also firming up plans to launch other models like DelivR, One W and Zero Smart in India, the UK and Europe.

"We aim to have three such centres in Delhi, Kolkata and Guwahati in next few months. In the next three years, we are aiming to have around 18 such experience centres," Kumar added. The company also plans to have a network of over 1,000 retailers in the next two years.

GoZero will also sell its signature range of lifestyle merchandise designed in the UK, which includes sweatshirts, jackets, belts, and wallets, among other products from the outlets, he added.

Commenting on its India entry and plans for this market, GoZero Mobility CEO, Ankit Kumar said "With the significant focus by the Government of India towards Electric Mobility especially 2-wheelers; we see this as an appropriate time for us to be here. E-bikes globally is playing a major role allowing the user to commute faster and contribute towards curbing pollution & reducing traffic congestion. In last few weeks, we have seen the worst of AQI in cities like New Delhi, this is an alarming situation and requires immediate attention. We see E-bikes to play a major role in transforming the way we commute in India. GoZero Mobility is determined to offer products with optimum performance and create a green-way to commute."

## TRICHY AIRPORT SOLAR

Trichy international airport on Friday got a solar power plant to power its campus here when Airports Authority of India (AAI) board member Anuj Agarwal commissioned the 1 megawatt plant set up on its premises.

![](_page_29_Picture_4.jpeg)

Established under the National Solar Mission at Rs 4.64 crore, the ground-based solar power plant in Capex model has commenced operation three months after work began on the project. Airport officials exuded confidence that the unit will produce 15.4 lakh units a year, which is approximately 25% of its annual energy consumption. It is expected to save the airport Rs 1.23 crore by way of electricity expenditure per year.

The payback period expected of the plant would be three years and nine months. The electricity sourced from the plant would light up the airport premises throughout the day while regular electricity supply will take care of the consumption at night. AAI also said that it was looking forward to effectively minimizing greenhouse gas emissions thereby contributing to India's goal of minimizing environmental degradation.

Airport director K Gunasekaran told reporters that "the use of solar power to meet our electricity demand will save several lakhs per month." He also said that AAI Trichy had handed over two ambulances to '108' services in Trichy at Friday's function.

The addition of the two ambulances has raised the number of vehicles to 32 including two bike ambulances. Ambulance service officials said that one of the ambulances would be stationed on the airport premises to be utilized in case of emergencies to passengers or visitors or anyone in the nearby area. The second one will be used at Pulivalam on the outskirts of Trichy near Thuraiyur.

## NEW SENSFORMER® ADVANCED WITH APPLICATIONS BASED ON DIGITAL TWIN SIMULATION OF TRANSFORMERS

Siemens is introducing Sensgear, its new digital switchgear portfolio, and the Sensformer advanced at this year's Hannover Messe. With the combination of the already well-established digitally connected transformer, the Sensformer, and the new Sensgear technology, all substation transmission assets are now fully connective, allowing operators to check their status via online applications in real time. Gas-insulated switchgear, circuit breakers, surge arresters, disconnectors, instrument transformers, and coil products will henceforth be equipped with Sensgear technology. All devices are connected via a smart and robust Internet of Things (IoT) gateway that securely transmits the required information to a cloud-based storage and visualization platform. All Sensgear

![](_page_30_Picture_2.jpeg)

products provide additional transparency with GPS and local weather information as well as product-specific measurement data that includes gas density, liquid temperature, gas leakage, and switching position.

With Sensformer and Sensgear technology, every operator will have access to a cloud-based platform application that visualizes the collected data and enables a comprehensive overview of all assets and the power grid's status in real time. These new levels of connectivity and transparency minimize the risk of unplanned outages, leakage, and potential carbon equivalent emission penalties. Real-time insights will help power system operators and energy companies face current challenges such as increased performance demands and cost reductions. It will also support them in integrating the growing proportion of renewables and distributed energy generation into the power grid.

"The digital age affects us in all areas of our business, in sales, production, logistics and to an increasing degree our products. In the IoT world, connectivity of our products will become a mandatory element of the functionality customers expect from our products. Today we would not buy a new car without connectivity enabling apps to support driving and for convenience. With Siemens Sensgear and Sensformer advanced we are shaping this trend in the energy transmission business with enhanced functionality for the main substation equipment," says Beatrix Natter, CEO of Transmission Products at Siemens Gas and Power. "Our innovations provide added transparency with a connective platform and with analytic app enrichment for transmission assets. And we are already taking the next steps: with digital twins, active overload management becomes advanced intelligence and makes enhanced productivity possible. Starting with transformers "born connected" in 2018, we will be rolling out connectivity within 2 years to all transmission products being delivered," she adds.

Digitalization is taking place at an unprecedented pace in the transmission product industry. The main substation elements are already prepared for scaling up of product features. With the additional two new extensions, the Sensformer advanced and Sensgear advanced, Siemens has launched a new value-add application that also enhances productivity and intelligence. It provides switchgear assets with a health index prediction to reduce unscheduled downtime and a reporting function that prevents emissions of fluorinated greenhouse gases (F-gas), along with other measurements. The version for transformers is based on a digital twin operation that simulates the behavior of the physical asset in real time. It comes with an active overload manager, a full temperature view, and life consumption analytics for transformers.

Cybersecurity is a critical factor in the success of digitalization, which is why end-to-end encryption is used when transmitting sensor data from Siemens substations to the cloud. Sensformer and Sensgear come with state-of-the-art IT security technology that complies with all relevant standards.

## JAPAN'S SPACE AGENCY TEAMS UP WITH TOYOTA TO DEVELOP MOON ROVER

The Japan Aerospace Exploration Agency (JAXA) announced Tuesday (March 12) that it is working with v e h i c l e manufacturer Toyota to develop the moon rover of the future – a massive vehicle powered by fuel cells.

The agreement allows JAXA and Toyota to further cooperate on and

![](_page_31_Picture_3.jpeg)

accelerate their ongoing joint study of a manned, pressurized rover that employs fuel cell electric vehicle technologies. Such a form of mobility is necessary for human exploration activities on the lunar surface.

The thought of a car company developing a lunar vehicle might seem unusual, but General Motors played a large role in developing the first—and so far the only—vehicle to transport astronauts across the lunar surface. While GM's work was focused on the American space mission, JAXA and Toyota are thinking on a global scale.

"The automotive industry has long done business with the concepts of 'hometown' and 'home country' largely in mind," said Toyota President, Akio Toyoda, in the joint announcement. "However, from now on, in responding to such matters as environmental issues of global scale, the concept of 'home planet,' from which all of us come, will become a very important concept."

#### The rover will be a behemoth

The huge pressurized lunar rover will be crewed by two astronauts but capable of carrying four in the event of an emergency. Based on the current concept designs, the vehicle will be at least 20 feet (6 meters) long, have six wheels, and measure 17 feet (5.2 meters) wide and 12.4 feet (3.8 meters) high. It will also have about 140 square feet (13 square meters) of living space, JAXA officials said, reports Space.com.

There are two concept images, both of them showing a beautifully sleek vehicle with a nose covered in angled windows. The images show the vehicle has headlights, running lights and even brake lights. One image also shows a roll-out solar display for generating solar power.

NASA's unpressurized lunar rovers were tricycles in comparison to the Toyota concept vehicle. They could seat two astronauts in space suits and had four wheels and were 10.1 feet long (3.1 meters) and 7.5 feet wide (2.3 meters), with a maximum height of 3.7 feet (1.14 meters). However - they did serve their purpose.

JAXA officials admit that building a rugged sports utility vehicle (SUV) for lunar traveling does have its challenges. "Lunar gravity is one-sixth of that on Earth. Meanwhile, the moon has a complex terrain with craters, cliffs, and hills," astronaut Koichi Wakata, JAXA's vice president, said in the statement.

"Moreover, it is exposed to radiation and temperature conditions that are much harsher than those on Earth, as well as an ultra-high vacuum environment."

While JAXA has said it is committed to participating in NASA's plans to return to the moon, JAXA officials did not specifically say that the Toyota moon rover project will be part of its contribution to a future human moon mission effort.

## SOLAR ROADWAY OPENS IN CHINA

In Jinan, China. According to China Daily it is 2 kilometers long (1.24 miles) and built with three layers: an insulating layer at the bottom, the photovoltaics in the middle, and then protected on top with a slab of "transparent concrete."

According to Echo Huang in Quartz, the solar collecting area totals 5,875 square meters (63,200 sq ft) and will generate one million kWh (3412 million BTUs or 750,000 horsepower hours for American readers) of electricity in a year. The cost was about 3,000 yuan per square meter. about or US\$ 42.6 per square foot. Similar projects worldwide have succeeded in scoring copious amounts of headlines, as well as questions about whether the benefit of these experiments are really worth their cost. And of course, China has a history of announcing eye-popping infrastructure projects that at first seem

![](_page_32_Picture_3.jpeg)

![](_page_32_Picture_4.jpeg)

a great leap forward for sustainability until they are given a closer once-over. For example, a "straddling bus" last year scored plenty of buzz at first, followed by heaps of ridicule.

He also notes that "other solar roads built elsewhere have proven to be a mixed bag." Indeed. The one in the Netherlands generates only 30 percent of what roof-mounted panels would, and cost millions of dollars. It just had to be strong enough to withstand the weight of bikes; the Jinan road has to deal with the pressure and vibration caused by trucks and buses. The sun has to get through dirt and oil that comes off of all those trucks, buses and cars.

"It's a solar panel, people. It doesn't matter where you put it". Actually, it does. The largest obstacle to solar power today is the logistical nightmare of getting the power into the power grid. The Solar Roadways solve that problem by BECOMING the power grid with the capacity to send power wherever it's needed.

Forgive others. Not because they deserve forgiveness, but because you deserve peace.

Electrical Installation Engineer - Newsletter - May 2019 38

## ENERGY, ELECTRICAL ENERGY AND RENEWABLE ENERGY – 20

#### Sustainable Growth, Sustainable Electrical Energy and Renewable Energy

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

## Bio Oil or Pyro Oil (Continued)

Production of Bio Oil from Biomass, of all types including leafy, stems and solid Biomass wastes from agriculture and Plantations and forests can all form the source of supply of raw materials for the Bio Oil Plants of all types and capacities including small capacity mobile plants. Utilizing all kinds of wastes available, it is even possible to replace most of, if not all of, Petroleum requirements of our country. It will be worth recalling at this point that one of the important factors affecting both our economy and challenging our efforts for energy security, is the large import of crude every year. More than 80% of our requirements are met through import of Crude.

We saw the example of Sugarcane Trash and Tops which are mostly burnt away where in Indian conditions it will be possible to produce about 20 Million Tons of Pyro Oil or Bio Oil. There are also a number of cases of large scale burning of Agricultural wastes like in the cases of Punjab and Haryana.

#### The following Table provides comparative Heat Values of Crude, Bio Oil and other products

Fuel Type	Oil	Kerosene	Propane	Natural Gas	Electricity	Bio Oil
Unit	Kg	Kg	Kg	Kg	Unit kwh	Kg
Kilo Calories	10,500	10,000	8,500	9,000	860	5,500*

\*\*\*\* Bio Oil is of about half the calorific value of Crude Oil. Processes are developed and being developed to either use the oil directly or process it to produce various petroleum products like Petrol, Diesel and so on.

**Bio-oil Produced from Biomass Pyrolysis Technology** 

![](_page_33_Figure_10.jpeg)

## Uses of Fast Pyrolysis Products (Diagram Next Page)

Fast pyrolysis utilizes biomass to produce bio-oil which is used both as an energy source and a feedstock for chemical production. In contrast to fossil fuels, the use of bio-oil for energy provides significant environmental advantages.

#### **Pyrolysis Process Diagram**

A simplified Process Diagram is shown below illustrating the basic principle of the Process. Based on this medium sized Plants of Capacities 200 Tons per Day or Mobile Plants of 2 to 3 Tons per day Plants are built to suit the needs and the Bio Mass supply rate etc.

Plant growth needed to generate biomass feed stocks removes atmospheric carbon dioxide, which offsets the increase in atmospheric carbon dioxide that results from biomass fuel combustion. A fluidized bed pyrolyzer is used to convert biomass into bio-oil and bio-char. Bio-oil, a main product of this process, and bio-char, a by-product, can be used for boiler applications of all types including Power Generation.

![](_page_34_Figure_0.jpeg)

![](_page_35_Picture_0.jpeg)

![](_page_35_Picture_1.jpeg)

## Biomass fast pyrolysis facility

Electrical Installation Engineer - Newsletter - May 2019 41

#### Biomass fast pyrolysis facility Features

- Biomass, agro-wastes, and forestry residues can be used as feedstock for bio-oil production
- The fluidized bed pyrolyzer, operated in one atmosphere and 400-500°C, can quickly convert feedstock into bio-oil and bio-char continuously

#### Benefits

- Bio-oil production is 50-70 wt% of feedstock and bio-char 15-25 wt%
- Syn-gases generated from pyrolyzer can be used as an energy source for converting feedstock into bio-oil and bio-char

#### Applications

- Bio-oil fuel for packaged boiler
- Bio-oil upgrading for drop in fuel
- Bio-char fuel for pulverized coal boiler
- Bio-char for soil improvement
- Bio-char for activated carbon

## **Challenges of Fast Pyrolysis to Produce Bio-Oil**

- Drying of Bio-mass
- Small particle size necessary
- Reactor Scale-up
- Secondary Cracking
- Coaly matter separation
- Liquid gathering

## Other Problems undergoing Research and Development

- Storage and longevity
- Low pH/ high acidity
- Immiscibility with non-aqueous liquids
- Combustion/Co-Firing
- Storage Stability Problems- viscosity increases with time.
- Combustion Problems Associated with Aging- particulate size increases because of polymerization reactions in heated bio-oil causing equipment clogs or frequent filter changes.

![](_page_36_Picture_26.jpeg)

42

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

![](_page_36_Picture_28.jpeg)

## RAMESH AGARWAL

Dainik Bhaskar

## ENTREPRENEUR

![](_page_37_Picture_3.jpeg)

RAMESH AGARWAL Dainik Bhaskar

![](_page_37_Picture_5.jpeg)

#### Bhaskar Group is Now India's Largest Read Newspaper Group

Dainik Bhaskar was established in 1958 by Dwarka Prasad Agarwal and passed on to his son Ramesh who has since taken it to "Mt. Everest" heights.

From a humble beginning of one Hindi Edition from Bhopal in 1958, the group today has grown to become India's Largest newspaper group with 1.98 crore readers, having 153 offices all over India with more than 8,000 employees, 27 publication centers, 2700 correspondents and 253 news bureaus. The group is now having 4 daily newspapers, 1 financial daily and one magazine. Today it covers 13 States with 65 editions and 4 languages.

The group has a strong presence in newspapers, radio, event marketing, printing, short code, internet portal. With its flagship Hindi daily newspaper, Dainik Bhaskar, Gujarati daily, Divya Bhaskar, Marathi daily Divya Marathi and English daily -DNA,. In addition to these, it also publishes Business Bhaskar, DB Star and Magazines like Aha! Zindagi, Balbhaskar, Young Bhaskar and Lakshay. The other media business includes My FM (radio channel), 54567 (Short Code), IMCL (internet services). This has been achieved by Ramesh with his three worthy sons, Sudhir, Girish and Pawan. The Group led by them is known for its aggressive marketing; their successful launch model not only has been categorized as orbit shifting innovation but won the Marico Innovation award for process innovation. When they launched DNA in Mumbai, its innovative advertising made it No. 2 within a year of its launch. The successful launch of Dainik Bhaskar in several cities is a typical case study in Business Schools. It has diversified in to other areas such as solvent extraction, textiles and power. Not forgetting the corporate social responsibility that comes with success, Dainik Bhaskar Group has established The Sanskar Valley School, Bhopal, to encourage children to carve their own path and have been working in the field of water conservation across all its markets. Dainik Bhaskar in the year 2011, announced Bhaskar Bolly wood Awards to honour the excellence in Bollywood selected through Public Votes.

newook				
What is written on Steve Jobs tombstone? iCame, iSaw, iConquered, iLeft, iCameBack iThinkDifferent iMac	What do you call having your grandma on speed dial? Instagram.	What happens when a Buddhist becomes totally absorbed with the computer he is working with? He enters Nerdvana.		
iPod, iTunes, iPhone, iPad, iCloud, iRIP Why do Java developers wear	What did the cat on the smart phone say? Can you hear meow? Because it left its windows open. What is an astronaut's favorite place	Why did Mark Zuckerberg visit Beijing, China? To see the "Great Firewall".		
glasses? Because they don't C#. What do you call a ride sharing app	on a computer? The Space bar!	Why are PCs like air conditioners? They stop working properly if you open Windows!		
that serves breakfast? Eggs Uber Easy.	What do you call a woman you married off the internet? Wife-I.	What was the hipster doing at the computer? Looking in the recycling bin for something retro.		

HUMOUR

## சர்க்கரை வியாதி உள்ளவர்கள் ஏன் பட்டை நீர் உட்கொள்ள வேண்டும் என உங்களுக்கு தெரியுமா?

நமது வாழ்க்கை முறை மாற்றம், ஆரோக்கியமற்ற வாழ்க்கை முறை, மன மற்றும் உடல் ரீதியான உடற்பயிற்சியின்மை, அதிக மன அழுத்தம் ஆகிய காரணங்களால் இந்த நீரிழிவு நோய் ஏற்படுகிறது. தேவையான அளவு இன்சுலினை உடல் உற்பத்தி செய்யாத (அ) உற்பத்தி செய்த இன்சுலினை பலனளிக்கும் விதத்தில் பயன்படுத்த முடியாத நிலையில் ரத்தத்தில் சர்க்கரையின் அளவு அதிகரிக்கும் போது இது ஏற்படுகிறது.

**நீரிழிவு அறிகுறிகள்:** அதிகமான தாகம் மற்றும் பசி, அடிக்கடி சிறுநீர் கழித்தல், மங்கலான பார்வை, எடை இழப்பு, அளவுக்கதிகமான களைப்பு. நோய் தொற்றுகள், கை மற்றும் கால்களில் உணர்வுகள் குறைதல்.

நீரிழிவு நோய் சிகிச்சையில் உணவுக் கட்டுப்பாடு முக்கிய பங்கு வகிக்கிறது. **உணவு முறையில் சில சிறு** மாற்றங்கள் செய்வதன் மூலம் ரத்தத்தில் சர்க்கரையின் அளவைக் குறைக்கலாம்.

**நாவல் விதைகள்:** 1 தேக்கரண்டி நாவல் விதை பவுடரை மிதமான சூடான நீரில் கலந்து தினமும் குடித்து வர வேண்டும்.

#### லவங்கபத்திரி இலை தூள், கற்றாழை ஜெல்:

கற்றாழை ஜெல் ரத்த க்ளுகோஸ் அளவை மேம்படுத்த உதவுகிறது. எனவே நீரிழிவு நோயாளிகளுக்கு சிகிச்சையளிக்க பயனள்ளதாக இருக்கிறது. மேலும் இது செரிமான அமைப்பை ஆரோக்கியமாக வைக்க உதவுகிறது. மலச்சிக்கலை போக்குகிறது. வலி மற்றும் வீக்கத்திற்கு சிகிச்சை அளிக்கிறது. அறுவை சிகிச்சைக்கு பிறகு வடு ஏற்படுவதைத் தடுக்கிறது. 1/2 டீஸ்பூன் லவங்கபத்திரி இலை தூள், 1/2 டீஸ்பூன் மஞ்சள் அலோவேரா ஜெல் இவற்றை ஒன்றாக கலந்து மதிய உணவு மற்றும் இரவு உணவுக்கு முன்பு எடுத்துக் கொள்ளவேண்டும். இது சர்க்கரையின் அளவைக் கட்டுப்படுத்தும்.

**மஞ்சள், நெல்லி பவுடர், வெந்தய பவுடர்**: 1/2 தேக்கரண்டி மஞ்சள் தூள், 1 தேக்கரண்டி பெரிய நெல்லிக்காய் பவுடர் மற்றும் 1/2 டீஸ்பூன் வெந்தய பவுடர் ஒன்றாக கலந்து 1/2 கப் நீரில் நன்றாக கலக்க வேண்டும். இந்த நீரை தினமும் காலை வெறும் வயிற்றில் குடிக்க வேண்டும்.

லவங்கப்பட்டை: 1 லிட்டர் தண்ணீரைக் கொதிக்க வைக்க வேண்டும். 20 நிமிடம் மிதமான வெப்பத்தில் தண்ணீரைக் கொதிக்க விட வேண்டும். 3 தேக்கரண்டி பட்டை தூள் சேர்த்து நன்கு கலக்க வேண்டும். இந்த நீரை வடிகட்டி தினமும் குடிக்க வேண்டும்.

**ஆலமரப்பட்டை:** ஆலமரப் பட்டைபொடியை (கடைகளில் கிடைக்கும்) எடுத்து 3 கப் நீரில் போட்டு 1 கப் ஆகும் வரை கொதிக்கவையுங்கள். பின்னர் இந்த டிகாஷனை வடிகட்டி, தினமும் 50 மி.லி குடிக்க வேண்டும். **வெண்டைக்காய்**: இது ரத்தத்தில் க்ளுகோஸின் அளவைக் குறைக்க உதவும் ஒரு சிறந்த உணவு. இரவு முழுவதும் நீரில் ஊற வைக்க வெண்டும். காலையில் வெறும் வயிற்றில் வெண்டைக்காயை சாப்பிட வெண்டும்.

**ப்ளு பெர்ரி:** ரத்த சர்க்கரை அளவைக் குறைக்க உதவுகிறது. இதன் சாறு நீரிழிவுக்கான சிகிச்சையாக அங் கீ கரி க் கப் படவில் லை. ஆனால் நீரிழிவு நோயாளிகளின் ரத்தத்தில் சர்க்கரை அளவைக் கட்டுப்படுத்துகிறது என்று கண்டறிந்துள்ளனர். பிளு பெர்ரியை பழமாகவோ (அ) சாறு பிழிந்தோ எடுத்துக் கொள்ளலாம்.

**திரிப்புலா**: திரிப்புலா மற்றும் இதன் மூலம் பெறப்படும் இதர பொருட்கள் ரத்தத்தில் சர்க்கரையின் அளவைக் குறைக்கும். இவற்றை மஞ்சளுடன் சேர்த்து ஒரு நாளுக்கு ஒரு முறை எடுக்கலாம்.

**பெரிய நெல்லிக்காய்:** ஒரு நாளைக்கு 2 முறை நெல்லிக்காய் சாறை பருக வேண்டும் (அ) ஒரு நாளைக்கு 2 நெல்லிக்காய் சாப்பிட வேண்டும்.

வெந்தயம்: வெந்தயம் நீரிழிவு 2வது வகைக்கு நல்ல மருந்தாக பயன்படுத்தப்படுகிறது. இது இன்சுலின் உற்பத்தியை அதிகரிக்க கணைய செல்களை ஊக்குவிக்கும் திறன் கொண்டது. 4 டீஸ்பூன் வெந்தயத்தை 300 மில்லி லிட்டர் நீரில் இரவு முழுவதும் ஊற வைத்துக் கொள்ளவும். காலையில் நீரை வடித்து வெந்தயத்தை அரைத்து நீருடன் குடிக்க வேண்டும். இவ்வாறு 3 மாதங்கள் தொடர்ந்து செய்ய வேண்டும். வெந்தயத்தை நீரில் இரவு முழுவதும் ஊர வைத்து காலையில் வெறும் வயிர்ரில் நீரையும் வெந்தயத்தையும் அருந்த வேண்டும். வெந்தயத்தை வெறும் வாணலியில் வருத்து பொடியை தினமும் நீரில் கலந்து குடிக்க வேண்டும்.

**பாகற்காய்:** பாகற்காய் ஆல்பா குளுகோசிடேஸ் என்சைமின் செயல்பாட்டைக் குறைக்கும் திறன் கொண்டது. இது சர்க்கரை அளவைக் குறைக்கிறது. 4 முதல் 5 பாகற்காயை எடுத்து அதில் உள்ள விதைகளை நீக்கவும். பாகற்காயை அரைத்து அதன் சாறை பிழிய வேண்டும். அந்த சாறை தினமும் காலை வெறும் வயிற்றில் குடிக்க வேண்டும்.

**நீரிழிவு உள்ளவர்கள் தவிர்க்க வேண்டிய** உணவுகள்: சர்க்கரை, கரும்புச்சாறு. நெய், எண்ணெய், கேக், வெல்லம், புளிப்பு பானங்கள், ஆல்கஹால், கார்போஹைட்ரேட் நிறைந்த உணவு, தயிர், குப்பை உணவுகள், வெண்ணெய், குளிர் பானங்கள், பிஸ்கட் போன்றவை. இவை அனைத்தையும் பின்பற்றி ஆரோக்கியமாக வாழுங்கள். நிறைய நார்சத்து நிறைந்த உணவுகள் எப்போதும் உங்களை கட்டுக்குள் வைத்திருக்கும்.

## உடலின் மூலை முடுக்குகளில் தேங்கியுள்ள சளியை வெளியேற்றும் சில அற்புத வழிகள்!

தற்போது குளிர்காலம் என்பதால் பலரும் சளி, இருமலால் அவஸ்தைப்படுவார்கள். சளி பிடித்துவிட்டால், மூச்சு விடுவதில் சிரமத்தை அனுபவிக்கக்கூடும். அதற்கு சுவாசக் குழாயில் சளித்தேக்கம் அதிகம் இருப்பது தான் காரணம். இந்த சளியைப் போக்க நாம் கடைகளில் விற்கப்படும் டானிக்கை வாங்கிக் குடிப்போம். அப்படி குடிக்கும்போது, சளியில் இருந்து நிவாரணம் கிடைத்தது போல் உணர்வோம். ஆனால் அது தற்காலிக நிவாரணி தான்.

ஒவ்வொருவரும் நம் உடலில் சளியை தேக்கிக் கொண்டு தான் இருக்கிறோம். ஒருவரது உடலில் சளி தேங்குவதற்கு உண்ணும் உணவுகள், பழக்கவழக்கங்கள் போன்றவையே காரணம். இப்படி உடலில் தேங்கும் சளியை நம் வீட்டில் உள்ள ஒரு சில பொருட்களின் மூலம் வெளியேற்றலாம். இக்கட்டுரையில் உடலின் மூலை முடுக்குகளில் தேங்கியுள்ள சளியை வெளியேற்றும் சில இயற்கை வழிகள் கொடுக்கப்பட்டுள்ளன.

**மஞ்சள்**: மஞ்சளில் உள்ள குர்குமின் என்னும் உட்பொருள் தான், அதன் மருத்துவ குணத்திற்கு காரணம். இது பாக்டீரியாக்களை எதிர்க்கும் மற்றும் இதை உப்புடன் சேர்த்து பயன்படுத்தும் போது, உடலினுள் உள்ள தொற்றுக்களை சரிசெய்து மற்றும் தொண்டை புண்ணை போக்கும். கீழே சளியை வெளியேற்ற மஞ்சளை உட்கொள்ளும் முறை கொடுக்கப்பட்டுள்ளது.

**தேவையான பொருட்கள்**: உடலில் இருந்து சளியை வெளியேற்ற உதவும் பானம் தயாரிக்கத் தேவையான பொருட்களாவன, 1 டீஸ்பூன் மஞ்சள், ½ டீஸ்பூன் உப்பு மற்றும் 1 டம்ளர் வெதுவெதுப்பான நீர்.

**தயாரிக்கும் முறை:** ஒரு டம்ளர் வெதுவெதுப்பான நீரில் மஞ்சள் தூள் மற்றும் உப்பு சேர்த்து கலந்து, தினமும் 3-4 முறை குடிக்க. சளி உருகி, தொண்டையில் கபம் தேங்குவது குறையும்.

**இஞ்சி:** இஞ்சியில் நோயெதிர்ப்பு சக்தியை அதிகரித்து. நோய் தாக்குதலை தடுக்கும் ஆன்டி-ஹிஸ்டமைன் ஏஜெண்ட்டும், சக்தி வாய்ந்த ஆன்டி-பாக்டீரியல் மற்றும் ஆன்டி-வைரல் பண்புகளும் நிறைந்துள்ளன. அதோடு இஞ்சி உடலில் தேங்கியுள்ள அதிகப்படியான சளியை வெளியேற்றும். அதற்கு இஞ்சியை கீழே கொடுக்கப்பட்டுள்ளவாறு பானம் போன்று தயாரித்து உட்கொள்ள வேண்டும். **தேவையான பொருட்கள்:** சளியை வெளியேற்றும் இஞ்சி பானம் தயாரிப்பதற்கு தேவையான பொருட்களாவன, இஞ்சி – 6-7 துண்டுகள், மிளகு – 1 டீஸ்பூன், தேன் - 1 டீஸ்பூன், தண்ணீர் – 2 கப்

**தயாரிக்கும் முறை:** முதலில் ஒரு பாத்திரத்தில் நீரை ஊற்றி கொதிக்க வைக்க வேண்டும். பின் அதில் இஞ்சி மற்றும் மிளகை சேர்த்து மிதமான தீயில் 5-7 நிமிடம் கொதிக்க வைத்து இறக்கி வடிகட்டி, தேன் கலந்தால் பானம் தயார். இதை சளி பிடித்திருக்கும் போது, தினமும் குடித்து வர சளி விரைவில் வெளியேறும்.

**ஆப்பிள்:** சீடர் வினிகர் ஆப்பிள் சீடர் வினிகர், உடலில் உள்ள PH சீராக்குவதோடு, அதிகப்படியான சளி உற்பத்தியைத் தடுக்கும். அதற்கு 1 டீஸ்பூன் ஆப்பிள் சீடர் வினிகரை 1 டம்ளர் நீரில் கலந்து, தினமும் குடிக்க வேண்டும்.

**ஆவி பிடிப்பது**: நல்ல சுடுநீரில் ஆவி பிடிப்பதால், சளி மற்றும் கபம் தளர்ந்து. சுவாசக் குழாய் சுத்தமாகி சுவாச பிரச்சனைகள் நீங்கி, நிம்மதியாக சுவாசிக்கலாம். முக்கியமாக ஆவி பிடிப்பதால் உடனடி நிவாரணம் கிடைக்கும்.

**தேவையான பொருட்கள்**: ஆவிப் பிடிப்பதற்கு வெறும் சுடுநீர் மட்டுமின்றி, அத்துடன் சிறிது மூலிகைகளையும் சேர்த்துக் கொள்வதால் நல்ல பலன் கிடைக்கும் தைலம் - ½ டீஸ்பூன், உலர்ந்த ரோஸ்மேரி – ½ டீஸ்பூன் சுடுநீர் – 4-5 கப்

**செய்முறை:** ஒரு பாத்திரத்தில் சுடுநீரை ஊற்றி, அதில் மூலிகைகளைப் போட்டு, பின் அந்நீரால் ஆவி பிடிக்க வேண்டும். இப்படி தினமும் 3-4 முறை செய்தால், சளி சீக்கிரம் வெளியேறிவிடும்.

**தேன் மற்றும் எலுமிச்சை:** சக்தி வாய்ந்த ஆன்டி-பாக்டீரியல், ஆன்டி-வைரல் மற்றும் பூஞ்சை எதிர்ப்பு பண்புகள் நிறைந்த தேன் சுவாச பாதையில் ஏற்படும் எரிச்சலைப் போக்கும். அதே சமயம் வைட்டமின் சி நிறைந்த எலுமிச்சை நோயெதிர்ப்பு சக்தியை மேப்படுத்தி தடையில்லாமல் சுவாசிக்க உதவும்

**தேவையான பொருட்கள்**: சளி மற்றும் கபத்தை வெளியேற்ற எலுமிச்சை மற்றும் தேனைக் கொண்டு அற்புத பானம் தயாரித்து பருக வேண்டும். அந்த பானம் தயாரிக்கத் தேவையான பொருட்களாவன, தேன் 1 டேபிள் ஸ்பூன், எலுமிச்சை சாறு – 2 டேபிள் ஸ்பூன்

**செய்முறை:** ஒரு பௌலில் எலுமிச்சை சாறு மற்றும் தேனை ஒன்றாக கலந்து, தினமும் மூன்று வேளைப் பருக சளி மற்றும் கபம் பிரச்சனையில் இருந்து நிவராணம் கிடைக்கும்.

## TIRUKKURAL AND FAIR AND ETHICAL MANAGEMENT - 4

![](_page_40_Picture_1.jpeg)

The quality of Equanimity is one of the essential of SQ and forms an important component of 'Fair and Ethical Management' and Tiruvalluvar shows more dimensions of this quality and shows more directions like uprightness and courage as brought out in the following Kurals:

Kedum Perukkamum Illalla Nenjaththuk Kodamai Sandrorkkani Kural 115 கேடும் பெருக்கமும் இல்லல்ல நெஞ்சத்துக்

கோடாமை சான்றோர்க் கணி.

"Evil and Good come unto all; but his upright heart is the Glory of the man of Worth"

Keduvalyan Enbathu Ariga; Than Nenjam Naduvoree Alla Seyin Kural 116

கெடுவல்யான் என்பது அறிகதன் நெஞ்சம் நடுவொரீஇ அல்ல செயின். குறள் 116

"When the heart sweareth from the Right and turneth unto Evil, know that thy destruction is near at hand"

Solkottam Illathu Seppam; Oruthalaya Ulkottam Inmai Perin Kural 119

சொற்கோட்டம் இல்லது செப்பம் ஒருதலையா உட்கோட்டம் இன்மை பெறின். *குறள் 119* 

"Verily the upright speech coming out of a man's mouth is a judgement, provided that he sweareth not at all from the Right to his heart"

(To be continued)

## HOME FESTIVALS - 6

ஆனி - Aani (June/July)

![](_page_40_Picture_15.jpeg)

குறள் 115

This is the one month of the year when there are no home festivals coinciding not uncoincidentally with an intense month of agricultural effort. However, during Aani, major temple festivals are held for Lord Siva as Nataraja, King of Dance (left), and for Siva and Parvati.

(To be continued)

The world is getting more connected through technology and travel. Cuisines are evolving. Some people are scared of globalization, but I think people will always take pride in cultural heritage. - JOHN MACKEY

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![](_page_41_Picture_8.jpeg)

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