ELECTRICAL INSTALLATION ENGINEER

NEWS LETTER

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

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EDITORIAL

Dear Members, Fellow Professionals and Friends,

Seasons Greetings To One And All!

Happy 75th Independence Day!!

Best Wishes To All For Good Health, Safety And Wellness!!!

This August 2021 is very special for all Indians as we all proudly celebrate the 75th Independence Day this month. Let us all resolve to be GOOD CITIZENS and PUT IN ALL OUR MIGHT FOR ALL ROUND BETTERMENT OF OUR GREAT NATION!

We have all read and heard a lot about our slavery for hundreds of years under the rules of invaders and the colonial rulers and about the brave warriors, fighters and great leaders who have all fought for our dear FREEDOM that was obtained on 15th August, 1947. They all had dreams of free and prosperous "Bharat" when they sacrificed everything including their lives in many cases, in course of fight for the Freedom. An honest analysis will show that we have not kept up to their dreams as we have lowered the standards of our Democracy during these 75 years through petty and selfish politics. We will be convinced of this if we read the poems of "Mahakavi Bhararathiar" written decades before we really got the Independence.

Our Great Country has not only a living civilization dating back to over 5000 years, but has also had a prosperous Economic Presence with International businesses for a long period of history. An International research tracing the Economic History of the World for the past 2000 years, has concluded that for 3/4th of the 2000 years period, ie up to around 1750 AD, the most leading economies of the world were only India and China. There was a downfall of Indian Economy after this period mainly due to the colonial rule and the Economy has certainly grown after our Independence and at faster rate after the liberalization policies in 1991. We have ambitious plans for growth which should again gallop after getting over the Pandemic.

The Pandemic seems to be coming under control in most parts of India, but the threat of another serious wave coming, in about a few months' time, is also being discussed by experts in the field. As far as our country is concerned, we are galloping with vaccination and we seem to have set some world records too in this regard. It is very essential that we do not relax on the precautionary measures like mask and wash and social distancing for some more time as advocated by Governments and experts.

It is very satisfying that normalcy is slowly and steadily returning with all precautions in place, so that the economic activities and the lively hood of people return at least to near normal levels as quickly as possible. It is indeed encouraging to know what India has achieved in terms of economy in the first quarter of the current year. The country reported its highest-ever merchandise exports at $95 billion in the first quarter of the current fiscal year, Government data showed on Friday, July 2. The exports recorded in the April-June quarter is 85 per cent higher than the exports registered in the corresponding period last year and this is also the highest export of merchandise ever achieved in a single quarter by India. With this kind of growth India is now targeting exports of $400 Billion for the Merchandise and $350 Billion for the Services. Normal and more than normal levels of monthly GST collections too indicate that the overall business activities are catching up normalcy. All these indicate better times ahead for the benefit and prosperity of all sections and businesses.

We thank all those members who have helped us by participating in the advertisement appearing for the issue June 2021 – E Focus Instruments India Pvt. Ltd., E Power Engineering & 3si Eco Power LLP.

Editor

INDIA INNOVATES TECHNOLOGY THAT GENERATES HYDROGEN DIRECTLY FROM AGRICULTURAL RESIDUE

Sentient Labs, an R&D innovation lab (incubated by KPIT Technologies with initial technical inputs) and MACS-Agharkar Research Institute (ARI), have developed the world's first technology that generates hydrogen directly from agricultural residue for use in fuel cell-powered vehicles.

Sentient Labs' vision is to build technology solutions for the electrification of mobility. It has identified bottlenecks in battery technology, fuel cell technologies, and technologies for hydrogen generation. Multiple efforts are underway to create the building blocks necessary for sustainable mobility.

MACS-Agharkar Research Institute is committed to conduct basic as well as applied research in life sciences and harness the genetic diversity of microbes for bio-energy generation and has been working towards developing solutions which are appropriate for national use.

Hydrogen fuel cell vehicle technology is estimated to be the next big step in the direction of sustainable mobility as it provides a large operating range, is suitable for commercial vehicles, and leaves a minimal environmental footprint. The need of the hour in crude oil-importing nations is to rapidly move towards self-reliant energy sources and sustainable mobility. The hydrogen generated from this technology will be utilized to power fuel cell vehicles that emit only water, thus making the entire cycle pollution-free.

This hydrogen generation technology uses agricultural residue rich in cellulose and hemicellulose content – in likes of paddy, wheat, or maize residue. The process uses microbial culture for the direct generation of hydrogen from agricultural residues. It further generates methane, which is utilized for producing additional hydrogen by steam methane reformation. This process can avoid the burning of bio-mass generated in large measure in the Indian countryside and generate organic manure and CO2, which finds applications in various industries.

A pertinent sustainability aspect of the innovation is that it models on the circular economy. In India, approximately 200 million tons of unutilized agricultural residue is generated. This agricultural residue, which is burnt in most of the cases, can be fed into this process to generate hydrogen.

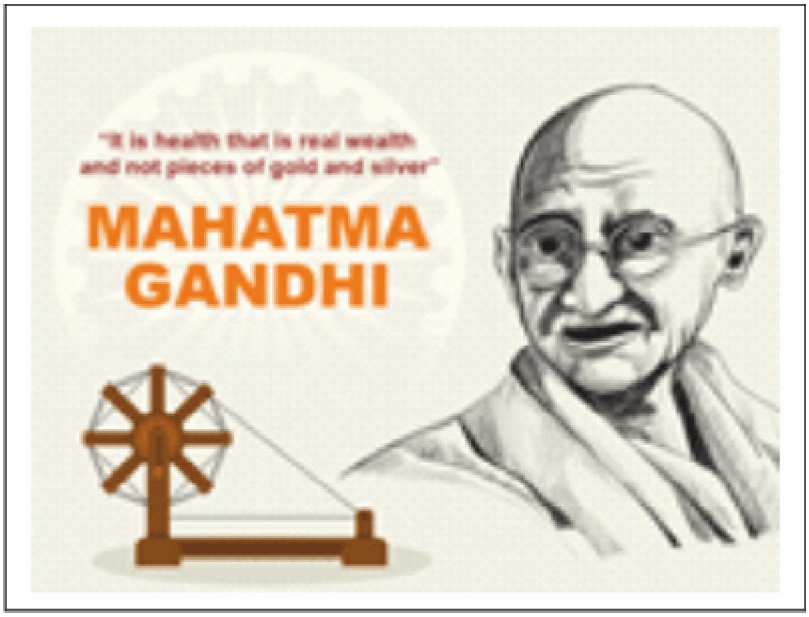
Ravi Pandit, Chairman, Sentient Labs said, "We incubated Sentient Labs to work on technology R&D projects related to mobility and energy. This innovation affirms our commitment to Mission Hydrogen and Make in India charter by the government. This breakthrough of generating hydrogen from unutilized agricultural residue will help us become self-reliant on energy resources. It will also add a major stream of revenue to the farmer community. We will continue R&D and invite partners to come on board for production and commercialising the same."

Dr. Prashant Dhakephalkar, Director, Agharkar Research Institute, said, "Our technology is 25% more efficient as compared to conventional anaerobic digestion processes used today. The innovative two stage process eliminates the pre-treatment of the biomass, thus making the process economical and environment friendly. This biologically benign process generates digestate rich in nutrients which can be used as organic fertilizer. Its by-products can be used as soil conditioners while undigested solids for briquetting that can be sold as solid fuel. I thank the scientists and engineers at Agharkar Research Institute &Sentient Labs for this achievement".

Pawan Sharma, President & CEO, Sentient Labs said, "The milestone in collaboration with Sentient Labs has the potential to radically transform the agricultural industry and garner new sources of value-creation. It will improve India's self-reliance in creating cleaner and sustainable solutions for the energy and transportation sectors and will help India comply with the Paris Climate Change agreement."

75TH INDEPENDENCE DAY

India an unprecedented story of success, but challenges remain



Foreign observers were sceptical about India's ability to remain free and united, especially given its diversity and internal lack of political and administrative coherence.

When India became Independent, there was joy. A long freedom struggle and the sacrifice of millions, over decades, finally led to self-rule — and what a remarkable journey it was , under the leadership of the Mahatma, for in striving for its own freedom, India showed the world the path of non-violent resistance. Indians would, finally, have the sovereign right to decide their own destiny — its Independence also inspired freedom struggles, especially in Africa, inaugurating an era of decolonisation across the world.

But along with the joy, there was a clear recognition that Independence came with tremendous challenges and responsibilities.

For one, the task of maintaining national unity, sovereignty and territorial integrity — in the wake of Partition — became even more critical. Foreign observers were sceptical about India's ability to remain free and united, especially given its diversity and internal lack of political and administrative coherence.

But it was not just the challenge of remaining sovereign. The vision of the freedom movement did not confine itself to merely displacing a set of foreign rulers and replacing them with a set of domestic elites. The movement was not nativist, but democratic in character. Sovereignty was to reside with the people. Those who governed would do so with the consent of the people. And that is why nurturing representative democracy, creating a set of democratic institutions in a society with deep inequalities, and ensuring that freedom for the nation translated into freedom for citizens was the cornerstone of the Indian project. This, then, was the second challenge.

But what was the objective of unity, sovereignty and democracy? Given India's deprivation, the overwhelming poverty, the inequalities that permeated every sphere, Independence had to mean socioeconomic justice. Political rights had to be accompanied with social and economic rights. And the State had to shape society and battle social ills. The quest for prosperity and justice constituted the third challenge.

But all of this hinged on a fourth challenge. Given India's breath taking diversity, its entrenched caste hierarchies, and also its deep intercommunity divisions, especially Hindu-Muslim tensions, social harmony, peace and the accommodation of all groups was central to moving India forward.

Would India be united and sovereign, democratic and free, just and equitable, harmonious and diverse? This was the fundamental challenge presented by India's Independence. And 73 years later, the Indian project must be judged on this metric.

The national unity project

For India, territorial integrity was sacrosanct. This is true for all nation-states, but in India's case, the wounds of the past and Partition led to even greater determination. The territory that was India's, through bonds of civilisation, history, geography, law and culture, would not be allowed to fragment.

India faced repeated challenges to its integrity — be it through Pakistan's incursion into Kashmir in 1948 itself, the Chinese offensive in 1962, Pakistan's attempts to marry external aggression with a sponsored internal rebellion in 1965, its patronage to terror for the last three decades and its silent conspiracy in Kargil in 1999, secessionist movements in various parts of the country or China's current aggression in Ladakh.

These territorial challenges — including the current one — have constituted a threat. But each time, India fought back. It may not, today, have all the areas it considers its own (Pakistan-occupied Kashmir and Aksai Chin being the most prominent ones), but the fact that India has remained united, that no secessionist movement has succeeded, that Indian citizens in every corner feel integrated with the national project, is an extraordinary achievement.

But along with unity, there was sovereignty. India was wounded by foreign invasions. And its leadership was clear that it would not entertain any external intervention in its internal decision making process. This post-colonial psychological imprint has been so strong that not only did it refuse to join any Cold War bloc by remaining non-aligned, but even today, speaks of strategic autonomy, self-reliance, and not entering any alliance system. To be sure, in an interconnected, globalised world, there is give and take; absolute sovereignty is a myth. But for most part, India has preserved its right to take its own decisions.

73 years later, it is clear that India has the intent and capacity and track record to resist any attempts to redraw the map of the subcontinent. But as geopolitics shifts, it must be ready for challenges to its unity and sovereignty, directly and indirectly.

The democratic project

To institutionalise the principle that the people were sovereign, India instituted — and has successfully implemented — the principles of democracy. Periodic elections have allowed citizens to choose their representatives. Independent institutions — the Election Commission, an independent judiciary, a free press — have ensured that there is a check on executive power. There is a federal structure with clearly defined division of powers between the Centre and states. A vibrant, noisy public sphere has allowed reasoned discussions to take place to chart the path forward, with democratic participation. Protests and social movements have given a voice to the weak and marginalised. Ideological battles have taken place within a peaceful framework. And India is stable because it is a democracy. This democracy, with the assertion of marginalised communities and the spread of technology, has become deeper.

Yet, there are, today, legitimate questions about the quality of Indian democracy. Elections remain a true people's festival where citizens exercise their franchise and choose among competing ideologies, parties and leaders. But some other elements of democracy have suffered. There is the rise of illiberalism. Political parties have become personal fiefdoms. Nepotism is rife. There is an intersection between crime, money and politics. There is an overcentralisation of power in select leaders. The federal compact is under strain. Institutions have become weaker, thus curtailing their ability to keep a critical watch on executive excesses. Free speech is often threatened under the garb of community sentiment. Individual liberties are often undermined. And parties resort to the most crude, violent, polarising techniques to mobilise voters in their quest for power.

Make no mistake. The Indian democratic project is a success. No other post-colonial democracy, with India's level of economic backwardness and social diversity, has sustained an almost uninterrupted democratic run (barring the Emergency interregnum). But just like unity and sovereignty, democracy is not a one-time achievement. It requires constant vigilance, perhaps more so today than earlier.

The justice project

Long before India became Independent, India's leaders were clear that this independence had to translate into substantial outcomes for citizens at large. The hope was that when India became free, it could finally address issues of structural inequality and backwardness, and citizens would enjoy the right to live with dignity, study,

work, and access public services. Through a range of instruments — a mixed economy and somewhat insular approach in the early decades and a more liberalised and globalised economic policy orientation from 1991 — India adapted itself to meet these goals. More Indians today have access to basic nutritional intake, education, and work, than ever before. And this is an achievement to be proud of.

But the Indian justice story hinges on growth and inclusion. In recent years, both have suffered. India was seeing a slowdown before the pandemic, and Covid-19 is now set to lead to a severe contraction in the economy. This will have a direct impact on jobs, incomes, and the quality of life.

Inclusion remains a partial story, too, though the failure on this front must be shared by all governments. State institutions — be it public health system or government schools — have not lived up to the mark, thus depriving the most marginalised of critical services. Welfare programmes have helped, from the right to employment to income transfer to farmers. But they have not been a substitute for the fact that India remains deeply unequal; that a large segment of the population works in the unorganised sector with no benefits; that work is irregular; and meeting basic needs remains a struggle for many. The fact that India is a young country, with a productive population, but limited opportunities, can become a serious destabilising factor.

This quest for socioeconomic justice, achievable only through both high growth and more effective inclusion frameworks, remains a challenge.

The harmony project

But, in a way, the most crucial challenge for India was to ensure internal social unity. To achieve this, the drafters of the Constitution and successive political regimes adopted a range of techniques. The State did not turn into a theocracy, like Pakistan. India's Muslims would be equal citizens, with equal rights. To address the structural inequities of the caste system, untouchability was abolished, discrimination on the basis of caste was declared illegal, and the State took affirmative action measures to create a level playing field.

The fact that this diverse land has remained united is a testament to the vision of the founders. India's Hindus and Muslims have together coexisted, from villages and towns scattered across the country to political parties. To be sure, there have been riots — some devastating — but they have not upset the larger social equilibrium. In terms of caste, too, more members of backward communities and Dalits have broken free of their chains than ever before in Indian history — through education, representation, reservation, welfare, and their own remarkable endeavour.

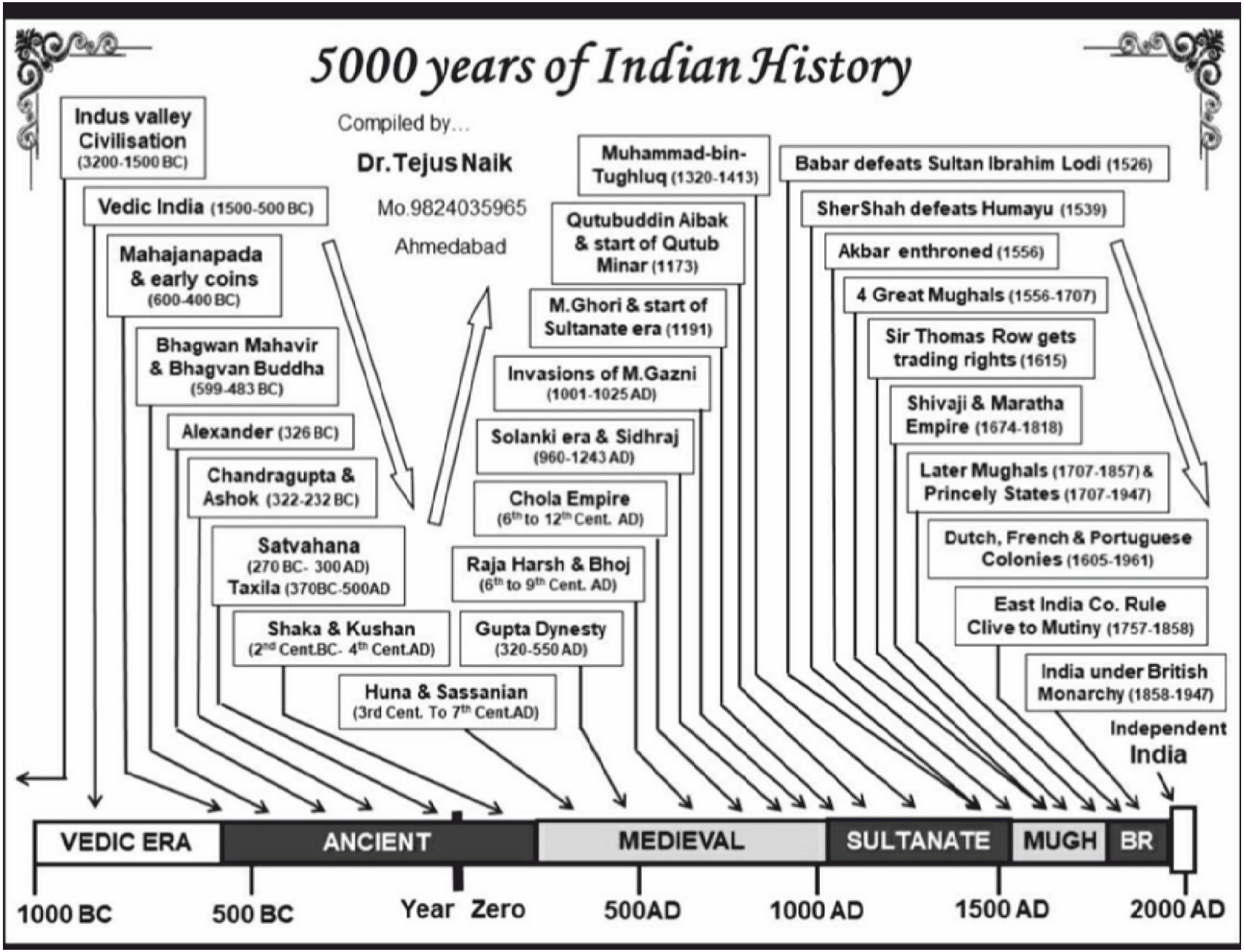
Yet, the story remains incomplete — and to some extent disturbing. There has been a turn towards majoritarianism in Indian politics. Minorities — particularly Muslims — have a sense of being excluded from power structures, with their lifestyle, food habits, cultural symbols becoming objects of suspicion. Arguably, Hindu-Muslim division is at its deepest today than at any point in the last seven decades, with the State itself seen as taking one side. Caste, too, remains a fundamental reality, with the political assertion of the marginalised not translating into their economic empowerment. Intercaste marriages may have increased but are still not the norm; atrocities against Dalits are only reported to be rising according to official data; and social divisions persist.

Citizens may coexist, but if they belong to different religions and castes, especially in smaller towns and villages, they coexist by living separately, not the ideal recipe for harmony.

And so, 74 years later, India is a story of success, yet a story of unfulfilled potential. It is a story of democracy which has beaten all odds, yet it is also a story of an incomplete democracy which has miles to go. It is a story of unity, yet a story of unity that is increasingly under threat due to external and internal factors. It is a story of a dream of a just society, yet a story where this quest for justice has hit some barriers. It is a story of remarkable achievement, yet a story of setbacks. It is a story of freedom, but also a story of how all citizens are not yet equally free.

Hindustan Times New Delhi

INDIA'S GLORIOUS HISTORY



ONE ELECTRIC SCOOTER EVERY 2 SECONDS! OLA ELECTRIC REVEALS DETAILS OF WORLD'S LARGEST TWO-WHEELER MEGA FACTORY

Ola factory will be the largest, fully integrated, two wheeler plant, to initially have annual production capacity of 2 million units

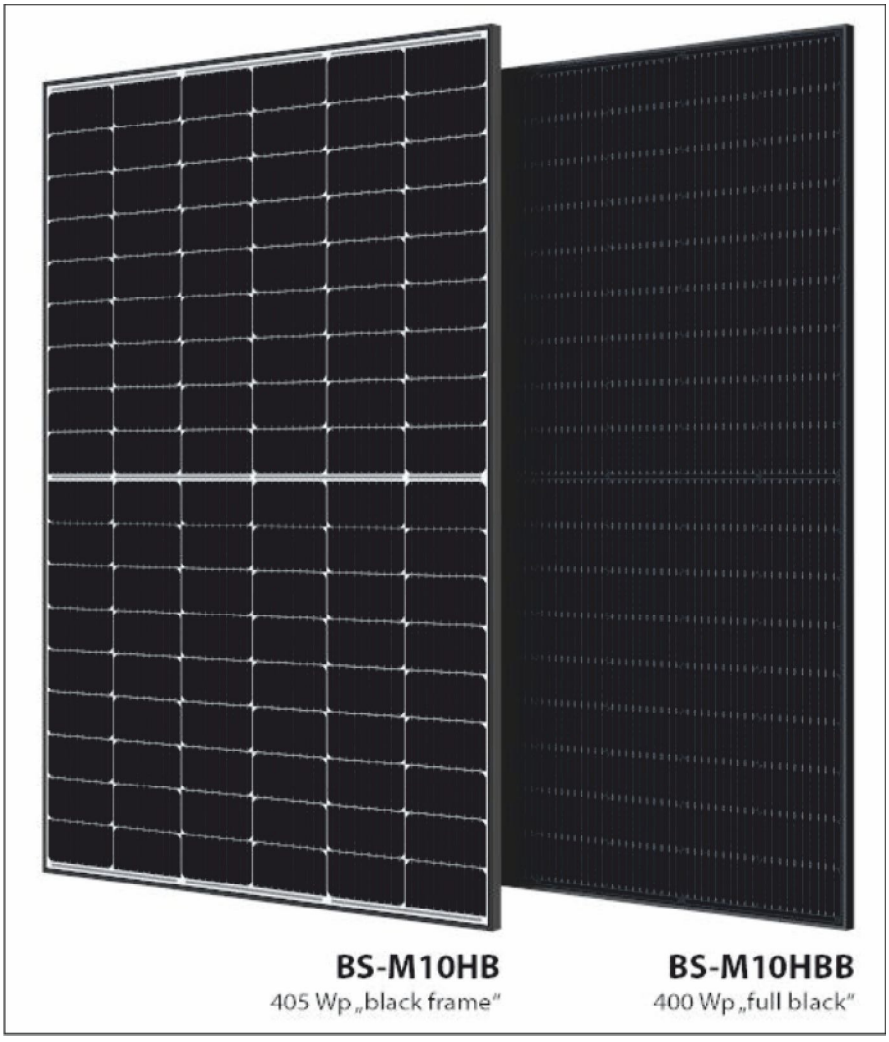
On July 15, 2021, Ola Electric Mobility opened bookings for its new Ola Scooter. The company claims to have received over 1 lakh pre-bookings in a matter of 24 hours, making it the most pre-booked scooter in the world. Customers could reserve their scooters at a refundable deposit of Rs 499 and those who have made these reservations will get priority delivery. Buyers would be able to select colour and variant of the new Ola Scooter at a later date. The company has not yet disclosed launch date but has confirmed competitive pricing. Ola Scooters will be manufactured at the Ola two wheeler factory in Krishnagiri, Pochampalli in Tamil Nadu which is slated to be the largest, fully integrated two wheeler plant.

Ola plant Robotics and Artificial Intelligence Ola's plant is being built at an investment of Rs 2,400 crores. It is the first electric scooter plant in Tamil Nadu. Once complete, it will offer job opportunities to 10,000 workers and the fully operational plant will comply with Industry 4.0 norms. The plant will comprise of most precision robotic welding unit, an advanced autonomous paint shop and 100 percent in-house battery manufacturing unit which will see 25,000 motors assembled per day.

Initial annual capacity is pegged at 20 lakh unit while the company is also working on setting up a Hypercharger Network that will include 1 lakh high speed charging points across 400 cities. Phase 1 of Ola e-scooter factory is nearing completion and as Ola Group Chairman and CEO Bhavish Aggarwal has announced, the first lot of vehicles will start rolling out soon. Ola factory is spread over a 500 acre property consisting of 100 acre forest cover and even has 2 acre forest cover inside its premises. It will be feature 3000 AI robots with 10 production lines. It will have the capacity to produce 1 scooter every 2 seconds. Ola e-scooter Fastest in Segment The soon to be launched Ola electric scooter promises to bring in mammoth change in the two wheeler industry. Already amassing over 1 lakh bookings, the e-scooter will receive several segment first features. This highly anticipated Ola Electric scooter as we call it today, could be named differently as Ola has filed three trademarks with names such as Series S, S1, and S1 Pro. Each variant is expected to have different features and battery packs.

GERMAN MANUFACTURER UNVEILS 10-BUSBAR, HALF-CELL PV MODULES

Bauer Solartechnik GmbH has released its new 400 W and 405 W BS-M10 PV panel series for rooftop projects.German PV module manufacturer Bauer Solartechnik GmbH has unveiled two new PV modules for residential and commercial rooftop solar projects.



Its new BS-M10 panels series includes two PV modules with outputs of 400 W and 405 W. The panels became available for sale from this month, the manufacturer said.

The two modules feature 10-busbar half-cells with efficiencies of 21%. A total of 108 half cells have been used for the modules, which measure 1,723 mm x 1,133 mm x 35 mm and weigh 21.7 kg. The panels are available with black aluminum frames and white or black backsheets.

Bauer Solartechnik said the use of half cells reduces power losses due to lower cell resistance. The cells also increase total reflection, it said, noting that the increase in the number of busbars to 10 helps to improve module performance. It also claimed that the cell arrangement will reduce performance losses when the modules are shaded. The hollow chamber frames, which are made of anodized aluminum, are torsion-resistant and corrosion-free. They are also compatible with all common mounting systems, the company said.

The new solar modules are immediately available to buy. However, due to high demand, the company has been unable to make any statements about delivery volumes thus far.

Bauer Solartechnik has a global production capacity of more than 500 MW.

KNOW THY POWER NETWORK - 160

I. Light Pollution – To Throw (Excessive) Light

The term pollution is generally known to all; normally it refers to a condition when any measurable entity like chemicals and gases in environment exceeds the permissible / tolerance limits. You may wonder why the light energy is also brought under this category. The excessive use of artificial light (production of light more than the need) brings many adverse impacts; it is the main reason for this categorization. Further efficient use of light energy constitutes one of the parts of Energy Saving Measures. So the role of light pollution mitigating measures in reducing energy wastages in a premise need to be brought to the centre stage. People associated with lighting arrangements especially electrical installation engineers should aware of this condition and they should be instrumental in tackling the menaces of this kind of pollution (Light Pollution).

The sources of this light pollution is invariably connected with "Artificial Light" produced by humans; in no way related / associated with the natural sun light (Day – Night). When human element enters the lighting sector, the problem starts; we go against the laws of nature and try to impose our own demands. That is to say, we try to make "Night" as "Day", thereby we exceed the permissible / tolerant limits and invite the wreath of nature and set ourselves to troubles.

II. More Abort Light Pollution

(a) Chief Causes

(i) Outcome of excessive use of artificial light.

(ii) Enhancement of these adverse conditions brought by the in-efficient use of luminaries and lamps

(b) Major Consequences

(i) Sky glow

(ii) Glare

(iii) Light trespass

(iv) Light clutter

(v) Decreased visibility at night

(vi) Waste of precious energy sources

(c) Sources

(i) Excessive illumination of building exteriors and interiors (e.g) (A big hospital looks like a five star hotel)

(ii) Advertising Boards; Flex Banners

(iii) Commercial Buildings Lighting

(iv) Factories – Front office, Shop floors, Switch yards

(v) Street lighting

(vi) Sports stadiums lighting especially during night matches (e.g) Night cricket match

(d) Adverse Impacts

(i) Like other pollutants, it impacts our surroundings, environment

(ii) Human health

(iii) Undesirable accidents

III. With this (introduction) let us learn more about the consequences of light pollution

(a) Sky Glow

It occurs when a portion of the artificial light from luminaries is emitted / spewed directly upwards in the sky. In turn, this light gets scattered in the atmosphere through the dust particles and gas molecules present there and forms an orange – yellow glow in the sky (fig. 1). As a result, the brightness of the space above a place gets increased and there by leading to poor visibility of stars and other celestial objects. During poor weather conditions, it becomes very intense, owing to the increased number of dust particles.

Fig 1: The night sky above Mexico City appears overtly bright due to sky glow

It is difficult to measure sky glow; the main reason in the presence of many uncontrollable contributing factors such as

- Angular distribution of light rays emitted upward from luminaries
- Reflected light from the ground
- Atmosphere effects like humidity
- Interaction of light with the aerosols present in the atmosphere
- Lack of data on the number of light sources involved and their distribution
- Wattage of the light sources involved
- The quantum of light energy reflected

(b) Glare

It can be termed as the discomfort / difficulty experienced by the human eyes to adjust the differences in brightness that occurs suddenly. The excessive contrast between bright and dark areas is the

reason for this happening. It is nothing but an excessive and uncontrolled brightness that occurs all of a sudden. Bright or poorly shielded lights of fast moving vehicles around the road is the factor responsible for this. It is one of the reasons for road accidents. It consists of two forms – (i) Disability Glare and (ii) Discomfort Glare. Disability Glare brings reduction in visibility (e.g) on coming vehicles' head lights; the other type of glare Viz. Discomfort Glare is the sensation of annoyance brought by overly bright light sources and lead to fatigues if experienced over extended / long periods.

(c) Clutter

It is nothing but the excessive groupings on placement of lights. Such a step leads to confusion, distraction and even accidents. Badly designed street lights on roads, brightly lit advertising boards on roads can be cited as examples for this phenomenon which normally distract drivers. An array of suburban commercial lightings near the airport can cause confusion with the run-away lighting to the pilots can be quoted as another illustration.

(d) Light Trespass

It is nothing but the unwanted entry of the light energy in places, where it is not required/ desired. (e.g) Entry of light from a street light into the nearby houses through the windows / doors and it may force the occupants to draw / pull their door / window contains (Fig.2 Ref Sourcing Electricals & Lighting Journal – July / Aug 2008). It is mainly caused by the street lighting fixtures that are either poorly shielded or whose focusing direction may not be set properly. This kind of light trespass can be avoided if the street light fixtures are properly set so as to direct its light properly at the ground only. It is difficult to measure / determine the light trespass at a location because of the complexity of various parameters / factors involved.

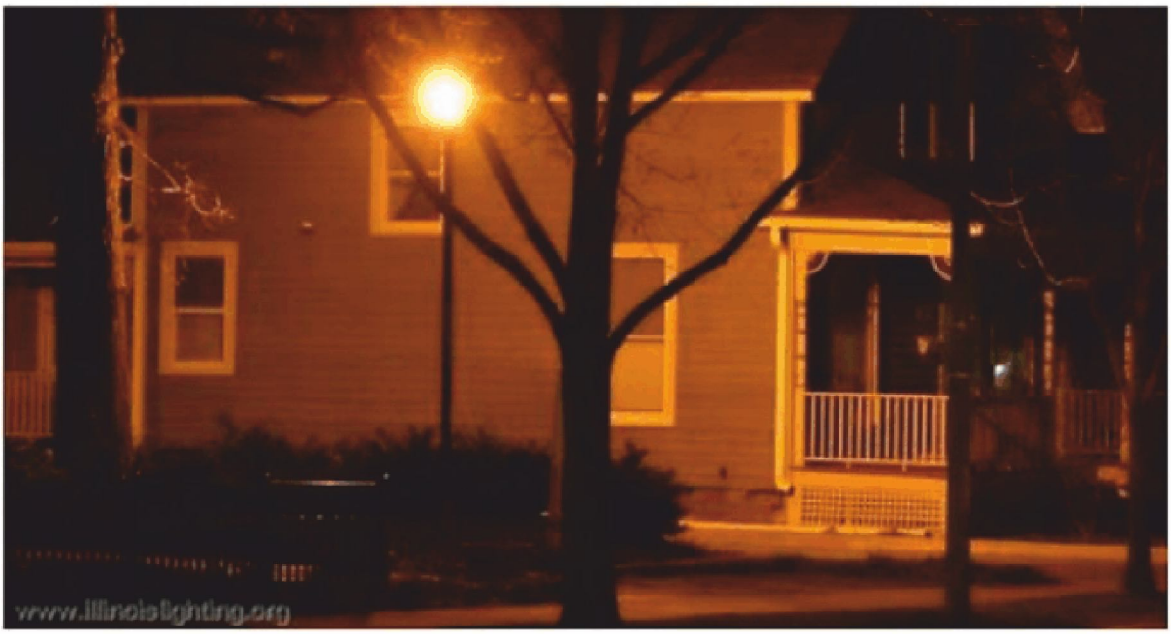


Fig 2: Light from a streetlamp entering houses through windows might force occupants to draw curtains

(e) Decreased Visibility at Night

It is mainly due to the components of light pollution like glare and clutter. Quality outdoor lighting and vehicle head lights can be considered as partial solutions for this problem.

(f) Wastage of Precious Energy Sources

As lighting forms a sizeable portion of our daily energy consumption, there is no need to stress the importance of reducing the energy losses brought by 'light pollution'. This pollution problem requires tackling mainly at the out-door lighting of buildings, Street lights and Vehicle head lights.

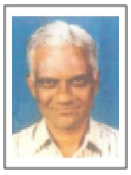
IV Mitigating Measures – Focal Points that need attention (Elimination of wasteful lighting)

- Turning off extra lights
- Minimizing light spillage by illuminative the required areas only.
- Usage of lower wattage, fully shielded light fittings preferably with a timer or motion sensor.
- Lowering light levels of street lights and out-door lights. This helps reduce reflected light which contributes to sky glow
- To avoid glare, use of fully shielded energy efficient light fixtures and set them to focus directly at the ground
- Set façade / architectural lighting from top down only
- Aiming flood lights properly on areas where light is required as in landscape and security lighting.
- Architects should strictly adhere to light pollution norms set by Govt and building codes)
- Selection of energy and light – efficient fixtures and other products

(Basis – Sourcing Electricals & Lighting – 07.08.2008 Journal)

Let me sign off here.

(To be continued)



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PADMA SHRI NOUF AL-MARWAAI
YOGA TEACHER - SAUDI ARABIA

Nouf al-Marwaai is a Yoga instructor in Saudi Arabia. Born without immunity and abandoned by doctors, she came to India, got completely cured and is now the first yoga teacher in Saudi. Yoga and Ayurveda, the ancient treasures of India, may be allergic to some, but she says 60% of the new generation in Saudi Arabia practises yoga and does Suryanamaskar.

She is the founder of the Arab Yoga Foundation in Saudi Arabia. Nouf Marwaai has contributed to making Yoga legal and get official recognition in Saudi Arabia. She was awarded India's fourth highest civilian award the ***Padma Shri*** by **President Kovind** in 2018.

3-PHASE DISTRIBUTION TRANSFORMERS 11 OR 433 KV/415-240V (OUTDOOR TYPE) - 7

35 INSPECTION:

35.1 In respect of raw material such as core stampings, winding conductors, insulating paper and oil, supplier shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

i. Invoice of supplier.

ii. Mill's certificate.

iii. Packing list.

iv. Bill of landing.

v. Bill of entry certificate by custom.

Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers' attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

36 INSPECTION AND TESTING OF TRANSFORMER OIL:

36.1 To ascertain the quality of the transformer oil, the original manufacturer's tests report should be submitted at the time of inspection. Arrangements should also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.

36.2 To ensure about the quality of transformers, the inspection shall be carried out by the purchaser's representative at following two stages:-

36.2.1 Online anytime during receipt of raw material and manufacture/ assembly whenever the purchaser desires.

36.2.2 At finished stage i.e. transformers are fully assembled and are ready for dispatch.

36.2.3 The stage inspection shall be carried out in accordance with **Annexure-II.**

36.2.4 After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection a few assembled core shall be dismantled to ensure that the laminations used are of good quality. Further, as and when the transformers are ready for despatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS shall be sent by the firm along with Routine Test Certificates. The inspection shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection. The proforma for pre delivery inspection of Distribution transformers is placed at **Annex- III**.

36.2.5 In case of any defect/defective workmanship observed at any stage by the purchaser's Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial

measures. Further processing should only be done after clearance from the Inspecting Officer/ purchaser.

36.2.6 All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the Inspector representing the Purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as Active Part Inspection during Acceptance Tests.

36.2.7 The manufacturer shall provide all services to establish and maintain quality of workman ship in his works and that of his sub-contractors to ensure the mechanical /electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

36.2.8 Purchaser shall have every right to appoint a third party inspection to carry out the inspection process.

36.2.9 The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality supplied. Purchaser has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser have every right to reject the entire lot or penalize the manufacturer, which may lead to blacklisting, among other things.

37 QUALITY ASSURANCE PLAN:

37.1 The bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

37.2 Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in the presence of bidder's representative, copies of test certificates.

37.3 Information and copies of test certificates as above in respect of bought out accessories.

37.4 List of manufacturing facilities available.

37.5 Level of automation achieved and list of areas where manual processing exists.

37.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.

37.7 List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports. These shall be furnished with the bid. Manufacturer shall posses 0.1 accuracy class instruments for measurement of losses.

37.8 Quality Assurance Plan (QAP) withhold points for purchasers inspection.

37.9 The successful bidder shall within 30 days of placement of order, submit following information to the purchaser:

"We welcome India's recent economic reforms as steps in the right direction...I have no doubt that future reform will strengthen trade and investment ties as well as benefit India's domestic industry."
– AXEL C HEITMANN, Chairman, Lanxess

37.9.1 List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

37.9.2 Type test certificates of the raw materials and bought out accessories.

37.9.3 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

38 DOCUMENTATION:

38.1 The bidder shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings.

38.2 Dimensional tolerances.

38.3 Weight of individual components and total weight.

38.4 An outline drawing front (both primary and secondary sides) and end-elevation and plan of the tank and terminal gear, wherein the principal dimensions shall be given.

38.5 Typical general arrangement drawings of the windings with the details of the insulation at each point and core construction of transformer.

38.6 Typical general arrangement drawing showing both primary and secondary sides and end-elevation and plan of the transformer.

39 PACKING AND FORWARDING:

39.1 The packing shall be done as per the manufacturer's standard practice.

However, it should be ensured that the packing is such that, the material would not get damaged during transit by Rail / Road / Sea.

39.2 The marking on each package shall be as per the relevant IS.

40 GUARANTEE

41 SCHEDULES:

41.1 The manufacturers of the transformer shall provide a guarantee of 24 months from the date of receipt at the stores of the Utility or 18 months from the date of commissioning, whichever is earlier. In case the distribution transformer fails within the guarantee period the purchaser will immediately inform the supplier who shall take back the failed DT within 15 days from the date of the intimation at his own cost and replace/repair the transformer within forty five days of date of intimation with a roll over guarantee.

41.2 The outage period i.e. period from the date of failure till unit is repaired/ replaced shall not be counted for arriving at the guarantee period.

41.3 In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

(To be continued)

Courtesy: www.mstcecommerce.com>RenderFileViewVideo

"Our long-term growth story in India is intact... Since 2008, we have more than doubled our sales in India. I believe the global megatrends mobility, urbanisation, water and agriculture will be the drivers for growth"

– Mr DAVID NOVAK, CEO, YUM! Brands

ELECTRICAL MAINTENANCE UNIT
(QUESTION & ANSWERS) - 9

146. What is power factor?

So from the above power explanation,

Cosφ = true power / apparent power = E * I * cosφ / E * I.

So that power factor is equal to

a. Cosine of angle of lead and lag of the resultant current with the applied voltage.
b. The ratio of R/Z.
c. The ratio of true power to the apparent power.

147. What is resonance in series circuit?

If in an AC circuit inductive reactance X_L and capacitive reactance X_C is equal the voltage across both will be equal and are 180° out of phase. So that each will cancel each other and the current limiting component will be the resistance of the circuit.

If we are in a position to alter the frequency of supply voltage at a particular frequency named as 'resonant frequency', AC series circuit's $X_L = X_C$ and the net reactance will be zero. So the current in the circuit is in-phase with the voltage. Because the controlling component of the circuit is resistance only and the current is maximum and equal to V/R amps.

This above said condition is called 'series resonance' and the frequency at which it occurs is called resonant frequency and the resonant frequency (F_R) is equal to (F_R) = $1/2\pi\sqrt{LC}$ cycles per second.

148. What is Q-factor?

The ratio of V_L/V or V_C/V at the resonant frequency is called the voltage magnification denoted as Q-factor.

$$Q - \text{factor} = \frac{1}{R}\sqrt{L/C}$$

149. What is Admittance?

Admittance: Admittance is the reciprocal of impedance. It is denoted by the letter 'Y' and the unit of measurement is mho.

Y = I/E = RMS current / RMS voltage.

Equation used in admittance

a. Conductance 'G' = Y * cosφ = 1/Z *R/Z = R/Z^2 mho.
b. Susceptance 'B' = Y * sinφ = 1/Z * X/Z = X/Z^2 mho.
c. Admittance 'Y' = $\sqrt{G^2 + B^2}$ mho.
d. In special cases when X = zero, then G = 1/R and R = zero, then B = 1/X.

150. What is the resonance frequency equation for parallel circuit?

In parallel circuit when $X_C = X_L$, the circuit is called the parallel resonance circuit.

That is $2\pi fL = 1/2\pi fC$.

In term (F_R) = $1/2\pi\sqrt{1/LC - R^2/L^2}$ cycles per second.

If 'R' is negligible, then (F_R) = $1/2\pi\sqrt{LC}$ cycles per second.

151. What is poly phase?

A system with two or more the two phases is known as poly phase system.

152. What is phase sequence?

The sequence of attaining the maximum value of the induced emf in each set of winding among those three sets is known as phase sequence. This phase sequence is usually indicated by the letters R, Y, B.

153. What is phase voltage?

The voltage between one of the phase and neutral is known as phase voltage and it is denoted by V_{Ph}.

154. What is line voltage?

The voltage across any two phases of the supply system is called line voltage and it is denoted by the letter V_L.

155. What is phase current?

The current flowing through any of the phase winding is known as phase current and it is denoted by I_{Ph}.

156. What is line current?

The current flowing between any two phases of the winding is called line current and it is denoted by the letter I_L.

157. What is balanced load and unbalance load?

Balanced load - In a three-phase system the power factors and the phase current or line currents of the 3-phase are equal, then that load is called balanced load.

Unbalance load - If the three-phases have different power factors and the phase current, then the load is called the unbalance load.

158. What is phase power and total power?

Phase power - The power measured between a phase and neutral is known as phase power.

Total power - The total power measured between the three phases is called total power.

159. What are the methods of connecting 3-phase windings?

There are two methods.

a. Star or wye (Y) connection.
b. Delta or mesh (<) connection.

160. What are the value of voltage and current in star connection and in delta connection?

Star connection

$I_L = I_{Ph}$.

$V_L = \sqrt{3}\, V_{Ph}$. $\therefore$ $V_{Ph} = V_L/\sqrt{3}$.

Note: in star connection we are getting neutral point and we can able to measure the phase as well as line voltage.

Delta connection

a. $V_L = V_{Ph}$.

b. $I_L = \sqrt{3}\, I_{Ph}$. $\therefore I_{Ph} = I_L/\sqrt{3}$.

161. What is the power in 3-phase supply system?

In a single-phase system power 'P' = $V_{Ph} * I_{Ph} * \cos\varphi$ watts.

In 3-φ system power 'P' = $3 * V_{Ph} * I_{Ph} * \cos\varphi$ watts.

In ***Star*** connection, $I_L = I_{Ph}$ and $V_{Ph} = V_L/\sqrt{3}$. Substituting the value of I_{Ph} and V_{Ph} in the above 3-φ power equation,

$P = 3 * V_{Ph} * I_{Ph} * \cos\varphi$ watts.

$P = 3 * V_L/\sqrt{3} * I_L * \cos\varphi$ watts.

$P = \sqrt{3} * V_L * I_L * \cos\varphi$ watts.

In ***Delta*** connection, $V_L = V_{Ph}$ and $I_{Ph} = IL/\sqrt{3}$. Substituting the value of I_{Ph} and V_{Ph} in the above 3-φ power equation,

$P = 3 * V_{Ph} * I_{Ph} * \cos\varphi$ watts.

$P = 3 * V_L * I_L/\sqrt{3} * \cos\varphi$ watts.

$P = \sqrt{3} * V_L * I_L * \cos\varphi$ watts.

So that the power in three phase supply system whether star connected or delta connected is same and power $P = \sqrt{3} * V_L * I_L * \cos\varphi$ watts.

So $\cos\varphi = P/\sqrt{3} * V_L * I_L$.

162. What are the advantages of rotating field system?

a. For rotating field alternators only two slip rings and brush gear assembly are required irrespective of number of phases.
b. The DC excitation voltage is low and it is very easy to insulate. This intern reduces the size of the machine.
c. Out put current can be taken directly from the fixed terminals on the stator. It is easy to insulate high voltage stationary stator (armature).
d. The armature winding can be easily braced to prevent any deformation produced by the mechanical stress set as a result of short circuit current and the high centrifugal brought into play.

163. What are the types of alternator?

Depending upon the speed there are three types.

a. Low speed b. Medium speed c. High speed

Depending on rotation there are two types.

a. Armature rotating b. Field rotating.

Depending on number of phases there are two types.

a. Single phase b. Poly phases.

With respect to excitation there are two types.

a. Self excited b. Separately excited.

164. What is the voltage equation for alternator?

165. What is voltage regulation?

166. How alternators are rated?

Alternators are rated in kVA.

167. What are the losses in an alternator?

Losses in alternators are same as DC generator and they are as follows.

a. Copper losses includes following losses

Armature copper losses ($I_a^2 r_a$).

Field copper losses ($I_{fe}^2 r_f$).

Losses in brush

b. Stray losses are as follows

Magnetic losses (Iron loss or core loss and pole shoes loss).

Mechanical losses includes bearing friction, slip ring friction and friction due to windage.

168. When the efficiency of the alternator is maximum or on what factor the efficiency of the alternator depends?

Efficiency of an alternator depends on its load power factor for a given load. As the power factor decreases I_a increases and the copper losses increases and thus efficiency decreases. The efficiency for given load is maximum only when the power factor is unity and it decreases as the power factor fall.

169. What are the methods of synchronizing?

a. Lamp method.

Dark lamp method and bright lamp method.

b. Synchroscope method.

170. What is synchroscope?

Synchroscope is an instrument, which shows the phase relationship of emf of the incoming alternator and at the same time it also indicates whether it is running slow or fast. This instrument works on the principle of rotating magnetic fields. It consists of a small motor with rotor and stator. Both wound for two phase. A potential transformer connected to two of the main bus-bar give supply to the stator 'A' winding and another potential transformer of same type connected to the corresponding terminals on the incoming machine supply to the stator 'B' winding. The rotor rotates if the stator resultant flux in the 'A' and 'B' is different and the exact time of synchronizing is the stand still position of the rotor. That means the both the voltages in winding 'A' and 'B' are same and there is no resultant flux to rotate the rotor. The speed of the rotor depends on the frequency of the alternator and is too fast when alternator (incoming machine) speed is more and less when alternator is too slow.

171. What is transformer?

Transformer is a static device by which AC power at one voltage in one circuit will be transformed into AC power of same frequency at another (decreased or increased voltage) or same voltage to an another circuit, which is in mutual inductive influence with the previous circuit and it is based on mutual electro-magnetic induction.

172. What are the purposes or advantages of transformer?

Purposes

a. Electrical energy may be transmitted economically over long distance by stepping up of voltages to reduce the line losses.

b. To distribute the low voltages at consumer side by stepping down the voltages.

Advantages

a. Transformer is a static machine and losses are very less. There by efficiency is high and about 95 to 98%.

b. Practically maintenance is very less.

173. What is the working principle of transformer?

A transformer works under the principle of mutual electro-magnetic induction (Faraday's laws of Electro-magnetic induction). It says that, whenever a changing flux links with a coil an emf is induced in it and this induced emf is proportional to the rate of change of flux and the number of turns in the coils linking the flux.

174. What are the types of transformer core?

a. Core type transformer core.

b. Shell type transformer core.

c. Berry type transformer core.

d. Spiral type transformer core.

175. What is the transformation ratio in transformer?

Equation for transformation ratio is,

$E_2/E_1 = N_2/N_1 = k$

k = >1 in step up transformer, where secondary turns are more and thus voltage is more to reduce the transmission current.

k = <1 in step down transformer, where secondary turns are less than primary and low voltage for consumer use.

If we include the current in transformation ration the equation is,

$E_2/E_1 = N_2/N_1 = I_1/I_2 = k$

(To be continued)

Courtesy: https://www.scribd.com/document/244623258/Question-and-Answers-Electrical-Maintenance-Unit

LIGHTING FUNDAMENTALS – 6

LUMINAIRES

- **Luminaire Efficiency**
- **Directing Light**

A luminaire, or light fixture, is a unit consisting of the following components:

- lamps
- lamp sockets
- ballasts
- reflective material
- lenses, refractors, or louvers
- housing

Luminaire

The main function of the luminaire is to direct light using reflective and shielding materials. Many lighting upgrade projects consist of replacing one or more of these components to improve fixture efficiency. Alternatively, users may consider replacing the entire luminaire with one that I designed to efficiently provide the appropriate quantity and quality of illumination.

There are several different types of luminaires. The following is a listing of some of the common luminaire types:

- general illumination fixtures such as 2x4, 2x2, & 1x4 fluorescent troffers
- downlights
- indirect lighting (light reflected off the ceiling/walls)
- spot or accent lighting
- task lighting
- outdoor area and flood lighting

Luminaire Efficiency

The efficiency of a luminaire is the percentage of lamp lumens produced that actually exit the fixture. The use of louvers can improve visual comfort, but because they reduce the lumen output of the fixture, efficiency is reduced. Generally, the most efficient fixtures have the poorest visual comfort (e.g. bare strip industrial fixtures). Conversely, the fixture that provides the highest visual comfort level is the least efficient. Thus, a lighting designer must determine the best compromise between efficiency and VCP when specifying luminaires.

Recently, some manufacturers have started offering fixtures with excellent VCP and efficiency. These so-called **"super fixtures"** combine state-of-the-art lens or louver designs to provide the best of both worlds.

Surface deterioration and accumulated dirt in older, poorly maintained fixtures can also cause reductions in luminaire efficiency. Refer to Lighting Maintenance for more information.

Directing Light

Each of the above luminaire types consist of a number of components that are designed to work together to produce and direct light. Because the subject of light production has been covered by the previous section, the text below focuses on the components used to direct the light produced by the lamps.

Reflectors

Reflectors are designed to redirect the light emitted from a lamp in order to achieve a desired distribution of light intensity outside of the luminaire.

In most incandescent spot and flood lights, highly specular (mirror-like) reflectors are usually built into the lamps.

One energy-efficient upgrade option is to install a custom-designed reflector to enhance the light control and efficiency of the fixture, which may allow partial delamping. Retrofit reflectors are useful for upgrading the efficiency of older, deteriorated luminaire surfaces. A variety of reflector materials are available: highly reflective white paint, silver film laminate, and two grades of anodized aluminum sheet (standard or enhanced reflectivity). Silver film laminate is generally considered to have the highest reflectance, but is considered less durable.

Proper design and installation of reflectors can have more effect on performance than the reflector materials. In combination with delamping, however, the use of reflectors may result in reduced light output and may redistribute the light, which may or may not be acceptable for a specific space or application. To ensure acceptable performance from reflectors, arrange for a trial installation and measure "before" and "after" light levels using the procedures outlined in Lighting Evaluations. For specific name-brand performance data, refer to Specifier Reports, "Specular Reflectors," Volume 1, Issue 3, National Lighting Product Information Program.

Lenses and Louvers

Most indoor commercial fluorescent fixtures use either a lens or a louver to prevent direct viewing of the lamps. Light that is emitted in the so-called "glare zone" (angles above 45 degrees from the fixture's vertical axis) can cause visual discomfort and reflections, which reduce contrast on work surfaces or computer screens. Lenses and louvers attempt to control these problems.

Lenses. Lenses made from clear ultraviolet-stabilized acrylic plastic deliver the most light output and uniformity of all shielding media. However, they provide less glare control than louvered fixtures. Clear lens types include prismatic, batwing, linear batwing, and polarized lenses. Lenses are usually much less expensive than louvers. White translucent diffusers are much less efficient than clear lenses, and they result in relatively low visual comfort probability. New low-glare lens materials are available for retrofit and provide high visual comfort (VCP>80) and high efficiency.

Louvers. Louvers provide superior glare control and high visual comfort compared with lens-diffuser systems. The most common application of louvers is to eliminate the fixture glare reflected on computer screens. So-called "deep-cell" parabolic louvers (with 5-7" cell apertures and depths of 2-4") provide a good balance between visual comfort and luminaire efficiency. Although small-cell parabolic louvers provide the highest level of visual comfort, they reduce luminaire efficiency to about 35-45 percent. For retrofit applications, both deep-cell and small-cell louvers are available for use with existing fixtures. Note that the deep-cell louver retrofit adds 2-4" to the overall depth of a troffer; verify that sufficient plenum depth is available before specifying the deep-cell retrofit.

Distribution

One of the primary functions of a luminaire is to direct the light to where it is needed. The light distribution produced by luminaires is characterized by the Illuminating Engineering Society as follows:

- Direct (90 to 100 percent of the light is directed downward for maximum use).
- Indirect (90 to 100 percent of the light is directed to the ceilings and upper walls and is reflected to all parts of a room).
- Semi-Direct (60 to 90 percent of the light is directed downward with the remainder directed upward).
- General Diffuse or Direct-Indirect (equal portions of the light are directed upward and downward).
- Highlighting (the beam projection distance and focusing ability characterize this luminaire).

The lighting distribution that is characteristic of a given luminaire is described using the candela distribution provided by the luminaire manufacturer. The candela distribution is represented by a curve on a polar graph showing the relative luminous intensity 360 around the fixture (looking at a cross-section of the fixture. This information is useful because it shows how much light is emitted in each direction and the relative proportions of downlighting and uplighting. The cut-off angle is the angle, measured from straight down, where the fixture begins to shield the light source and no direct light from the source is visible. The **shielding angle** is the angle, measured from horizontal, through which the fixture provides shielding to prevent direct viewing of the light source. The shielding and cut-off angles add up to 90 degrees.

The lighting upgrade products mentioned in this document are described in more detail in Lighting Upgrade Technologies.

Courtesy: U.S. EPA Green Lights

...we believe there is tremendous potential... The underlying strengths of India remain. It is the largest producer of milk in the world; it is one of the top three producers of wheat in the world and has the largest growing middle class.
– Mr MICHEL COMBES, Global CEO, Alcatel-Lucent

HOW REMOTE OFFICES CAN HELP COMPANIES GO GREEN

Turning your home into your workplace doesn't just mean going easy with your dressing and flexible timings. But it has some REAL impacts on our eco-system and numerous benefits for the businesses. Working from the remote offices can help the environment by cutting commutes, reducing traffic load on roads, and reduced waste.

Going green is nowadays a subject undergoing intense study. In the past few years, the has population has badly affected mother nature. We all notice how our atmosphere is changing due to the irresponsible actions of humanity. That came a limit, and our earth told us that we need to stop polluting and take better care of our planet's gifts. Just then, the COVID-19 stepped in. It immediately stopped everything, and here we are now, running our businesses from home!

But, going green is not only beneficial for the environment. Using virtual office to set up the business allows companies to save on their office spaces. Additionally, practicing a more eco-friendly approach can offer several commercial-based advantages, from bottom-line cost savings to an outstanding market advantage.

Consider these amazing benefits of working from home to going green for business, and see how efforts toward sustainability can help boost business.

It Cuts Down Added Expenses

New regulations are passed every year, and it raises the standards for businesses to be more justifiable in their processes. Practicing to make a "green" business will not only help improve your brand image and attract the ever-growing market of environmentally-minded consumers. When you and your teamwork from home, you cut down 50% of your expenses. Your business saves money from bills, parking lot charges, and other rents.

Other than that, working from home minimizes transportation costs, thus reducing the business expenses and saving the environment altogether.

Promotes Healthier & Safer Work Ethics

Working from home and staying safe is the top priority of the COVID-19 pandemic and the uncertain times. We all care for our team members, and when they're logged in from their places, they're safe. Following your state's laws, you can tell the government that your company is fully cooperative and spreading the message of social distancing. You can try establishing a rewards programme for employees who share pictures of their home workplaces.

Conserves the Office Space

Every individual who is remotely working is one less person who needs to use an additional space resource when going to the office. The space you choose in your home, to work, will always be there, either you use it or not. But the space a business needs to accommodate its employees can be conserved when fewer employees are there. You can also temporarily shut down the office premises to save the area completely until the situation gets better. So, who's winning? (Obviously, you! The business owner!)

Boosts Productivity

Let's now discuss the memes and myths floating around related to the laziness of employees in WFH (work from home). They say remote workers are lazy pseudo-professionals without real jobs. Researches have shown that those employees are more productive than employees who work from a physical office. Allow your team to work from home, and help the global cause of going green! (in fact, secretly get the business advantage).

Increased efficiency among remote member is mainly due to the reduced workplace distractions and more freedom to work during hours they find most productive. Even tiny improvements in the efficiency of your team members can improve the overall productivity of business operations. It ultimately results in increased sales and more profits.

Strengthens Customer Loyalty

Other than acquiring new customers, the practice of remote working to go green can also strengthen your relationship with your existing customers. You highly attract the audience who are conscious of the benefits of going green. Adding this idea to your business's mission is a great way to strengthen ties with new and current customers.

Health and eco-conscious buyers show extraordinary brand loyalty when they are informed that your business not only deals with the best quality products but is also committed to providing a healthy environment for them.

Improves Employee Retention

Work from home has facilitated employees like nothing else. Surprisingly, a report found that 42% of employees would take a salary cut to have more flexible work hours from their employers. Despite the high unemployment rate, employees are willing to sacrifice more than 10% of their salaries to achieve professional flexibility' work from home' provides.

Other than these employees, team members who can't concentrate in noisy areas are relaxed enough to have their small one-room office in their comfort zone.

Spreads Brand Awareness

Everybody is concerned about the planet. So, the people interested in your products also expect that businesses should also care about preserving the environment. For this, adding a green campaign to your business can do wonders in building brand awareness. It makes your business unique and favourite! Businesses that support going green movements will have increased brand awareness and will be more popular in public.

Earns Eco-friendly Incentives and Refunds

Earn special discounts for your going green efforts. Some sources can help you save while going "green." It includes federal tax credits for energy by different states, incentives from energy companies, and other environmental corporations. Research and find out the programmes for your state and federal programs to see if your business qualifies them.

FINAL WORDS:

Remote offices are playing a vital part in going green, and going green is helping the planet and your business equally. These benefits are quite measurable and meaningful. From saved overhead

costs to increased employee retention and positive environmental impacts, employers who embrace telework plans within their business models can enjoy the advantages of being part of the modern US workforce without sacrificing business performance.

It can help differentiate you from the competition, attract customers, retain employees, save overhead costs, and be productive. Let's continue working from home and our efforts to go green to see the positive impact we can make.

Good Luck!

SUBSTATION DESIGN / APPLICATION GUIDE - 3

3.2 Substation Type

Substations are classified as two types of substation, i.e. Air Insulated Switchgear (AIS) 'open terminal' substation and Gas Insulated Switchgear (GIS) 'metalclad' substation.

Open terminal arrangements, as the name suggests, utilises primary equipment whose terminals are in air. Consequently large clearances are required between these terminals and earth and between terminals of different phases. As a result 'open terminal' substations occupy relatively large areas of land.

Metalclad equipment utilises either solid or gaseous (SF6) insulation to allow phase to earth and phase to phase clearance to be drastically reduced.

The space saving advantages of metalclad equipment can be significant particularly for high voltage substations in large cities where space is difficult to obtain and land is very expensive.

Metalclad equipment may also be attractive for other reasons, notably visual impact in environmentally sensitive areas and operation in heavily polluted environments.

Air insulated substations generally cost less than an equivalent gas insulated substation.

Almost all GIS substations are built indoor. GIS can be easily built underground to avoid any environmental concern. The internal GIS insulation is independent of atmospheric pressure.

3.3 Substation Equipment

3.3.1 Circuit Breakers

A circuit breaker is a mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of short circuit.

As systems have increased in size and complexity, the circuit breaker has been called upon to have better short circuit interrupting performance, to operate faster and to tolerate higher and higher system voltages.

Initially as fault currents increased circuit breakers become more and more complex to achieve the required performance, particularly when 400kV systems with fault currents of up to 63kA were designed.

Thankfully the introduction of sulphur hexafluoride interrupters led to a reduction in the number of interrupters required in series for a particular voltage to the point where modern designs of SF6 circuit breaker can meet system requirements with a single interrupter up to 245kV 50kA and up to 420kV 63kA with two interrupters in series.

Under special circumstances, such as when switching capacitor banks for power factor correction or arc furnace switching, where circuit breakers may operate many times a day, replacement may be necessary after a shorter period, or point on wave switching (POW) is needed.

3.3.2 Dis-connectors and Earth Switches

Dis-connectors (Isolators) are devices which are generally operated off-load to provide isolation of main plant items for maintenance, on to isolate faulted equipment from other live equipment. Open terminal dis-connectors are available in several forms for different applications. At the lower voltages single break types are usual with either 'rocker' type or single end rotating post types being predominant.

At higher voltages, rotating centre post, double end rotating post, vertical break and pantograph type dis-connectors are more common.

Disconnectors are usually interlocked with the associated circuit breaker to prevent any attempt being made to interrupt load current. Disconnectors are not designed to break fault current although some designs will make fault current.

Most disconnectors are available with either a manual drive mechanism or motor operated drive mechanism and the appropriate drive method must be selected for a particular disconnector in a particular substation, e.g. in a remotely controlled unmanned double busbar substation the busbar selector disconnectors would be motor operated to allow 'on load' busbar changes without a site visit being required.

Disconnector mechanisms incorporate a set of auxiliary switches for remote indication of disconnector position, electrical interlocking and current transformer switching for busbar protection.

Earthing switches are usually associated and interlocked with disconnectors and mounted on the same base frame. They are driven by a separate, but similar, mechanism to that used for the disconnector. This arrangement avoids the need for separate post insulators for the earth switch and often simplifies interlocking. Normally earth switches are designed to be applied to dead and isolated circuits and do not have a fault making capability, however special designs are available with fault making capability if required.

One practical point worth noting is that line or cable circuit earth switches are normally interlocked with the local line disconnector, but reliance is placed on operating procedures to ensure that the circuit is isolated at the remote end before the earth is applied.

3.3.3 Instrument Transformers

a) Current Transformers – The majority of current transformers used in substations are bar (i.e. single turn) primary type but their method of installation varies considerably. In metalclad switchgear they are usually mounted around the insulated connections between circuit breaker fixed connectors and the cable box terminals, whereas in open terminal substations they may be mounted around the bushings of transformers or dead tank circuit breakers.

b) Alternatively where live tank switchgear is used, the current transformers are mounted in a form known as the post type current transformer where the secondary windings are fitted into a housing insulated from earth by a hollow support insulator. The secondary windings and leads are insulated from the housing and the secondary leads, also heavily insulated, are brought down to a terminal box at the base of the support insulator.

c) Voltage Transformers – The choice is basically between 'wound' voltage transformers and 'capacitor' voltage transformers. Generally where high accuracy metering standard outputs are required the wound voltage transformer is used and where protection and instrumentation outputs only are required a capacitor voltage transformer is often more cost effective at voltages above 145kV. A further advantage of capacitor voltage

It's an important country. The level of absorption of smartphone is moving significantly. You have the biggest middle class in the world with about 150 million people
– Ms NANCY J POWELL, US Ambassador to India

transformers is that they can be used to provide coupling facilities for power line carrier systems used for protection, signalling, telemetry or telecommunications.

3.3.4 Power Transformers

In any substation the power transformer is probably the most expensive piece of equipment and one of the most inconvenient to replace or repair, due to the sheer size of the equipment particularly at high voltages.

Power transformers are usually of the two winding type. The capacity of the transformers is usually decided by system requirements. Transformers may be designed with all three phases in common tank or as three separate single phase units.

From the power system operator's point of view, a transformer is a simple device. Due to economic considerations, a power transformer generally has auxiliary systems which are essential to its effective operation.

In the smaller sizes, it is quite common for transformers to have off-circuit tap change facilities, natural air cooling and a minimum of protective devices.

In the larger sizes, transformers are fitted with on-load tap change facilities, forced air or forced air/forced oil cooling and in some cases forced oil/liquid cooling systems.

Typically a transformer designed for ONAF (Oil Natural Air Forced) cooling can sustain 65-70% of its ONAF rating without auxiliary supplies, whereas an OFAF (Oil Forced Air Forced) transformer can sustain only 50%.

For OFLC (Oil Forced Liquid Cooling) transformers the output without cooling maybe as low as 30% of the OFLC rating.

The on-load tap changer facility will be designed to match the transformer by the transformer designer but typically would have 19 or 21 tap positions with a tap-step of 1_1.5% possibly giving a range of perhaps +10% -20% i.e. the secondary voltage can be maintained constant for a variation of primary voltage from +10% to -20%. The controls and monitoring circuits for tap changers, particularly when operated automatically, can be quite complex requiring output voltage, load current and tap position of associated transformers to be monitored.

The on-load tap changer is a mechanical switching device and it is usually the tap changer which determines the frequency of maintenance of transformers. After large numbers of operations switching contacts may need to be changed and the oil within the switching chamber be replaced.

Transformers are also protected against excessive temperature as rapid deterioration of insulation can occur if transformers become overheated. The normal method of protection is to monitor the insulating top oil temperature and on large transformers the winding temperature is monitored.

It is not usual to monitor this directly due to risk of insulation failure with devices embedded in the winding; normally oil temperature is monitored and an additional heating element fed from a current transformer measuring load current is used to simulate the winding 'hot spot' temperature within the monitoring device.

(To be Continued)

Courtesy: V Ayadurai Bsc, C.Eng, FIEE
Engineering Expert

"We are looking to use India as a source, not just to make great product but also to make manufacturing equipment that we will use to produce our products in other countries."
– Mr JEFF WHITE, President - India & SAARC, Cisco Systems

ENERGY INDEPENDENCE AND ENERGY SELF RELIANCE - 10

Sustainable Growth, Sustainable Energy and Renewable Energy

Wind and Solar Initiatives have been in the forefront ever since with lot of investments, visibility and progress.

Bioenergy which is a 'Firm Energy' (24x365) as against Wind and Solar which are 'Infirm Energy' (Seasonal and part of the day only), require investments in Innovation and Technology as India has a huge potential.

CBG (Compressed Bio Gas) which is also known and called as ReNG (Renewable Natural Gas) by some manufacturers, is certainly big step forward in making vehicles use Biofuel in place of Petrol, Diesel and CNG. CBG can be straight away be used in place of CNG in all vehicles, which are dual fuel vehicles, which include 3 Wheelers, Cars and Buses and Trucks, already manufactured and in use in major parts of India. All the Oil Companies in India like IOC, BPCL, HPCL etc have already entered into arrangement to procure and distribute CBG through their petroleum outlets or dedicated outlets. India seems to be galloping towards the 15 Million Tons target it has set for itself in the first phase. The following News and Press releases will be interesting to know the progress.

INDIA NEWS

UP leads in setting up compressed bio gas plants, followed by Maharashtra and Haryana

Biomass sources such as agricultural residue, cattle dung, sugarcane press mud, municipal solid waste and waste from sewage treatment plants is used to produce bio-gas through the process of anaerobic decomposition. (HT file photo)

Uttar Pradesh is followed by Maharashtra and Haryana, according to the petroleum ministry.

Hindustan Times, New Delhi | By Rajeev Jayaswal

UPDATED ON JUL 27, 2020 02:29 PM IST

Uttar Pradesh leads states in setting up plants to produce compressed bio-gas (CBG) as part of efforts to reduce India's dependence on imported energy and to check pollution from stubble burning that chokes the National Capital Region every winter.

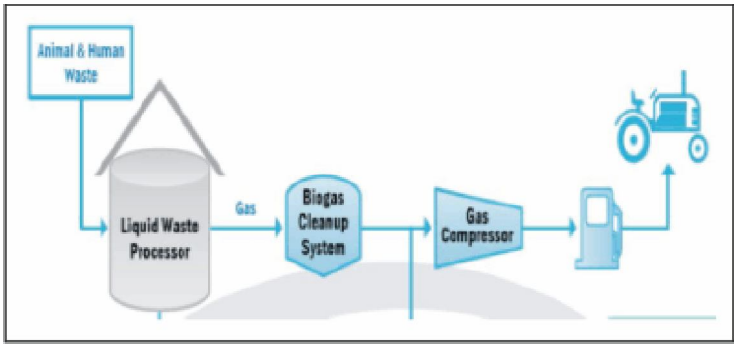
The state is followed by Maharashtra and Haryana, according to the petroleum ministry.

Of the 515 letters of intent (LoI) issued to entrepreneurs for setting up CBG plants across the country, 126 projects are located in Uttar Pradesh, 75 in Maharashtra, 59 in Haryana, 35 in Andhra Pradesh, 24 in Punjab and seven in Delhi, the official data showed.

Gujarat received the nod for setting up 32 plants, Karnataka 25, Madhya Pradesh 24, Chhattisgarh 22, Tamil Nadu 16, West Bengal 13, Bihar 11, Odisha, Uttarakhand and Telangana nine each, Jharkhand seven, Rajasthan five, and Goa, Jammu and Kashmir and Assam two each.

The estimated cost of the 515 CBG plants is Rs 18,000 crore.

A spokesperson of the petroleum ministry said, "The SATAT (Sustainable Alternative Towards Affordable Transportation) scheme is expected to have 5,000 plants across the country by 2023 that can produce 15 million metric tonnes of CBG and proportionately reduce our dependence on energy imports."



Extracts from the white paper on CBG Scenario, Technologies and Marketing

1. India is among the fastest growing economy in the world and its energy consumption is slated to increase rapidly. According to the Ministry of Petroleum and Natural Gas (MoP&NG) estimates, India has a total reserve of 763 Million Metric Ton (MMT) of crude oil and 1,488 Billion Cubic Meter (BCM) of natural gas. The country currently imports nearly 77% of its crude oil requirements and about 50% of natural gas requirement, leading the Government of India to set a target of reducing this import by at least 10% by 2022. Further, it has set a target of increasing the contribution of gas in India's energy mix from existing 6.5% (global average is 23.5%) to 15% by 2022.
2. Hon'ble Prime Minister has given the following four pillars of our vision of India's energy future – energy access, energy efficiency, energy sustainability and energy security. The Government of India has also set a target of – 'Doubling Farmers Income by 2022'.
3. Waste / Bio-mass sources like agricultural residue, cattle dung, sugarcane press mud, municipal solid waste and sewage treatment plant waste, etc. produce bio-gas through the process of anaerobic decomposition. The

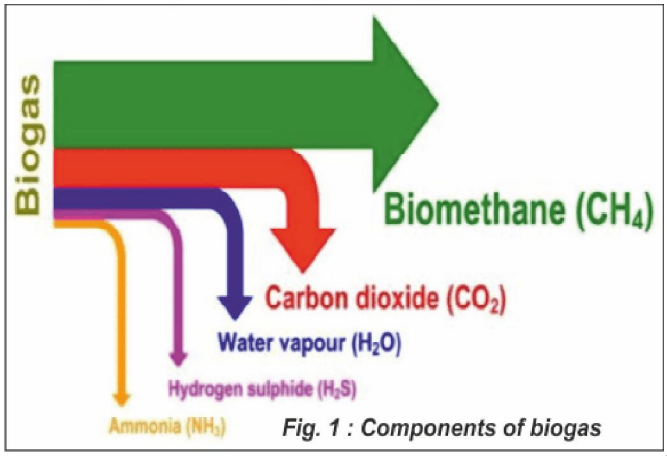


Fig. 1 : Components of biogas

bio-gas is purified to remove hydrogen sulfide (H_2S), carbon dioxide (CO_2), water vapor and compressed as Compressed Bio Gas (CBG), which has methane (CH_4) content of more than 90%.

4. CBG has calorific value and other properties similar to CNG and hence can be utilized as green renewable automotive fuel. Thus it can replace CNG in automotive, industrial and commercial areas, given the abundance biomass availability within the country.
5. Conversion of agricultural residue, cattle dung and municipal solid waste (MSW) into CBG in a commercial scale is expected to have the following benefits
   - Import reduction of natural gas and crude.
   - Utilization of agricultural residue, cattle dung and MSW for the production of CBG and thus to achieve reduction in emissions and pollution.
   - A boost towards fulfillment of National commitments in achieving climate change goals.
   - Providing a buffer against energy security concerns and crude/gas price fluctuations.
   - Contribution towards Swachh Bharat Mission through responsible waste management
   - Lowering pollution and carbon emission.
   - Providing additional source of revenue to the farmers, rural employment and amelioration of the rural economy

Global Initiatives

Countries such as Germany, Italy, UK, France and Switzerland are promoting bio-gas usage promoted by supporting legal frameworks, education schemes and the availability of technology. Biogas produced in European countries is mostly fed into local natural gas grids and used for power generation. Grid injection is most common in European states followed by vehicles fuelled with biogas (either pure or in blend with natural gas) and biogas is also used for heating purposes either directly or blended to natural gas.

The number of bio-gas plants in Germany has doubled to nearly 9,000 plants from 4,136 plants in 2010. The total bio-gas production capacity of the plants is 8.98 Billion Cubic Meter (BCM) equivalent to 6.6 Million Metric Ton (MMT). They are primarily operated by farmer co-operatives, and utilize crops like maize or turnips as feedstock in their plants.

Policy Support

Government of India has released the National Policy on Bio-Fuels 2018 vide gazette notification no. 33004/99 dated 8.6.2018. The policy emphasizes on promotion of advanced Bio-fuels including CBG.

The Galvanizing Organic Bio-Agro Resources Dhan (GOBAR-DHAN) scheme was launched by Government of India to convert cattle dung and solid waste in farms to Bio-CNG (CBG) and compost. GOBAR-DHAN scheme proposes to cover 700 projects across the country in 2018-19.

Ministry of New and Renewable Energy has notified Central Financial Assistance (CFA) for Bio-CNG.

Compressed Bio Gas (CBG) in India

The estimated CBG potential from various sources in India is nearly 62 MMT with bio- manure generation capacity of 370 MMT. CBG is envisaged to be produced from various bio-mass / waste sources including agricultural residue, municipal solid waste, sugarcane press mud, distillery spent wash, cattle dung and sewage treatment plant waste.

The other waste streams viz. rotten potatoes from cold storage, rotten vegetables, dairy plants, chicken/poultry litter, food waste, horticulture waste, forestry residues and industrial Effluent Treatment Plants (ETPs) treating organic waste can be used in the generation of biogas.

The biogas produced contains approximately 55% to 60% methane, 40% to 45% carbon dioxide and trace amounts of hydrogen sulphide. Biogas is purified to remove carbon dioxide and hydrogen sulphide gases to prepare CBG. The CBG can be transported through cylinder cascades or pipelines to retail outlets.

Vide Gazette Notification no. 395 dated 16th June 2015, Ministry of Road Transport and Highways, Government of India had permitted usage of bio-compressed natural gas (bio-CNG) for motor vehicles as an alternate composition of the compressed natural gas (CNG).

Compressed Bio Gas (CBG) to be supplied shall meet IS 16087:2016 specifications of BIS (detailed below) and any other further revisions in the said specifications.

Table 1 : Composition of CBG

IS 16087 : 2016 Standard

S No.	Characteristic	Requirement
1	Methane percentage (CH_4), minimum	90.0 %
2	Only Carbon Dioxide percentage (CO_2),, maximum	4%
3	Carbon Dioxide (CO_2)+ Nitrogen (N_2)+ Oxygen (O_2) percentage maximum	10%
4	Oxygen (O_2) percentage maximum	0.5%
5	Total sulphur (including H_2S) mg/m^3, maximum	20 mg/m^3
6	Moisture mg/m^3, maximum	5 mg/m^3

Also as per the IS 16087:2016 specifications, the following shall also be met

i. CBG shall be free from liquids over the entire range of temperature and pressure encountered in storage and dispensing system

ii. The CBG shall be free from particulate matter such as dirt, dust, etc.

iii. CBG delivered shall be odorized similar to a level found in local distribution (ref. IS 15319)

The CBG is to be compressed at 250 Bar and supplied through Cascades to the Oil Company Retail Outlets as mentioned in the EOI document.

CBG Production Technology

Biogas is a product from the process of degradation of organic matter by anaerobic bacteria. The biogas generation process consists of four subsequent chemical and biochemical reactions i.e. Hydrolysis reaction, Acidogenesis reaction, Acetogenesis reaction and Methanogenesis reaction.

Hydrolysis reaction decomposes organic molecule such as carbohydrates, proteins and fats into glucose, amino acids and fatty acids, respectively. Acidogenesis converts those generated small organic molecules to volatile organic acids with help from bacteria. During the Acetogenesis process, bacteria in the acetic group digests volatile organic acids and releases acetic acid. Lastly, anaerobic bacteria in the methanogenic producing bacteria group will complete the Methanogenesis process by converting acetic acid to methane gas and other gases like carbon dioxide and hydrogen sulfide.

I don't think that India is much celebrated for its democracy. Democracy has been a very neglected commodity at home and abroad.

— AMARTYA SEN

Hydrogen sulfide is a corrosive gas. Presence of carbon-dioxide in the bio-gas reduces its calorific value. Hence the bio-gas needs to be purified. Various technologies are used for removal of hydrogen sulfide, as detailed below:

Table 2 : Comparative analysis of technologies to remove Hydrogen Sulphide

Method	Efficiency	Cap Cost	O&M	Complexity
Biological Fixation	Moderate	Moderate	Low	Moderate
Iron chloride dosing	Moderate	Low	Moderate	Low
Water scrubbing	High	High	Moderate	High
Activated Carbon	High	High	Moderate	Moderate
Iron Hydroxide or Oxide	High	Moderate	Moderate	Moderate
Sodium Hydroxide	High	Moderate	High	Moderate

For removal of carbon dioxide, the following technologies are used

Pressure Swing Adsorption (PSA)

This technology is most prevalent for large bio-gas systems in India. With this technique, carbon dioxide is separated from the biogas by adsorption on a surface under elevated pressure. The adsorbing material, usually activated carbon or zeolites, is regenerated by a sequential decrease in pressure before the column is reloaded again, hence the name of the technique. Hydrogen sulphide and water needs to be removed before the PSA-column. There is significant loss of methane (20-30%) in this process.

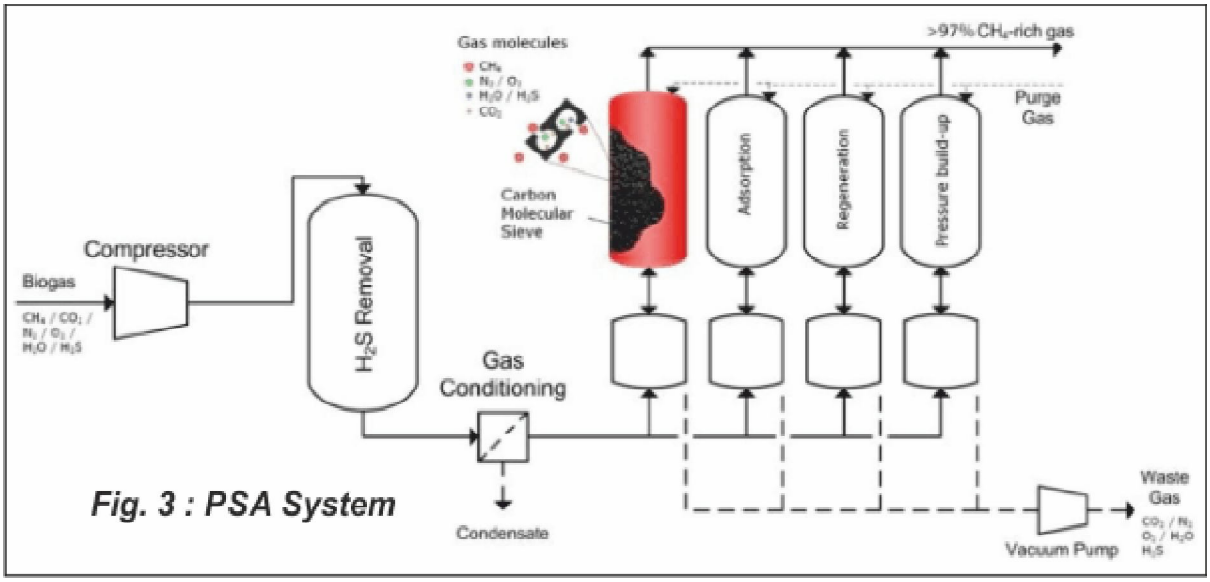


Fig. 3 : PSA System

Water scrubbing

Carbon dioxide has a higher solubility in water than methane. Carbon dioxide will therefore be dissolved to a higher extent than methane, particularly at lower temperatures. In the scrubber column carbon dioxide is dissolved in the water, while the methane concentration in the gas phase increases. The gas leaving the scrubber has therefore an increased concentration of methane.

There are technologies available through which 97% purity of methane can be achieved with minimal (<5%) methane loss.

Membrane Separation

Dry membranes for biogas upgrading are made of materials that are permeable to carbon dioxide, water and ammonia. Hydrogen sulphide, and oxygen permeate through the membrane to some extent while nitrogen and methane only pass to a very low extent. Usually membranes are in the form of hollow fibers bundled together.

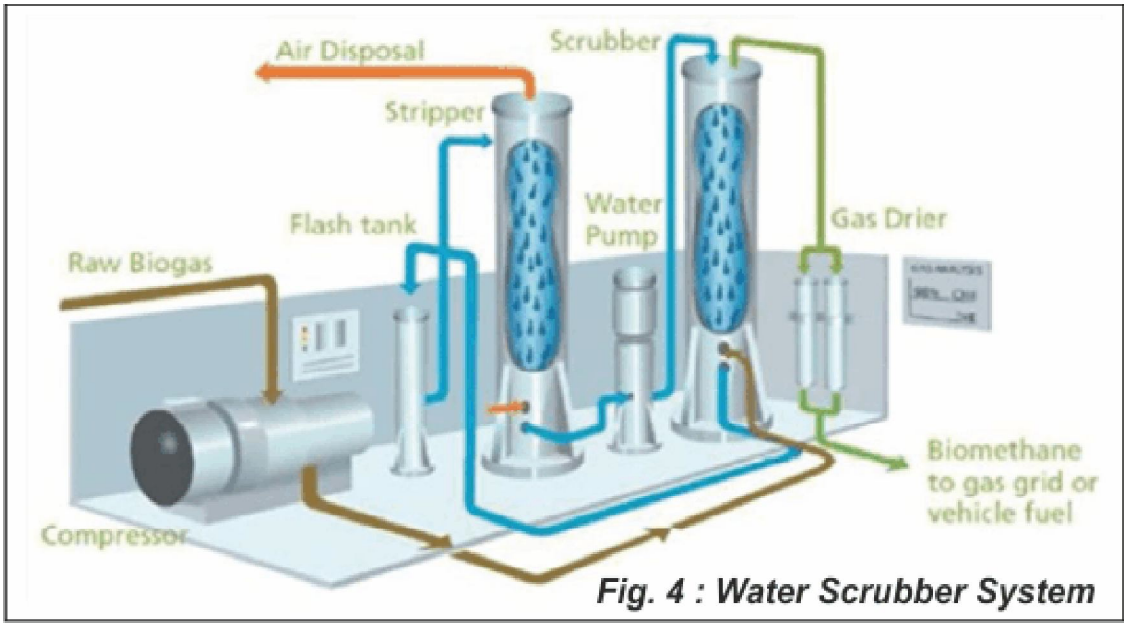


Fig. 4 : Water Scrubber System

Chemical scrubbing - Monoethylammine (MEA) system

This is one of the best systems for bio-gas purification achieving 99.9% purity with negligible loss of methane. The systems are being extensively used in Germany for purification of bio-gas. Carbon dioxide is not only absorbed in the liquid, but also reacts chemically with the amine in the liquid. Since the chemical reaction is strongly selective, the methane loss might be as low as <0.1%.

Apart from the above, there are also developing technologies like Cryogenic upgrading. Comparison of the available technologies is as under:

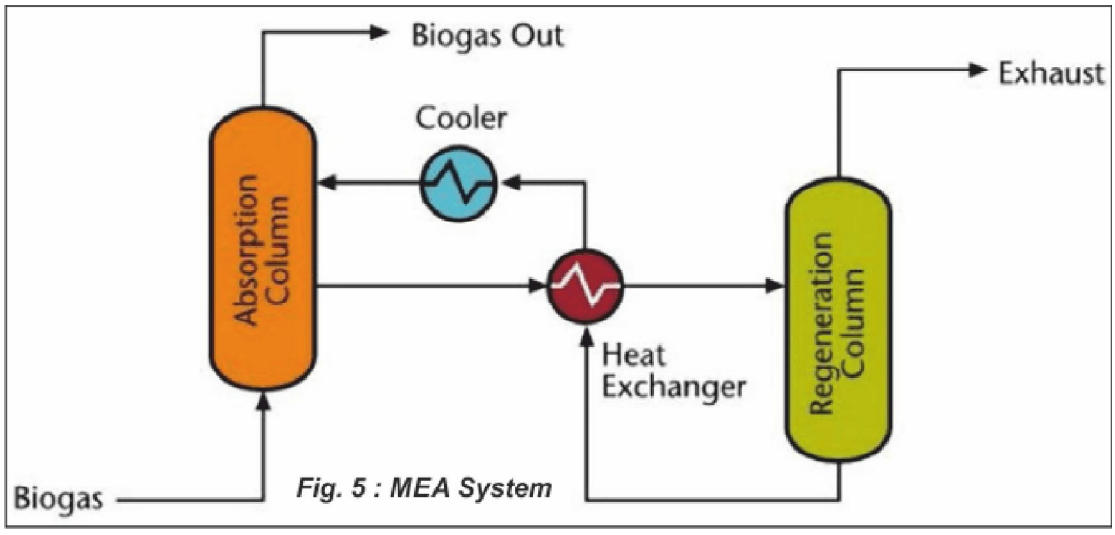


Fig. 5 : MEA System

As the largest and most developed democracies of Asia (India and Japan), we have a mutual stake in each other's progress and prosperity.
— MANMOHAN SINGH

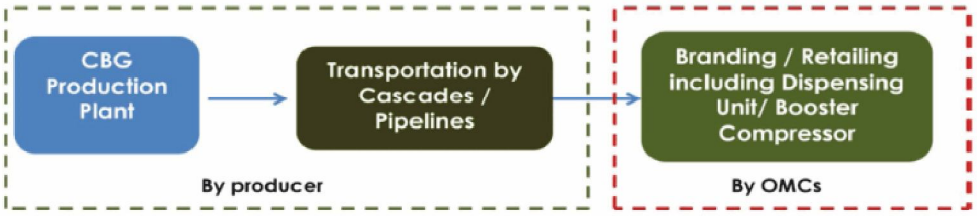
Table 3 : Comparative analysis of technologies to remove Carbon Dioxide

Parameter	PSA	Water Scrubber	Mono-ethylammine (MEA) system
Pre-H_2S removal required	Yes	No	Yes
Working pressure (bar)	4-7	4-7	No pressure
Methane loss	20-30%	5-10%	<0.1%
Methane content in upgraded gas	>96%	>97%	>99%
Electricity consumption (kWh/m3)	0.25	<0.25	<0.15

Envisaged Business Model for Oil Marketing Companies (OMCs)

The CBG Plants shall be set up by mainly through independent Entrepreneurs and in few specific cases OMCs may consider setting up of CBG plant. The marketing of all the CBG produced through such plants will be through OMC network, under their respective brand names.

Producer(s) / Seller(s) (Party/Entrepreneur) shall deliver CBG (within 25 Km, an indicative maximum distance), at Public sector Oil Marketing Companies' existing or new Retail Outlet / Stand alone Selling Point, through Cascades. The equipment for dispensing CBG at Public sector Oil Marketing Companies' existing or new Retail Outlet / Stand alone Selling Point shall be installed and maintained by Public sector Oil Marketing Companies', however, the CBG nozzles shall be manned and operated by RO Dealer. Electricity expenses towards dispensing of CBG through sale point shall be reimbursed to the Party who is actually bearing the costs. The outlet flange of the Cascade / Inlet Flange of Compressor at the Retail Outlet shall be the Point of Sale for CBG. The cascade to remain connected to the compressor at retail outlet till the dispensation is operationally feasible.



Pricing Framework of CBG

(To be retailed through OMCs / Fixed for three years from 1.10.2018 / The price will be reviewed at the end of 3 years.)

Item	Unit	Price
Basic Price of CBG meeting IS 16087 : 2016 standard, compressed at 250 bar and delivered at OMC Retail Outlet in cascades	Rs./kg	46.00
GST at 5%	Rs./kg	2.30
Total supply price (incl. GST) to be paid to party	Rs./kg	**48.30**

Additionally, an element of Rs. 2 per kg of CBG towards cost of setting up of infrastructure e.g. booster compressor, dispensing unit, etc. at retail outlet and Rs. 0.50 per kg of CBG towards electricity charges for operation of booster compressor, dispensing unit, etc at retail outlet, shall be provided to OMC or APPLICANT, as per whosoever sets up infrastructure at retail outlet.

Extracts from the white paper on CBG is completed.

(To be continued)

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MAKE HYDROGEN IN INDIA

Driving India towards the clean energy technology frontier

The energy transition is continuing at an unprecedented pace and scale, requiring new low carbon technologies.

To date, India has had limited success in capturing the manufacturing benefits of certain clean energy technologies, such as solar PV and batteries.

TERI sees green hydrogen as the next 'clean energy prize', which will require coordinated action from industry and government for India to capture the benefits.

Early demand markets for hydrogen include fuel cells for trucking, balancing supply and demand in the power sector and replacing fossil fuels in industry.

The potential scale of hydrogen use in India is huge; increasing between 3 and 10 times by 2050.

Hydrogen can provide a supplementary role to renewables and batteries, in a transition to a carbon neutral economy.

Hydrogen can be divided into 'grey' (produced from fossil fuels), 'blue' (produced from fossil fuels with carbon capture and storage) or 'green' (produced from renewable electricity).

Technology for the energy transition

The world is undergoing a transition to clean, low carbon sources of energy at an unprecedented pace and scale. New technologies are required to replace existing fossil fuels in order to move towards a net carbon neutral economy at the earliest. Keeping ahead of the technology curve is a matter of strategic importance for all countries but especially India, which will be one of the world's largest markets for these technologies in the decades to come. India needs to position itself at the technology frontier to maximise the benefits of the energy transition – to be a technology maker, not a technology taker.

Whilst the markets for clean technologies such as solar PV and lithium ion batteries have already been dominated by a few leading companies, there is a need for new technologies to reduce emissions from other sectors of the economy, beyond electricity. One such area is technologies related to the production, transportation, storage and use of low carbon hydrogen.

India's track record on technology innovation

There are a few clean energy technologies which have dominated the energy transition so far, namely, solar PV, wind (both onshore and offshore) and lithium ion batteries. The large-scale manufacture and deployment of these technologies has seen their costs plummet, with costs falling by 84% for batteries, 87% for solar PV, 47% for onshore wind and 32% for offshore wind between 2010 and 2018. The development and manufacture of these technologies has occurred largely outside India (apart from onshore wind), with companies weighted towards the US, Europe and China (Mazzucato, Semieniuk, & Watson, 2015). To become technology leaders, these countries have implemented strong supply-push policies for priority technologies, in part by ensuring adequate and appropriate financing across the innovation chain, with both public and private funding playing an important role. In parallel, they have also introduced demand-side policies to pull technologies towards deployment and diffusion, including subsidies for novel technologies or standards and regulations, which have limited the deployment of fossil fuel equivalents (Mazzucato & Semieniuk, 2017). Deployment, in particular, played a significant role here. For example, the German Feed-in-Tariff scheme and subsequent solar auctions guaranteed markets for the mass manufacture of solar panels in China, which in turn caused costs to plummet.

India has largely lost out on the benefits of manufacturing these technologies, which include high value-added employment, increased tax return and the ability to innovate on existing manufacturing processes to develop the next generation of renewable technologies. To avoid missing out on the future benefits of the energy transition,

India needs to be proactive in creating a productive innovation ecosystem for the development, deployment and diffusion of technologies. This policy brief outlines how this can be achieved for hydrogen-related technologies.It is also the case that India has played an important role in helping to bring down the costs of these technologies by deploying them at scale. From 2014 to 2018, a total of $42bn was invested in India's renewables sector, helping to further drive down costs (IBEF, 2019). Whilst there are significant benefits of deploying renewables, not least reducing local air pollution and carbon dioxide emissions, unfortunately for India, much of this spending was to the benefit of companies based outside the country.

The limits of direct electrification

India is already experiencing first-hand the range of benefits that come with renewable electricity, including providing greater energy access, reducing local air pollution and carbon dioxide emissions and reducing energy imports. There are clear routes for increasing the role of renewable electricity in the grid (Pachouri, Spencer, & Renjith, 2019), as well as in end-use sectors,such as transport and industry. There are nonetheless cost, technology and practicality barriers to the full-scale electrification of all existing energy uses, which limits the extent to which renewable electricity can directly replace fossil fuels.

Transport

In transport, whilst the majority of light passenger vehicles look set to be electrified over the coming decades, the options for heavy-duty vehicles looks less certain. This is largely due to the limiting factors of batteries energy-to- weight ratios and the speed at which such large batteries could be recharged versus the rate of hydrogen refuelling (ETC, 2018). Presently, hydrogen fuel cell vehicles (FCEVs) can be recharged between 5-15 minutes, versus the well over 90 minutes required for battery electric vehicles (BEVs).

India's heavy-duty transport market is set to rapidly expand and with it, associated CO2 emissions. According to the IEA, oil demand from heavy-duty road transport in India will nearly treble by 2040 (IEA, 2017). India will see the greatest increase in heavy-duty road transport of any region in the world, presenting both a huge challenge and an opportunity.

Zero-carbon trucks, using hydrogen fuel cells are already technically feasible, although the cost and carbon intensity are currently greater than that of diesel equivalents, assuming an emissions intensity of grid electricity for India of around 700gCO2/kWh. Nonetheless, there is a clear path towards cost parity, which is expected in the 2020s. Companies are showing support for this technology, with the US-based FCEV truck manufacturer, Nikola, already receiving orders for 14,000 trucks (Freightwaves, 2019).

Industry

In industry, full-scale electrification of process heat can incur significant costs and is often impractical or technically challenging. It is also the case that many industrial processes require chemical feedstocks, such as iron ore direct reduction for primary steel production, that switching to direct electrification would not provide (Hall, Spencer, & Kumar, 2020). Whilst carbon, capture and storage (CCS) has a potential role to play in decarbonising industry, its future is highly uncertain in India, given the lack of understanding around its potential scale and costs.

Taking the steel sector as an example, pilot plants using high shares of hydrogen are already being established in Europe. The HYBRIT project in Sweden aims to have a demonstration plant up and running by 2026, a full-scale plant operating in 2035, with the intention to have switched over their entire fleet by 2045 (SSAB, 2019). If supplied with zero-carbon hydrogen and combined with an electric arc furnace supplied with zero-carbon electricity, this has the potential to reduce emissions by over 94% compared with conventional technologies. Residual emissions occur from the use of graphite electrodes in the EAF, as well as use of lime and natural gas. These could be brought down to zero with further research and development (Vogl & Ahman, 2019).

Power

In the power sector, as the electricity grid approaches higher and higher shares of variable renewable electricity generation from the likes of wind and solar, it will become increasingly difficult to balance the electricity grid over long periods, without thermal or hydro generation (or other forms of long-term seasonal storage). This is especially true for India's renewable generation, which can experience significant seasonal variation during monsoon and winter periods.

Batteries will be able to provide cost-effective intraday storage, as a result of their high round-trip efficiencies and ability to cycle multiple times within 24 hours. This allows energy to be shifted from times of the day of high renewable energy production to times of low production and high demand. However, batteries are unlikely to provide cost-effective storage on the time scale of several days or weeks and for this purpose, hydrogen may be a more suitable option. This is due to the lower capital costs of developing hydrogen storage facilities at scale, including salt caverns or steel tanks. The lower the electricity input cost, the lower the final cost of electricity stored, with hydrogen becoming competitive at lower costs as the capital costs become the dominating factor, over the operating efficiencies.Scale

When combining these end-uses together, across several sectors, demand for hydrogen has the potential to increase significantly in the coming decades. Global demand for hydrogen is currently around 70Mt but the ETC, BNEF and the Hydrogen Council all expect this to multiply many times over by 2050, to enable countries to transition to low carbon. There is still considerable uncertainty in these projections given the unknowns around levels of policy support, speed of cost reduction and cost-effectiveness versus alternatives.

In India, current hydrogen demand is largely focused in the chemical and petrochemical sectors. Future demand will be driven by greater use across transport, industry and power. Scaling this demand to these existing projections could see demand for hydrogen increasing between 3 to 10 times in India by 2050. This represents a significant scale of demand for India, which in turn can generate further cost reductions as technologies, such as electrolysers, are deployed.

Hydrogen as the next clean energy prize

Given the limits of direct electrification and the potential of hydrogen to overcome some of these barriers, we see it as the next clean energy prize under the energy transition. A range of countries, companies and multi-lateral organisations are already pushing ahead with ambitious plans to develop and deploy hydrogen at scale. Whilst 'grey' hydrogen production technologies are mature, many 'green' hydrogen technologies are still at a stage of emergence, whereby markets are still developing and manufacturers are engaged in experimentalist learning (Victor, Geels, & Sharpe, 2019).1

At the country level, Japan has been at the forefront of developing hydrogen technologies, with strong support from government and industry. The Ministry for Economy, Trade and Industry (METI) first developed a Strategic Roadmap for Hydrogen and Fuel Cells in 2014. This was most recently revised in 2019, where the Council for a Strategy for Hydrogen and Fuel Cells set out (i) new targets on the specification of basic technologies and the breakdown of costs; (ii) necessary measures for achieving these goals; and (iii) the intention to convene a working group to review the status of implementation in each area of the roadmap (METI, 2019). Recently, Japan opened the largest green hydrogen plant, with a 20 MW solar array feeding a 10 MW electrolyser plant (RECHARGE, 2020). Interest is also now growing elsewhere, with the European Union, the United States, Australia and China all developing serious plans for the deployment of hydrogen technologies in sectors such as steel, shipping, petrochemicals and power.

In terms of companies, there are a number of multinational corporations undertaking serious activity on hydrogen. This includes Shell, who has hydrogen refuelling stations operational in Europe and the US and is working with truck manufacturers to expand into the heavy-duty transport sector. The Swedish steel company, SSAB, along with partners LKAB and Vattenfall are planning to deploy a commercial-scale hydrogen direct reduction steel

plant by 2026, the first in the world. Maersk, the shipping company, have identified low carbon hydrogen as vital for decarbonising sea-borne freight, through using it to produce green ammonia. The German-based engineering firm, Siemens, is also expanding its activity in hydrogen, continuing to manufacture PEM electrolysers, as well as developing hydrogen-fuelled turbines to facilitate clean electricity generation. Lastly, Mitsubishi Hitachi Power Systems are planning to switch natural gas turbines to run on 100% hydrogen in Los Angeles before 2035.

There is also growing interest in hydrogen among multilateral organisations focused on coordinating innovation activities between countries. This includes Mission Innovation, which India is a founding member of, who launched an innovation challenge on 'Renewables and Clean Hydrogen'. Also, the Clean Energy Ministerial, coordinated by the International Energy Agency (IEA), launched their 'Hydrogen Initiative' in 2019, focused on the use of hydrogen in industry, transport and communities.

Current status of hydrogen in India

Hydrogen is already used extensively in India, mainly as an industrial feedstock in the creation of ammonia-based fertilisers. Most hydrogen in India is produced through reforming methane (CH4), resulting in significant carbon dioxide emissions. There is the potential to capture these emissions using carbon capture and storage (CCS) technology, although this is relatively underdeveloped in India. An alternative means of production is electrolysis, where water (H2O) is split into its component parts using electricity. India has claim to one of the first large- scale alkaline electrolyser facilities in the world, which produced hydrogen from electricity at the Nangal Facility from 1962. Whilst there is significant research activity around electrolysis, photolysis and biogenic methods of producing hydrogen, these low carbon technologies are yet to be deployed at scale.

In part, this is due to the costs of hydrogen production from low carbon sources today, which are higher than fossil fuel-based hydrogen or other fossil-fuel equivalents. It is however possible that these costs could reach parity in future, with green hydrogen undercutting grey hydrogen in favourable regions. This is made more possible in India, where renewable electricity tariffs are already among the lowest in the world and supplies of natural gas are limited and costly.

Along with electricity prices, the other important factor for reducing the costs of green hydrogen is the capital cost of electrolysers. These are expected to continue to fall with a scale-up in deployment, as most electrolysers today are manufactured on a relatively small- scale (BNEF, 2019). Marco Alvera, CEO of Snam Chemicals, estimates in his book 'Generation H' that the world will need to build 50 GW of electrolyser capacity (vs. 135 MW today) to help drive the prices of green hydrogen down to $2/kg, where it will become competitive with a range of fossil fuels (Alvera, 2019; BNEF, 2020).

In this context, it is also worth comparing electrolysers with previous clean energy technologies. Arguably, electrolysers are similar to batteries, being modular in design and relatively easy to transport. Batteries and electrolysers also share the same electrochemical foundations, both applying electrolyte and membrane materials. As a result, we could see global supply chains developing for electrolysers, as we have with batteries, where a significant amount is manufactured in China but used throughout Europe and the US. This provides India with an opportunity to develop a manufacturing hub here, taking advantage of competitive labour costs and a technically proficient workforce.

The Ministry of New and Renewable Energy (MNRE) has seen hydrogen as an area of strategic interest since at least 2006, when the first Hydrogen and Fuel Cell Roadmap was launched (MNRE, 2006). More recently, in 2016, MNRE published a report laying out a comprehensive plan for increasing R&D activity. This included significant funding for different electrolyser technologies and their integration with renewable electricity sources, which has strong potential in India given the cost and availability of renewable electricity. Across Indian industry, there are considerable efforts to establish a hydrogen economy in India, not least, the work being taken forward by Indian Oil.

Despite these positive moves from Government and industry, current activity is still an order of magnitude below where it needs to be to fully take advantage of a transition to hydrogen technologies, with manufacturing centered in India. In terms of the investment requirements, if India is to deploy green hydrogen as a clean energy solution for key sectors, including transport, industry and power, by 2050, this would require significant investment in electrolysers. Beyond this, additional investment in renewable electricity would be required, at a time when other demands for electricity in India will still be growing rapidly. This would clearly be a challenge to deliver, which is why it is imperative that India begins now in scaling-up activity.

An ambitious Hydrogen Mission for India

For India to guarantee its role as a technology leader in the next phase of the energy transition, it will need to greatly increase activity across the public and private sectors to develop a hydrogen economy. India should focus public money for R&D and technology development to try and be on the global frontier in each part of the value chain of green hydrogen, with the objective of lowering costs and increasing deployment. This requires a coordinated push from the supply-side, with increased investment and R&D commitments by government and industry, as well as demand-side support in the form of guaranteed markets, enabled by government procurement, subsidy schemes or regulations / standards on fossil fuel alternatives.

To ensure success, significant commitments under a National Mission, along with effective public-private partnerships, are required; there would be little point in a sub-optimal effort that fails to mobilise sufficient resources. This is an opportunity for India to expand on the successes seen in the Defence and Pharmaceutical sectors, to commit strategic resources to deliver breakthroughs for hydrogen technologies, yielding significant benefits for the Indian economy.

Whilst it is important that India pushes ahead with developing and manufacturing hydrogen technologies domestically, it will also be important for other countries to do the same. Only through the mass manufacture and deployment of hydrogen technologies at scale will we see cost reductions where hydrogen can start to displace significant amounts of fossil fuel use, without government subsidy.

Our recommendations for driving forward hydrogen in India include:

Mission statement:

‘India is committed to the rapid expansion of the hydrogen economy, ensuring the cost- effective deployment of low carbon hydrogen technologies across the transport, industry and power sectors by 2030

Clear recognition of hydrogen’s cross-economy role, with outlines for scaling-up use in transport, industry and power

Commitment to update existing regulations to permit the safe use of hydrogen, at high pressure, across a number of end-use sectors

‘Make in India’ policy support to maximise domestic manufacturing content across all parts of the value chain, including joint ventures with multinational companies

Champion electrolyser manufacture and commercialisation, realising their suitability to the Indian market and significant potential for emissions reduction

Significant increases in existing hydrogen R,D&D spending, to support demonstration projects in the steel and power sectors, as well as the commercialisation of more mature technologies

Policies to create a guaranteed market for hydrogen technologies, where they are not yet at cost parity with fossil-fuel equivalents, for example in the steel sector

Meaningful engagement in international collaborations on developing hydrogen technologies, including Mission Innovation and the Clean Energy Ministerial.

தமிழ்நாடு அரசு

மக்கள் நல்வாழ்வு மற்றும் குடும்பநலத்துறை

இந்திய மருத்துவம் மற்றும் ஹோமியோபதி ஆணையரகம்

நிலவேம்பு குடிநீர்

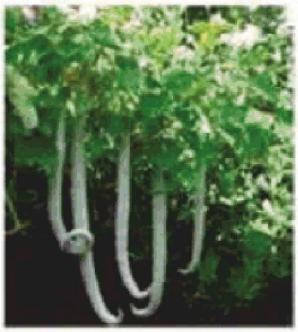
இவற்றில் சேரும் மருந்துகள்

நிலவேம்பு

வெட்டிவேர்

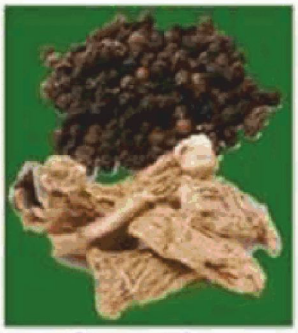
விலாமிச்சம்வேர்

சந்தனம்

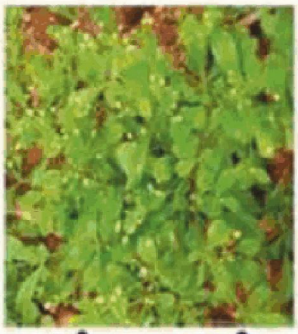


பேய்ப்புடல்

கோரைக்கிழங்கு



சுக்கு,மிளகு



பற்பாடகம்

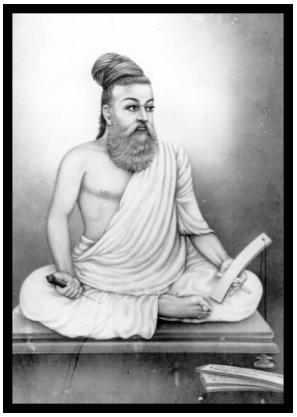
குடிநீர் அளவு

5 வயது முதல் 12 வயது வரை உள்ள குழந்தைகளுக்கு 10 மி.லி. தினமும் 2 வேளை அருந்தவும்.

பெரியவர்களுக்கு 50மி.லி. தினமும் 2 வேளை அருந்தவும்.

எல்லா வகை காய்ச்சலும் குணமாகும்

TENETS FROM TIRUKKURAL FOR GOOD GOVERNANCE AND GOOD LEADER



As we elaborated earlier, Tirukkural deals with all aspects of Life, Morals, Government, Business and Leadership and guidance and solutions for all situations. Present times being Pandemic time in all parts of the world, we picked up relevant advice and procedure which was covered in the last issue.

Given below is a Kural referred by our Prime Minister recently in the same context of Pandemic and the Vaccine and the occasion of the successful development of Vaccine indigenously.

There are historical references about the primitive but effective way in which vaccination was done for smallpox, over a thousand or more years back in our country and the fundamental methodology mentioned in Tirukkural was quoted by the PM.

Noynadi Noymudal Nadi Athuthanikkum
Vaynadi Vayppach Cheyal Kural 948

நோய்நாடி நோய்முதல் நாடி அதுதணிக்கும்
வாய்நாடி வாய்ப்பச் செயல் குறள் 948

"Consider the disease and the root and the means of curing it; and then set about the cure with every precaution."

HUMOUR

The Blind Firemen

A priest, a doctor, and an engineer were waiting one morning for a particularly slow group of golfers. The engineer fumed, "What's with those guys? We must have been waiting for fifteen minutes!" The doctor chimed in, "I don't know, but I've never seen such inept golf!"

The priest said, "Here comes the green-keeper. Let's have a word with him." He said, "Hello George, what's wrong with that group ahead of us? They're rather slow, aren't they?"

The green-keeper replied, "Oh, yes. That's a group of blind firemen. They lost their sight saving our clubhouse from a fire last year, so we always let them play for free anytime."

The group fell silent for a moment. The priest said, "That's so sad. I think I will say a special prayer for them tonight." The doctor said, "Good idea. I'm going to contact my ophthalmologist colleague and see if there's anything he can do for them."

The engineer said, "Why can't they play at night?"

An Engineer's Dream Salary

Reaching the end of a job interview, the Human Resources Manager asked the young engineer fresh out of university, "And what starting salary were you looking for?"

The engineer said, "In the neighborhood of **$100,000** a year, depending on the benefit's package."

The HR Manager said, "Well, what would you say to a package of **$200,000** a year, **5 weeks** vacation, **14 paid** holidays, full medical and dental coverage, company matching retirement fund to **50%** of salary, and a company car leased every **2 years** — say, a red Mercedes?"

The engineer sat up straight and said, "Wow!!! Are you joking?"

HR Manager says, "Of course, ...but you started it."

A Misunderstanding

Customer: Do you have any two-watt, 4-volt bulbs?

Sales Rep: For what?

Customer: No, two.

Sales Rep: Two what?

Customer: Yes.

Sales Rep: No.

HOME FESTIVALS - 8

ஆவணி - AVANI (August/September)

This is a busy month, with two major festivals celebrated both at home and at the temple. Krishna Jayanthi, the birth of Lord Krishna, comes first. In the painting at right is the rescue of the baby Krishna, who was born in a prison. His father carries him across a swollen stream while the seven-headed serpent, AdiSeshan, protects the incarnation of Lord Vishnu from the storm. In the Home, offerings of butter and yoghurt are made to Krishna's image, and footprints made with red powder reveal his path from the home's front door to the shrine room, suggesting that Krishna has come to participate. Ganesha Chathurthi is a mammoth festival across all of India, ten days in celebration of His manifestation. Shown in the centre of the painting is a statue of Lord Ganesha and a devotee offering obeisance by pulling his ears and bobbing up and down, a practice called *thopukarnam* in Tamil, done only for Ganesha – one explanation being that it is to make the Baby Ganesha laugh. The icon of Ganesha is made by the devotees from river clay and painted and decorated. At festival's end is the Visarjana or departure, when the clay icon is placed into the river the Deity is bid farewell. In North India Visarjana is celebrated by millions of people. At far right in the art is depicted the story of Ganesha consuming so many sweet offerings that He had to tie a snake around his belly to keep it from bursting. Ganesha chastised the Moon for laughing at His predicament, and as penance the Moon has ever since waxed and waned through the month instead of remaining constantly bright.

HOME FESTIVALS - 9

புரட்டாசி - Purattasi (September/October)

Navaratri ("nine nights") is the principal festival this month. The Goddess is worshipped in Her many forms, and on the ninth day, Sarasvati (center of the painting) is invoked to bless musical instruments, account books, agricultural instruments and home tools(upper left). On Vijaya Dasami, the day following Navaratri, Goddess Durga is invoked as children are given their first instruction, worship their school books and honour their teacher. A decorated display of dolls is displayed through the nine days, then dismantled and stored on the tenth day. **Vijaya Dasami is also the birthday of Lord Venkateshwara**, presiding Deity of Tirupati temple in Andhra Pradesh, India's wealthiest temple.

(To be continued)

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