



ELECTRICAL

INSTALLATION ENGINEER

NEWS LETTER

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

Old No. 82 / New No. 123, Lloyds Enclave, Avvai Shanmugam Road, Royapettah, Chennai 600 014.

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*Thanks for your
Continuous Support*

EVENTS

12th Edition

Green Building Congress 2014

India's Flagship event on Green Buildings

International Conference & Exhibition on Green Buildings
4 - 6 September 2014, Hyderabad, India

Asia's Largest Green Building Conference & Exhibition

Events Profile: The construction industry is one of the largest economic activities contributing to India's development. India has been witnessing tremendous growth in building and construction sector for the past 5 years. With a modest beginning of 20,000 sq.ft of green footprint in the country in the year 2001, today over 2,007 Green Buildings with a Footprint of over 1.40 Billion sq.ft are being constructed all over India. To advance green building movement in the country, IGBC is organising India's flagship event on green buildings.

Date: 4th - 6th September 2014

Venue: Hyderabad International Convention Centre (HICC), Near Hitec City, Hyderabad

Website: <http://www.greenbuildingcongress.com/site/gbc/index.jsp>



Event Profile: Organised by UBM India, the Renewable Energy India Expo is an annual event that aims to accelerate growth of the Indian renewable energy sector by offering sustainable development opportunities to businesses in this industry.

Date & Time: 3rd - 5th September 2014

Venue: India Expo Centre, Greater Noida, India

Website: <http://www.renewableenergyindiaexpo.com>

WIRE & CABLE
INDIA 2012

International Exhibition and Conference for the Wire & Cable Industry

Events Profile: The Confederation of Indian Industry (CII) and Messe Düsseldorf will jointly organize Wire & Cable India. Messe Düsseldorf is the organizer of wire Düsseldorf - the world's No. 1 Trade Fair for the wire and cable industries.

Date: 28th - 30th October 2014

Venue: Mumbai, India

Website: <http://www.mdna.com/trade-shows/details/wireindia>

4th Annual Executive Congress on LED Lighting

Leading India's Green Energy Revolution

FROST & SULLIVAN
8th July, 2014 - The Imperial, New Delhi

EVENT Profile: Today, India deals with challenges of energy deficiency, sustainability, and electrification for its urban and remote rural regions. Of the entire energy consumption in India, lighting accounts for 20 percent. Light Emitting Diode (LED) has emerged as a very effective solution to India's lighting challenges.

Date: 8th July 2014

Venue: The Imperial, New Delhi, India

Website: <http://www.led-professional.com/events/2014%20Top%20Events/leading-indias-green-energy-revolution>



Presenting 'Solar South' by Smart Expos!

EVENT Profile: An exhibition which offers a tremendous opportunity for

stakeholders in the Solar Energy space. An event where you come together to connect, collaborate, create mutual opportunities and gain better access to a sunrise industry exploding with possibilities. Solar South will bring together manufacturers, traders, distributors, consultants, installation experts and virtually everyone directly or indirectly associated with the alternative power generation involving Solar Energy.

Date: 18th - 20th July 2014

Venue: Chennai Trade Centre, Nandambakkam, Chennai

Website: <http://www.solarsouth.in/>

EDITORIAL

Dear Members, Fellow Professionals, Friends and Well wishers,

Seasons greetings to one and all!

This is the 100th issue of the news letter and this first land mark is achieved through your continued support and wishes!!

We take this opportunity to thank you all and convey our best wishes!!!

It is interesting to note that this 100th Issue of News Letter, co-insides with the formation of New Government at the Centre after a Historical Election, which makes us feel proud about our Great Democracy. Historically, we are a Country with Great Cultural Heritage and eminent position with Technological capabilities and Economic prosperity till about 300 years ago, in the Global Scene. It is History that when Vasco da gama was on his way to finding Sea Route to India, he came across very large, 10 times larger than his ship, Indian Merchant Ships who guided him to reach Indian shores and complete his Mission. We had lost out due to invasions and foreign rulers and Colonization, but our Country has made great strides of progress since Independence and we are certainly marching towards regaining that position of Economic Super Power within few more decades.

In the area of Energy, particularly Electrical Energy, there have been great progress in the past decades, but shortages loom large, partly due to galloping demands due to Growth and also due to poor efficiencies at all stages of Generation, Transmission, Distribution and End Use. As Electrical Installation Engineering Professionals, we are a part of all the steps for corrections and improvements, like for example the higher and higher voltages for Transmission, Steps towards National Grid formation, Power Factor improvements, addressing Harmonics, addressing Distribution and End Use Efficiencies and so on. We also realize that there is still a long way to go to reach the current and future International levels of Efficiencies. Since the passage of Energy Conservation Act in 2001, the Steps taken, the encouragements announced and pressures created by the Government have all contributed to some extent, but it is only the full commitment and involvement of Engineering Professionals of all disciplines at all levels, both Government and other Sectors that can help march towards the Goal of Best of Efficiencies. We have also been doing our bit through this News Letter in reminding the Professional Fraternity about the Technologies and the developments that are happening around. We will continue to do this work and we also seek the participation of all the Professionals in sharing their experiences and ideas and suggestions.

The New Government is rightly stressing on Development as the main focus and to progress in this direction, Water and Energy assume paramount importance. While talking about Water, the example of Electricity is quoted that, when you switch on, Electricity immediately flows, whether it is generated from a nearby Power House or from one located anywhere in the country, or from wind or solar or hydro or thermal etc because of the GRID. Likewise, Water Grid needs to be created utilizing all the Water Resources – Rivers of the Country, so that Water will be available for any one in the Country just by opening of the Tap or the Valve for Domestic, Agriculture or Industrial use. Total availability of water in the Country with surpluses and deficiencies in different parts of the Country in ‘Cycles’ over the years and decades, indicates that there is abundance and there is scope for equitable distribution. But the Challenge remains and the reason is only the WILL to do it more than the Technologies and the Economics. We Hope and Pray that there will be progress and achievements in this direction in the course of the coming decade.

We remind ourselves that our Professional priorities, apart from Ethics, revolve around Technology, Efficiency and more importantly, Safety. We will continue to strive for Excellence in all these fronts.

We thank all those members who have helped us by participating in the advertisements appearing for the issue May 2014 – Galaxy Earthing Electrodes Pvt. Ltd., Elmeasure India Pvt. Ltd., Prolite Autoglo Ltd., Power Links, Max Electric Co., FLIR Systems India Pvt. Ltd., Sri Bhoomidurga Marketing (P) Ltd., Universal Earthing Systems Pvt. Ltd., Faith Power Solutions, Wilson Power and Distribution Technologies Pvt. Ltd., Cape Electric Pvt. Ltd., Supreme & Co Pvt. Ltd., Heat Craft Engineers Pvt. Ltd., Ashlok Safe Earthing Electrode Ltd., Abirami Electricals.

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From the Desk of

Er. S. APPAVOO

Chief Electrical Inspector to Government



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ELECTRICAL INSPECTORATE**

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Dear Mr. Baskaran,

I am very happy to hear that the News Letter of your Association, "Electrical Installation Engineer" is coming out with the 100th Issue in June'14. I have been regularly going through all the issues of this News Letter almost from its inception.

I hereby convey my Congratulations and Best Wishes for the Association on behalf of my department for its continuing effort.

The subject of electrical safety and its awareness was so far limited to very few stake holders like, Government through the officials of electrical inspectorate, contractors' associations, consultants and few consumers across the State. It is now gaining attention of large section of consumers through such magazines, most importantly, in a continuous manner. I find the articles and matters published in the areas of Electrical Safety and energy conservation are not only useful and informative, it has become a helping hand to our department in propagating these subjects to the end users.

I express my sincere thanks to the Association, especially, to those who started this idea, to the authors contributing various articles and to the team consistently developing and publishing it. I assure you of our suggestions and guidance as and when needed.

**Best Wishes,
S. Appavoo**

From the President Desk



Dear Members,

My Greetings to one and all!

It is indeed a great honour and privilege to be addressing you from the desk of the President of the Tamilnadu Electrical Installation Engineers' Association 'A' Grade (TNEIEA).

It is with a sense of Joy and Prestige that I am writing this Note to you on the occasion of releasing the 100th Issue of our Association's **NEWS LETTER "ELECTRICAL INSTALLATION ENGINEER"**.

The Joy is, due to the fact that the Association has been able to muster all round support, to continue to come out, with News Letter month after month, without interruption, resulting of which the First Land Mark of 100th Issue is materialized.

I take this opportunity to convey my respectful regards to the then President and other Office bearers, who ventured to start the News Letter with purposes of Communicating with Members, Sharing Technology Developments and Experiences and Celebration of Events and also providing opportunities for Equipment Manufacturers and Service Providers to Advertise their Products and Services. There have been satisfactory achievements in all these fronts, but we are aware that there is scope for lot of improvements.

My sincere thanks to our Members, Subscribers and Govt. Officials whose continuous support in bringing this 100th issue. I, once again express my thanks to one and all and in particular to the Chief Electrical Inspector to Government, whose continuous Guidance and Support have been very valuable.

We at the TNEIEA presidency, request you to extend your valuable support, good wishes and guidance to the Association, which would strengthen us.

Thanking you,
U. BASKARAN

From the Secretary Desk



My Dear Members,

My Greetings and Best Wishes!

I wish to place on record, with a sense of satisfaction, that the Issue dated June 2014, is the 100th Issue of our Association's **NEWS LETTER – "ELECTRICAL INSTALLATION ENGINEER"**. I congratulate the Editorial Team and the Publisher for continuing to do a Good Job month after month.

Apart from communicating with the Members and the Professional Fraternity, we also desired to make it a valuable Print Media for the Advertisers and in order to make easily accessible and affordable, we made the Tariffs low. We looked at the two fold benefits of Information for the Members and Business Development for the Advertisers. There have been fairly Good Response from many Companies, but the scope here is enormous as we desire to have more and more companies to use this effective media, reaching the hands of all professionals who matter in the realm of Electrical Technology in general and Electrical Installation Engineering and Consultancy in particular.

We, therefore appeal to all our Members and Well Wishers to request all their suppliers, associates and others known to them to use this valuable media for Advertising their Products and Services.

My Thanks to all Members and Well Wishers for their continued support and Guidance.

Warm Regards,
K. KANNAN

Message from Er. L.A. SRINIVASAN, B.E., F.I.E., F.S.E.I., CEIG (Retd.)

1st Issue

Dear Mr. S. Sitaraman,

I am glad to know that our Electrical Installation Engineers' Association has proposed to bring out a monthly News Letter to be circulated free of cost among members. I am sure that this venture will be very much appreciated and will be very helpful for members for updating their Technical knowledge in the Electrical field. I wish all success in this matter.

With best wishes

100th Issue

20.05.2014

I am very happy to know that the Installation Engineers Association is going to have their 100th issue of "News Letter" magazine. Even though the magazine bears the name "News Letter" informing about the various activities of the Association, the contents cover the latest developments in the Electrical field & Technology with various useful and interesting articles dealing with medicine, Literature, Health, culture and Humour required for the benefit of the members. Each article is quite interesting, informative & useful. In an era when electronic communications seem to be everywhere, the role of paper magazine like yours, is still important to an organization having different categories of readers.

It is time to recognise the role that the staffs of the editorial board and office bearers of the Association play and they deserve hearty congratulations and encouragement from every reader.

With Best Wishes

Message from Mr. J.M. MENEZES, Past President, TNEIEA, Chennai

1st Issue

Dear Mr. S. Sitaraman,

The periodical Newsletter which is now on the agenda of the Association is surely a new benchmark for the office bearers. This must have been a long felt necessity for the contracting fraternity. No doubt a journal like a Newsletter leads to be the understanding of mutual problems and help to highlight achievements of members as well as pose their problems to the community at large.

I am sure there are many learned friends who are itching to find an outlet to express their knowledge, from their achievements and share their experience for the benefit of the community at large. Please do not hesitate to send in your articles.

My Congratulations to the office bearers who are instrumental in taking this bold step to bring out a Newsletter. I wish the Association the very best. I am certain that the Newsletter will encompass many spheres of activity and will be such that members would eagerly look forward to receive every issue on mail.

Congratulations & Good wishes! Once again!!

100th Issue

Dt. 23.05.2014

Dear Sir,

Congratulations to "**Tamilnadu Electrical Installation Engineers Association 'A' Grade**" and the editor **Mr. G. Venkatesh** on momentous occasion of publishing the **100th NEWSLETTER**.

The successive editors have progressively taken the NEWSLETTER to the current high level on technical subjects embracing all aspects of generation, transmission and utilization of electricity. Safety factors are often highlighted with information on latest developments. The NEWSLETTER covers topics like renewable energy papers on solar and wind generation are of particular interest.

The NEWSLETTER does not forget to humour readers through its column "**HUMOUR**". It even covers non-technical subjects like **life and achievements of famous scientists** and **engineers and even historical figures**. When the 100th issue of NEWSLETTER is published we will have a new government headed by a dynamic leader.

Let us wish him success in steering the country to greater prosperity and social balance. Let us wish him and his team well.

FIRST ISSUE MESSAGES from Our Well Wishers

MESSAGE FROM Mr. C.S. GANESAN, *Past President, TNEIEA,*
Special Director, Best & Crompton Engg. Co. Ltd., (Retd.)

To

The President,

I am very glad to note that TNEIEA is coming forward to bring out a monthly magazine, I am sure it will be found very useful, particularly for the smaller contractors who will be having ambitious programmes for expansion of their activities. I wish you endeavour all success for sustained growth from strength to strength.

MESSAGE FROM Mr. M.J. ANANTHAMURTHY, *C.E.I.G. (Retd.)*

Dear Bhikkaji,

I thank you very much for your letter informing me that the Tamilnadu Electrical Installation Engineers Association is bringing out a Newsletter for the first time. I wish you all success and I am sure it will be very useful to our fraternity.

100th ISSUE MESSAGES from Our Well Wishers

Dt. 08.05.2014

Sir,

I am very happy to know that the "**Tamilnadu Electrical Installation Engineers' Association 'A' Grade**" Chennai – 600 014 is publishing their **100th ISSUE** of the **NEWSLETTER**. My heartiest congratulations to the Chief Editor and Members of the association for the publication of the 100th issue of the NEWSLETTER.

The NEWSLETTER is a guide to all practicing Electrical Engineers and Electrical Contractors. It contains highly technical articles on electricity and I used to wonder how much efforts the editor should take to gather such highly technical matters and publish these matters in the NEWSLETTER.

Since the NEWSLETTER is a valuable guide for all Electrical Engineers, I pray to god that the association should continue its publication for many more years to come and read by all Electrical Engineers' in India and Abroad.

I wish to make a suggestion that the **NEWSLETTER is freely distributed to all leading Engineers', Colleges in TamilNadu**, so that it will be kept in the reading room of the college library, and read by Electrical Engineering students to enrich their knowledge regarding Electricity and Electrical Installations.

Hats off to the association for the publication of the Electrical NEWSLETTER every month. May its publication grow in strength and wide circulation.

Yours Sincerely,

T. CHUHARAJ, B.E., *Electrical Inspector (Retd.), Chennai*

Dt. 16.05.2014

The Magazine is useful for the fellow Engineers, Contractors and the persons in our Electrical field. I wish every success in the years to come and serve the nation and the fraternity in every possible way.

R. SUBHRAMANYAM, *CEIG (Retd.), Karur*

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121.	Veera Electrical	ESA 332	Chennai	95000 85936, 98415 85936
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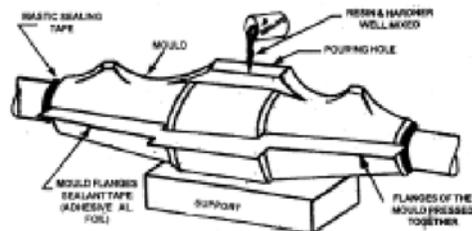
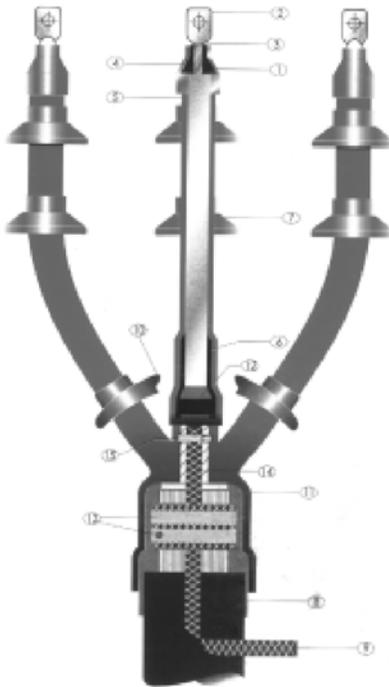
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EXCERPTS FROM THE PAST

1ST ISSUE
NEWSLETTER BORN



ELECTRICAL INSTALLATION ENGINEER

**TAMILNADU ELECTRICAL INSTALLATION
ENGINEERS' ASSOCIATION 'A' GRADE**
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MARCH 2006

VOL : No. 1/2006 / ISSUE NO. 1

PRESIDENT MESSAGE

Hello Members,
It gives me immense pleasure and pride to pen a few words in the maiden issue of our News Letter, an in-house publication to be circulated free of cost amongst our members, providing insight on advanced technical matters, new products, safety requirements, commercial developments etc., which would be of vital importance to us. I take this opportunity to appeal to everyone of you to partake actively in our endeavour and make this event a grand success with your generous contribution both in terms of sponsorship/advertisement from manufacturers and your valuable articles for publication.

Dear Member,

I am sure you must be proud of being a member of TNEIEA which is more than five decades old. The association has come a long way in the services of the Electrical contracting family. Our activities in conducting seminars, Liasion with Electrical Inspectorate, BIS, Government and non government institution is well known to our members. It is felt the long time requirement of a permanent and regular communication channel in the form of a in-house newsletter is over due and with this Newsletter in your hand the same has been demonstrated spontaneously for which act, members can really be proud of. In the technical area our publication stands out unique and the Guideline on Electrical Installation for Practicing Contractors book is well received by the professional sector.

In March 2005 we have established a training centre for the technicians, Electrical Supervisors and Engineers which will go a long way in enhancing the 'Know How' of the field personnel. A fullfledged administrative office and a library attached thereof is available to members for their benefits.

Our ambition is to become one of the leading non governmental forum. To reach our target and ambition, I appeal to our members to come forward to actively take part in the activities of the association amidst their busy schedules. Please send your articles and technical data for the newsletter.

Yours Truly
A.K. Venkatasamy

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with best wishes from :
shanti enterprises
electricals private limited
37, JOSIER STREET, CHENNAI - 600 034.
PH : 28279451 28275834 FAX : 28234500

Yours Sincerely
T.M. Bhikshaji





ELECTRICAL INSTALLATION ENGINEER

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APRIL 2006

Vol : No. 1/2006 / Monthly Issue No. 2

EDITOR'S NOTE

Dear Members,
I am glad to speak to you once again through this Newsletter.
The First Issue of our News Letter has received appreciation as well as lot of suggestions. We will endeavour to make improvements as we go along and we are confident that your continued participation will make it better.

M/s **ABB** have come forward to sponsor the April '06 and there are more requests which is encouraging.
During March'06, we had a rather emotional function in our Association premises on the 17th to release the First Issue of our News Letter, when the Portraits of the Eminent Past Presidents of our Association were also unveiled.
On the 24th we also had Visitors from M/ Greenlee, a Textron American Company from USA and these events are covered in detail in this issue.
Our Special "Chittirai" New Year Greetings to all our Members!!
Your Sincerely,
T.M.Bhikkaji

THE HINDU - 16-04-2006
Power Engineers' plea
Chennai : The Power Engineers' Society of Tamil Nadu has called upon the Electricity Board to negotiate with private power producers and revise the power purchase agreement entered with them. It also requested the State Government to find ways to beneficially utilise the large quantity of fly ash lying unused in thermal stations. Resolutions to this effect were adopted at the Society's council meeting. -Special Correspondent.



Electronics Engineers(USA) and CMD of M/S Rowsons Marketing Private Ltd., Chennai. Felicitation were offered by Dr.G.V.Roa, Mr.M.J.Anandamurthy, C.E.IG (Retd) and Mr.L.A.Srinivasan C.E.I.G. (Retired). The function concluded with a vote of thanks by Mr.Rhon.Vice president TNEIEA



Photograph taken on the occasion of Visit of Officials from U.S.Consulate and M/S Greenlee, a Textron American Company from USA, to our association for a meeting and discussions, on the 24th March. M/s Greenlee, who are leading Manufacturers of Hand Tools for Electrical and other Installations, explained broadly about the interesting features of their various products and have also agreed to hold a Seminar shortly for the benefit of our Members.

SPECIAL NEWS - Er. S. Shanmugasundaram B.E., Senior Electrical Inspector to Govt. of Tamilnadu has taken additional charge as CEIG on 31st March 2006.

SPONSORS OF THIS ISSUE

with best wishes from:
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ELECTRICAL INSTALLATION ENGINEER

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS ASSOCIATION - A GRADE
 CMA No. 02 / 1999 No. 123, Light House Ave, Shanmugam Road, Kogalambalam, Chennai - 600 014
 Phone: 28111000 Fax: 28118886 28115978
 ISSN NO 21 VOL : No 22007 / MONTHLY ISSUE NO 101 (PRIVATE CIRCULATION ONLY) NOVEMBER 2007
 SEMINAR & PHOTOS - 27.10.2007

EDITORIAL

Dear Members and Friends,
 With the Celebration of Light and Sweets and feast with health a commonly observed mark the beginning of Prosperous and successful period participated for all Business Endeavour. On this Occasion I would like to request that all our customers and the Society at the Best possible manner.
 We had an interesting, Informative and well attended Technical Seminar on Saturday the 27th Oct 2007 at the Hotel Sree Rama Kogalambalam, Chennai. 600 014. With the topic chosen for the Seminar as
SAFETY AND RELIABLE APPROACH BY UNTESTED SUB-STATION WITH DRY TYPE TRANSFORMERS.
 After the inauguration, informative and well attended Technical Seminar in the above topic.
 We had the pleasure of Mr. N. M. GADGE, General Manager, Maharashtra State Electricity Commission, Mumbai, Maharashtra, Government of India, who was also invited to inaugurate the seminar and presented the Theme Paper, which was most interesting, informative and instructive. The invited speaker, Mr. N. M. GADGE, General Manager, Maharashtra State Electricity Commission, Mumbai, Maharashtra, Government of India, who was also invited to inaugurate the seminar and presented the Theme Paper, which was most interesting, informative and instructive. The invited speaker, Mr. N. M. GADGE, General Manager, Maharashtra State Electricity Commission, Mumbai, Maharashtra, Government of India, who was also invited to inaugurate the seminar and presented the Theme Paper, which was most interesting, informative and instructive.

NEWS LETTER

After the Technical Seminar and Lunch We had the Annual General Body Meeting.
 Of our Association as scheduled apart from discussing and clearing regular and irregular Association Affairs, it was decided to have a Piece of Motion to Kuttuvailam hills. It is really gratifying to note the all round encouragement given by the members of the Association to participate in the sports and other activities which is a very important factor to help our members to improve their health and fitness.
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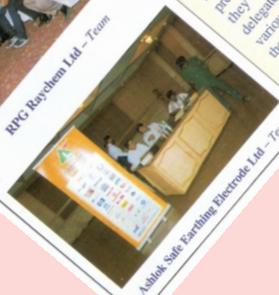
CORRECTIONS & CLARIFICATIONS
 In the Article page No. 89 by Subramanyam, Location of Load Center Diagrammed Agency should be read as KVP.

TECHNICAL SEMINAR AT MADURAI ON 24th JULY 2010

Our association conducted very successfully at the holy temple city Madurai on 24th July 2010 on Recent Development and Earthing System at the prestigious Hotel Sangam. The highlight of the programme was the inauguration by Mr. S. APPAYOOG, I.E.E., the Chief Electrical Inspector to Govt., who delivered the key note address and emphasised the importance of selection of High Voltage equipment and other accessories with regard to standard and attraction for the delegate was a power point presentation on Electrical Installation practices pertaining to Electrical safety electrical installation practices right from designing the sub station to the entire distribution arrangement up to the Electrical Installation Engineers. We are very much grateful to him for his presentation. The programme was also got entertained like Mr. Shivvardi, Mr. Inampooram, Mr. Kanthikeyan, Mr. Thennayyan, other Assauians and staff of Electrical Inspectorate.

The technical paper presented by Mr. RRG Roycherm Ltd. transformers, was on dry type transformers, and Roycherm cable joining termination and installation practices which were all very well received by the audience and there was highly educative interactive session. The team of officers from RRG Roycherm Ltd. who presented the lunch session are Mr. Vijay T. Wankhede, Manager- Sales & Marketing, Mr. T.J. Kuma Manikandan, Manager- Sales & Marketing, Mr. Anupam Agrawal, National Sales Head, Mr. Akash Haldar, Regional Manager, and we whole heartedly thank them.

The concluding session was on latest trend in Earthing System by Mr. Ashlok Safe Earthing Electrode Ltd., who are the members in this field. Mr. Beni, Regional Manager presented a lively centre on the chemical earthing and earthing they also demonstrated the safe earth electrode to the delegates and narrated their experience and solutions to the various earthing problems which they have encountered. At the end of the day the gathering left the hall with the immense satisfaction of enhancing their knowledge with latest development in Electrical installation practices. The meeting was concluded with a grand dinner hosted by the association.



July 2006



ELECTRICAL ENGINEER
INSTALLATION ENGINEER

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS ASSOCIATION 'A' GRADE
 Old No. 82, New No. 123, Linds Road, Avudai Chatterjee Road, Royapettah, Chennai - 600 014.
 Phone : 2811 1999 / 2811 4886 / 2811 5978 Fax : 2811 0162 E-mail: indoeengr@aol.com

Vol. : No. 172006 / MONTHLY ISSUE NO. 5 JULY 2006

EDITORIAL
 Dear Friends and Members,
 I am glad to inform you that the "SEMINAR" ON THE ENERGY CONSERVATION (ACT-2001) was held on Sunday the 26th June 2006 at "HOTEL DUCCAN PLAZA" Chennai-600 014. Ex. K. SHANMUGANATHAN B.E. - CHIEF ELECTRICAL INSPECTOR for Govt. of Tamilnadu.
 In course of his address the CEIG said that the next meeting of the association will be held on 27th September 2006 at CENTRELA, ANI STATE GOVERNMENTS level to embark upon energy efficiency drive in the country.
 The Seminar was most successful and attended by a large number of members and members.
 The most effective session was addressed by Sr SAPPANOO B.E., Electrical Inspector, Govt. of Tamil Nadu, which was enlightening. Addressing the members he said that although the CEIG is available at TNBB Mill Collection centers, an arrangement to reduce cost of these bulbs in several instances could also be made.
 There was also a lecture Demonstration on ENERGY MANAGEMENT IN INDUSTRY by the Executive of ELCON "PULLETTIN".
 I hope many members will participate in the forthcoming SEMINARS.

SEMINAR - PHOTOS

Dr. K. SHANMUGANATHAN B.E.
 The Chief Electrical Inspector for Govt. of Tamilnadu

Dr. S. APPANOO B.E.
 Sr. Electrical Inspector, Govt. of Tamilnadu

Dr. I. BALASUBRAMANIAM B.E.
 Sr. Electrical Inspector, Govt. of Tamilnadu

Dr. S. SURESH K. R.
 Sr. Electrical Inspector, Govt. of Tamilnadu

NEWSLETTER
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SPONSORS OF THIS ISSUE

Best Wishes from:
Quick Electricals
 Electrical Contractors
 New No. 16, Old No. 281, Chokkikulambam, Annamaram, Chennai - 600 025.
 Phone : 044-28282109 Fax : 044-28286109
 E-mail: quickelectricals@yahoo.com

January 2007



ELECTRICAL ENGINEER
INSTALLATION ENGINEER

TAMILNADU ELECTRICAL INSTALLATION ENGINEERS ASSOCIATION 'A' GRADE
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Vol. : No. 22007 / MONTHLY ISSUE NO. 1 JANUARY 2007

EDITORIAL
 Dear Members and Friends,
GREETINGS FOR HAPPY AND PROSPEROUS 2007!!
MAY GOD BLESS US WITH ALL HIS BLESSINGS IN THE YEAR!!!
 We are indeed Proud and Happy that our Association Participated in the 10th Anniversary Celebrations of the Honorable Minister for Electricity, Tamil Nadu Government, who referred to the achievement of Tamilnadu in the Power Sector and the Future Plans and the best on Energy Conservation, stressed the need for Energy Efficiency Measures for kinds of usage. A Book, containing simple and Practical Tips for Saving Energy was also released by the CEIG on the Occasion. Mr. S. Suresh Kumar, President of the CEIG, on the Occasion, spoke on the importance of Energy Conservation in the various sectors of the Association and Mr. S. Shanmuganathan B.E., Chairman of the Association, also spoke on the importance of Energy Conservation in the various sectors of the Association and Mr. S. Shanmuganathan B.E., Chairman of the Association, also spoke on the importance of Energy Conservation in the various sectors of the Association.
 I hope many members will participate in the forthcoming SEMINARS.

NEWS LETTER
 We request you to send any Technical articles, Case Studies etc. to help the Electrical Engineers, Electrical Contractors and those in Electrical Trade.
 Products write-ups with ADVERTISEMENTS may kindly be sent to reach the Electrical Engineers & Contractors through our NEWSLETTER.
 (without write-ups you can also advertise this product).

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July 2009

EARTHING - SAFETY CHECKLIST

- The objective of earthing is to limit the potential between the non-current carrying parts of the installation and between these parts and earth to a safe value under all conditions of normal and abnormal system operations.
- Effective earthing is of paramount importance for the safety of operating personnel as well as proper system earthing. Other extremely important factors among other considerations of a good earthing system is that the earthing should conform to the requirements of IEC-1050 & size of the earthing conductor should be as per IS-3043 & IEEE-1100, 2000. In general Guidance check list
 - Copper earth strip to be painted with green paint and shall be raised at the joints as well as where contact with Galvanized steel, etc.
 - Each Earth electrode should be (3m) three meters apart from one another (1.5m) one and half meters away from any building.
 - RCC cover (or) cast iron cover caps should be provided for each earth electrode and identified with numbers permanently.
 - Double clamping arrangements with HTS bolts and nuts including spring & chain washers to be provided.
 - The size of the earth containing conductors should be corrected with size of the current carrying conductor, which is half the size of the main conductors.
 - All bus running (BBT) shall be provided with duplicate earth bus to be run along the bus and earthed at both ends (not in middle).
 - Copper earth strips were connected to aluminum bus in insulated wire from the earth bus with proper sockets.
 - Earth wire should not be used as neutral.
 - All the earth conductors should be socketed, a single socket should be used for connections.
 - Earth main (Bus to Bus) minimum of 2 nos. of HTS bolts to be used for better contact.
 - Always earth joints shall be bracing for copper & welding for GI conductor.

Rating of ABY 3 Ph HV Equipment (kV)	Equipment Earth Lead Size	Size of Earthing Conductor	Clamp used
Up to 10	10 SWG	10 SWG	10 SWG
10-15	8 SWG	8 SWG	8 SWG
15-20	6 SWG	25 X 1.5 mm	25 X 1.5 mm
20-250	25 X 1.5 mm	25 X 1.5 mm	25 X 1.5 mm
250 & above	25 X 1.5 mm	40 X 6 mm	40 X 6 mm

Note: The minimum size of earth grid shall not be less than 25 X 3 mm Copper.

S. Srinivasan, DDM Constraints

SERVICE IS THE HIGHEST FORM OF WORSHIP

Electrical Installation Engineer - Newsletter - July 2009

August 2011

PHOTOS TAKEN DURING TECHNICAL SEMINAR ON 16th JULY 2011 AT CHENNAI TRADE CENTRE



Thiru. K.R. Thangaraj, President, Tamil Nadu Small and Tiny Industries Association, addressing the Welcome Address



Er. S. Appanoo, B.E. Chief Executive In-charge in Charge, IIT Madras, addressing the Inaugural Address



Thiru. N.K. Jahn, NK Jahn Consulting Engineers, presenting the Technical Paper



Thiru. Manan Kamath, Director (Energy Solutions), International Copper Promotion Council (India), presenting the Technical Paper



Thiru. M.M.K. Sivaraj, Senior Consultant, International Copper Promotion Council (India), presenting the Technical Paper

Electrical Installation Engineer - Newsletter - August 2011

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மாண்புமிகு தமிழ்நாடு முதலமைச்சர் செல்வி ஜெ ஜெயலலிதா அவர்களின் அறிக்கை - 27.05.2014

செ.கு.எண் : 092

நாள் 27.05.2014

தமிழ்நாட்டின் மின் நிலைமை குறித்து எனது தலைமையில் இன்று (27.05.2014) தலைமைச் செயலகத்தில் ஆய்வுக் கூட்டம் நடைபெற்றது.

இந்தக் கூட்டத்தில் மாண்புமிகு நிதி மற்றும் பொதுப் பணித் துறை அமைச்சர் திரு. ஓ. பன்னீர்செல்வம், மாண்புமிகு மின்சாரம், மதுவிலக்கு மற்றும் ஆயத்தீர்வைத்துறை திரு. நத்தம் ஆர். விஸ்வநாதன், மாண்புமிகு வீட்டு வசதி மற்றும் நகர்ப்புற வளர்ச்சித் துறை அமைச்சர் திரு. ஆர் வைத்திலிங்கம், மாண்புமிகு நெடுஞ்சாலை மற்றும் சிறுதுறைமுகங்கள் துறை அமைச்சர் திரு. எடப்பாடி கே. பழனிச்சாமி, மாண்புமிகு நகராட்சி நிர்வாகம் மற்றும் ஊரக வளர்ச்சித் துறை அமைச்சர் திரு. எஸ்.பி. வேலுமணி, தலைமைச் செயலாளர் திரு. மோகன் வர்கீஸ் சுங்கத், இ.ஆ.ப., தமிழ்நாடு அரசின் ஆலோசகர் திருமதி ஷீலா பாலகிருஷ்ணன், இ.ஆ.ப., (ஓய்வு), நிதித் துறை முதன்மைச் செயலாளர் திரு. கே. சண்முகம், இ.ஆ.ப., தமிழ்நாடு மின்சார வாரியத்தின் தலைவர் திரு. கு. ஞானதேசிகன், இ.ஆ.ப., உள்துறை முதன்மைச் செயலாளர் திரு. அபூர்வ வர்மா, இ.ஆ.ப., நகராட்சி நிர்வாகம் மற்றும் குடிநீர் வழங்கல் துறை முதன்மைச் செயலாளர் திரு. கே. பணீந்திர ரெட்டி, இ.ஆ.ப., வேளாண்மைத் துறை முதன்மைச் செயலாளர் திரு. சந்தீப் சக்சேனா, இ.ஆ.ப., எரிசக்தி துறை செயலாளர் திரு. ராஜேஷ் லக்கானி, இ.ஆ.ப., மற்றும் அரசு உயர் அதிகாரிகள் கலந்து கொண்டனர்.

பொருளாதார வளர்ச்சிக்கும், தொழில் துறை வளர்ச்சிக்கும் இன்றியமையாததாக விளங்குவது மின்சாரமே ஆகும். 2011 ஆம் ஆண்டு மே மாதம் மூன்றாவது முறையாக நான் முதலமைச்சராக பொறுப்பேற்ற போது, தமிழகத்தின் மின் தேவை 12,000 மெகாவாட் என்ற அளவில் இருந்தது. ஆனால், கிடைத்த மின்சாரமோ வெறும் 8,000 மெகாவாட் தான். அதாவது கிடைத்த மின்சாரத்திற்கும், தேவைப்பட்ட மின்சாரத்திற்குமான இடைவெளி 4,000 மெகாவாட்டாக இருந்தது. மேலும், தமிழ்நாடு மின்சார வாரியமும் கடுமையான நிதி நெருக்கடியில் சிக்கித் தவித்து வந்தது. இவற்றையெல்லாம் சீர் செய்வதற்கான பகீரத முயற்சிகளை எனது தலைமையிலான அரசு எடுத்ததன் விளைவாக, கடந்த மூன்று ஆண்டுகளில் சுமார் 2,500 மெகாவாட் அளவுக்கு புதிய மின் உற்பத்தி நிறுவ திறன் ஏற்படுத்தப்பட்டுள்ளது. இது தவிர, 500 மெகாவாட் அளவுக்கு மின்சாரம் கொள்முதல் செய்ய நடுத்தர கால ஒப்பந்தங்கள் போடப்பட்டு, அந்த மின்சாரம் பெறப்பட்டு வருகிறது. இது தவிர, 3,300 மெகாவாட் மின்சாரத்தை நீண்ட கால அடிப்படையில் வாங்குவதற்கான ஒப்பந்தங்கள் போடப்பட்டுள்ளன. இந்த மின்சாரம் வரும் ஆகஸ்ட் மாதத்திலிருந்து படிப்படியாக பெறப்படும்.

புதிய மின் உற்பத்தி நிலையங்கள் மூலமும், கொள்முதல் செய்யப்படும் மின்சாரத்தின் மூலமும் நமக்குத் தேவையான மின்சாரம் தற்போது கிடைக்கப் பெற்று வருகிறது. எனவே, கடந்த ஐந்து நாட்களாக தமிழகத்தின் மின் தடை என்பதே இல்லாத நிலை உருவாகியுள்ளது. வரும் ஜூன் மாதம் முதல் காற்றாலை மூலம் அதிக அளவில் மின்சாரம் கிடைக்கும். காற்றாலை மூலம் உற்பத்தி செய்யப்படும் மின்சாரம் முழுவதையும் பயன்படுத்தி வேண்டும் என்று நான் தமிழ்நாடு மின்சார வாரியத்தை அறிவுறுத்தியுள்ளேன்.

ஜூன் மாதம் முதல் கிடைக்கப் பெறும் காற்றாலை மின்சாரத்தையும் கருத்தில் கொண்டு, தமிழகத்தில் இதுவரை நடைமுறையில் உள்ள மின் கட்டுப்பாட்டு முறைகள் அனைத்தையும் 1.6.2014 முதல் அறவே நீக்க நான் உத்தரவிட்டுள்ளேன்.

இதன்படி, தற்போது உயர் மின் அழுத்த தொழில் மற்றும் வணிக மின் நுகர்வோர்களுக்கு மாலை 6 மணி முதல் இரவு 10 மணி வரை நடைமுறையில் உள்ள 90 விழுக்காடு மின் கட்டுப்பாடு 1.6.2014 முதல் நீக்கப்படும்.

இதே போன்று, உயர் மின் அழுத்த தொழில் மற்றும் வணிக மின் நுகர்வோர்களுக்கு மற்ற நேரங்களில் தற்போது நடைமுறையில் உள்ள 20 விழுக்காடு மின் கட்டுப்பாடும் 1.6.2014 முதல் நீக்கப்படும்.

இதன் மூலம் 1.11.2008 முதல் தமிழ்நாட்டில் முந்தைய மைனாரிட்டி தி.மு.க. ஆட்சியினரால் அமல்படுத்தப்பட்ட மின் கட்டுப்பாடுகள் அனைத்தும் முற்றிலும் நீக்கப்படும் என்பதை மகிழ்ச்சியுடன் தெரிவித்துக் கொள்கிறேன்.

இந்த நடவடிக்கையின் காரணமாக தமிழ்நாட்டில் தொழில் வளம் மேலும் பெருகவும், புதிய வேலைவாய்ப்புகள் உருவாகவும் வழிவகை ஏற்படும்.

நான் ஏற்கெனவே உறுதி அளித்தபடி மின் வெட்டே இல்லாத மாநிலம் என்ற நிலைக்கு தமிழ்நாட்டை மூன்றே ஆண்டுகளில் கொண்டு வந்ததில் நான் பெருமிதம் அடைகிறேன்.

ஜெ ஜெயலலிதா, தமிழ்நாடு முதலமைச்சர்

வெளியீடு : இயக்குநர், செய்தி மக்கள் தொடர்புத் துறை, சென்னை - 9

KNOW THY POWER NETWORK – 81

Oh! One month has elapsed since we last connected. Now, it is time for me to meet you all again through this column. Welcome to all. Wait. There is a small deviation from our regular topic. Kindly get some more information on Smart items that are connected with our lives. This time let us learn about “**Smart Government, Smart Tooth Brush and Smart Locks.**”

Smart Government is one for which we are waiting for a long time. Here “SMART” stands for a simple, moral, accountable, responsive and transparent government. This government meets the aspirations of our people to the maximum extent through “E Governance” and other modern, Smart methods.

The next topic is about “**Smart Tooth Brushes**”. As its name itself implies it does “brushing”. No doubt about it. But it performs some more functions. It is natural for us to expect this since a high amount is normally invested on it. It tracks and informs the total brushing time taken, the frequency of brushings done and finally the zones that need frequent brushings. Then it syncs the data thus collected wirelessly through Bluetooth to your phone/computers and from there to your Dentist for your reference.

The next Smart item that draws **our attention is “Smart Locks”**. It has many special features. It locks and unlocks the doors as per the directions of the user’s handheld Smart devices like Smart phones. Further it unlocks the doors automatically when the user comes closer to it. With its inbuilt camera, it does this work. It permits the lock owner to give virtual keys to his/her friends and visitors or any other reliable persons when he/she is away from his/her house. The virtual keys can be handed over to them through “emails” or other Smart means. Its other features include access alerts and a complete activity log. It can easily identify strangers or other unwanted persons and give alarms or signals. Now you can simply entrust the safety and protection of your house to these Smart locks and do your jobs calmly.

Now let us focus on your regular topic viz the security of the “Smart Grid” You may be of keen interest to know.

- What is Power Grid or Electricity Grid?
- What is Smart Grid? What makes the Ordinary Power Grid to act as Smart Electricity Grid?
- What do you mean by “Cyber” and how does the term “Cyber Security” or “Security of Smart Grid” attains a notable significance?

To find answers to these probing questions, Kindly proceed further. “Power Grid or Electricity Grid” is nothing but an infrastructure or structural arrangement which contains a closely meshed interconnection of all Generating Stations and Bulk Power or Transmission Sub stations through a large number of EHV- Transmission lines in a state or in a region. The main purpose of such a strong interconnection is to maintain the reliability level at 100 percent or very close to it. That is, the continuous flow of electricity is expected to be maintained for all the 24 x 7 Hours. A very good bonding or interconnection amongst all the connected power stations and substations (elements of the Grid) is the main feature of this Grid arrangement. On earlier days manual or semi-automatic devices/means were employed to control and maintain the continuous flow of electrical energy in this kind of Grid arrangement. Presently digital computers and communication systems are widely applied to achieve the above objective. [eg. SCADA for monitoring, control and operation.]

When Computers and Communication systems with the digital electronic basics enter into the operation and maintenance segment of the electricity grid, the system becomes ‘Complex’.

The term “Cyber” refers to the virtual or invisible world created by the Computer Softwares.

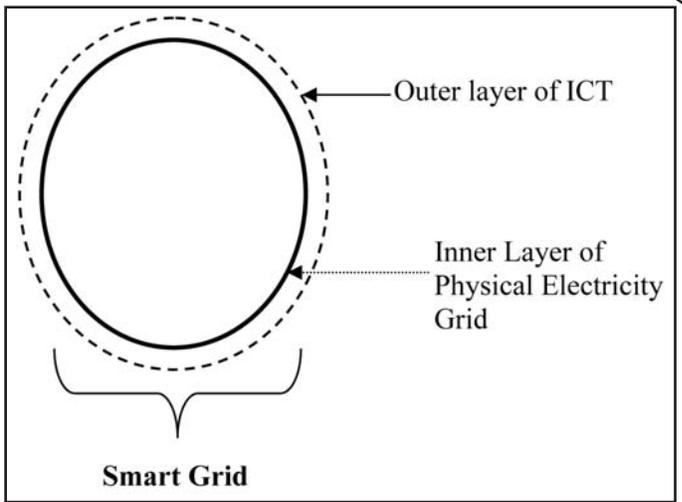


Smart Tooth Brush



Smart Lock

Thus with the entry of ICT, the electricity grid is automatically engulfed or veiled by an invisible layer of “Cyber or virtual world”. Simply put, the physical electrical infrastructure is now covered by a virtual grid of electronic devices. The end result is the formation of a “**cyber-physical electrical grid**”. This arrangement is called as ‘Smart Grid’. It can also be visualized as an infrastructure containing two layers-physical electricity grid infrastructure and the cyber or virtual layer of ICT. [Information and Communication Technology] as shown below.



Normally Power Grid or the Bulk Power System is exposed to unexpected disturbances such as short circuits or unanticipated loss of system elements due to natural causes like equipment faults, presence of lightning, switching surges or trippings caused by external objects or man made attacks. Now upon adding a layer of Cyber or virtual world over this physical infrastructure, it is open to the disturbances caused by man made cyber attacks or other events in the cyber part of the Grid also. Thus Cyber Security measures assume a greater significance. Our main aim is that the events in the cyber or physical systems of the Smart Grid should not be permitted to impair the system reliability under any circumstances. Now, a question arises before us is “What is meant by the terms ‘Security’ and “Reliability” of the Power Systems and how they are related. Prior to this, kindly note the adage, which states that “we are living in a world where everything is based on “Security”. As per the definition given to the term Security in the dictionary, it refers to the freedom from any dangerous or uncertain situations. Reliability refers to the efforts taken to maintain the flow of anything especially electricity continuously without any break. Thus we use the term “Security” to describe the ability of the bulk power systems or Smart Grid to withstand the unexpected disturbances or unforeseen loss of system elements.

Let me sign off here.

(To be continued...)

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ON-LINE DIAGNOSIS OF POWER TRANSFORMER INSULATION SYSTEM: EXPERIENCE OF CPRI, INDIA

Power transformers play a vital role in handling large amount of power from generating stations [through Generating Station Units (GSU)] to transmitting stations (through power transformers) and to end user through distribution transformers. Power transformers involve large amount of capital investment and the failure of transformers causes severe financial loss to the utility and inconvenience to the end users. Periodic maintenance and condition monitoring are the key factors for successful operation of power transformers. A number of diagnostic tools are in vogue. Most of these tests are conventional off-line techniques and require power shut down and disconnection of transformer from the circuit. Several alternate nonconventional on-line techniques are being adopted and Acoustic Emission (AE) technique is one among them. Central Power Research Institute (CPRI), India, is employing AE technique for on-line diagnosis of power transformers. Nearly 200 transformers have been tested and investigated covering rating up to 315 MVA, 400 kV.

The paper discusses some of the important aspects of on-line diagnosis of oil-filled power transformers employing AE technique. A few important case studies which have helped utilities and transformer manufacturers for initiating corrective actions are covered in the paper.

Keywords: *On-line diagnosis, Off-line diagnosis, Insulation diagnosis, Condition monitoring, Transformers, Partial discharge, Acoustic emission.*

1.0 INTRODUCTION

Periodic condition monitoring of insulation system of power transformers is essential for their continuous usage and operation so as to avoid unforeseen outages and shutdowns.

Several conventional diagnostic tests that are presently being adopted by many utilities include measurement of capacitance and tan delta of the insulation, Insulation Resistance (IR), polarization index (PI), Recovery Voltage Measurement (RVM), PD measurement, moisture analysis, Dissolved Gas Analysis (DGA), etc.

Except DGA, most of these techniques are offline methods and require disconnection of the transformers from the circuit. Several alternate nonconventional on-line techniques are being adopted to overcome practical limitations of off-line techniques, and Acoustic Emission (AE) technique is one among them. AE technique is one of the latest on-line techniques which is gaining importance due to its specific merits over other on-site diagnostic techniques. The main advantages of AE testing are:

- a) it is nondestructive,
- b) can be applied on-line and hence no power shut down and disconnection of transformer from the circuit and
- c) possibility of locating the defective sites.

The acoustic method for PD measurement is based on detection, acquisition and analysis of acoustic emission signals generated during PD activity [1, 2]. Acoustic emissions are transient elastic waves generated by the rapid release of energy from localized sources (designated as defects) within the material. Acoustic emissions can occur inside the transformer as a result of small-scale breakdown (PD) and other events such as arcing, tracking and heating [3,4]. When this happens, acoustic emissions are produced which can propagate through the oil and other insulating media. High-frequency piezoelectric sensors mounted strategically on the wall of the transformer can detect these acoustic emissions and measure the time of arrival of the signal and signal features. Phenomenal advancement in software and hardware technology including data acquisition, data analysis, computational technique, etc., has resulted in successful application of AE technique as one of the on-line diagnostic techniques for power transformers. Some of the manufacturers fix the sensors at suitable positions within the transformer at the time of manufacturing.

2.0 ON-LINE DIAGNOSIS BY ACOUSTIC PD: PRESENT SCENARIO

Acoustic emission technique is being tried as one of the diagnostic tools by several organizations, including CPRI, for on-line condition monitoring of power equipment. A working group WG 14 has been set up by IEC TC 42 to look into "Measurement of PD by electromagnetic and acoustic methods". In this connection, formulation of IEC standard "IEC62478-A prospective Standard for Acoustic and Electromagnetic PD measurements" is in progress. CPRI is a member of working group WG 14 of IEC TC 42. Also, IEEE trial-use guidelines have been published in "IEEE Std C57.127-2000: Trial-use guide for the detection of acoustic emissions from partial discharges in oil immersed power transformers".

3.0 APPLICATION OF AE TECHNIQUE FOR ON-LINE DIAGNOSIS

AE technique has been applied for on-site testing of oil-filled transformers, in association with some of the major power utilities and transformer manufacturers. Nearly, 200 transformers have been tested so far, covering rating up to 400 kV, 315 MVA [5-8]. The methodology adopted by CPRI for performing on-line testing of power transformers is outlined below.

3.1 Mounting of AE Sensors

AE sensors are mounted on the outer surface of transformer tank using magnetic holders after cleaning the surface and applying suitable couplant grease for proper sensor contact. Identification numbers are assigned to the sensors and their coordinates (x,y,z) are noted with reference to lower left corner of the high voltage side as origin (0,0,0). The sensor mounting positions vary with the size, design, rating of the transformer. It is useful to maintain the same sensor positions for transformers of similar design for comparison purposes. Necessary safety precautions are to be followed while mounting the sensors. Figure 1 shows a view of sensors mounted on a single-phase 220 kV transformer.

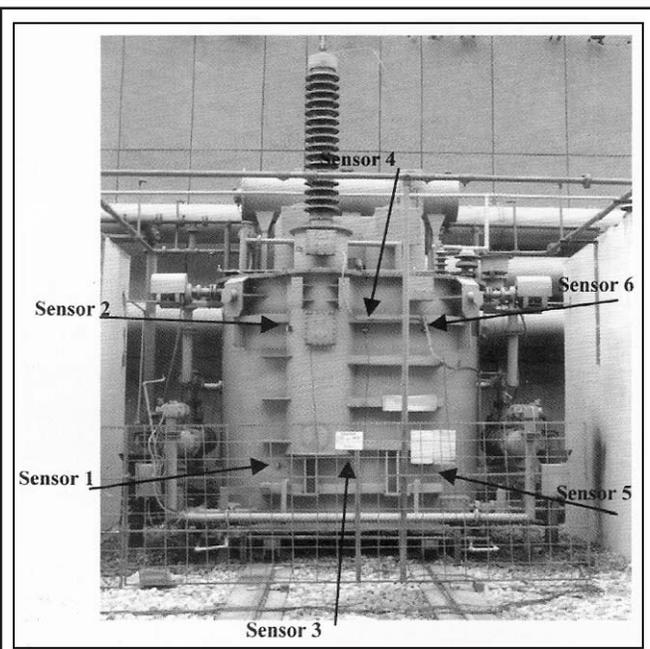


Fig.1: A view of sensors mounted on the HV side of 43.33 MVA, 220 / $\sqrt{3}$ kv, Single-Phase generating station unit transformer

4.0 AE TESTING OF OIL-FILLED TRANSFORMERS: CPRI EXPERIENCE

CPRI has carried out AE testing on nearly 200 numbers of power transformers of rating up to 400 kV at various substations [7-11]. Power transformers tested include both single-phase and three-phase units. Table 1 gives the summary of on-line testing of power transformers by AE method.

TABLE 1:- SUMMARY OF TRANSFORMERS TESTED BY CPRI

Voltage rating of transformers	Number of transformers tested
220kV	30
220kV	99
400kV	68

Figures 2 and 3 show the magnitudes (max.) of acoustic signals received from different transformers of rating 400 kV and 220 kV, respectively, tested so far at various substations and power stations.

Three different case studies of on-line diagnosis of transformers based on AE technique are discussed covering (1) periodic testing of 220 kV transformers in a hydroelectric power station, (2) periodic testing of 33 kV transformers in a steel plant and (3) combined on-line PD testing and off-line testing of EHV grade transformers.

4.1 Case Study 1: Periodic Testing of 220 kV GSU Transformers in a Hydroelectric Power Station

At the request of a power utility, 18 numbers of Generating Station Unit transformers of identical rating

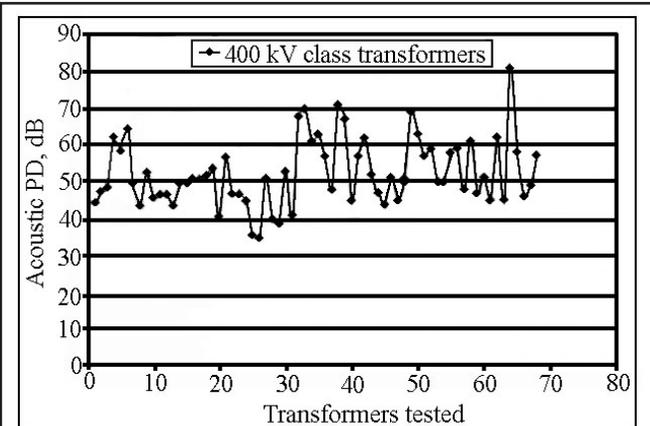


Fig.2: Measured value of acoustic PD magnitude for power transformers of rating 400 kV tested by CPRI

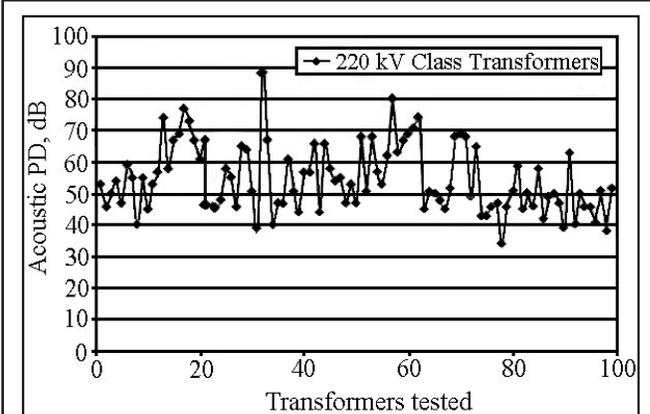


Fig.3: Measured value of acoustic PD magnitude for power transformers of rating 220 kV tested by CPRI

[11 kV/(220/√3) kV, 43.33 MVA, 1-phase] were tested during the year 2005 for on-line PD at a Hydroelectric Power Station, India. A view of the transformers offered for testing is shown in Figure 4A. Measurement was repeated after 3 years at the prevailing operating conditions. Results of periodic AE testing during 2005 and 2008 are depicted in Figure 4B.

As can be seen from Figure 4B, out of the 18 transformers tested, 6 have shown slight change in AE activity. Transformers 13, 16 and 17 have shown slightly reduced AE activity and transformers 1, 8 and 11 have shown marginally increased activity. Out of 18 tested, only one transformer has shown very high AE activity, and it is on an increasing trend from 74 dB (during 2005) to 80 dB (during 2008). The magnitude of acoustic PD for “transformer 1” measured during 2008 is shown in Figure 4C. As the magnitude of acoustic activity was high, the power utility was suggested to carry out frequent DGA test and other diagnostic tests immediately. It was informed that the transformer was removed from the circuit for further investigations. All other transformers have shown activity below 75 dB with a marginal change from previous values and are reported to be functioning satisfactorily.

4.2 Case Study 2: Periodic Testing of 33 kV Transformers in a Steel Plant

At the request of a Steel Plant, CPRI carried out on-line condition monitoring of 25 transformers, which include power transformers, NGT and Rectifier transformers during July 2002. Out of the 25 transformers tested, 4 were showing acoustic signals of magnitude more than 70 dB. According to CPRI recommendation, the plant engineers took various maintenance actions for these four transformers. AE testing was repeated on the transformers during year 2006 and the results showed improvement in the performance of the transformers. Table 2 gives amplitude of acoustic signals recorded during periodic monitoring for these transformers during the year 2002, 2004 and 2006 along with maintenance work carried out.

As can be seen from Table 2, periodic AE testing is found to be effective in identifying critical transformers and has helped the steel plant engineers in scheduling preventive maintenance.

4.3 Case Study 3: Transformer Diagnosis Employing both Conventional and Non-Conventional Techniques

For assessing the insulation condition of power transformers at site, several conventional offline electrical diagnostic tests were performed. As conventional electrical PD test at site on EHV grade transformers was practically not possible, non-conventional acoustic PD method was employed. Offline conventional tests carried out were Insulation Resistance (IR)/ Polarization Index (PI), capacitance and tan delta, DC leakage current, Residual Voltage Measurement (RVM) and FRA. Two typical case studies are presented here for a healthy transformer and a defective transformer, where both conventional and non-conventional diagnostic tools were employed.

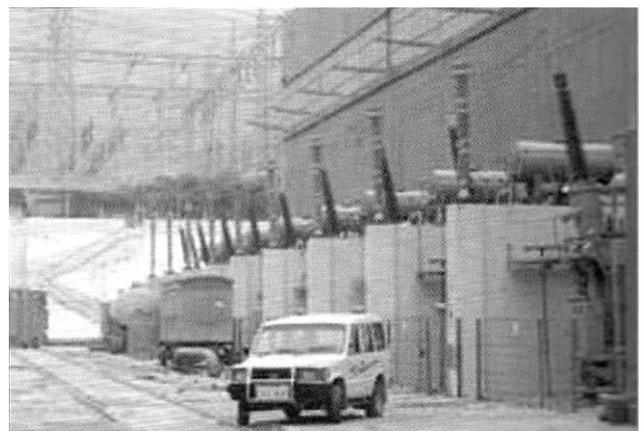


Fig.4A: A view of transformers of rating 11 kV/(220 / √3) kV, 43.33 MVA, 1-Phase at a hydroelectric power station, INDIA

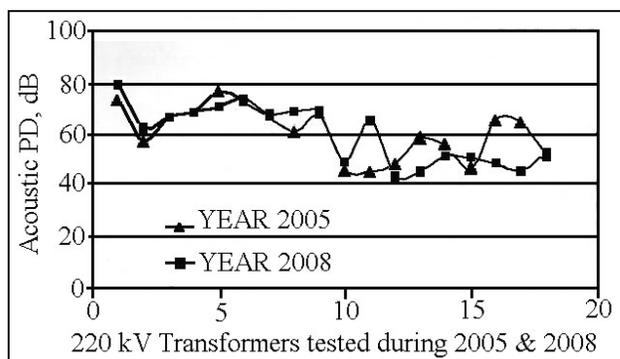


Fig.4B: Periodic Measurement of acoustic PD for 18 GSU transformers of rating 11 kV/(220 / √3) kV, 43.33 MVA, 1-Phase, during 2005 and 2008

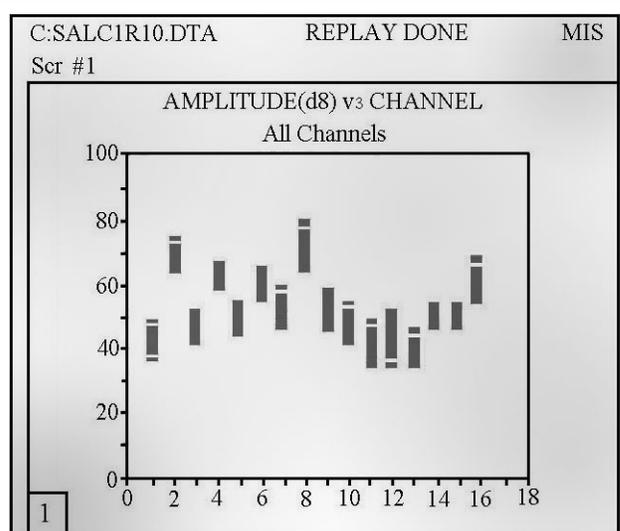


Fig.4C: Acoustic PD Magnitude measured during 2008 for a GSU transformer of rating 11 kV/ (220 / √3) kV, 43.33 MVA, 1-phase

Results of on-site diagnostic tests on a 33-year-old transformer of rating 230 kV/3.3 kV, 20 MVA are summarized in Table 3. Measured values indicate low PD activity (47 dBAE max.) and satisfactory values of other diagnostic tests. The transformer insulation appears to be healthy.

**TABLE 2:- PERIODIC TESTING OF TRANSFORMERS
DURING THE YEAR 2002, 2004 AND 2006 EMPLOYING AE TECHNIQUE**

Transformer details	Magnitude (dB) of acoustic signals measured during			Maintenance performed
	2002	2004	2006	
Transformer-1, 25 MVA, 33/6.6kV	72	66	56	Oil filtration, tightening of terminals, Megger value improved 24 to 58 MΩ
Transformer-2, 5.8 MVA, 33/0.8 kV	71	64	59	Oil filtration, cleaning, tightening of terminals
Transformer-3, 5.8 MVA, 33/0.8 kV	74	73	60	Oil filtration, cleaning, tightening of terminals, plugging of leakage
Transformer-4, 5.8 MVA, 33/0.8kV	75	74	62	Oil filtration, tightening of terminals, plugging of leakage

**TABLE 3:- ON-SITE DIAGNOSTIC ON-LINE AND OFF-LINE TEST RESULTS
ON A 230 kV, 20 MVA TRANSFORMER**

Test	Measured values at test connection			Remarks
	(i)	(ii)	(iii)	
On-line acoustic PD at Un, dB		47		Acoustic PD activity is low
Insulation resistance at 2.5 kV dc, MΩ	60 sec	3550	3800	Test results are satisfactory and therefore, transformer insulation appears to be healthy
	600 sec	6745	6845	
Polarization index	1.9	1.8	1.75	
Capacitance, nF at 2.5 kV	21	22	27	
Tan delta (%) at 2.5 kV	0.5	0.5	0.5	
DC leakage current, μA at 8 kV dc	30	30	30	
RVM test at 2 kV DC	Smooth polarization spectra, without dominant peak, indicates homogeneous condition of transformer insulation. Estimated moisture content in transformer insulation is below 2%			
FRA	Results are normal. No winding deformation / displacement. Mechanical integrity is healthy.			

- (i) HV winding versus LV winding shorted to grounded tank.
- (ii) HV winding versus LV winding ungrounded.
- (iii) LV winding versus HV winding shorted to grounded tank.

Results of on-site diagnostic tests on a 10-year old transformer of rating 230 kV/3.3 kV, 35 MVA are summarized in Table 4. Measured values indicate high PD activity (85 dBAE max.), low DBV for oil, and tan δ was high. These case studies indicate, among other things, the effectiveness of acoustic technique in discriminating healthy and faulty transformer, particularly, for large ratings where electrical methods have been known to be precluded.

5.0 ASSESSMENT BASED ON AE TESTING

Once acoustic activity is detected and/or located, the major concern of maintenance engineers is to assess the severity of the fault in order to plan the corrective actions that need to be taken up. In order to address this issue, a grading system has been developed based on AE testing, as given in Table 5.

TABLE 4:- ON-SITE DIAGNOSIS OF A 220KV, 35 MVA TRANSFORMER

Test	Measured values at test connection			Remarks
	(i)	(ii)	(iii)	
Acoustic PD at Un, dB		85		High PD activity
Insulation resistance at 2.5 kV DC, MΩ	60 sec	1050	1020	Tan δ values are high, BDV of oil is low and therefore, transformer insulation appears to be not healthy
	600 sec	2150	2050	
Polarization index	2.05	2.01	2.05	
Capacitance, nF at 2.5 kV	19	20	20	
Tan δ (%) at 2.5 kV	8.2	9.4	7.5	
DC leakage current, μA at 8 kV DC	200	210	300	
BDV of oil	<30 kV			
DGA result	Fluctuating DGA values			

TABLE 5:- GRADING OF TRANSFORMERS BASED ON AE TESTING

Grade	AE test result	Recommended action
A	No activity detected	No follow-up required
B	Minor acoustic activity detected. Keep the test data on records for further reference.	No follow-up required
C	Medium acoustic activity detected, use other diagnostic techniques including DGA to confirm the result	Requires more frequent measurements
D	Considerable acoustic activity registered, immediate action recommended, use other diagnostic techniques including DGA to confirm the result.	Immediate action recommended

The grading system, as in Table 5, has been applied for transformers of rating <220 kV, 220 kV and 400 kV tested by CPRI and the results are presented in Table 6.

TABLE 6:- GRADING SYSTEM APPLIED TO THE TRANSFORMERS TESTED BY CPRI

Grade	Number of equipment falling to this grade (for CPRI data)			Recommended action
	400 kV class	220 kV class	220 kV class	
A	0%	0%	0%	No follow-up required
B	80%	60%	59%	No follow-up required
C	20%	37%	41%	Requires more frequent measurements
D	0%	3%	0%	Immediate action recommended

Fixing the intensity levels of acoustic activity for different grades requires experience and expertise based on large data bank of field test. As stated earlier, CPRI is in the process of generating the data bank. This exercise is only a starting point and the proposed grading pattern may require revision after augmenting more data on new and aged transformers of different types and ratings. The main aim of this exercise is to help maintenance personnel in prioritizing the maintenance/ inspection tasks using AE technique.

6.0 SUMMARY

The latest on-line technology based on acoustic emission has been customized for on-line diagnosis of power transformers. Methodology has also been proposed to assess and grade the equipment tested based on severity of AE activity. CPRI has received encouraging response from power utilities and equipment manufacturers. It is expected that the facility and methodology developed will be of great help to power utility to detect the defective transformers and weeding out the faulty transformer before they fail during service.

ACKNOWLEDGEMENT

The authors are thankful to CPRI for according permission to publish the paper. The authors are also grateful to Mr. G. Govinda Rao, Mr. S. Neelakantan and Mr. K. Sashi for their support in executing the work.

Courtesy: Nagamani HN and Bhavani Shanker T, CPRI Journal

INTERVIEW WITH Dr. S. GOMATHINAYAGAM ABOUT INDIAN WIND ENERGY SECTOR & CWET

by G. VENKATESH, Editor,
Joint Secretary, TNEIA



CENTRE FOR WIND ENERGY TECHNOLOGY

1. The availability of land is becoming a major threat since potential wind sites had all been exhausted and the remaining available sites are generally low and medium windy ones.

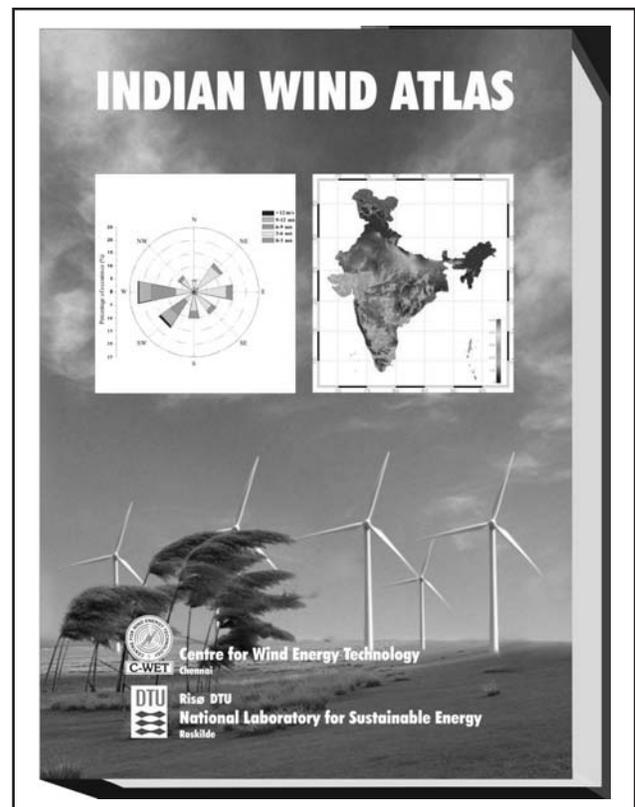
Yes. The availability of land in most of the States are scarce in good windy sites. Already low & medium windy sites are only available for further deployment of wind farms. However, there is a possibility of wind power development with a larger rotor diameters and taller towers for such regions. This is happening in Madhya Pradesh already. In addition since wind farms do not require barren land, it can also be installed in windy sites after installation of which normal cultivation are functional use of the land can be continued as the foot print occupied by wind turbine towers are much less in terms of land requirement. It is only the right-of-way for ensuring access to the wind turbine locations for periodical maintenance has to be ensured by sheer societal will and local co-ordination.

2. Like in Europe, the time is now not far away to think on off shore wind turbines. What is the potential in India for offshore WT.

Offshore wind power potential has not been accessed in India by rigorous measurements. C-WET is in the process of getting offshore wind data in one of the most potential locations close to Rameswaram, Dhanuskoti Region. In terms of potential, C-WET has already identified nearly one GW Potential each at locations (i) North of Dhanushkoti and (ii) South of Kanyakumari. However, further measured validation and collection of realistic oceanographic data are essential to move forward in offshore wind power in India.

3. Indian Wind Atlas 2010 by CWET.

The Indian Wind Atlas has a measured validated potential of 49 GW onshore at 50 m level and an indicative potential of 103 GW at 80 m level which is under validation through real time field measurements using 100m met mast spread in 73 locations all over India. The wind atlas as existing today provides indicative potential of wind speed distribution and direction distribution at 174000 locations identified by Latitude and Longitude at a very nominal cost of about Rs.550/- per site which can be very



useful information for deploying measurement mast for bankable investment grade wind resource assessment.

4. The effective capacity utilization factor of small (<500kW) machines in Tamil Nadu is estimated at less than 15%. What is your remedy for old & inefficient turbines located in high wind potential areas?

Subject to availability of evacuation of potential and flow of power in transformers connected to wind farms a fractional solarization without affecting the total capacity of transmission network could be one of the solutions as most places wind and solar are complementary natural resources. The other solution could be repowering with the special policy to attract the old investors who have got well appreciated land over the years.

5. Is CWET has any coordination with solar power generation, which enables hybrid power generation.

Yes, C-WET provides in addition to Wind Resource Assessment all over India Solar Radiation Resource Assessment (SRRRA) also in more than 119 locations in real time along with other met parameters influencing solar radiation. As most of the SRRRA stations are having wind as well as solar measurements, hybrid power generation solutions can be well planned at any site.

6. General CWET - Research Activities, Wind resource assessment, Testing Services, Certificate services, Training & Conclusion.

For various Research activity and other activities referred in the question you may please refer to C-WET's up-to-date website cwet.res.in in which has several information and downloads including quarterly magazine of Pavan Newsletter which gives the current trends in wind power development along with the activities of C-WET. You may also refer a comprehensive Video for an hour is available in YouTube the link of which can be obtained by a google search string- "CWETWindSolar"

PROFILE OF DR. S. GOMATHINAYAGAM

Indian Institute of Technology , Madras, Chennai , India

Ph.D (Ocean Engineering), Dynamic Wind Effects on onshore/Offshore structures

Executive Director, C-WET January 2009 – Present

Awards

1. Awarded '**Certificate of Special Mention**' for the paper published in the International Journal of Computers & Structures, by the committee that selected the best technical paper for Dr. Ramaiah Prize (SERC, Madras) in 1999.
2. Received a '**Certificate of Appreciation**' from Director, SERC, Madras in 2000 for the development of Advanced computational methodologies, modeling techniques and software for analysis and design of complex structures at SERC, Madras, in winning the '**CSIR Technology prize for Engineering Technology for the Year 1999**'.
3. Received a '**Certificate of Appreciation**' from Director, SERC, Madras in 2000 for the scientific contributions made as a member of the Wind Engineering Group of SERC, Madras, in winning the '**CSIR Shield for Engineering Technology for the Year 2000**'.
4. Member of SERC team which was awarded '**A.S. ARYA-UOR Disaster Prevention Award 2000**' from University of Roorkee in 2000.
5. Awarded '**The Dr. Jai Krishna Medal**' for the best paper published in the Journal of the Institution, from **The Institution of Engineers (India) in 2001**.
6. Awarded '**Certificate of merit**' for best experimental study, by the committee that selected of **Dr. Ramaiah Prize (SERC, Madras) in 2003**.
7. Awarded '**Certificate of Best technical paper**' for a international journal paper published by the committee that selected the best technical paper for **Dr. Ramaiah Prize (SERC, Madras) in 2004**.
8. **ISWE best paper award -2002** for international journal paper on "**cyclone damage to buildings and structures – a case study**" by **Indian Society for Wind engineering given at Nagpur 2004**

Press Information Bureau
Government of India
Ministry of New and Renewable Energy
Generation of Wind Energy

10-February-2014 12:06 IST

India is endowed with large wind energy potential. The total estimated wind Energy Potential taken at the wind speed of 50m/hr. is 49130 MW & calculated at the rate of wind speed of 80m/hr. is 102788 MW.

The State-wise wind power potential as per Wind Atlas is as below:

States / UTs	Estimated potential (MW)	
	@ 50 m	@ 80 m *
Andaman & Nicobar	2	365
Andhra Pradesh	5394	14497
Arunachal Pradesh	201	236
Assam	53	112
Bihar	-	144
Chhattisgarh	23	314
Dieu Daman	-	4
Gujarat	10609	35071
Haryana	-	93
Himachal Pradesh	20	64
Jharkhand	-	91
Jammu & Kashmir	5311	5685
Karnataka	8591	13593
Kerala	790	837
Lakshadweep	16	16
Madhya Pradesh	920	2931
Maharashtra	5439	5961
Manipur	7	56
Meghalaya	44	82
Nagaland	3	16
Orissa	910	1384
Pondicherry	-	120
Rajasthan	5005	5050
Sikkim	98	98
Tamil Nadu	5374	14152
Uttarakhand	161	534
Uttar Pradesh	137	1260
West Bengal	22	22
Total	49130	102788

*To be validated through field measurements

The installed Capacity of Wind Energy is as below:

(a) Wind Power Total Achievement

Sl.No.	States	Achievement (Upto January, 2014)
1.	Andhra Pradesh	648
2.	Gujarat	3384
3.	Karnataka	2312
4.	Kerala	35
5.	Madhya Pradesh	386
6.	Maharashtra	3472
7.	Rajasthan	2734
8.	Tamil Nadu	7251
9.	Others	4
Total		20226

Regarding Wind Energy, under the Generation Based Incentive (GBI), Rs.0.50/Unit is provided to private developers as incentive for generation of power subject to a ceiling of Rs.1.00 crore/MW. The benefit is to be availed in more than 4 years and less than 10 years. The year-wise targets and achievement in last three years and current year are given below:

Year	Target (MW)	Achievement (MW)
2010-11	2000	2350
2011-12	2400	3196
2012-13	2500	1700
2013-14	2500	1174 (upto January, 2014)

The wind power development is taking place with private sector investment, for which proposals are not to be submitted in the Ministry. The GBI claims of developers are settled by Indian Renewable Energy Development Agency (IREDA) and as such no proposals are received in the Ministry from States/UTs.

Regarding Wind Energy, the expenditure under GBI scheme in last three years and current year is given below:-

Year	Expenditure (Rs. In crore)
2010-11	25.00
2011-12	21.18
2012-13	44.46
2013-14	224.56

TEQUILA SUNRISE: BIG BENEFIT FROM CO-LOCATING AGAVE CROPS AND SOLAR POWER

Solar power in the desert has problems: big land use requirements, and the need for scarce water to clean the panels and suppress dust. In an unrelated story, biofuels production has problems: life cycle greenhouse gas emission issues, and land use questions again. How about solving both sets of problems at once? Stanford researchers have modeled the co-location of solar panels with agave plants used to make ethanol, and found it to be a winning combination.



The idea of “agrivoltaics”, or combined solar power and agricultural production, has been floating around for a while now. It’s an idea that springs at least partially from the modern distaste for “monoculture”, or the growing of a single crop over huge swaths of land. The reasoning: Instead of “growing” only solar power on a plot of land, why not use the space between and underneath the photovoltaic panels to also grow crops? There are some projects in France that have tried this, and a post-Fukushima Renewable Energy Village in Japan also features crops underneath PV. There are also experiments at the University of Massachusetts, and some small-scale “solar farm” installations in Wisconsin.

It seemed unlikely, however, that the idea of studding the land around the solar plants that have started cropping up across the arid deserts of the American southwest would take root. But the Stanford folks, led by post-doctoral researcher Sujith Ravi, realized that the water required for a solar plant could actually make the desert more hospitable to agriculture as well. To test the idea, they chose agave plants, biofuel sources that are already quite hardy and require little water to survive.

They found that by combining a PV plant with agave production, a given area could yield more energy for the same amount of water than either PV or agave alone. The study, published in the journal *Environmental Science & Technology*, showed a “high-yield” scenario where only 0.42 liters of water would be needed to produce one mega-joule of energy.

“It could be a win-win situation,” Ravi said in a press release. “Water is already limited in many areas and could be a major constraint in the future. This approach could allow us to produce energy and agriculture with the same water.” This marriage of agave and solar panels is especially compelling for two reasons. First, because agave plants require roughly the same amount of water needed to keep solar panels clean and to suppress dust, it’s possible to use the water dripping off a newly cleaned solar panel to nourish the plant. And a 2011 study found that the plants, also used to make tequila, perform just as well or better than corn, sugarcane, and switchgrass in terms of lifecycle greenhouse gas emissions and other parameters.

Aside from planting crops beneath existing solar panels, there are other ways to think about combining PV with plants. In a report on the topic, the National Renewable Energy Laboratory encouraged farmers to consider locating solar panels in the unused corners of their center-pivot farm plots. In Colorado alone, those currently underused spots could generate enough power to meet all of the state’s electricity needs. Clearly, farming and solar power should become much better friends in the future.



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PRODUCT OF THE MONTH

ABB's EMAX 2 BREAKER WINS RED DOT 2014 PRODUCT DESIGN AWARD

2014-03-28 - The Emax 2 is the world's first low voltage circuit breaker with integrated power management. The Red Dot Product Design Award (red-dot.org) has recognized international excellence in product design since 1954.

Launched in 2013, ABB's innovation, the Emax 2 circuit breaker, replaces existing traditional breakers and has the potential to achieve annual savings that are equivalent to the electric consumption of 1.4 million EU households per year - or 5.8 million megawatt-hours (MWh).

Breakers are used where protection and control of large amounts of energy is needed in a low-voltage environment like industrial and commercial buildings, data centers The breaker contains a protection trip relay with an integrated power controller that measures and evaluates energy consumption, then manages the loads to maintain or reduce the peak power usage as determined by the user. The Emax 2 is the only breaker of its kind to both protect electrical



circuits, and also reduce energy consumption based on our needs, thereby leading to massive reductions in energy waste and a lower carbon footprint. What makes it truly exceptional, is that it achieves all of that within a single device.

Ekip Touch

SACE Emax 2 circuit-breakers are equipped with a new generation of protection trip units that are easy to programme and read. The **Ekip Touch** trip units **measure power and energy with precision** and save the most recent alarms, events and measurements in order to prevent faults to the installation or trip effectively when necessary.

Conserve to Preserve

Network Analyzer

On request, the **Network Analyzer** function is also available, which controls the quality of absorbed power in real time and with extreme precision.

In addition, the innovative Ekip Touch and Hi Touch trip units in the G version include all the functions of generator protection switchgear, offering a safe control solution that is ready to use.

No external devices, wiring and inspections are required.

“We are proud of our ground-breaking technology and the Red Dot Product Design Award recognizes the team’s achievement,” said Giampiero Frisio, head of ABB’s Breakers and Switches business unit. “Breakers are all around us and now they can not only break power when required, but also manage this power.”

All the advantages for Consultants

Protection : Emax 2 is able to provide plug-and-play solutions for any protection need: it can grant protection of the generator without the need for external dedicated relays, guarantee total selectivity using zone selectivity between upstream and downstream breakers and provide the maximum continuity of service thanks to the embedded directional protection (in the case of a fault on one transformer, only that transformer will be disconnected).

Measuring : Traditional measuring (currents, voltages, powers, etc.) is granted by Emax 2 with first class accuracy: both current and voltages are measured according to IEC 61577-12 Class 1. Moreover, with Emax 2, integrated, true power quality analysis as a standard feature is a reality.

Communication : Not only Modbus or Profibus, but also Devicenet and Ethernet based protocols like Modbus TCP-IP, Profinet and IEC61850. Thanks to its IEC61850 communication capability, Emax 2 is the first low voltage breaker ever to be perfectly integrated in the Substation Automation world of possibilities.

Plant management and load control : Any time interruptible loads are available, Ekip Power Controller, a simple load management system, is available for Emax 2. Using an advanced algorithm, Ekip trip units can implement an effective load shedding / load inserting routine, basing the actions on their accurate measurement.

All the advantages for Panel Builders

The new, cutting edge technology implemented in Emax 2 not only provides a complete new generation of trip units but also the most compact footprint ever seen in the LV distribution world. Inside this optimized envelope, ABB SACE created new solutions for its panel builder customers.

Easier connection to the busbars, easier installation of the breaker, easier connections in the terminal box are just the starting point. Enhanced safety is the second pillar, hinged on the new safe accessory area inside the breaker.

Last but not least, comes the communication. SACE Emax 2, for the first time in the LV market, offers the ultimate ensemble of communication options embedded inside the breaker; from twisted pair to Ethernet protocols, all the solutions are available.

Busbar friendly: New terminals. SACE Emax 2 terminals can be changed from horizontal to vertical on-site by rotating 90°. In addition to the flexibility this feature creates for the design and installation of switchboards, the terminals have been designed specifically to fit the most common bus sizes per amperage, creating fast, easy connection of one to four bus runs.

More connected: Every Emax 2 circuit breaker can be equipped with multiple cartridge-type communication modules that can be easily installed directly on the terminal box at any time. With the new terminal box with spring clamps, cabling has never been so easy: no tools are required for the connection.

Safer: Safe accessory installation. Removal of the main Emax 2 cover allows access to the accessory area only, not to the area containing the operating mechanism.

Easier: Ease of installation. Dedicated guide rails simplify movement and allow correct and locked positioning from “racked-out” to “test” to “racked-in”. Neutral pole flexibility. The neutral position for Emax 2 circuit breakers can be modified directly from the trip unit to change from N, L1, L2, L3 to L1, L2, L3, N.

“For example, in a manufacturing plant, all lines are being used and then an additional piece of equipment with a high power load is needed, which would exceed the maximum power use, the Emax 2 would stop the electricity supply to a non-essential source such as the air-conditioning in the canteen, which is empty because lunch is over,” Mr. Frisio explained. “The building manager can determine how it is set to meet the specific requirements of the plant and ensure optimum energy efficiency.”

The development of the new Emax 2 breaker took several years and was led by ABB’s development center in Bergamo, Italy.

SOLAR-POWERED LAPTOP HITS MARKET FOR \$350

The Ubuntu Sol laptop is the world's first solar-powered personal computer, boasting a 10-hour battery life from just two hours of sunlight

Canadian technology company WeWi Telecommunications has brought to the market a device that it claims is the world's first solar-powered laptop (in 2011 Samsung launched its NC215S solar netbook, which - although powered by sunlight - is not technically a laptop computer).

The Sol laptop is set to retail for just US\$350, boasting the usual roll-call of specs (built-in GPS, Bluetooth 4.0, WIFI, 3G/4G LTE capabilities) and an impressive 10-hour battery life that can be fully charged after just two to three hours of exposure to sunlight.



To charge, the Sol laptop undergoes a rather striking transformation. While in normal mode the laptop appears little different than many others in this price range (if a little bulkier), the case unfolds to reveal a detachable solar array comprising four solar panels attached to a power cable.

The Ubuntu Sol's creator, David Snir, says that these panels should be placed in direct sunlight in order to charge the laptop's battery, with each panel producing around 10 W per square foot.

Reviewers have reported mixed results, with one stating that after five hours under strong sunshine in the Philippines the battery was only 75% charged. Others have enjoyed swifter charging results, often after placing the panels under a high-noon sun on a clear day for just a couple of hours.

Built to be rugged, durable and portable, the laptop's creators hope to market the Sol to the military, adventurers, researchers and students who require computing capabilities **in remote locations** that lack access to a reliable electricity connection.

Read more: <http://www.pv-magazine.com>

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INTERVIEW WITH Mr. MANNAR MANNAN ABOUT E-WASTE CHALLENGES & SOLUTIONS

by G. VENKATESH, Editor, Joint Secretary, TNEIEA



1. In India, E Waste is not considered as a potential problem. Why?

We have an excellent network of unauthorized ewaste collectors. This is a well established network developed over several decades. This ensures presence of ewaste in common landfills or municipal dump sites; moreover, consumers do not through the gadgets in garbage, they try to sell it, hence environmental pollution due to dumping is limited. The current legislation tries to arrest the unauthorized processing and not unauthorized collection and hence the potential environmental risks due to improper disposal is minimized.

2. Why there is very little awareness regarding E Waste in India?

The awareness about e Waste generation in India has increased exponentially in the past 2-3 years. Nowadays due to vast media coverage pertaining to this issue, the people have come to understand that they should dispose their electronic goods only with authorized e-Waste recycler. Still it has not reached a proportion to completely stop unauthorized disposal and recycling.

3. What are the Government regulations in place regarding E waste Generation & Disposal?

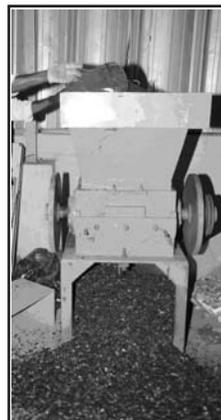
The government has in place strict regulation regarding e Waste generation & disposal. The government has introduced a new rule called the e-Waste Rules, 2011 which have made disposing e-Waste to unauthorized e-Waste recycler impossible. They have also introduced a new system called Extended Producers Responsibility (EPR) where the old electronic waste should be collected by the manufacturer and be disposed to an e-Waste recycler.

4. What more should the Government do to mitigate the impending danger in future?

- Should increase awareness
- Should subsidize recycling
- Should strictly implement the rule
- Encourage recycling and effectively implement 'Extended Producer Responsibility'

5. What as responsible citizens should do?

- They should dispose their e-waste only to authorized recyclers



b. Inform and encourage neighbors/ co-community dwellers to go for clean disposal

6. How did you get into this Business?

a. Promoter is basically an environmental engineer, he is also a consultant on environmental management to various corporates

b. When CPCB released the first guidelines on e-waste recycling in 2008, he was enthused by the business opportunity and started this company

c. GEMS Recycling Pvt Ltd., is one of the oldest recyclers in the country

7. As a business proposal, how do you see this E waste issue?

Not very lucrative as of now, but will pick up momentum as awareness improves and implementation of rule becomes stringent.

8. Who all do you think can be in this Business, What type of qualification, Infrastructure, experience you need to enter this Business?

Knowledge on IT equipment, hardware engineering and good business acumen is sufficient to enter the business.

9. How different it is from normal scrap dealing business?

Requires some detoxification, dismantling and segregation in an environment friendly manner is the main difference. The infrastructure requirement and investments and legal approvals towards the same makes all the difference.

10. About your company

We GEMS Recycling Private Limited are one of the leading e-Waste recyclers in India based in Kancheepuram near Chennai and operating throughout the country. GEMS is managed by a group of professionals who have the qualifications for processing electrical and electronic wastes in an eco-friendly manner.

11. Any voluntary adherence to these types of issues is mainly encouraged by incentives. Any incentives are available with Government or what type of incentives shall make the E waste management more attractive?

No. No incentives are available as of now from GOI.



“ENVIRONMENTALLY SOUND OPTIONS FOR E-WASTES MANAGEMENT”

*by*Ramachandra T.V., * Saira Varghese K.*

E-waste “is a popular, informal name for electronic products nearing the end of their” useful life. Waste from used electrical and electronic equipment – commonly known as e-waste or WEEE – is one of the fastest growing solid waste streams around the world today “E-wastes are considered dangerous, as certain components of some electronic products contain materials that are hazardous, depending on their condition and density. The hazardous content of these materials pose a threat to human health and environment. Discarded computers, televisions, VCRs, stereos, copiers, fax machines, electric lamps, cell phones, audio equipment and batteries if improperly disposed can leach lead and other substances into soil and groundwater. Many of these products can be reused, refurbished, or recycled in an environmentally sound manner so that they are less harmful to the ecosystem. This paper highlights the hazards of e-wastes, the need for its appropriate management and options that can be implemented.

INTRODUCTION

Industrial revolution followed by the advances in information technology during the last century has radically changed people’s lifestyle. Although this development has helped the human race, mismanagement has led to new problems of contamination and pollution. The technical prowess acquired during the last century has posed a new challenge in the management of wastes. For example, personal computers (PCs) contain certain components, which are highly toxic, such as chlorinated and brominated substances, toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives. The hazardous content of these materials pose an environmental and health threat. Thus proper management is necessary while disposing or recycling e-wastes.



These days computer has become most common and widely used gadget in all kinds of activities ranging from schools, residences, offices to manufacturing industries. E-toxic components in computers could be summarized as circuit boards containing heavy metals like lead & cadmium; batteries containing cadmium; cathode ray tubes with lead oxide & barium; brominated flame-retardants used on printed circuit boards, cables and plastic casing; poly vinyl chloride (PVC) coated copper cables and plastic computer casings that release highly toxic dioxins & furans when burnt to recover valuable metals; mercury switches; mercury in flat screens; poly chlorinated

biphenyl's (PCB's) present in older capacitors; transformers; etc. The rapid uptake of information technology around the world, coupled with the advent of new designs and technologies at regular intervals is causing the early obsolescence of much electrical and electronic equipment (EEE). In the United States, believed to produce the largest amounts of e-waste in the world, it is estimated that over 100 million computers, monitors and televisions become obsolete each year and that amount is growing year on year. In the European Union (EU), the total generation of e-waste



in 2005 was estimated to be 9.3 million tonnes which included 40 million personal computers and 32 million televisions. The same scenario applies to mobile phones and other hand held electronic items used in the present society. Each year over 130 million mobile phones in the United States and over 105 million mobile phones in Europe reach their end-of-life and are thrown away [3]. As a result, e-waste has become a serious social problem and an environmental threat to many countries worldwide. The United Nations estimate that, collectively, the world generates 20 to 50 million tonnes of e-waste every year. The latest report released by the United Nations [5] predicts that by 2020 e-waste from old computers in South Africa and China will have jumped by 200–400 % and by 500 % in India compared to 2007 levels. It also states that by 2020 e-waste from discarded mobile phones will be about 7 times higher than 2007 in China and 18 times higher in India. The report also cites that in the United States more than 150 million mobiles and pagers were sold in 2008, up from 90 million five years before, and globally more than 1 billion mobile phones were sold in 2007, up from 896 million in 2006. The UN report also estimates that countries like Senegal and Uganda can expect e-waste flows from personal computers alone to increase 4 to 8-fold by 2020.

EFFECTS ON ENVIRONMENT AND HUMAN HEALTH

Disposal of e-wastes is a particular problem faced in many regions across the globe. Computer wastes that are landfilled produces contaminated leachates which eventually pollute the groundwater. Acids and sludge obtained from melting computer chips, if disposed on the ground causes acidification of soil. A toxicity study of sediments collected from two rivers in Guiyu, China, where significant amount of informal e-waste recycling is taking place, showed that most sediments exhibited acute toxicity due to elevated levels of heavy metals and other chemicals and low pH caused by uncontrolled acid discharge [8]. Furthermore, a study of heavy metals (copper, cadmium, lead, zinc, arsenic, mercury) and persistent organic compounds including polycyclic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) conducted in Wenling, an emerging e-waste recycling facility in Taizhou area, China, found high levels of the above compared to reference sites [9]. China and India are not the only countries impacted by e-waste. A number of other countries in Asia including Philippines, Hong Kong, Indonesia, Sri Lanka, Pakistan, Bangladesh, Malaysia and Vietnam and also a number of countries in Africa including Nigeria, Kenya, Senegal and Ghana are the latest targets for dumping e-waste generated in advanced economies. Managing e-waste in these countries is not easy given that most developing countries have neither a well-established system for separation, storage, transportation, treatment and disposal of waste nor any effective enforcement related to managing e-waste. Thus, co-disposal of e-waste with domestic waste in open dumps is generally practiced in many developing countries causing severe damage to the environment and human health.

This is due to disposal of recycling wastes such as acids, sludges etc. in rivers. Now water is being transported from faraway towns to cater to the demands of the population. Incineration of e-wastes can emit toxic fumes and gases, thereby polluting the surrounding air. Improperly monitored landfills can cause environmental hazards.

Mercury will leach when certain electronic devices, such as circuit breakers are destroyed. E-waste also contains brominated flame retardants (BFRs) such as polybrominated biphenyls (PBB) and polybrominated diphenylethers (PBDEs) which are used in printed circuit boards, connectors, covers and cables. A recent comprehensive review conducted by A. Sepulveda et al., where scientific data related to concentrations of lead (Pb), PBDEs, polychlorinated dioxins and furans were monitored around e-waste recycling areas in China and India. This highlighted the very high levels of the aforementioned compounds in air, dust, soil and water samples, which at times considerably exceeded the concentration levels found in other industrial urban areas. These findings are further confirmed by studies conducted by Ni et al. [11] where they found high concentrations of above compounds in e-waste recycling sites in China.

Not only does the leaching of mercury poses specific problems, the vaporization of metallic mercury and dimethylene mercury, both part of Waste Electrical and Electronic Equipment (WEEE) is also of concern. In addition, uncontrolled fires may arise at landfills and this could be a frequent occurrence in many countries. When exposed to fire, metals and other chemical substances, such as the extremely toxic dioxins and furans (TCDD tetrachloro dibenzo-dioxin, PCDDs-polychlorinated dibenzo-dioxins. PBDDs-polybrominated dibenzo-dioxin and PCDFs-poly chlorinated dibenzo furans) from halogenated flame retardant products and PCB



containing condensers can be emitted. The most dangerous form of burning e-waste is the open-air burning of plastics in order to recover copper and other metals. The toxic fall-out from open air burning affects both the local environment and broader global air currents, depositing highly toxic by products in many places throughout the world.

Table I summarizes the health effects of certain constituents in e-wastes. If these electronic items are discarded with other household garbage, the toxics pose a threat to both health and vital components of the ecosystem. In view of the ill-effects of hazardous wastes to both environment and health, several countries exhorted the need for a global agreement to address the problems and challenges posed by hazardous waste. Also, in the late 1980s, a tightening of environmental regulations in industrialized countries led to a dramatic rise in the cost of hazardous waste disposal. Searching for cheaper ways to get rid of the wastes, “toxic traders” began shipping hazardous waste to developing countries. International outrage following these irresponsible activities led to the drafting and adoption of strategic plans and regulations at the Basel Convention. The Convention secretariat, in Geneva, Switzerland, facilitates and implementation of the Convention and related agreements. It also provides assistance and guidelines on legal and technical issues, gathers statistical data, and conducts training on the proper management of hazardous waste.

BASEL CONVENTION

The fundamental aims of the Basel Convention are the control and reduction of transboundary movements of hazardous and other wastes including the prevention and minimization of their generation, the environmentally sound management of such wastes and the active promotion of the transfer and use of technologies.

A Draft Strategic Plan has been proposed for the implementation of the Basel Convention. The Draft Strategic Plan takes into account existing regional plans, programmes or strategies, the decisions of the Conference of the Parties and its subsidiary bodies, ongoing project activities and process of international environmental governance and sustainable development. The Draft requires action at all levels of society: training, information, communication, methodological tools, capacity building with financial support, transfer of know-how, knowledge and sound, proven cleaner technologies and processes to assist in the concrete implementation of the Basel Declaration. It also calls for the effective involvement and coordination by all concerned stakeholders as essential for achieving the aims of the Basel Declaration within the approach of common but differentiated responsibility.

Table I: Effects of E-Waste constituent on health

Source of e-wastes	Constituent	Health effects
Solder in printed circuit boards, glass panels and gaskets in computer monitors	Lead (Pb)	<ul style="list-style-type: none"> ➤ Damage to central and peripheral nervous systems, blood systems and kidney damage. ➤ Affects brain development of children.
Chip resistors and semiconductors	Cadmium (Cd)	<ul style="list-style-type: none"> ➤ Toxic irreversible effects on human health. ➤ Accumulates in kidney and liver. ➤ Causes neural damage. ➤ Teratogenic.
Relays and switches, printed circuit boards	Mercury (Hg)	<ul style="list-style-type: none"> ➤ Chronic damage to the brain. ➤ Respiratory and skin disorders due to bioaccumulation in fishes.
Corrosion protection of untreated and galvanized steel plates, decorator or hardener for steel housings	Hexavalent Chromium (Cr VI)	<ul style="list-style-type: none"> ➤ Asthmatic bronchitis. ➤ DNA damage.
Cabling and computer housing	Plastics including PVC	<p>Burning produces dioxin. It causes</p> <ul style="list-style-type: none"> ➤ Reproductive and developmental problems; ➤ Immune system damage; ➤ Interfere with regulatory hormones
Plastic housing of electronic equipments and circuit boards.	Brominated flame retardants (BFR)	<ul style="list-style-type: none"> ➤ Disrupts endocrine system functions
Front panel of CRTs	Barium (Ba)	<p>Short term exposure causes:</p> <ul style="list-style-type: none"> ➤ Muscle weakness; ➤ Damage to heart, liver and spleen.
Motherboard	Beryllium (Be)	<ul style="list-style-type: none"> ➤ Carcinogenic (lung cancer) ➤ Inhalation of fumes and dust. Causes chronic beryllium disease or berylliosis. ➤ Skin diseases such as warts.

A set. of interrelated and mutually supportive strategies are proposed to support the concrete implementation of the activities as indicated in the website (www.basel.int/DraftstrateKJcplan4Seot.pdf) is described below:

1. To involve experts in designing communication tools for creating awareness at the highest level to promote the aims of the Basel Declaration on environmentally sound management and the ratification and implementation of the Basel Convention, its amendments and protocol with the emphasis on the short-term activities.
2. To engage and stimulate a group of interested parties to assist the secretariat in exploring fund raising strategies including the preparation of projects and in making full use of expertise in non-governmental organizations and other institutions in joint projects.
3. To motivate selective partners among various stakeholders to bring added value to making progress in the short-term.
4. To disseminate and make information easily accessible through the internet and other electronic and printed materials on the transfer of know-how, in particular through Basel Convention Regional Centers (BCRCs).
5. To undertake periodic review of activities in relation to the agreed indicators;
6. To collaborate with existing institutions and programmes to promote better use of cleaner technology and its transfer, methodology, economic instruments or policy to facilitate or support capacity-building for the environmentally sound management of hazardous and other wastes.

The Basel Convention brought about a respite to the transboundary movement of hazardous waste. India and other countries have ratified the convention. However United States (US) is not a party to the ban and is responsible for disposing hazardous waste, such as, e-waste to Asian countries even today. Developed countries such as US should enforce stricter legislations in their own country for the prevention of this horrifying act.

In the European Union where the annual quantity of electronic waste is likely to double in the next 12 years, the European Parliament recently passed legislation that will require manufacturers to take back their electronic products when consumers discard them. This is called Extended Producer Responsibility. It also mandates a timetable for phasing out most toxic substances in electronic products.

MANAGEMENT OF E-WASTES

It is estimated that 75% of electronic items are stored due to uncertainty of how to manage it. These electronic junks lie unattended in houses, offices, warehouses etc. and normally mixed with household wastes, which are finally disposed off at landfills. This necessitates implementable management measures.

In industries management of e-waste should begin at the point of generation. This can be done by waste minimization techniques and by sustainable product design. Waste minimization in industries involves adopting:

- inventory management,
- production-process modification,
- volume reduction,
- recovery and reuse.

Inventory management

Proper control over the materials used in the manufacturing process is an important way to reduce waste generation (Freeman, 1989). By reducing both the quantity of hazardous materials used in the process and the amount of excess raw materials in stock, the quantity of waste generated can be reduced. This can be done in two ways i.e. establishing material-purchase review and control procedures and inventory tracking system.

Developing review procedures for all material purchased is the first step in establishing an inventory management program. Procedures should require that all materials be approved prior to purchase. In the approval process all production materials are evaluated to examine if they contain hazardous constituents and whether alternative non-hazardous materials are available.

Another inventory management procedure for waste reduction is to ensure that only the needed quantity of a material is ordered. This will require the establishment of a strict inventory tracking system. Purchase procedures must be implemented which ensure that materials are ordered only on an as-needed basis and that only the amount needed for a specific period of time is ordered.

Production-process modification

Changes can be made in the production process, which will reduce waste generation. This reduction can be accomplished by changing the materials used to make the product or by the more efficient use of input materials in the production process or both. Potential waste minimization techniques can be broken down into three categories:

- i) Improved operating and maintenance procedures,
- ii) Material change and
- iii) Process-equipment modification.

Improvements in the operation and maintenance of process equipment can result in significant waste reduction. This can be accomplished by reviewing current operational procedures or lack of procedures and examination of the production process for ways to improve its efficiency. Instituting standard operation procedures can optimise the use of raw materials in the production process and reduce the potential for materials to be lost through leaks and spills. A strict maintenance program, which stresses corrective maintenance, can reduce waste generation caused by equipment failure. An employee-training program is a key element of any waste reduction program. Training should include correct operating and handling procedures, proper equipment use, recommended maintenance and inspection schedules, correct process control specifications and proper management of waste materials.

Hazardous materials used in either a product formulation or a production process may be replaced with a less hazardous or non-hazardous material. This is a very widely used technique and is applicable to most manufacturing processes. Implementation of this waste -reduction technique may require only some minor process adjustments or it may require extensive new process equipment. For example, a circuit board manufacturer can replace solvent-based product with water-based flux and simultaneously replace solvent vapor degreaser with detergent parts washer.

Installing more efficient process equipment or modifying existing equipment to take advantage of better production techniques can significantly reduce waste generation. New or updated equipment can use process materials more efficiently producing less waste. Additionally such efficiency reduces the number of rejected or off-specification products, thereby reducing the amount of material which has to be reworked or disposed of. Modifying existing process equipment can be a very cost-effective method of reducing waste generation. In many cases the modification can just be relatively simple changes in the way the materials are handled within the process to ensure that they are not wasted. For example, in many electronic manufacturing operations, which involve coating a product, such as electroplating or painting, chemicals are used to strip off coating from rejected products so that they can be recoated. These chemicals, which can include acids, caustics, cyanides etc are often a hazardous waste and must be properly managed. By reducing the number of parts that have to be reworked, the quantity of waste can be significantly reduced.

Volume reduction

Volume reduction includes those techniques that remove the hazardous portion of a waste from a non-hazardous portion. These techniques are usually to reduce the volume, and thus the cost of disposing of a waste material. The techniques that can be used to reduce waste-stream volume can be divided into 2 general categories: source segregation and waste concentration. Segregation of wastes is in many cases a simple and economical technique for waste reduction. Wastes containing different types of metals can be treated separately so that the metal value in the sludge can be recovered. Concentration of a waste stream may increase the likelihood that the material can be recycled or reused. Methods include gravity and vacuum filtration, ultra filtration, reverse osmosis, freeze vaporization etc.

For example, an electronic component manufacturer can use compaction equipments to reduce volume of waste cathode ray-tube.

Recovery and reuse

This technique could eliminate waste disposal costs, reduce raw material costs and provide income from a salable waste. Waste can be recovered on-site, or at an off-site recovery facility, or through inter industry exchange. A number of physical and chemical techniques are available to reclaim a waste material such as reverse osmosis, electrolysis, condensation, electrolytic recovery, filtration, centrifugation etc. For example, a printed-circuit board manufacturer can use electrolytic recovery to reclaim metals from copper and tin-lead plating bath.

However recycling of hazardous products has little environmental benefit if it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to redesign the product to use non-hazardous materials, such recycling is a false solution.

Sustainable product design

Minimization of hazardous wastes should be at product design stage itself keeping in mind the following factors*

- ***Rethink the product design:*** Efforts should be made to design a product with fewer amounts of hazardous materials. For example, the efforts to reduce material use are reflected in some new computer designs that are flatter, lighter and more integrated. Other companies propose centralized networks similar to the telephone system.
- ***Use of renewable materials and energy:*** Bio-based plastics are plastics made with plant-based chemicals or plant-produced polymers rather than from petro-chemicals. Bio-based toners, glues and inks are used more frequently. Solar computers also exist but they are currently very expensive.
- ***Use of non-renewable materials that are safer:*** Because many of the materials used are non-renewable, designers could ensure the product is built for re-use, repair and/or upgradeability. Some computer manufacturers such as Dell and Gateway lease out their products thereby ensuring they get them back to further upgrade and lease out again.

* <http://www.svtc.org/cleanclDubs/savno.htm>

THE INDIAN SCENARIO

While the world is marveling at the technological revolution, countries like India are facing an imminent danger. E-waste of developed countries, such as the US, dispose their wastes to India and other Asian countries. A recent investigation revealed that much of the electronics turned over for recycling in the United States ends up in Asia, where they are either disposed of or recycled with little or no regard for environmental or worker health and safety. Major reasons for exports are cheap labour and lack of environmental and occupational standards in Asia and in this way the toxic effluent of the developed nations 'would flood towards the world's poorest nations. The magnitude of these problems is yet to be documented. However, groups like Toxic Links India are already working on collating data that could be a step towards controlling this hazardous trade.

It is imperative that developing countries and India in particular wake up to the monopoly of the developed countries and set up appropriate management measures to prevent the hazards and mishaps due to mismanagement of e-wastes.

MANAGEMENT OPTIONS

Considering the severity of the problem, it is imperative that certain management options be adopted to handle the bulk e-wastes. Following are some of the management options suggested for the government, industries and the public.

Responsibilities of the Government

- (i) Governments should set up regulatory agencies in each district, which are vested with the responsibility of co-ordinating and consolidating the regulatory functions of the various government authorities regarding hazardous substances.
- (ii) Governments should be responsible for providing an adequate system of laws, controls and administrative procedures for hazardous waste management (Third World Network. 1991). Existing laws concerning e-waste disposal be reviewed and revamped. A comprehensive law that provides e-waste regulation and management and proper disposal of hazardous wastes is required. Such a law should empower the agency to control, supervise and regulate the relevant activities of government departments.

Under this law, the agency concerned should

- Collect basic information on the materials from manufacturers, processors and importers and to maintain an inventory of these materials. The information should include toxicity and potential harmful effects.
 - Identify potentially harmful substances and require the industry to test them for adverse health and environmental effects.
 - Control risks from manufacture, processing, distribution, use and disposal of electronic wastes.
 - Encourage beneficial reuse of “e-waste” and encouraging business activities that use waste. Set up programs so as to promote recycling among citizens and businesses.
 - Educate e-waste generators on reuse/recycling options
- (iii) Governments must encourage research into the development and standard of hazardous waste management, environmental monitoring and the regulation of hazardous waste-disposal.
 - (iv) Governments should enforce strict regulations against dumping e-waste in the country by outsiders. Where the laws are flouted, stringent penalties must be imposed. In particular, custodial sentences should be preferred to paltry fines, which these outsiders / foreign nationals can pay.
 - (v) Governments should enforce strict regulations and heavy fines levied on industries, which do not practice waste prevention and recovery in the production facilities.
 - (vi) Polluter pays principle and extended producer responsibility should be adopted.
 - (vii) Governments should encourage and support NGOs and other organizations to involve actively in solving the nation’s e-waste problems.
 - (viii) Uncontrolled dumping is an unsatisfactory method for disposal of hazardous waste and should be phased out.
 - (ix) Governments should explore opportunities to partner with manufacturers and retailers to provide recycling services.

Responsibility and Role of industries

1. Generators of wastes should take responsibility to determine the output characteristics of wastes and if hazardous, should provide management options.
2. All personnel involved in handling e-waste in industries including those at the policy, management, control and operational levels, should be properly qualified and trained. Companies can adopt their own policies while handling e-wastes. Some are given below:
 - Use label materials to assist in recycling (particularly plastics).
 - Standardize components for easy disassembly.
 - Re-evaluate ‘cheap products’ use, make product cycle ‘cheap’ and so that it has no inherent value that would encourage a recycling infrastructure.
 - Create computer components and peripherals of biodegradable materials.
 - Utilize technology sharing particularly for manufacturing and de manufacturing.
 - Encourage / promote / require green procurement for corporate buyers.
 - Look at green packaging options.

3. Companies can and should adopt waste minimization techniques, which will make a significant reduction in the quantity of e-waste generated and thereby lessening the impact on the environment. It is a “reverse production” system that designs infrastructure to recover and reuse every material contained within e-wastes metals such as lead, copper, aluminum and gold, and various plastics, glass and wire. Such a “closed loop” manufacturing and recovery system offers a win-win situation for everyone, less of the Earth will be mined for raw materials, and groundwater will be protected, researchers explain.
4. Manufacturers, distributors, and retailers should undertake the responsibility of recycling/disposal of their own products.
5. Manufacturers of computer monitors, television sets and other electronic devices containing hazardous materials must be responsible for educating consumers and the general public regarding the potential threat to public health and the environment posed by their products. At minimum, all computer monitors, television sets and other electronic devices containing hazardous materials must be clearly labeled to identify environmental hazards and proper materials management.

Responsibilities of the Citizen

Waste prevention is perhaps more preferred to any other waste management option including recycling. Donating electronics for reuse extends the lives of valuable products and keeps them out of the waste management system for a longer time. But care should be taken while donating such items i.e. the items should be in working condition.

Reuse, in addition to being an environmentally preferable alternative, also benefits society. By donating used electronics, schools, non-profit organizations, and lower-income families can afford to use equipment that they otherwise could not afford.

E-wastes should never be disposed with garbage and other household wastes. This should be segregated at the site and sold or donated to various organizations.

While buying electronic products opt for those that:

- are made with fewer toxic constituents
- use recycled content
- are energy efficient
- are designed for easy upgrading or disassembly
- utilize minimal packaging
- offer leasing or take back options
- have been certified by regulatory authorities. Customers should opt for upgrading their computers or other electronic items to the latest versions rather than buying new equipments.

NGOs should adopt a participatory approach in management of e-wastes.

What is e-waste?

E-waste is a term used to cover almost all types of electrical and electronic equipment (EEE) that has or could enter the waste stream. Although e-waste is a general term, it can be considered to cover TVs, computers, mobile phones, white goods (e.g. fridges, washing machines, dryers etc), home entertainment and stereo systems, toys, toasters, kettles – almost any household or business item with circuitry or electrical components with power or battery supply.

Why is e-waste growing?

E-waste is growing exponentially simply because the markets in which these products are produced are also growing rapidly as many parts of the world cross over to the other side of the ‘Digital Divide’. For example, between 2000 and 2005, the Organisation for Economic Co-operation and Development (OECD) notes a 22% growth in Information and Communications Technology (ICT) in China (1). Furthermore, China was the 6th largest ICT market in 2006, after the US, Japan, Germany, UK and France (2). This is astounding when one considers that just ten years ago, under 1% of China’s population owned a computer (3).

Computers are only one part of the e-waste stream though, as we see that in the EU in 2005, fridges and other cooling and freezing appliances, combined with large household appliances, accounted for 44% of total e-waste, according to UNU’s Study supporting the 2008 Review of the Waste Electrical and Electronic Equipment (WEEE) Directive (4).

Rapid product innovations and replacement, especially in ICT and office equipment, combined with the migration from analogue to digital technologies and to flat-screen TVs and monitors, for example, are fuelling the increase. Additionally, economies of scale have given way to lower prices for many electrical goods, which has increased global demand for many products that eventually end up as e-waste.

Why is e-waste different from general municipal waste?

In addition to various hazardous materials, e-waste also contains many valuable and precious materials. In fact up to 60 elements from the periodic table can be found in complex electronics. Using the personal computer (PC) as an example – a normal Cathode Ray Tube (CRT) computer monitor contains many valuable but also many toxic substances. One of these toxic substances is cadmium (Cd), which is used in rechargeable computer batteries and contacts and switches in older CRT monitors.

Cadmium can bio-accumulate in the environment and is extremely toxic to humans, in particular adversely affecting kidneys and bones (5). It is also one of the six



toxic substances that has been banned in the European Restriction on Hazardous Substances (RoHS) Directive. Beyond CRT monitors, plastics, including polyvinyl chloride (PVC) cabling is used for printed circuit boards, connectors, plastic covers and cables.

When burnt or land-filled, these PVCs release dioxins that have harmful effects on human reproductive and immune systems (6). Mercury (Hg), which is used in lighting devices in flat screen displays, can cause damage to the nervous system, kidneys and brain, and can even be passed on to infants through breast milk (7).

Electrical goods contain a range of other toxic substances such as lead (Pb), beryllium (Be), brominated flame retardants and polychlorinated biphenyls (PCB) just to name a few. Lead plays an important role in the overall metal production processes and while attempts to design-out lead from EEE does not necessarily mean that it is no longer used. Even the lead-free solder elements are co-produced with lead. This illustrates the need for a holistic view to be taken in analyzing the e-waste situation for working out possible solutions.

On the other hand, the huge impact of EEE on valuable metals resources must not be neglected. A mobile phone e.g. can contain over 40 elements including base metals (copper (Cu), tin (Sn),...), special metals (cobalt (Co), indium (In), antimony (Sb), ..), and precious metals (silver (Ag), gold (Au), palladium (Pd), ..). The most common metal is copper (9 g), while the precious metal content is in the order of milligrams only: 250 mg silver, 24 mg gold and 9 mg palladium. Furthermore, the lithium-ion battery contains about 3.5 grams of cobalt. This appears to be quite marginal but with the leverage of 1.2 billion mobile phones sold globally in 2007 this leads to a significant metal demand (8).

Similar calculations can be made for computers or other complex electronics and the increasing functionality of EEE products is largely achieved using the unique properties of precious and special metals. For example 80% of the world indium demand is used for LCD screens, over 80% of ruthenium is used for hard disks and 50% of the worldwide demand for antimony is used for flame retardants. Taking into account the highly dynamic growth rates of EEE, it becomes clear that they are a major driver for the development of demand and prices of certain metals.

Because of this complex composition of valuable and hazardous substances, specialized, often “high-tech” methods are required to process e-waste in ways that maximize resource recovery and minimize potential harm to humans or the environment. Unfortunately, the use of these specialized methods is rare, with much of the world’s e-waste traveling great distances, mostly to developing countries, where crude techniques are often used to extract precious materials or recycle parts for further use. These “backyard” techniques pose dangers to poorly protected workers and their local natural environment.

Moreover, they are very inefficient in terms of resource recovery as recycling in these instances usually focuses on a few valuable elements like gold and copper (with often poor recycling yields), while most other metals are discarded and inevitably lost. In this sense it can be demonstrated that resource efficiency is another important dimension in the e-waste discussion in addition to the ecological, human security, economical and societal aspects.

How much e-waste is there?

Because so much of the planet's e-waste is unaccounted for, it is difficult to quantify e-waste amounts. Moreover, the types of e-waste included in government-initiated analyses and collection programmes vary from country to country. Under the current version of the WEEE Directive, the EU has 10 distinct product categories, whereas in North America it is typically limited to Information and Communications Technology (ICT) products and televisions and in Japan to four product categories including TVs, air conditioners, refrigerators and washing machines.

The deviation in categorization of e-waste notwithstanding, reasonable estimates are in the order of 40 million tonnes p.a., which is enough to fill a line of dump-trucks stretching half way around the globe.

A recent review of European legislation on e-waste, known as the "Waste Electrical Electronic Equipment (WEEE)" Directive (mentioned earlier), highlights that in 2005 in Europe alone, there were between 8.3 and 9.1 million tonnes of e-waste, tendency rising.

In Australia, with an average of 22 electrical items per household, the Australian Bureau of Statistics has estimated that in the next two years, most of the 9 million computers, 5 million printers and 2 million scanners in Australian homes will be replaced (9).

In the US the Environment Protection Agency (EPA) has reported that the US generated 1.9 to 2.2 million tonnes of e-waste in 2005, with only 12.5% collected for recycling (10).

Why is so much e-waste unaccounted for?

The US-EPA has estimated a 5 to 10% increase in the generation of e-waste each year globally. Perhaps even more alarming is that only 5% of this amount is being recovered (11)– so where are the other 38 million tonnes? In Europe the review of the WEEE Directive by the United Nations University found that 25% of the total weight of the EU's e-waste in 2005 was unaccounted for. Astoundingly, this finding clearly demonstrates that there was no scientific data available to explain where over 6 million tonnes of e-waste is going each year.

So why is so much e-waste unaccounted for? – We don't really know for sure. Enough is known to suggest a few explanations, such as illegal shipments to developing countries, like China and India; domestic 'informal' processing centres; as well as the e-waste that remains in the sheds, attics and storage rooms of sentimental owners.

E-waste – A global challenge

In summary one can clearly grasp and understand the e-waste problem is of global concern because of the nature of production and disposal of waste in a globalized world. Although it is difficult to quantify global e-waste amounts, we do know that large amounts are ending up in places where processing occurs at a very rudimentary level. This raises concerns about resource efficiency and also the immediate concerns of the dangers to humans and the environment.

There is a long and often complicated chain of events in the e-waste problem, beginning from an idea that someone has for a new product and then its production, ending in its purchase and eventual disposal by the end user. By engaging with various stakeholders and relevant scientific wisdom within this chain of events, we are on the way to Solve the E-waste Problem (StEP).

About Prof. T. V. Ramachandra

Ramachandra T. V. obtained his Ph.D. from Indian Institute of Science (IISc), Bangalore in Energy and Environment. Currently he is a faculty at the Centre for Ecological Sciences (CES), Centre for Sustainable Technologies (CST) and Centre for infrastructure, Sustainable Transport and Urban Planning (CiSTUP) at IISc, Bangalore.

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He has published 184 research papers in national and international journals, and has more than 118 papers in conferences and has written 14 books on related topics. He is a recipient of the prestigious Satish Dhawan Young Engineer Award, 2007 of Karnataka State Government, India. He is a fellow of Institution of Engineers (India), IEE (UK), Senior member, IEEE (USA) and many similar institutions.

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ELECTRICAL INSTALLATIONS IN INDUSTRIAL BUILDINGS - 5

ANNEX E (Clause 9.1.1)

RECOMMENDED VALUES OF ILLUMINATION AND LIMITING VALUES OF GLARE INDEX – INDUSTRIAL BUILDINGS

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
i)	General factor areas:		
	a) Canteens	150	–
	b) Cloakrooms	100	–
	c) Entrances, Corridors, stairs	100	–
ii)	Factory outdoor areas: Stockyards, main entrances, exit roads, car parks, internal factory roads	20	–
iii)	Aircraft factories and maintenance hangers:		
	a) Stock parts productions	450	25
	b) Drilling, riveting, screw fastening, sheet aluminium layout and template work, wing sections, cowling welding, sub-assembly, final assembly, inspection	300	25
	c) Maintenance and repairs (Hangers)	300	25
iv)	Assembly shops:		
	a) Rough work, for example, frame assembly, assembly of heavy machinery	150	28
	b) Medium work, for example, machined parts, engine assembly, vehicle body assembly	300	25
	c) Fine work, for example, radio and telephone equipment, typewriter and office machinery assembly	700	22
	d) Very fine work, for example, assembly of very small precision mechanisms, instruments	1 500 ¹⁾	19
v)	Bakeries:		
	a) Mixing and make-up rooms, oven rooms, wrapping rooms	150	25
	b) Decorating and icing	200	25
vi)	Boiler houses (industrial):		
	a) Coal and ash handling	100	–
	b) Boiler rooms:		
	1) Boiler fronts and operating areas	100 ²⁾	–
2) Other areas	20 to 25	–	
	c) Outdoor plants:		
	1) Catwalks	20	–
	2) Platforms	50	–

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
vii)	Bookbinding:		
	a) Pasting, punching and stitching	200	25
	b) Binding and folding; miscellaneous machines	300	22
	c) Finishing, blocking and in laying	300	22
viii)	Boot and shoe factories:		
	a) Sorting and grading	1 000 ³⁾	19
	b) Clicking and closing, preparatory operations	700	22
	c) Cutting table and presses, stitching	1 000	22
	d) Bottom stock preparation, lasting and bottoming, finishing	700	22
	e) Shoe rooms	700	22
ix)	Breweries and distilleries:		
	a) General working areas	150	25
	b) Brewhouse, bottling and canning plants	200	25
	c) Bottle inspection	Special Lighting	—
x)	Canning and preserving factories:		
	a) Inspection of beans, rice, barley, etc	450	22
	b) Preparation: kettle areas, mechanical cleaning, dicing, trimming	300	25
	c) Canned and bottled goods: retorts	200	25
	d) High speed labeling lines	300	25
	e) Can inspection	450	—
xi)	Carpet factories:		
	a) Winding, beaming	200	25
	b) Designing, Jacquard and cutting, setting pattern, tufting, topping, cutting, hemming, fringing	450	22
	c) Weaving, mending, inspection	450	22
xii)	Ceramics – <i>See</i> pottery and clay products		
xiii)	Chemical works:		
	a) Hand furnaces, boiling tanks, stationery driers, stationery or gravity crystalizers, mechanical driers, evaporators, filtration plants, mechanical crystallising bleaching, extractors, percolators, nitrators. electrolytic cells	150	28
	b) Controls, gauges, valves, etc.	100	—
	c) Control rooms:		
	1) Vertical control panels	200-300	19
	2) Control desks	300	19
xiv)	Chocolate and confectionery factories:		
	a) Mixing, blending, boiling	150	28
	b) Chocolate husking, winnowing, fat extraction, crushing and refining, feeding, bean cleaning, sorting, milling, cream making	200	25
	c) Hand decorating, inspection, wrapping, packing	300	22

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
xv)	Clothing factories:		
	a) Matching-up	450 ³⁾	19
	b) Cutting sewing:		
	1) Light	300	22
	2) Medium	450	22
	3) Dark	700	22
	4) Pressing	300	22
	c) Inspection:		
	1) Light	450	19
	2) Medium	1 000	19
	3) Dark	1 500	19
	d) Hand tailoring:		
1) Light	450	19	
2) Medium	1 000	19	
3) Dark	1 500	19	
xvi)	Collieries (surface buildings):		
	a) Coal preparation plant:		
	1) Working areas	150	—
	2) Other areas	100	—
	3) Picking belts	300	—
	4) Winding houses	150	—
	b) Lamp rooms:		
	1) Main areas	100	—
	2) Repair sections	150	—
3) Weigh cabin	150	—	
c) Fan houses	100	—	
xvii)	Dairies:		
	a) General working areas	200 ²⁾	25
	b) Bottle inspection	Special lighting	—
	c) Bottle filling	450	25
xviii)	Die sinking:		
	a) General	300	—
	b) Fine	1 000	19
xix)	Dye works:		
	a) Reception, 'grey' perching	700	—
	b) Wet processes	150 ²⁾	28
	c) Dry processes	200 ²⁾	28
	d) Dyers' offices	700 ³⁾	19
	e) Final perching	2 000 ³⁾	—

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
xx)	Electricity generating stations: Indoor locations		
	a) Turbine halls	200	25
	b) Auxiliary equipment; battery rooms, blowers auxiliary generators, switchgear and transformer chambers	100	—
	c) Boiler houses (including operating floors) platforms, coal conveyors, pulverizers, feeders, precipitators, soot and slag blowers	70-100	—
	d) Boiler house and turbine house	100	—
	e) Basements	70	—
	f) Conveyor houses, conveyor gantries, junction towers	70-100	—
	g) Control rooms:		
	1) Vertical control panels	200-300	19
	2) Control desks	300	19
	3) Rear of control panels	150	19
	4) Switch houses	150	25
	h) Nuclear reactors and steam, raising plants:		
	1) Reactor areas, boilers, galleries	150	25
2) Gas circulator days	150	25	
3) Reactor charge/discharge face	200	25	
xxi)	Electricity generating stations: Outdoor locations		
	a) Coal unloading areas	20	—
	b) Coal storage areas	20	—
	c) Conveyors	50	—
	d) Fuel oil delivery headers	50	—
	e) Oil storage tanks	50	—
	f) Catwalks	50	—
	g) Platforms, boiler and turbine decks	50	—
	h) Transformers and outdoor switchgear	100	—
xxii)	Engraving:		
	a) Hand	1 000	19
	b) Machine (<i>see</i> Die sinking)	—	—
xxiii)	Farm buildings (dairies)		
	a) Boiler houses	50	—
	b) Milk rooms	150	25
	c) Washing and sterilizing rooms	150	25
	d) Stables	50	—
	e) Milking parlours	150	25
xxiv)	Flour mills:		
	a) Roller, purifier, sifting and packing floors	150	25
	b) Wetting tables	300	25

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
xxv)	Forges: General	150	28
xxvi)	Foundries:		
	a) Charging floors, tumbling cleaning, pouring, shaking out, rough moulding and rough core making	150	25
	b) Fine moulding and core making, inspection	300	25
xxvii)	Garages:		
	a) Parking areas (interior)	70	28
	b) Washing and polishing, greasing, general servicing, pits	150	28
	c) Repairs	300	25
xxviii)	Gas works:		
	a) Retort houses, oil gas plants, water gas plants, purifiers, coke screening and coke handling plants (indoor)	30-50 ⁴⁾	28
	b) Governor, meter, compressor, booster and exhaustor houses	100	25
	c) Open type plants:		
	1) Catwalks	20 ⁴⁾	—
	2) Platforms	50 ⁴⁾	—
xxix)	Gauge and tool rooms: General	700 ⁵⁾	19
xxx)	Glass works and processes:		
	a) Furnace rooms, bending, annealing lehrs	100	28
	b) Mixing rooms, forming (blowing, drawing, pressing, rolling)	150	28
	c) Cutting to size, grinding, polishing, toughening	200	25
	d) Finishing (beveling, decorating, etching, silvering)	300	22
	e) Brilliant cutting	700	19
	f) Inspection:		
	1) General	200	19
	2) Fine	700	19
xxxi)	Glove making:		
	a) Pressing, knitting, sorting, cutting	300	22
	b) Sewing:		
	1) Light	300	22
	2) Medium	450	22
	3) Dark	700	22
xxxii)	Hat making		
	a) Stiffening, braiding, cleaning, refining forming, sizing, pouncing, flanging, finishing ironing	150	22
	b) Sewing:		
	1) Light	300	22
	2) Medium	450	22
	3) Dark	700	22

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
xxxiii)	Hosiery and knitwear:		
	a) Circular and flat knitting machines universal winders, cutting out, folding and pressing	300	22
	b) Lock stitch and overlooking machines:		
	1) Light	300	22
	2) Medium	450	22
	3) Dark	700	22
	c) Mending	1 500	19
xxxiv)	d) Examining and hand finishing, light, medium, dark	700	19
	e) Linking or running-on	450	19
	Inspection shops (Engineering)		
	a) Rough work, for example, counting, rough checking of stock parts, etc.	150	28
	b) Medium work, for example, 'Go' and 'No-go' gauges, sub-assemblies	300	25
	c) Fine work, for example, radio and telecommunication equipment, calibrated scales, precision mechanisms, instruments	700	22
	d) Very fine work, for example, gauging and inspection of small intricate parts	1 500	19
xxxv)	e) Minute work, for example, very small instruments	3 000 ²⁾	19
	Iron and steel works		
	a) Marshalling and outdoor stockyards	10-20	—
	b) Stairs, gangways, basements, quarries, loading docks	100	—
	c) Slab yards' melting shops, ingot stripping soaking pits, blast furnace working areas, picking and cleaning lines, mechanical plants, pump houses	100	28
	d) Mould preparation, rolling and wire mills, mills motors rooms, power blower houses	150	28
	e) Slab inspection and conditioning, cold strip mills, sheet and plate finishing, tinning, galvanizing, machine and roll shops	200	28
xxxvi)	f) Plate inspection	300	—
	g) Tinsplate inspection	Special lighting	—
	Jewellery and watchmaking		
xxxvii)	a) Fine processes	700 ¹⁾	19
	b) Minute processes	3 000 ¹⁾	10
	c) Gem cutting, polishing, setting	1 500 ³⁾	—
xxxviii)	Laboratories and test rooms		
	a) General laboratories, balance rooms	300	19
	b) Electrical and instrument laboratories	450	19

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
xxxviii)	Laundries and dry cleaning works		
	a) Receiving, sorting, washing, drying, ironing (calendering), despatch	200	25
	b) Drycleaning, bulk machine work	200	25
	c) Fine hand ironing, pressing, inspection mending, spotting	300	25
xxxix)	Leather dressing		
	a) Vats, cleaning, tanning, stretching, cutting, fleshing and stuffing	150	28
	b) Finishing, staking, splitting and scarfing	200	28
xl)	Leather working		
	a) Pressing and glazing	450	22
	b) Cutting, scarfing, sewing	700	22
	c) Grading and matching	1 000 ³⁾	19
xli)	Machine and fitting shops		
	a) Rough bench and machine work	150	28
	b) Medium bench and machine work, ordinary automatic machines, rough grinding, medium buffing and polishing	300	25
	c) Fine bench and machine work, fine automatic machines, medium grinding fine buffing and polishing	700	22
xlii)	Motor vehicle plants		
	a) General sub-assemblies, chassis assembly, car assembly	300	25
	b) Final inspection	450	25
	c) Trim shops, body sub-assemblies, body assembly	300	25
	d) Spray booths	450	—
xliii)	Paint works		
	a) General automatic processes	200	25
	b) Special batch mixing	450	22
	c) Colour matching	700 ³⁾	19
xliv)	Paint shops and spraying booths:		
	a) Dipping, firing rough spraying	150	25
	b) Rubbing, ordinary painting, spraying and finishing	300	25
	c) Fine painting, spraying and finishing	450	25
	d) Retouching and matching	700 ³⁾	19
xlv)	Paper-works:		
	a) Paper and board making:		
	1) Machine houses, calendering pulp mills, preparation plants, cutting, finishing, trimming	200	25
	2) Inspection and sorting (over hauling)	300	22
	b) Paper converting processes:		
1) Corrugated board, cartons, containers and paper sack manufacture, coating and laminating processes	200	25	
	2) Associated printing	300	25

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
xlvi)	Pharmaceuticals and fine chemicals works:		
	a) Raw material storage	200	28
	b) Control laboratories and testing	300	19
	c) Pharmaceuticals manufacturing: grinding, granulating, mixing and drying, tableting, sterilizing and washing, preparation of solutions and filling, labelling, capping, cartoning and wrapping, inspection	300	25
	d) Fine chemical manufacture:		
1) Plant processing	200	25	
2) Fine chemical finishing	300	25	
xlvii)	Plastics works:		
	a) Manufacture (<i>see</i> Chemical works)	—	—
	b) Processing:		
	1) Calendering, extrusion	300	25
	2) Moulding-compression, injection	200	25
	3) Sheet fabrication:		
i) Shaping	200	25	
ii) Trimming, machining, polishing	300	25	
iii) Cementing	200	25	
xlviii)	Plating shops:		
	a) Vat and baths, filter pressing, kin rooms, moulding, pressing, cleaning, trimming, glazing, firing	150	28
	b) Enamelling, colouring, decorating	450 ³⁾	19
xlix)	Printing works:		
	a) Type foundries:		
	1) Matrix making, dressing type, hand and machine casting	200	25
	2) Front assembly, sorting	450	25
	b) Printing plants:		
	1) Machine composition, imposing stones	200	25
	2) Presses	300	25
	3) Composing room	450	19
	4) Proof reading	300	19
	c) Electrotyping:		
	1) Block-making, electroplating, washing, backing	200	25
	2) Moulding, finishing, routing	300	25
	d) Photo-engraving:		
1) Block-making, etching, masking	200	25	
2) Finishing, routing	300	25	
e) Colour printing: Inspection area	700 ³⁾	19	

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
l)	Rubber processing:		
	a) Fabric preparation creels	200	25
	b) Dipping, moulding, compounding calendars	150	25
	c) Tyre and tube making	200	25
li)	Sheet metal works:		
	a) Benchwork, scribing, pressing, punching shearing, stamping, spinning, folding	200	25
	b) Sheet inspection	Special lighting	
lii)	Soap factories:		
	a) Kettle houses and ancillaries, glycerine evaporation and distillation, continuous indoor soap making, plants:		
	1) General areas	150	25
	2) Control panels	200-300	25
	b) Batch or continuous soap cooling, cutting and drying, soap milling, plodding:		
	1) General areas	150	25
	2) Control panels, key equipment	200-300	25
	c) Soap stamping, wrapping and packing, granules making, granules storage and handling, filling and packing granules:		
	1) General areas	150	25
	2) Control panels, machines	200-300	25
	d) Edible products processing and packing	200	25
liii)	Structural steel fabrication plants:		
	a) General	150	28
	b) Marking off	300	28
liv)	Textile mills (cotton or linen):		
	a) Bale breaking, blowing, carding, roving, slubbing, spinning (ordinary counts), winding, heckling, spreading, cabling	150	25
	b) Warping, slashing, dressing and dyeing, doubling (fancy), spinning (fine counts)	200	25
	c) Healding (drawing-in)	700	—
	d) Weaving:		
	1) Patterned cloths, fine counts dark	700	19
	2) Patterned cloths, fine counts light	300	19
	3) Plain 'grey' cloth	200	19
e) Cloth inspection	700 ¹⁾	—	
lv)	Textile mills (silk or synthetics):		
	a) Soaking, fugitive tinting, conditioning or setting of twist	200	25
	b) Spinning	450	25

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
	c) Winding, twisting, rewinding and coning, quality slashing:		
	1) Light thread	200	25
	2) Dark thread	300	25
	d) Warping	300	25
	e) Healding (drawing-in)	700	—
	f) Weaving	700	19
	g) Inspection	1 000 ³⁾	19
lvi)	Textile mills (woollen):		
	a) Scouring, carbonizing, teasing, preparing, raising, brushing, pressing, back-washing, gilling, crabbing and blowing	150	25
	b) Blending, carding, combing (white), tentering, drying, cropping	200	25
	c) Spinning, roving, winding, warping, combing (coloured), twisting	450	25
	d) Healding (drawing-in)	700	—
	e) Weaving:		
	1) Fine worsteds	700	19
	2) Medium worsteds, fine woollens	450	19
	3) Heavy woollens	300	19
	f) Burling and mending	700	19
	g) Perching:		
	1) Grey	700	—
	2) Final	2 000 ³⁾	—
lvii)	Textile mills (jute):		
	a) Weaving, spinning, flat, jacquard carpet looms, cop winding	200	25
	b) Yarn calender	150	25
lviii)	Tobacco factories: All processes	300 ³⁾	22
lix)	Upholstering, furniture and vehicles	300	22
Ix)	Warehouses and bulk stores:		
	a) Large material, loading bays	100	28
	b) Small material, racks	150	25
	c) Packing and despatch	150	25
lxi)	Welding and soldering:		
	a) Gas and arc welding, rough spot welding	150	28
	b) Medium soldering, brazing and spot welding, for example, domestic hardware	300	25
	c) Fine soldering and spot welding, for example, instruments, radio set assembly	700	22
	d) Very fine soldering and spot welding, for example, radio valves	150	19
xii)	Woodworking shops:		
	a) Rough sawing and bench work	150	22

SI No. (1)	Industrial Buildings and Processes (2)	Average Illumination, lux (3)	Limiting Glare Index (4)
	b) Sizing, planning, rough sanding, medium machine, and bench work, gluing, veneering, cooperage	200	22
	c) Fine bench and machine work, fine sanding and finishing	300	22

1) Optical aids should be used where necessary.

2) Supplementary local lighting may be required for gauge glasses and instrument panels.

3) Special attention should be paid to the colour quality of the light.

4) Supplementary local lighting should be used at important points.

5) Supplementary local lighting and optical aids should be used where necessary.

ANNEX F (Clause 10)

POWER FACTOR IN INDUSTRIAL INSTALLATIONS

F-1 The general guidelines for power factor compensation is given in the code. For guidance, the natural power factor for some three phase electrical installations are given in Table 4. The recommended capacitor ratings at rated voltage, for direct connection to ac induction motor in industries are given in Table 5.

Table 4 Power Factor for Three Phase Electrical Installations (Clause F-1)

SI No. (1)	Type of Installation (2)	Natural Power Factor (3)	SI No. (1)	Type of Installation (2)	Natural Power Factor (3)
i)	Cold storage and fisheries	0.76-0.80	xviii)	Flour Mills	0.61
ii)	Cinemas	0.78-0.80	xix)	Gas works	0.87
iii)	Metal pressing	0.57-0.72	xx)	Textile mills	0.86
iv)	Confectionery	0.77	xxi)	Oil mills	0.51-0.59
v)	Dyeing and printing (textile)	0.60-0.87	xxii)	Woolen mills	0.70
vi)	Plastic moulding	0.57-0.73	xxiii)	Potteries	0.61
vii)	Film studios	0.65 to 0.74	xxiv)	Cigarette manufacturing	0.80
viii)	Newspapers	0.58	xxv)	Cotton press	0.63-0.68
ix)	Heavy engineering works	0.48-0.75	xxvi)	Foundries	0.59
x)	Rubber extrusion and moulding	0.48	xxvii)	Tiles and Mosaic	0.61
xi)	Pharmaceuticals	0.75-0.86	xxviii)	Structural engineering	0.53-0.68
xii)	Oil and paint manufacturing	0.51-0.69	xxix)	Chemicals	0.72-0.87
xiii)	Silk Mills	0.58-0.68	xxx)	Municipal pumping stations	0.65-0.75
xiv)	Biscuit Factory	0.60	xxxi)	Oil terminals	0.64-0.83
xv)	Printing Press	0.65-0.75	xxxii)	Telephone Exchange	0.66-0.80
xvi)	Food Products	0.63	xxxiii)	Rolling Mills	0.72-0.60
xvii)	Laundries	0.92	xxxiv)	Irrigation pumps	0.52-0.70

Table 5 Capacitor Ratings at Rated Voltage (Clause F-1)

Rated Output of Motors kW (1)	Capacitor Rating in kvar for Motor Speed					
	3 000 rev/min (2)	1 500 rev/min (3)	1 000 rev/min (4)	750 rev/min (5)	600 rev/min (6)	500 rev/min (7)
2.25	1	1	1.5	2	2.5	2.5
3.7	2	2	2.5	3.5	4	4
5.7	2.5	3	3.5	4.5	5	5.5
7.5	3	4	4.5	5.5	6	6.5
11.2	4	5	6	7.5	8.5	9
15	5	6	7	9	11	12
18.7	6	7	9	10.5	13	14.5
22.5	7	8	10	12	15	17
37	11	12.5	16	18	23	25
57	16	17	21	23	29	32
75	21	23	26	28	35	40
102	31	33	36	38	48	55
150	40	42	45	47	60	67
187	46	50	53	55	68	76

NOTES:

- 1 The reference to speed of motor has been made since the manufacturers provide information on that basis.
- 2 The capacitive current supplied by condensers directly across induction motor terminals should not exceed the magnetizing current of the induction motors, to guard against excess transient torques and overvoltages.
- 3 Should a consumer desire to improve the power factor beyond a value which is limited by considerations of magnetizing kVAR of the motor as stated in Note 2, then he may install the calculated capacitor kVAR as a separate circuit with its independent controlgear.

Courtesy: National Electrical Code 2011

ROBOTS CLEAN SOLAR PANEL

Israel is a hotbed of technology and research, being an oasis of sorts in the desert, too. Still, water is a precious commodity, and all effort must be made to conserve as much water as possible. Ketura Sun, a large commercial solar field in Israel, has a special method of cleaning its solar panels using robots. What makes these robots special would be the fact that they do not need to make use of any water at all throughout the cleaning process, ensuring that they thrive in their jobs while being in the Negev desert.

This is a big deal, since such robots would prove to be a successful, working model of helping solar power plants being less dependent on water. The **Ecoppia E4** robots happen to be mounted on a frame which moves laterally along the panels, while robots would themselves move up and down the panels. A rotating brush that is comprised of soft microfiber as well as air blowers will do the job of removing dust build-up with an efficiency level of 99% – all without using a single drop of water, now how about that? Ensuring a solar panel remains as clean as possible is important to help maintain the efficiency level of the solar panel's output.



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THE 3% SOLUTION COULD SAVE US BUSINESSES \$780 BILLION WITHIN 10 YEARS

A joint report published by the World Wildlife Fund (WWF) and the Carbon Disclosure Project (CDP) outlines an analysis that could save companies billions as well as help the corporate sector contribute to the goal of avoiding pushing global temperatures over 2°C above pre-industrial levels.



The 3% Solution: Driving Profits Through Carbon Reduction, released Tuesday, provides an analysis demonstrating that US businesses can act now to reduce emissions by an average of 3% annually, which would amount to savings of \$780 billion over the next 10 years and reducing the greenhouse gas emissions in 2020 by 1.2 gigatonnes of CO₂ from 2010 levels. That would put the US corporate sector on track to a 25% reduction against 1990 levels, but is only representative of the lower end of what the Intergovernmental Panel on Climate Change (IPCC) says is necessary to avoid a global temperature increase of 2°C by 2020.

According to the report, 4 out of 5 companies from the S&P 500 (Standard & Poor's 500) who report their emissions to the Carbon Disclosure Project could see huge financial returns on their carbon reduction investments over their overall capital investments, which makes "reallocation of their capital expenditures a sound business decision" according to the press release published by the WWF and CDP.

The report concludes that the US corporate sector would on average have to invest 3 to 4% of their capital expenditures each year on "low-risk, profitable carbon reduction projects."

Naturally, to promote the idea of a 3% reduction, the report comes with an online Carbon Target and Profit Calculator which can provide companies with a guide to setting their emission reduction goals. The calculator — available at the3percentsolution.org — provides companies with the opportunity to visualise the savings they can make by setting "ambitious 2020 carbon reduction targets" — and hopefully understand the import such decisions have on the environment at large.

"World governments have moved far too slow to address the climate change threat and people are looking for leadership from the brands they trust to take concrete actions now," said Carter Roberts, President and CEO of WWF. "These numbers provide a glimpse into the future — where smart companies slashed emissions, increased profits and helped secure a better future for all of us."

"The report points to specific financial opportunities that US corporations can seize," Paul Simpson, CEO of CDP added. "But it is critical that senior management devote much more attention to the issue to drive the necessary near-term increase in capital expenditure required for companies to capture the full economic benefit of greenhouse gas emissions reductions".

"Corporations must act now not only to address environmental risk, but also to aid economic recovery in the United States and build resilience. Investing in energy efficiency and renewable energy saves cost, stimulates innovation, creates jobs and builds energy independence and security."

WWF and CDP are now recommending that companies interested in capturing these savings do the following:

1. Run the calculator and set or revise a carbon reduction target to claim the company's share of the savings
2. Reallocate capital to deliver better returns at lower risk
3. Translate the savings to the company's bottom line

Several big-name companies have already commented on The 3% Solution;

“This report shows that not taking action to reduce emissions and fight climate change is like leaving big money on the table,” said Chris Librie, Senior Director, Sustainability Programs, HP Sustainability & Social Innovation. “HP is already taking actions in line with those recommended by *The 3% Solution*. During 2012, we completed a comprehensive carbon footprint analysis to better understand the impact of our company and our products. HP is among the first companies globally to publish this level of information. We work to reduce the impact of our products and operations. In addition, we collaborate with suppliers to improve their environmental performance – resulting in a 24% decrease in production supplier GHG emissions intensity over four years. HP calls on other American businesses to heed the call made in *The 3% Solution* and capture their share of these savings – all while doing some good for the planet.”

“This study shows that there are tremendous opportunities for companies to make operational changes that benefit both the environment and their economic bottom-lines,” said Jeff Seabright, Vice President, Environment & Water, The Coca-Cola Company. “There is a pressing need for business, government and civil society to work together to pursue these ‘no regret’ opportunities if we are to stabilize emissions in this decade.”

“Sprint is the first and, to date, only U.S. telecom company to publicly announce an absolute greenhouse gas (GHG) emission reduction goal (an absolute 20% reduction of scope 1 and scope 2 by emissions by 2017 below 2007 levels),” said Bill White, Senior Vice President of Corporate Responsibility, Sprint. “We continue to look for opportunities to drive energy and emission efficiencies and *The 3% Solution* presents business leaders with strong evidence that can significantly reduce costs and their environmental impact.”

The sad reality is that many companies will only make environmentally-conscious decisions if it affects their bottom line. Yes, there are some companies out there who understand not only the environmental benefit of taking action, but also the good PR and moral leadership that comes with such a decision. But, on the whole, if an environmentally-friendly decision doesn't have financial benefits as well, many companies won't bother. Subsequently, reports and tools which so clearly demonstrate the financial benefits of environmentally-friendly action are all the more appreciated in this day and age.

Read more at

<http://cleantechnica.com/2013/06/20/the-3-solution-could-save-companies-and-environment/#QLo4meBc1VY8JjvU.99>



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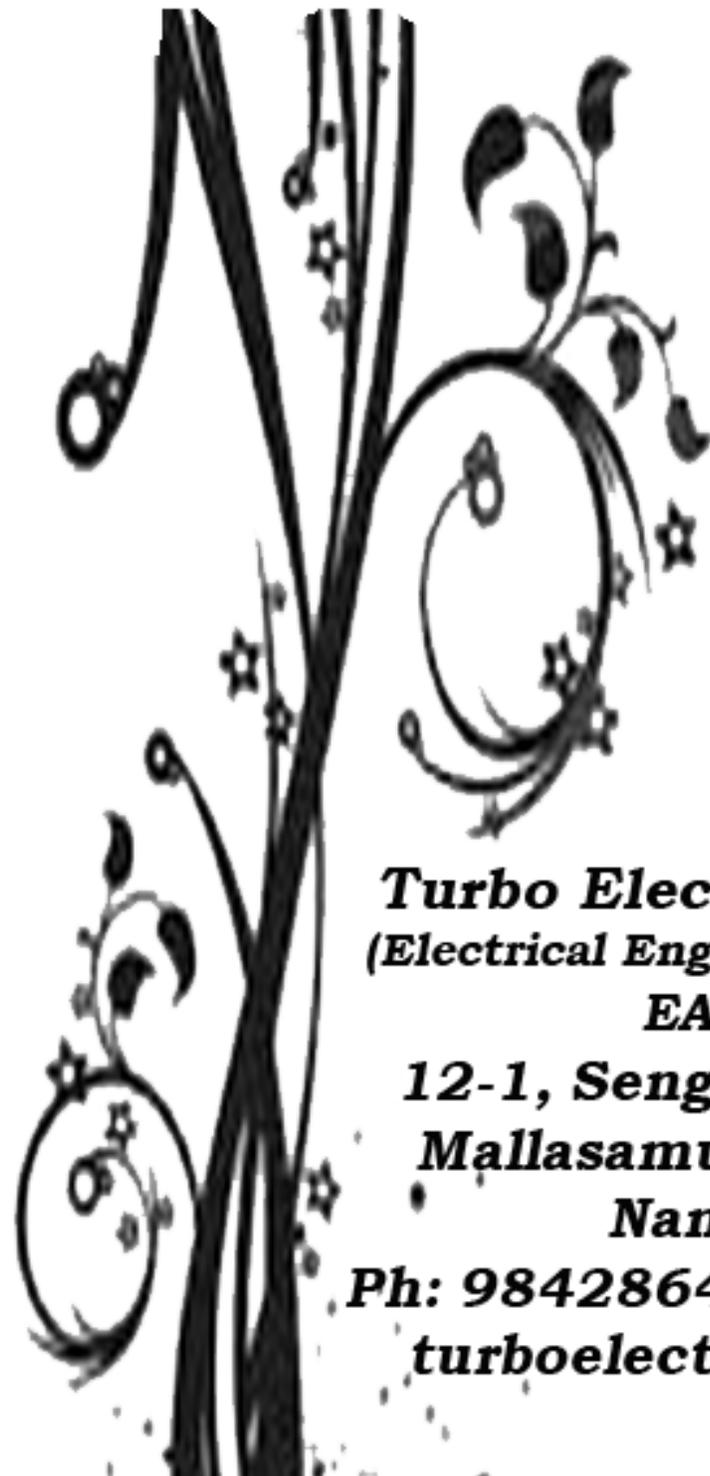
OTHER PUBLICATIONS

1	National Electric Code 2011 (NEC 2011)	4,070
2	National Lighting Code 2010 (NLC 2010)	3,370

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5 CRUCIAL SOLAR MANUFACTURING STATS FOR 2014

Most solar manufacturing statistics released over the last few years focused on the severity of oversupply and its painful ramifications: how much excess capacity existed, how steeply prices had fallen, how many firms had been forced out of the market, and how many millions of dollars in losses suppliers had racked up.

The last six months, however, have witnessed a strong turnaround in market conditions and significant improvement in solar supply fundamentals. Thanks to burgeoning demand (primarily out of China, Japan and the U.S.) and the retreat, however temporary, of uncompetitive suppliers, pricing has been stable-to-up, profit margins are back in the black, and shipments to all markets outside of Europe have been on the rise.



With 2014 expected to witness a continuation of the supply sector's resurgence, now is a good time for industry participants and observers to move past the overcapacity-induced doldrums of the previous few years and turn their attention to the path ahead. Here are five figures that illustrate the state of solar manufacturing in 2014.

Number of Gigawatt Facilities: 90

Across the key segments of the solar value chain — polysilicon, wafers, cells, modules and inverters — GTM Research estimates show that 90 solar manufacturing facilities now have an annual production capacity of 1 gigawatt or greater, more than double the count for 2010. Of these 90 “gigafabs,” 36 are inverter assembly plants, nineteen are polysilicon plants, and nineteen are module production facilities (including both standalone module assembly plants and integrated wafer-cell-module fabs). The increasing number of such large plants (owned mostly by established producers such as REC, GCL, Motech and Solar Frontier) and their constantly growing scale means that the barrier to entry for new entrants or potentially disruptive technologies is more daunting than ever before.

Module Manufacturing Cost: \$0.48 per watt

For the first time in history, a module company achieved a manufacturing cost of less than 50 cents a watt. That firm would be China-based JinkoSolar, which achieved the feat in the dying light of 2013, using good old-fashioned multicrystalline silicon technology. That Jinko managed to do so ahead of other Chinese peers such as Trina and Yingli was largely due to high exposure to the polysilicon spot market, as well as a high degree of upstream integration: not only does Jinko own the production process from ingot to module, it also manufactures consumables such as junction boxes and frames. While Jinko stood alone in attaining sub- $\$0.50$ per watt-cost in 2013, we expect other Chinese firms to catch up this year, and First Solar's Malaysian plant is also making great strides toward this mark.

Polysilicon Manufacturing Cost: \$12 per kilogram

Factors such as a low-cost production location (even for China), the latest in Siemens-based technology, and generous government assistance have given a significant advantage to Daqo New Energy's brand-spanking-new polysilicon plant in the Xinjiang autonomous province. At its current capacity of roughly 6,000 metric tons (MT), manufacturing costs are around $\$14$ per kilogram, which the company aims to reduce to $\$12$ per kilogram after another 6,000 MT comes on-line in 2014. With other new plants from firms such as Wacker, Hemlock and Tokuyama also scheduled to begin operation in 2014-2015 (also employing more modern, lower-cost technology), a pricing environment of less than $\$20/\text{kg}$ — until recently associated with a grossly oversupplied market — can be a sustainable reality.

Polysilicon Pricing Increase: 25 Percent

While the cost curve for polysilicon, especially pertaining to new technologies, will only head further south, don't expect this to be reflected in 2014 pricing trends. Spot prices for solar-grade silicon have rebounded strongly

since bottoming out at less than \$16 per kilogram in early 2013, and are now above \$20 per kilogram for the first time in more than a year and a half. With demand expected to grow strongly in 2014 and only a limited amount of low-cost supply available, we believe this trend will continue over the course of the year. Fortunately for module suppliers and their customers, this shouldn't make too large a dent in their bottom lines — even if, as GTM Research expects, average pricing for polysilicon increases by 25 percent in 2014, improvements in processing costs and silicon consumption mean that module costs would only rise by a few percentage points.

Thin Film Market Share: 10 Percent

Thin film's relevance to the solar market at large has been on the wane since 2009, when it reached a high of 19 percent of total module production. The reasons for this are simple: barring some notable exceptions, thin film is more expensive, less efficient, and less bankable than Chinese crystalline silicon technology, which dominates the marketplace today. While thin film production levels have increased steadily over the years, they have been easily outpaced by growth in c-Si output, and despite what is expected to be a strong year for industry leaders First Solar and Solar Frontier, GTM Research estimates indicate that thin film will only make up 10 percent of total module production in 2014, its lowest share of the market since in 2006. It's still too early to dismiss thin film as being destined for niche status, but it doesn't bode well for the technology that its largest and most successful proponent, First Solar, has had to resort to becoming its own customer in order to eke out a living.

By Shyam Mehta

Courtesy: Greentech Solar

Shyam Mehta is Lead Upstream Analyst at GTM Research, where he covers the PV manufacturing sector.

TIDAL LAGOON POWER 'CHEAPER THAN WIND'

Three tidal lagoons could be in operation around Britain by 2021 says Tidal Lagoon Power.

Three tidal lagoons could be in operation around Britain by 2021 producing large-scale low carbon power at a cheaper price than offshore wind, according to their developer, Tidal Lagoon Power.

The company said a report commissioned from management consultant, Pöyry confirmed the lagoons, starting with one at Swansea Bay in south Wales, could produce power for about £100 per megawatt hour (MWh).

"This study clearly demonstrates that tidal lagoons can rapidly become one of the cheapest sources of electricity in the UK. The more water we impound, the more power we produce, the less support we require," said Mark Shorrocks, chief executive of Tidal Lagoon Power.

The £100 per MWh cost compares with recent government calculations for a deep sea offshore wind farm in 2021 of about £131 per MWh. The cheapest of the projects assessed, Lagoon 3, has a cost of about £90 per MWh, broadly similar to onshore wind, large-scale solar and even gas-fired plants, Shorrocks said.

This month, plans for the world's first tidal lagoon power plant in **Swansea Bay** were accepted for consideration by the government's Planning Inspectorate. Tidal Lagoon Power is hoping construction can start in spring 2015 with the first power generated in 2018.

Environmentalists, who have scuppered other tidal projects such as the Severn Barrage in the past, remain cautious about the impact of the scheme on wildlife and a former business partner, Tidal Electric, claims to be in dispute with the Swansea Bay developers over the design of the scheme.



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LEDs CAN TRIPLE THE EFFICIENCY OF GREENHOUSE LIGHTING

Solid-state lighting could improve the world food supply.

LED greenhouse lighting is poised on the hockey stick of the adoption curve, saving electricity while potentially improving the world food supply.

The past year has seen production-scale deployment emerge out of years of trial grower installations, at users such as Rainbow Greenhouses in British Columbia, Clean Fresh Food in Wisconsin, Butter Valley Harvest in Pennsylvania, and many others.

The scale of modern greenhouse operations is visible in places such as Almeria, Spain, where greenhouses are actually changing the regional climate. In attempting to reproduce the energy flux of the sun over many acres, inefficient legacy lighting ends up drawing a staggering amount of electricity — well into the megawatt range. There are growers that have to notify the local power company of their operating schedule. Lumigrow has a Canadian customer which operates its lights sixteen hours a day, seven months a year, and has a winter electricity bill that is ten times higher than it is in summer.

Growers also encounter local power caps. A commercial greenhouse complex in Indiana lost

an entire summer's worth of plants when its electricity was curtailed during a heat wave. To this should be added the approximately 1.3 quads (quadrillion BTUs) of energy spent **hauling food**, an amount nearly equal to the energy in the food itself. Roses and salad delicacies are hauled many thousands of miles to northern Europe, Canada, and Alaska, with the roses often transported by air.

LEDs have a unique efficacy advantage in horticulture. Plants appear green because they absorb red and blue, the bandgap energy of the two primary photosynthetic reactions. With LED lighting, the color of the light can be tuned to "horticultural red" (660 nanometers) — deeper than the standard traffic light or brake light.

So why on earth has everyone been feeding plants orange high pressure sodium (HPS) light, the dominant horticultural lighting technology? The answer is that from a total output, lifespan and cost point of view, HPS used to be just the best of a bad lot.

Spherical emitters such as HPS lose up to 40 percent of their photons getting the light stream turned around in a downlight application. As with street lighting, LEDs have the advantage of being a natural downlight emitter.

PAR is for plants, lumens are for humans

An LED luminaire, for example, could put out red and blue photosynthetically available radiation (PAR) slightly greater than a standard 1,000-watt HPS luminaire, while consuming only 325 watts. The PAR unit of measurement



is standard in horticultural lighting, since it is weighted for plant photosynthetic response. The lumen unit is useless in this context, as it is based solely on human visual response.

Obvious greenhouse lighting candidates are facilities located in cloudy northern areas with long winter nights. But any locale can employ year-round supplementation for especially light-hungry crops such as corn and tomato. There are a surprising number of tropical uses, including stretching the never-long tropical summer daylight, and the raising of crops that are intolerant of humid heat. All lettuce consumed in the tropics must either be grown in greenhouses or shipped in from a higher latitude.

LED horticultural lighting may yield one of the more financially viable greentech investment niches. Sector sales are growing rapidly, with market saturation still only in low-single-digit percents. While the total available market is respectable at \$4.8 billion for North America, the far larger streetlight and residential lighting markets have distracted the attention of worldwide lighting majors and Asian exporters (with one or two significant exceptions). Challenges include the technology's higher initial cost and the tendency of farmers to deliberate carefully before gambling an entire crop cycle on something new. Economics at present are channeling LED applications towards boutique areas such as flowers, seed stock growing, and salad herbs and delicacies. However, costs are falling. Payoff time is now often less than three years, and the latitude line for the viability of greenhouse lighting has dropped from Indiana southwards to Santa Barbara.

Beyond the energy savings, LED greenhouse lighting offers hope for continued technical progress in world food production. Observers such as Lester Brown and the Worldwatch Institute have noted that the years after the new millennium saw a reversal of some of the progress of the 1990s in eliminating world hunger. Drought in California is currently driving up food prices regionally; reportedly, the state government is considering diverting research funds to investigate greenhouse growing for saving water. The potential of LED lighting in the greenhouse is a bright spot for a hungry world.

By Doug Widney

Doug Widney is Manager of Engineering for LumiGrow, based in Novato, Calif. He has previously been a consultant in solar, batteries, and LEDs. LumiGrow, which recently achieved profitability, is funded by Clean Pacific Ventures.

"Best Wishes" - 100th issue NEWSLETTER"



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FIRST STEPS TOWARDS ACHIEVING BETTER AND CHEAPER BIODIESEL

The UPV/EHU-University of the Basque Country is studying some methods for producing, more easily and more economically, the supplements that biodiesel needs to enable it to function properly in our vehicles.

Is there any connection between wine and biodiesel? The answer is yes, however surprising it may seem. Acetals are chemical compounds found in many wines, like port, for example, which give it a unique, sweet smell. However if acetals are blended with biodiesel, they improve its properties.

The SUPREN research group of the Department of Chemical Engineering and the Environment of the Faculty of Engineering in Bilbao (UPV/EHU) is working on a project that is seeking to encourage the use of this rare fuel. The idea is to produce acetals more easily and more cheaply. The starting point is the alcohol obtained from sugar-rich plants, or glycerol, a bi-product of biodiesel which is also a kind of alcohol. The aim is to come up with an industrial process to obtain the supplements that will improve the biodiesel we will eventually be putting into our vehicles.



If we compare petroleum-based diesel fuel with that based on plants, biodiesel has better properties in terms of oily texture and biodegradation; yet it is worse from the point of view of oxidation, energy potential and contamination. SUPREN, the Sustainable Process Engineering Group of the Department of Chemical Engineering and the Environment of the Faculty of Engineering in Bilbao (UPV/EHU), is studying the supplements that could overcome these drawbacks. They have delved into acetal production in particular.

From the point of view of chemistry, acetals are obtained through the reaction of an alcohol and an aldehyde. They are generated naturally in fermentation processes. For example, in many wines like port, acetals are the indicators of quality because of the tremendously special, sweet smell they give the wine. When the liquid is poured from glasses into the fuel tank, the acetals improve the properties of the biodiesel when they mix with it: combustion is more effective and, what is more, it is less polluting because engine performance is increased. It is vitally important to come up with a method to obtain acetals easily and cheaply, as a litre of biodiesel may have an acetal content of about 15%.

From the lab to industry

It is easy to produce acetals in a laboratory, but designing an industrial-scale process is quite another matter, according to the UPV/EHU researcher Ion Agirre. He is trying to make this process possible with the help of his colleagues in the SUPREN group. He has experimented with the alcohol that is the by-product of sugar-rich plants (sugar cane, beetroot, etc.) and also with glycerol, both of which are alcohols of renewable origin. Glycerol is also an alcohol and is a by-product obtained from the reaction to produce the biodiesel. It is used, above all, in cosmetic creams and other products, but it is difficult to channel all the glycerol generated in biodiesel production to this use. That is why it would be advantageous to validate this compound in acetal production.

One of the conclusions of the research has been that glycerol-based acetals transmit better properties to the biodiesel in comparison with the alcohols from sugar-rich plants like, for example, ethanol or butanol. Research has also been done to see what would be the most suitable process for producing acetals from the point of view of output. And the conversion level of the reaction would in fact range between 50% and 60%, in other words, only that quantity of alcohol would be turned into acetal. To make the process industrially valid, the aim would be to reach 100% output or conversion, and the latest experiments have shown that this is possible. Using a resin as a solid catalyst instead of sulphuric acid, and glycerol and butyraldehyde or acetaldehyde as the starting point, they have obtained outputs of 100%.

They have used laboratory techniques to achieve these results, techniques that have been little developed industrially; but the production of acetals from glycerol using conventional techniques would appear to be feasible. This research has made it possible to gain in-depth knowledge about the reactions for obtaining acetals, thus making it possible to design an industrial process and making an advance calculation of the details of the costs which acetal production would involve.

Source: AAAS EurekaAlert

BMW LASERLIGHTS TO HIT STREETS IN AUTUMN 2014

BMW will become the first automotive company to supply Laserlights in headlights.

BMW Laserlights claim to deliver a luminous intensity 10 times greater than that of traditional light sources, such as halogen, xenon or LED. The high beam range of up to 600 metres is double that of conventional headlights.

The space-saving light, requires a small reflector which translates to weight-saving potential, is capable of a 30 per cent reduction in energy consumption. The light-emitting surface area of a laser diode is one hundred times smaller than that of a conventional LED, which measures one square millimetre.

Consequently, a far smaller reflector is needed for laser light. In the case of the BMW i8, a diameter of less than 30 millimetres is sufficient, saving valuable installation space in the vehicle and opening up the potential for significant weight savings, too. By way of comparison: xenon light requires a reflector/lens diameter of around 70 millimetres and halogen light 120 millimetres in order to achieve an adequate light output and range for the respective lighting technology. Another highly beneficial characteristic is the laser light's excellent efficiency, with a reduction in energy consumption of some 30 per cent. Laser light therefore helps to improve the vehicle's overall efficiency as well as lowering CO₂ emissions. Moreover, the compact construction also opens up new scope in terms of design, while the flat form lends itself to optimum vehicle aerodynamics.

The BMW i8 headlight was co-developed by Osram.



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MODEST SOLAR GROWTH FORECAST FOR ASIA-PACIFIC REGION BY 2015

Research and consulting firm GlobalData has published a new report that suggests PV module growth in the Asia-Pacific (APAC) region is likely to enjoy a modest performance over the coming year.

The report estimates a Compound Annual Growth Rate (CAGR) of 7.9%, rising in revenue from \$6.7 billion in 2012 to \$8.6 billion by 2015.

However, APAC's solar installation growth will increase at a far greater rate, finds GlobalData's report, which anticipates a CAGR increase of 18.6% per year, rising from 19.6 GW cumulative installed capacity in 2012 to 420.6 GW by 2030. Last year, the twin market leaders of Japan and China accounted for 77% of all installations in APAC's solar PV industry – a share that will fall slightly but still be dominant in the coming years.

“Governments in the region are promoting solar PV through long-term policies, financial incentives, subsidies and tax benefits,” said **GlobalData's senior analyst covering Alternative Energy**, Prasad Tanikella. “The strong commitment from APAC's countries towards the development of solar energy has led to many research and development initiatives and increased solar power plant installations, which will drive future market growth.”

The APAC region already boasts three of the world's leading manufacturing nations for solar energy systems – China, Japan and Taiwan, with Tanikella confident that continued favorable conditions in the region will contribute to a thriving manufacturing industry for years to come.

“Domestically available polysilicon, a favorable regulatory environment and an easily available and inexpensive labor force has allowed APAC companies, such as **Yingli Green Energy**, Canadian Solar Inc., **Trina Solar**, LDK Solar and Suntech Power Holdings Co., to lead solar module production with annual capacities of over 1,000 MW each,” concluded the analyst.

Read more: <http://www.pv-magazine.com>

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ENERGY STORY

ENERGY EFFICIENCY – THE FIFTH FUEL - PART 15

In this concluding part, one more News extract is published which contains expressions from **Dr. PACHURI**, The Director – General of TERI. Dr Pachauri is also Chairman of the Intergovernmental Panel on Climate Change (IPCC), the world’s leading intergovernmental organization for the assessment of climate change.

Energy efficiency amounts to a vast, underutilized energy source.

Efficient measures can reduce energy consumption by 20-30% in MSME sector: TERI

The Energy and Resources Institute (TERI) has come up with an advisory which said that energy efficient measures can reduce energy consumption by 20-30 per cent in MSME sector.

“Within the industrial sector, the Micro, Small and Medium Enterprise (MSME) segment is associated with low efficiencies due to several barriers such as use of obsolete technologies, non-availability of readymade technological solutions, low level of awareness/information availability, non-availability of technology providers at local/cluster level, relatively high cost of technologies and poor access to finance,” TERI said in a press release.

“It is estimated that there is a possibility to reduce energy consumption by up to 25-30 per cent by introducing energy efficiency measures in these sectors,” it added.

The advisory released on May-13, while setting an agenda for the new government addresses not only the way forward but also deals with the critical aspect of the cost of developmental inaction.

It has addressed key aspects pertaining to water, air pollution, waste, green infrastructure, transport, energy security, renewables and solar energy that need to be addressed by the new government.

TERI has proposed a few quick solutions which are basic and easily implementable. The measures will not only bring down the costs of inaction, but improve the lives of millions in a sustainable manner, it said.

Commenting on the advisory, Director-General, TERI, R K Pachauri said, “Environmental issues are often presented within the framework of conflict between environment and development. What is attempted here is a refreshing departure which provides a price tag on the damage that poor environmental quality and degradation is imposing on human society and how substantially lower-cost action can avoid this burden.

“What is included here are sectors largely within urban areas, but a similar analysis and presentation is essential for rural environmental degradation as well. Undoubtedly, that would be a far more complex challenge analytically, but given the large population in our villages, ignoring such analysis would be at the cost of ignoring the welfare of two-thirds of our population,” said Pachauri, who is also the chairperson of Intergovernmental Panel on Climate Change (IPCC).

“To achieve tangible results in the first 100 days, the new Government will have to perform beyond expectations in the field of sustainable development, which broadly covers fundamental issues such as water, energy and food security,” the TERI press release said.

The new Government should focus on specific policies and institutional frameworks which will help achieve quick results and reverse the current trend, it said.



Significantly, the document has revealed some startling facts on how costs mount: Poor sanitation has cost the country Rs 5,400 crore; Of the 133,760 tonnes of waste generated per day only 25,884 tonnes is treated per day, while the rest is disposed on land.

Further, outdoor pollution has caused damage amounting to Rs one lakh crore annually. On the other hand, the cost in terms of disability adjusted life years (DALY) for diarrhoea among children due to poor sanitation is estimated at Rs 500 crore.

In addition, the number of mortalities due to ambient air pollution is 6,20,000; and 1,27,000 lives can be saved through the introduction of BS-VI fuel quality and vehicular norms by 2030, TERI said.

“We need leapfrog measures now, that also cover the un-served population of our country,” said Pachauri.

In the report, TERI recommends development of ‘Water and Sanitation Safety Plans’ for Jal Boards, Urban Local Bodies and rural piped water supply and sanitation services could be made mandatory in order to maintain high standards in the sector. A high-level committee may be formed having representations from all the relevant Ministries, Boards, Water and Sanitation organizations and important stakeholders in order to ensure effective and efficient implementation of the water and sanitation safety plans, it said.

With regard to air pollution, TERI recommends improvement in fuel quality and advancement of vehicular emissions norms is the key to reduce vehicular emissions. The emission reduction that can be accrued through the introduction of BS-VI fuel quality and vehicular norms can result in the reduction of 127,000 mortalities by 2030, and economic benefits ranging between Rs 3.9–6.7 lakh crore cumulatively till the year 2030. Benefits of implementation of these norms will soon outweigh the costs incurred on initial capital investments, it said.

As far as waste management is concerned, “The way to address waste mismanagement would be to build waste reduction strategies in overall waste management programmes, increase waste processing, maximize resource recovery, recycling and ensure that land requirement for ultimate disposal is minimized by adopting resource efficient processes,” it said.

For sustainable transport and infrastructure, TERI recommends that cities above the 0.5-million population mark be provided with adequate and quality bus transport. Million-plus cities should also have an action plan to implement transport demand management tools to encourage use of sustainable transport.

It has proposed higher taxes on non-compliant and inefficient appliances/buildings and developing transparent institutional mechanisms at the state and municipal levels, to facilitate implementation of resource efficiency through Green Rating for Integrated Habitat Assessment (GRIHA).

Among other recommendations are setting up of a cabinet of secretaries (CoS) to define policy and address issues in an integrated manner for energy security, launching of a wind mission and making renewable power the focus of the new power policy.

The report highlights the need to make manufacturing in the solar sector competitive in the global market and to consider special incentives.

TERI has called for the new Union government to focus on bio-energy development and launch of an ‘Indian Bio-Mission’. According to Pachauri, a similar analysis and presentation is essential for rural environmental degradation as well.

About TERI

TERI was formally established in 1974, originally named Tata Energy Research Institute and later name changed as The Energy Research Institute, with the purpose of tackling and dealing with the immense and acute problems that mankind is likely to face within in the years ahead

- on account of the gradual depletion of the earth’s finite energy resources which are largely non-renewable and
- on account of the existing methods of their use which are polluting

The Institute’s growth has been evolutionary, driven by a vision of the future and rooted in challenges looming today, based on an approach that looks beyond the present and across the globe. TERI has, therefore, grown to establish a presence not only in different corners and regions of India but is perhaps the only developing country institution to have established a presence in North America and Europe and on the Asian continent in Japan, Malaysia and the Gulf.

(To be continued)

*S. Mahadevan, B.E., F.I.E., M.B.A., Consultant,
Energy and Energy Efficiency, Mobile: 98401 55209*

“People shouldn’t be afraid of their government. Governments should be afraid of their people.” – ALAN MOORE, V for Vendetta

FLEXIBLE BATTERY, NO LITHIUM REQUIRED

Rice chemist James Tour and his colleagues have developed a flexible material with nanoporous nickel-fluoride electrodes layered around a solid electrolyte to deliver battery-like supercapacitor performance that combines the best qualities of a high-energy battery and a high-powered supercapacitor without the lithium found in commercial batteries today.

The new work by the Rice lab of chemist James Tour is detailed in the *Journal of the American Chemical Society*.

Their electrochemical capacitor is about a hundredth of an inch thick but can be scaled up for devices either by increasing the size or adding layers, said Rice postdoctoral researcher Yang Yang, co-lead author of the paper with graduate student Gedeng Ruan. They expect that standard manufacturing techniques may allow the battery to be even thinner.

In tests, the students found their square-inch device held 76 percent of its capacity over 10,000 charge-discharge cycles and 1,000 bending cycles.

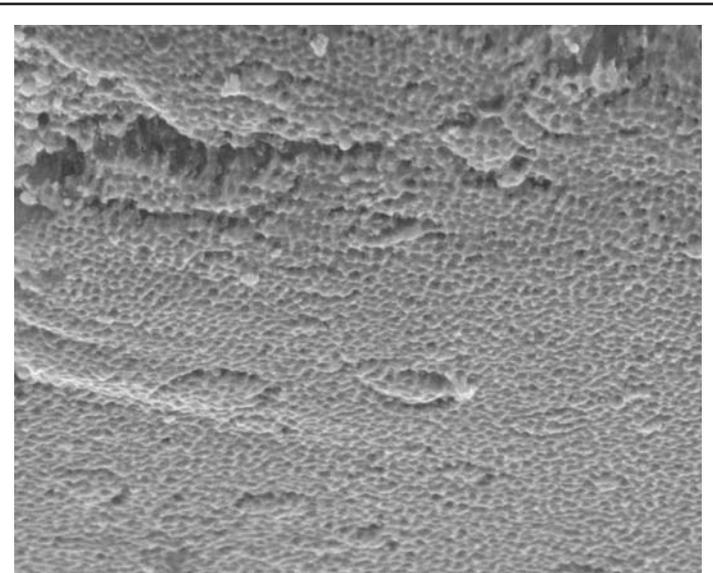
Tour said the team set out to find a material that has the flexible qualities of graphene, carbon nanotubes and conducting polymers while possessing much higher electrical storage capacity typically found in inorganic metal compounds. Inorganic compounds have, until recently, lacked flexibility, he said.

“This is not easy to do, because materials with such high capacity are usually brittle,” he said. “And we’ve had really good, flexible carbon storage systems in the past, but carbon as a material has never hit the theoretical value that can be found in inorganic systems, and nickel fluoride in particular.”

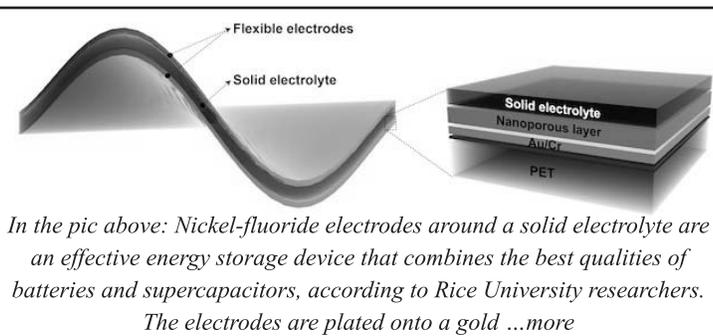
“Compared with a lithium-ion device, the structure is quite simple and safe,” Yang said. “It behaves like a battery but the structure is that of a supercapacitor. If we use it as a supercapacitor, we can charge quickly at a high current rate and discharge it in a very short time. But for other applications, we find we can set it up to charge more slowly and to discharge slowly like a battery.”

To create the battery/supercapacitor, the team deposited a nickel layer on a backing. They etched it to create 5-nanometer pores within the 900-nanometer-thick nickel fluoride layer, giving it high surface area for storage. Once they removed the backing, they sandwiched the electrodes around an electrolyte of potassium hydroxide in polyvinyl alcohol. Testing found no degradation of the pore structure even after 10,000 charge/recharge cycles. The researchers also found no significant degradation to the electrode-electrolyte interface.

Read more at: <http://phys.org/news/2014-04-flexible-battery-lithium-required.html#jCp>



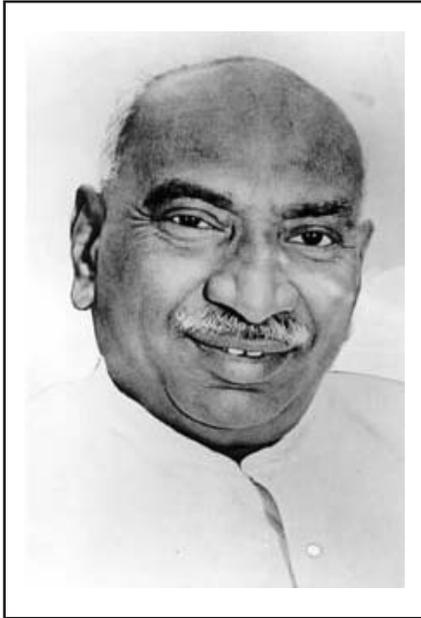
*In the pic above :A porous nickel-fluoride film less than a micron thick, seen here in an electron microscope image, is an effective electrode in a new type of battery created at Rice University.
The flexible film combines the best qualities of supercapacitors*



*In the pic above: Nickel-fluoride electrodes around a solid electrolyte are an effective energy storage device that combines the best qualities of batteries and supercapacitors, according to Rice University researchers.
The electrodes are plated onto a gold ...more*

K. KAMARAJ

In this Indian name, the name *Kumarasami* is a patronymic, not a family name, and the person should be referred to by the given name, *Kamaraj*.



K. KAMARAJ

Member of Parliament (Lok Sabha) for Nagercoil

In office 1967–1975
Preceded by A. Nesamony
Succeeded by Kumari Ananthan
Constituency Nagercoil

Member of Tamil Nadu Legislative Assembly for Sattur

In office 1957–1967
Preceded by S. Ramaswamy Naidu
Succeeded by S. Ramaswamy Naidu
Constituency Sattur

Member of Tamil Nadu Legislative Assembly for Gudiyatham

In office 1954–1957
Preceded by Rathnaswamy and A. J. Arunachala Mudaliar
Succeeded by V. K. Kothandaraman and T. Manavalan
Constituency Gudiyatham

Chief Minister of the Madras State (Tamil Nadu)

In office 1954–1963
Preceded by C. Rajagopalachari
Succeeded by M. Bhakthavatsalam

Member of Parliament (Lok Sabha) for Srivilliputhur

In office 1952–1954
Preceded by None

Succeeded by S. S. Natarajan
Constituency Srivilliputhur
President of the Indian National Congress (Organisation)
In office 1967–1971
Preceded by None
Succeeded by Morarji Desai
President of the Indian National Congress
In office 1963–1967
Preceded by Neelam Sanjiva Reddy
Succeeded by S. Nijalingappa
President of the Madras Provincial Congress Committee
In office 1946–1952
Succeeded by P. Subbarayan

Personal details

Born 15 July 1903
 Virudhunagar, Tamil Nadu, India
Died 2 October 1975 (aged 72)
 Chennai, Tamil Nadu, India
Nationality Indian
Political party Indian National Congress
Religion Hinduism

Signature

Kumarasami Kamaraj better known as K. Kamaraj (15 July 1903 – 2 October 1975) was an Indian politician from Tamil Nadu widely acknowledged as the “**Kingmaker**” in Indian politics during the 1960s. He was the chief minister of Tamil Nadu during 1954-1963 and a Member of Parliament during 1952-1954 and 1969-1975. He was known for his simplicity and integrity. He was involved in the Indian independence movement. As a high-ranking office bearer of the Indian National Congress, he was instrumental in bringing to power two Prime Ministers, Lal Bahadur Shastri in 1964 and Indira Gandhi in 1966. In Tamil Nadu, his home state, he is still remembered for bringing school education to millions of the rural poor by introducing free education and the free Midday Meal Scheme during his tenure as chief minister. He was awarded India’s highest civilian honour, the Bharat Ratna, posthumously in 1976. The domestic terminal of the Chennai airport is named “**Kamaraj Terminal**”, Chennai’s Beach Road renamed “**Kamarajar Salai**”, Bengaluru’s North Parade Road as “**K. Kamaraj Road**” and the Madurai Kamaraj University in his honour.

Early life - Kamaraj was born on 15 July 1903 to Kumarasamy Nadar and Sivakami Ammal at

Virudhunagar in Tamil Nadu. His real name was Kamakshi and his mother affectionately called him Raja and later his name became Kamaraj (Kamatchi + Raja). His parents were from a trading family. His father Kumarasamy Nadar, was a coconut merchant. In 1907, four years after the birth of Kamaraj his sister Nagammal was born. At age 5 (1907), Kamaraj was admitted to traditional school (called 'Thinnai Palli' in Tamil which was a system of school available in the past) on the next day of "Saraswathy Pooja". In 1908, he was admitted in Yenadhi Narayana Vidhya Salai. In 1909 Kamaraj was admitted in Virudupatti High School - Kshatriya Vidhyasala which is the only high school in Virudupatti. Kamaraj's father died when he was six years old and his mother was forced to support her family by selling her jewellery. In 1914, Kamaraj dropped out of school to support his family. After that he worked in his uncle's clothshop as a salesboy.

During this time, he started joining processions and attended public meetings about Home Rule Movement and British Rule addressed by orators like Dr. Varadarajulu Naidu, V.Kalyana Sundara Mudaliar and George Joseph. Kamaraj developed interest in prevailing political conditions by reading newspapers daily. Punjab Massacre was the decisive turning point in his life and at this point he decided his aim was to fight for the National freedom and to bring an end to foreign rule. In 1920, at the age of 18 he became active political worker and joined Congress as full-time worker. In 1921, Kamaraj was organising public meetings at Virudhunagar for congress leaders. He was eager to meet Gandhi and when Gandhi visited Madurai on September 21, 1921, Kamaraj attended Gandhi's public meeting and met him for the first time in person. He visited villages carrying Congress propaganda.

In 1922, Congress was boycotting the visit of Prince of Wales as part of Non-cooperation movement. Kamaraj came to Madras and took part in this event. Kamaraj participated in the famous Vaikom Satyagraha led by George Joseph against the atrocities of the higher caste Hindus on the Harijans. In 1923-25, Kamaraj participated in Nagpur Flag Satyagraha. In 1927, Kamaraj started Sword Satyagraha in Madras and also he was chosen to lead the Neil Statue Satyagraha but it was given up later in view of Simon Commission boycott. Kamaraj lead almost all the agitation and demonstration against the British rule. Kamaraj was first jailed in June 1930 for two years in Alipore Jail, Calcutta for participation in "Salt Satyagraha" led by Rajagopalachari at Vedaranyam and was released earlier in 1931 in consequence of Gandhi-Irwin Pact before he could serve full term imprisonment.

In 1932, Section 144 was imposed in Madras prohibiting the holdings of meetings and organising procession against the arrest of Gandhi in Bombay. In Virudhunagar under Kamaraj leadership everyday processions and

demonstrations happened. Kamaraj was arrested again in Jan 1932 and sentenced for 1 year imprisonment. In 1933, Kamaraj was falsely implicated in the Virudhunagar bomb case. Dr. Varadarajulu Naidu and George Joseph argued on Kamaraj's behalf and proved the charges to be baseless. Kamaraj was doing a vigorous campaign through the state asking people not to contribute to war funds when Sir Arthur Hope the Madras Governor was collecting contributions to funds for Second World War. In Dec 1940, he was arrested again at Guntur under the 'Defence of Indian Rules' for speeches opposing contributions to the war fund and sent to Vellore Central Prison while he was on his way to Wardha to get Gandhiji's approval for a list of Satyagrahis. While he was in jail, he was elected as Municipal Council of Virudhunagar. He got released 9 months later in Nov 1941 and he resigned from his post as he thought he had greater responsibility for the nation. His principle was "One should not accept any post to which one could not do full justice".

In 1942, Kamaraj attended All India Congress Committee in Bombay and returned to spread propaganda material for the "Quit India Movement" called by Gandhiji. The Police issued orders to all the leaders who attended this Bombay session. Kamaraj did not want to get arrested before he takes the message to all district and local leaders. He decided not to go to Madras and decided to cut short his trip and saw large number of policemen waiting for the arrest of congress leaders in Arakonam. He managed to escape from the police and went to Ranipet, Tanjore, Trichy, Madurai and informed local leaders about the Programme. He reached Virudhunagar after finishing his work and sent message to the local police that he was ready to be arrested. He was arrested on August 1942. He was under detention for 3 years and was released on June 1945. This was the last term of his prison life. Kamaraj was imprisoned six times by British and spent nine years in jail for his Pro-Independence activities.

Politics

On 13 April 1954, K. Kamaraj became the Chief Minister of Madras Province. To everyone's surprise, Kamaraj nominated C. Subramaniam and M. Bhakthavatsalam, who had contested his leadership, to the newly formed cabinet. Never did Kamaraj aspire for any post in the party or in the administration. For him the posts were like a towel over the shoulder. Without any hesitation he chose to quit posts for the benefit of future generation.

Education

Kamaraj removed the family vocation based Hereditary Education Policy introduced by Rajaji. He reopened the 6000 schools closed by Rajaji government for financial reasons and also added 12000 more schools. The State made immense strides in education and trade. New schools were opened, so that poor rural students were

to walk no more than 3 miles (4.8 km) to their nearest school. Better facilities were added to existing ones. No village remained without a primary school and no panchayat without a high school. Kamaraj strove to eradicate illiteracy by introducing free and compulsory education up to the eleventh standard. He introduced the Midday Meal Scheme to provide at least one meal per day to the lakhs of poor school children (first time in the world). He introduced free school uniforms to weed out caste, creed and class distinctions among young minds.



During British regime the education was only 7 percent. But in Kamaraj's period it reached 37%. During Rajaji's period there were 12000 schools in the state. Whereas it was 27000 in the period of Kamaraj. Apart from increasing number of schools, steps were taken to improve standard of education. To improve the standards, number of working day were increased from 180 to 200. Unnecessary holidays were reduced. Syllabus were prepared to give opportunity to various abilities. Kamaraj and Sri Bishnuram Medhi (Governor) took efforts to establish IIT Madras in 1959.

Agriculture

Major irrigation schemes were planned in Kamaraj's period. Dams and irrigation canals were built across Lower Bhavani, Mani Muthar, Aarani, Vaigai, Amaravathi, Sathanur, Krishnagiri, Pullambadi, Parambikulam and Neyyar among others. The Lower Bhavani Dam in Erode district brought 207,000 acres (840 km²) of land under cultivation. 45,000 acres (180 km²) of land benefited from canals constructed

from Mettur Dam. Vaigai and Sathanur systems facilitated cultivation across thousands of acres of lands in Madurai and North Arcot districts respectively. Rs 30 crores were planned to be spent for Parambikulam River scheme in Kamaraj's period. 150 lakhs of acres of lands was brought under cultivation. One third of this i.e. 56 lakhs of acres of land got permanent irrigation facility. In 1957-61 1,628 Tanks were de-silted under Small Irrigation Scheme 2000 wells were dug with outlets. Long term loans with 25% subsidy were given to farmers. Apart from farmers who are having dry lands were given oil engines, electric pump sets on installment basis.

Commerce and Industry

Industries with huge investments in crores of Rupees were started in his period. Neyveli Lignite Corporation, BHEL at Trichy, Manali Oil Refinery, Hindustan raw photo film factory at Ooty, Surgical instruments factory at Chennai, Railway Coach factory at Chennai were established. Industries such as paper, sugar, chemicals and cement took off during the period.

Kamaraj Plan

Kamaraj remained Chief Minister for three consecutive terms, winning elections in 1957 and 1962. Kamaraj noticed that the Congress party was slowly losing its vigor. He came up with a plan which was called the "Kamaraj Plan".

On 2nd October 1963, he resigned from the Tamil Nadu Chief Minister Post. He proposed that all senior Congress leaders should resign from their posts and devote all their energy to the re-vitalization of the Congress. In 1963 he suggested to Nehru that senior Congress leaders should leave ministerial posts to take up organisational work. This suggestion came to be known as the **Kamaraj Plan**, which was designed primarily to dispel from the minds of Congressmen the lure for power, creating in its place a dedicated attachment to the objectives and policies of the organisation. Well impressed by the achievements and acumen of Kamraj, Prime Minister Jawaharlal Nehru felt that his services were needed more at the national level. In a swift move he brought Kamaraj to Delhi as the President of the Indian National Congress. Nehru realized that if he had wide learning and vision, Kamaraj possessed enormous common sense and pragmatism. Kamaraj was elected President, Indian National Congress, on 9th October 1963.

The King Maker

After Nehru's death in 1964, Kamaraj successfully navigated the party through the turbulent times. As the president of the Indian National Congress, he refused to become the next Prime Minister himself and was instrumental in bringing to power two Prime Ministers, Lal Bahadur Shastri in 1964 and Nehru's daughter Indira Gandhi in 1966. For this role, he is widely acclaimed as the "King Maker" during the 1960s.



Split of Congress

When the Congress split in 1969, Kamaraj became the leader of the INC (O) in Tamil Nadu. The party fared poorly in the 1971 elections amid allegations of fraud by the opposition parties. He remained as the leader of INC (O) till his death in 1975.

Electoral history

Year	Post	Constituency	Party	Opponent	Election	Result
1937	M.L.A	Sattur	INC	Unopposed	1937 elections	Won
1946	M.L.A	Sattur-Aruppukottai	INC	Unopposed	1946 elections	Won
1952	M.P	Srivilliputtur	INC	G. D. Naidu	Indian General Elections, 1951	Won
1954	M.L.A	Gudiyatham	INC	V. K. Kothandaraman	Bye Election	Won
1957	M.L.A	Sattur	INC	Jayarama Reddiar	Madras legislative assembly election, 1957	Won
1962	M.L.A	Sattur	INC	P. Ramamoorthy	Madras legislative assembly election, 1962	Won
1967	M.L.A	Virudhunagar	INC	P. Seenivasan	Tamil Nadu state assembly election, 1967	Lost
1969	M.P	Nagercoil	INC	M. Mathias	Bye Election	Won
1971	M.P	Nagercoil	INC (O)	M. C. Balan	Indian General Elections, 1971	Won

Death

Kamaraj died on October 2, 1975, in his house. He was awarded India's highest civilian honour, the 'BHARAT RATNA' posthumously in 1976.

Legacy

A large number of statues have been erected in his honor across the state. The domestic terminal of the Chennai airport has been named "Kamaraj Terminal", Chennai's Beach Road renamed "Kamarajar Salai", Bengaluru's North Parade Road as "K. Kamaraj Road" and the Madurai Kamaraj University in his honour.

Popular culture

In 2004, a Tamil film titled KAMARAJ was made based on the life history of Kamaraj. The English version of the film was released on DVD in 2007.

HUMOUR

CONVERSATION WITH GOD!

Man: God?

God: Yes?

Man: Can I ask you something?

God: Of course!

Man: What is for you a million of years?

God: A second.

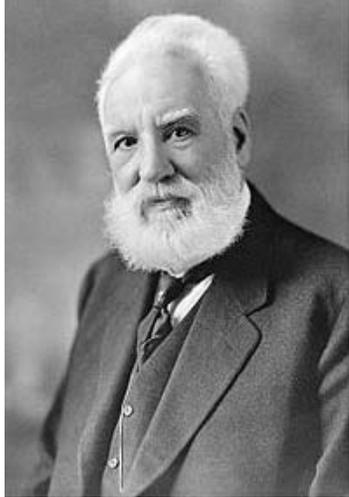
Man: And a million dollars?

God: A penny.

Man: God, Can you give me a penny?

God: Wait a second.

ALEXANDER GRAHAM BELL (1847-1922)



Alexander Graham Bell

Alexander Bell was born in Edinburgh, Scotland on March 3, 1847. As a child, young Alexander displayed a natural curiosity about his world, resulting in gathering botanical specimens as well as experimenting even at an early age. From his early years, Bell showed a sensitive nature and a talent for art, poetry and music that was encouraged by his mother. With no formal training, he mastered the piano and became the family's pianist. Despite being normally quiet and introspective, he reveled in mimicry. Bell was also deeply affected by his mother's gradual deafness, and learned a manual finger language so he could sit at her side and tap out silently the conversations swirling around the family parlour. He also developed a technique of speaking in clear, modulated tones directly into his mother's forehead wherein she would hear him with reasonable clarity. Bell's preoccupation with his mother's deafness led him to study acoustics. His family was long associated with the teaching of elocution. He could decipher Visible Speech representing virtually every language, including Latin, Scottish Gaelic and even Sanskrit, accurately reciting written tracts without any prior knowledge of their pronunciation.

Education

As a young child, Bell, like his brothers, received his early schooling at home from his father. At an early age, however, he was enrolled at the Royal High School, Edinburgh, Scotland, which he left at age 15, completing only the first four forms. His school record was undistinguished, marked by absenteeism and lacklustre grades. His main interest remained in the sciences, especially biology, while he treated other school subjects with indifference. At age 16, Bell secured a position as a "pupil-teacher" of elocution and music, in Weston House Academy, at Elgin, Moray, Scotland. Although

he was enrolled as a student in Latin and Greek, he instructed classes himself in return for board and £10 per session. The following year, he attended the University of Edinburgh; joining his older brother Melville who had enrolled there the previous year. In 1868, not long before he departed for Canada with his family, Aleck completed his matriculation exams and was accepted for admission to the University of London.

First experiments with sound

Bell's father encouraged Aleck's interest in speech and in 1863, took his sons to see a unique automaton, developed by Sir Charles Wheatstone based on the earlier work of Baron Wolfgang von Kempelen. The rudimentary "mechanical man" simulated a human voice. Aleck tackled the more difficult task of recreating a realistic skull. His efforts resulted in a remarkably lifelike head that could "speak", albeit only a few words. The boys would carefully adjust the "lips" and when a bellows forced air through the windpipe, a very recognizable "Mama" ensued, to the delight of neighbors who came to see the Bell invention.

Intrigued by the results of the automaton, these initial forays into experimentation with sound led Bell to undertake his first serious work on the transmission of sound, using tuning forks to explore resonance.

He continued his interest in the study of the human voice and when he discovered the Six Nations Reserve across the river at Onondaga, he learned the Mohawk language and translated its unwritten vocabulary into Visible Speech symbols. For his work, Bell was awarded the title of Honorary Chief and participated in a ceremony where he donned a Mohawk headdress and danced traditional dances. After setting up his workshop, Bell continued experiments based on Helmholtz's work with electricity and sound. He designed a piano, which, by means of electricity, could transmit its music at a distance. In 1871, he accompanied his father to Montreal, where Melville was offered a position to teach his System of Visible Speech. Traveling to Boston in April 1871, Bell proved successful in training the school's instructors. He was subsequently asked to repeat the program at the American Asylum for Deaf-mutes in Hartford, Connecticut, and the Clarke School for the Deaf in Northampton, Massachusetts. Bell continued his experiments with his "harmonic telegraph". The basic concept behind his device was that messages could be sent through a single wire if each message was transmitted at a different pitch, but work on both the transmitter and receiver was needed. In October 1872 Alexander Bell opened his "School of Vocal Physiology and Mechanics of Speech" in Boston, which attracted a large number of deaf pupils with his first class numbering 30 students. Several influential

people of the time, including Bell, viewed deafness as something that ought to be eradicated, and also believed that with resources and effort they could teach the deaf to speak and avoid the use of sign language, thus enabling their integration within the wider society from which many were often being excluded.



Continuing experimentation

In the following year, Bell became professor of Vocal Physiology and Elocution at the Boston University School of Oratory. During this period, he alternated between Boston and Brantford, spending summers in his Canadian home. At Boston University, Bell was “swept up” by the excitement engendered by the many scientists and inventors residing in the city. He continued his research in sound and endeavoured to find a way to transmit musical notes and articulate speech, but although absorbed by his experiments, he found it difficult to devote enough time to experimentation.

Telephone

By 1874, Bell’s initial work on the harmonic telegraph had entered a formative stage with progress it made both at his new Boston “laboratory” (a rented facility) as well as at his family home in Canada a big success. While working that summer in Brantford, Bell experimented with a “phonautograph”, a pen-like machine that could draw shapes of sound waves on smoked glass by tracing their vibrations. Bell thought it might be possible to generate undulating electrical currents that corresponded to sound waves. Bell also thought that multiple metal reeds tuned to different frequencies like a harp would be able to convert the undulating currents back into sound. With financial support from Sanders and Hubbard, Bell hired Thomas Watson as his assistant, and the two of them experimented with acoustic telegraphy. On June 2, 1875, Watson accidentally plucked one of the reeds and Bell, at the receiving end of the wire, heard the overtones of the reed; overtones that would be necessary for transmitting speech. That demonstrated to Bell that only one reed or armature was necessary, not multiple reeds. This led to the “gallows” sound-powered telephone,

which could transmit indistinct, voice-like sounds, but not clear speech.

On March 10, 1876, three days after his patent was issued, Bell succeeded in getting his telephone to work, using a liquid transmitter similar to Gray’s design. Vibration of the diaphragm caused a needle to vibrate in the water, varying the electrical resistance in the circuit. When Bell spoke the famous sentence “Mr Watson—Come here—I want to see you” into the liquid transmitter, Watson, listening at the receiving end in an adjoining room, heard the words clearly. Bell began a series of public demonstrations and lectures to introduce the new invention to the scientific community as well as the general public. The enthusiasm surrounding Bell’s public displays laid the groundwork for universal acceptance of the revolutionary device. The Bell Telephone Company was created in 1877, and by 1886, more than 150,000 people in the U.S. owned telephones. Bell company engineers made numerous other improvements to the telephone, which emerged as one of the most successful products ever. In 1879, the Bell company acquired Edison’s patents for the carbon microphone from Western Union. This made the telephone practical for longer distances and it was no longer necessary to shout to be heard at the receiving telephone. In January 1915, Bell made the first ceremonial transcontinental telephone call. Calling from the AT&T head office at 15 Dey Street in New York City, Bell was heard by Thomas Watson at 333 Grant Avenue in San Francisco.



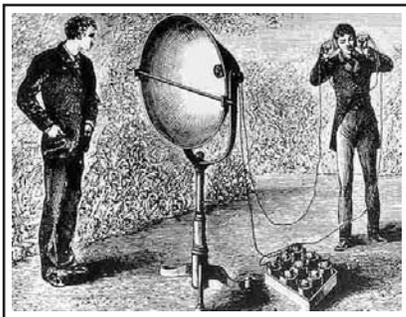
Later inventions

Although Alexander Graham Bell is most often associated with the invention of the telephone, his interests were extremely varied. The range of Bell’s inventive genius is represented only in part by the 18 patents granted in his name alone and the 12 he shared with his collaborators. These included 14 for

the telephone and telegraph, four for the photophone, one for the phonograph, five for aerial vehicles, four for “hydroairplanes” and two for selenium cells. Bell’s inventions spanned a wide range of interests and included a metal jacket to assist in breathing, the audiometer to detect minor hearing problems, a device to locate icebergs, investigations on how to separate salt from seawater, and work on finding alternative fuels. Bell worked extensively in medical research and invented techniques for teaching speech to the deaf. During his Volta Laboratory period, Bell and his associates considered impressing a magnetic field on a record as a means of reproducing sound. Although the trio briefly experimented with the concept, they could not develop a workable prototype. They abandoned the idea, never realizing they had glimpsed a basic principle which would one day find its application in the tape recorder, the hard disc and floppy disc drive and other magnetic media. Bell’s own home used a primitive form of air conditioning, in which fans blew currents of air across great blocks of ice. He also anticipated modern concerns with fuel shortages and industrial pollution. Methane gas, he reasoned, could be produced from the waste of farms and factories. At his Canadian estate in Nova Scotia, he experimented with composting toilets and devices to capture water from the atmosphere. In a magazine interview published shortly before his death, he reflected on the possibility of using solar panels to heat houses.

Photophone

Bell and his assistant Charles Sumner Tainter jointly invented a wireless telephone, named a photophone, which allowed for the transmission of both sounds and normal human conversations on a beam of light. Both men later became full associates in the Volta Laboratory Association. On June 21, 1880, Bell’s assistant transmitted a wireless voice telephone message a considerable distance, from the roof of the Franklin School in Washington, D.C., to Bell at the window of his laboratory, some 213 metres (700 ft) away, 19 years before the first voice radio transmissions.



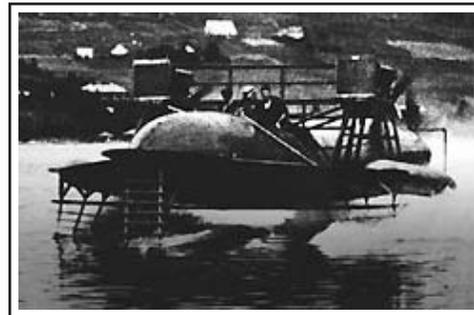
Bell believed the photophone’s principles were his life’s “greatest achievement”, telling a reporter shortly before his death that the photophone was “the greatest invention [I have] ever made, greater than the telephone”. The photophone was a precursor to the fiber-optic communication systems which achieved popular

worldwide usage in the 1980s. Its master patent was issued in December 1880, many decades before the photophone’s principles came into popular use.

Metal detector

Bell is also credited with the invention of the metal detector in 1881. The device was quickly put together in an attempt to find the bullet in the body of US President James Garfield. According to some accounts, the metal detector worked flawlessly in tests but did not find the assassin’s bullet partly because the metal bed frame on which the President was lying disturbed the instrument, resulting in static. Bell’s own detailed account, presented to the American Association for the Advancement of Science in 1882, differs in several particulars from most of the many and varied versions now in circulation, most notably by concluding that extraneous metal was not to blame for failure to locate the bullet. Perplexed by the peculiar results he had obtained during an examination of Garfield, Bell “...proceeded to the Executive Mansion the next morning...to ascertain from the surgeons whether they were perfectly sure that all metal had been removed from the neighborhood of the bed. The extent of the [area that produced a response from the detector] having been so small, as compared with the area of the bed, it seemed reasonable to conclude that the steel mattress had produced no detrimental effect.” In a footnote, Bell adds that “The death of President Garfield and the subsequent *post-mortem* examination, however, proved that the bullet was at too great a distance from the surface to have affected our apparatus.”

Hydrofoils



The March 1906 *Scientific American* article by American pioneer William E. Meacham explained the basic principle of hydrofoils and hydroplanes. Bell considered the invention of the hydroplane as a very significant achievement. Based on information gained from that article he began to sketch concepts of what is now called a hydrofoil boat. Bell and assistant Frederick W. “Casey” Baldwin began hydrofoil experimentation in the summer of 1908 as a possible aid to airplane takeoff from water. Baldwin studied the work of the Italian inventor Enrico Forlanini and began testing models. This led him and Bell to the development of practical hydrofoil watercraft.

During his world tour of 1910–11, Bell and Baldwin met with Forlanini in France. They had rides in the Forlanini hydrofoil boat over Lake Maggiore. Baldwin described it as being as smooth as flying. On returning to Baddeck, a number of initial concepts were built as experimental models, including the *Dhonnas Beag*, the first self-propelled Bell-Baldwin hydrofoil. The experimental boats were essentially proof-of-concept prototypes that culminated in the more substantial HD-4, powered by Renault engines. A top speed of 54 miles per hour (87 km/h) was achieved, with the hydrofoil exhibiting rapid acceleration, good stability and steering along with the ability to take waves without difficulty.

Aeronautics

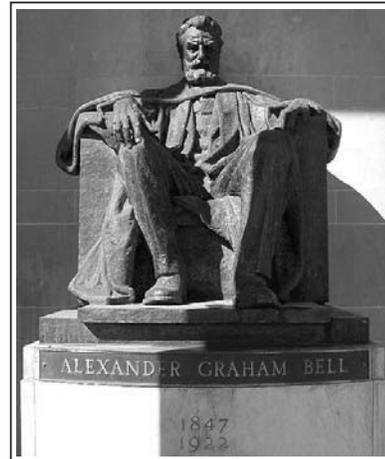
In 1891, Bell had begun experiments to develop motor-powered heavier-than-air aircraft. In 1898, Bell experimented with tetrahedral box kites and wings constructed of multiple compound tetrahedral kites covered in maroon silk. The tetrahedral wings were named *Cygnets* I, II and III, and were flown both unmanned and manned (*Cygnets I* crashed during a flight carrying Selfridge) in the period from 1907–1912. Some of Bell's kites are on display at the Alexander Graham Bell National Historic Site. Bell was a supporter of aerospace engineering research through the Aerial Experiment Association (AEA), officially formed at Baddeck, Nova Scotia, in October 1907 at the suggestion of his wife Mabel and with her financial support after the sale of some of her real estate. Their final aircraft design, the *Silver Dart* embodied all of the advancements found in the earlier machines. On February 23, 1909, Bell was present as the *Silver Dart* flown by J.A.D. McCurdy from the frozen ice of Bras d'Or, made the first aircraft flight in Canada. Bell had worried that the flight was too dangerous and had arranged for a doctor to be on hand. With the successful flight, the AEA disbanded and the *Silver Dart* would revert to Baldwin and McCurdy who began the Canadian Aerodrome Company and would later demonstrate the aircraft to the Canadian Army.

Eugenics

Bell was connected with the eugenics movement in the United States. In his lecture *Memoir upon the formation of a deaf variety of the human race* presented to the National Academy of Sciences on November 13, 1883 he noted that congenitally deaf parents were more likely to produce deaf children and tentatively suggested that couples where both parties were deaf should not marry. However, it was his hobby of livestock breeding which led to his appointment to biologist David Starr Jordan's Committee on Eugenics, under the auspices of the American Breeders Association. From 1912 until 1918 he was the chairman of the board of scientific advisers to the Eugenics Record Office associated with Cold Spring Harbor Laboratory in New York, and regularly attended

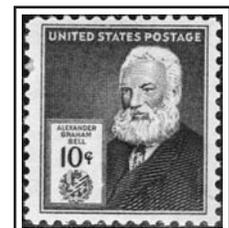
meetings. In 1921, he was the honorary president of the Second International Congress of Eugenics held under the auspices of the American Museum of Natural History in New York. Organisations such as these advocated passing laws (with success in some states) that established the compulsory sterilization of people deemed to be, as Bell called them, a "defective variety of the human race". By the late 1930s, about half the states in the U.S. had eugenics laws, and California's compulsory sterilization law was used as a model for that of Nazi Germany.

Legacy and honors



Honors and tributes flowed to Bell in increasing numbers as his most famous invention became ubiquitous and his personal fame grew. Bell received numerous honorary degrees from colleges and universities, to the point that the requests almost became burdensome. During his life he also received dozens of major awards, medals and other tributes. These included statuary monuments to both him and the new form of communication his telephone created, notably the Bell Telephone Memorial erected in his honor in *Alexander Graham Bell Gardens* in Brantford, Ontario, in 1917. A large number of Bell's writings, personal correspondence, notebooks, papers and other documents reside at both the United States Library of Congress Manuscript Division (as the *Alexander Graham Bell Family Papers*), and at the Alexander Graham Bell Institute, Cape Breton University, Nova Scotia; major portions of which are available for online viewing. A number of historic sites and other marks commemorate Bell in North America and Europe, including the first telephone companies of the United States and Canada. Among the major sites are:

The Alexander Graham Bell National Historic Site, maintained by Parks Canada, which incorporates the Alexander Graham Bell Museum, in Baddeck, Nova Scotia, close to the Bell estate Beinn Bhreagh. The Bell



Homestead National Historic Site, includes the Bell family home, "Melville House", and farm overlooking Brantford, Ontario and the Grand River.

Honorary degrees

Alexander Graham Bell, who could not complete the university program of his youth, received numerous Honorary Degrees from academic institutions, including: Gallaudet College in Washington, D.C. (PhD) in 1880 Harvard University in Cambridge, Massachusetts (LL.D) in 1896

University of Würzburg in Würzburg, Bavaria (PhD) in 1902

University of Edinburgh in Edinburgh, Scotland (LL.D) in April 1906

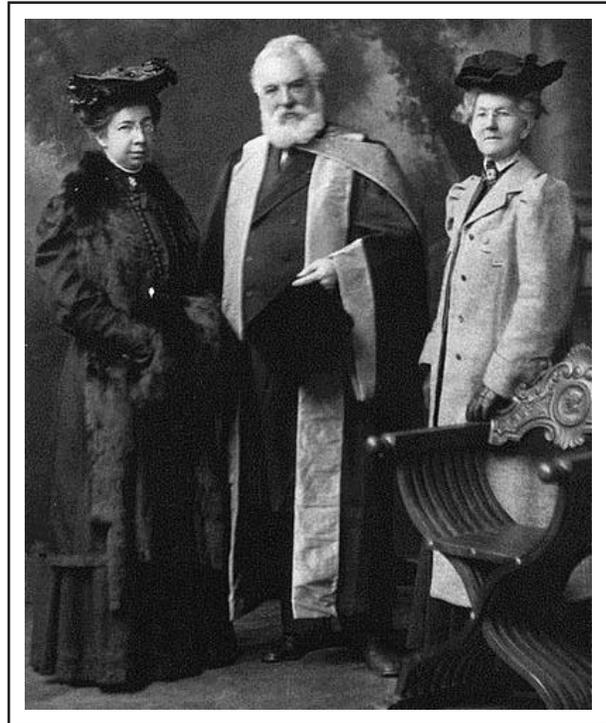
Queen's University in Kingston, Ontario in 1909

Dartmouth College in Hanover, New Hampshire (LL.D) on June 25, 1913

Death

Bell died of complications arising from diabetes on August 2, 1922, at his private estate, Beinn Bhreagh, Nova Scotia, at age 75. Bell had also been afflicted with pernicious anemia. His last view of the land he had inhabited was by moonlight on his mountain estate at 2:00 A.M. While tending to her husband after his long

illness, Mabel whispered, "Don't leave me." By way of reply, Bell traced the sign for *no*—and then he expired.



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HOME FESTIVALS

Adi (July/August)

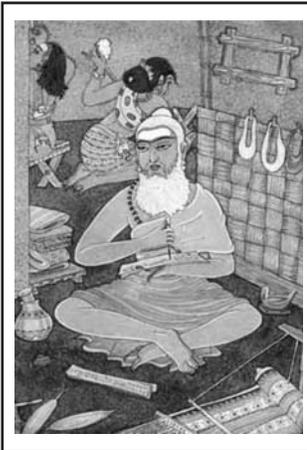


There are two major home festivals this month. The first is **Adi-Perukku**, in honour of the Kaveri River. Women and girls go to the nearest river where they

place offerings on a bamboo tray (upper left) into the water, then have a feast upon the riverbank. **Varalakshmi Vratam** (“Vow to bring Lakshmi”) is also a ladies’ festival, in which paintings of the Goddess of Wealth are made upon the walls (upper right), kumbha pots intended for worship are decorated with Her image. Beside the pot are placed various cosmetics, comb, beads, etc and worship is done. Then the ladies sing songs inviting the Goddess to their home. Kozhukkatai, rice and jaggery cakes are a favourite of the day. In the evening, friends are invited to the home and given clothing, coconuts and sweets.

(To be continued)

TIRUKKURAL AND MANAGEMENT IN A ‘NUTSHELL’ 14



As the New Government is taking charge with a massive mandate and with a Promise to make avast difference in every sphere, let us look at some Basic Rules that are laid in Tirukkural for Good Rule or Governance.

Tirukkural devotes 10 Kurals just to outline the basics of a Good Rule and let us review some of them below:

**Padaikudi Koozhamaichchu Natpuaran Aarum
Udaiyan Arasarul Eeru Kural 381**

படைகுடி கூழ்அமைச்சு நட்புஅரண் ஆறும்
உடையான் அரசருள் ஏறு. குறள் 381

“He is a Lion among Rulers who is endowed to respect and ensure six things – Powerful Army, People of Caliber and Character, Food and comforts for all, Capable Council of Ministers, alliances and Well Protected Borders.”

**Anjamai Eegai Arivuokkam Innangum
Enjamai Ventharkku Iyalbu Kural 382**

அஞ்சாமை ஈகை அறிவுஊக்கம் இந்நான்கும்
எஞ்சாமை வேந்தற்கு இயல்பு. குறள் 382

“Four Qualities should never be wanting in the Ruler namely – Courage, Liberality, Sagacity and Energy”

**Aranizhukkathu Allavai Neecki Maranizhukka
Manam Udaiyathu Arasu Kural 384**

அறன்இழுக்காது அல்லவை நீக்கி மறன்இழுக்கா
மானம் உடையது அரசு. குறள் 384

“The Ruler shall not fail in virtue and shall abolish unrighteousness; he shall guard his honor jealously but shall not sin against the laws of valour”

SEVEN-STAR HOTEL, BURJ AL ARAB HOTEL, DUBAI

There is no question that the Burj Al Arab Hotel is one of the wonders of Dubai. It is also the most expensive 7-star hotel in the world. Home to some of the most expensive hotel suites this is one of the most expensive buildings in the world. Measuring 321 meters in height, it is currently the fourth tallest building in the world. Shaped like the sail of a ship, this towering building has much to recommend it, not just its height. There is some debate over whether this is indeed a seven-star hotel, but there is no questioning its luxury quotient. In that department, the Burj Al Arab Hotel is unmatched.

When architect Tom Wright of WS Atkins PLC was designing the Burj Al Arab, he knew what he was gunning for. He had to create an iconic building for Dubai, something on the lines of what the Opera House was to Sydney and the Eiffel Tower was to Paris. The idea of the Burj Al Arab or "Tower of Arabs" was born in October 1993. The imposing building that has since become a symbol for Dubai was completed in 1999. It may not be the tallest building in the world, but the Burj Al Arab Hotel continues to hold pride of place as the tallest stand-alone hotel.

The 7-star hotel stands on a man-made island located 300 meters off the Jumeirah beach, rising up like a mirage. The sail-like design is a throwback to the region's rich history of seafaring. However, the design itself is modern and inspired by the spinnaker sail of a hi-tech J-class yacht.

Study the technical details of constructing the Burj Al Arab Hotel and you will realize that this is no ordinary structure. It took three years to reclaim the land. And then, the building itself was made secure on a foundation of 250 concrete piles that extend to 40 meters below sea level. The sheer size of this impeccable construction, makes the Burj Al Arab Hotel even more expensive. Spread over 1.2 million square feet, the 7-star hotel houses 28 double height floors. Each floor is 7 meters high.

The building is also home to the tallest atrium in the world. Soaring to 182 meters above ground level, the atrium offers access to the 202 deluxe suites within the Burj Al Arab Hotel. You will spot tall pillars bearing 22-carat gold soaring up several floors.

Highest Tennis Court

The Burj Al Arab hotel has a lot going for it. But one of the highlights of this extraordinary building is its tennis court. The 7-star hotel is currently home to the highest tennis court in the world. The circular tennis court is located fairly close to the top of this building. The one-of-a-kind tennis court made waves when the luxury hotel invited Roger Federer and Andre Agassi to play some rounds here in the year 2005. The two pro tennis players were in Dubai for a tournament at the time. Moreover, this circular area is not solely a tennis court. It also doubles up as a helipad. How many other tennis courts can do that?

Live In 7-Star Luxury

Why is it called a 7-star hotel? The hotel calls itself a 5-star. The 7-star tag came from a British journalist who wrote a pre-opening review. Regardless of whether the Burj Al Arab Hotel deserves its 7-star tag or not, one must admit that this is one of the most luxurious hotels in the business. Can you expect anything less from a hotel that houses only luxury suites? As you enter the luxury hotel, wait for your senses to be assailed by the sheer grandeur of the hotel. As you enter, the ever-smiling staff will greet you, ready to do your bidding. Waiting at the reception are hotel staff armed with hot towels, perfumes, dates and coffee. Of course, this is after you have been driven here in a Rolls-Royce or flown in on a helicopter. (Note: The helicopter commute will cost extra.)

The Burj Al Arab Hotel promises a range of high-end facilities to justify its status as the most expensive 7-star hotel. You can do yoga, get a massage, go swimming in either the indoor or outdoor pool and so on. You can play billiards, go sightseeing, or catch a nice meal at one of the hotel's star restaurants.

Did you know that a Burj Al Arab ashtray made waves for being the most expensive ashtray in the world? Made of borosilicate glass and studded with three high-quality diamonds, the Burj Al Arab ashtray cost \$7,250. Staggering isn't it?

Inside The VIP Suites

When you step into the VIP suites, you will find a reminder of why this is the most expensive 7-star hotel in the world. Travelling with messy children becomes a non-problem thanks to the presence of a valet who will put away their clothes and ensure that the suite is in order. Each suite houses an office area as well.

Of course, guests at the most expensive 7-star hotel are expected to pay through their nose. The smallest of the 202 suites in the hotel offers 1,820 square feet of space; the largest offers 8,400 square feet. Every suite has rain showers and Jacuzzis. Also on offer are Hermes toiletries, pillow menus and marble staircases.

Most Expensive Hotel Suite

Much has been written about the Royal Suite, aka, one of the most expensive hotel suites in the world. Located on the 25th floor, this luxury suite offers 780 square meters of space (nearly 8,400 square feet). A private elevator carries guests to this grand luxury suite. The Burj Al Arab Hotel may house several internationally acclaimed restaurants, but if you want to sneak in a private dinner, the Royal Suite has its own elaborate dining area. Entertain guests at the spacious Royal Suite lounge or head to your own private cinema. If you are eager to splurge on one of the most expensive hotel suites in the world, this is one of your top options. The opulent Arab interiors include a grand marble staircase – how many other luxury suites can boast of such decadence? The master bedroom is a study in indulgence. It houses a rotating four-poster canopy bed. The other bedrooms are no less grand, with each housing marble bathroom with a walk-in shower and a spa bath. Now you know what to expect at this 7-star hotel. If you were baulking at the Burj Al Arab prices, prepare to be stunned by the price pinch for the Royal Suite – \$18,716 per night was what we last heard.

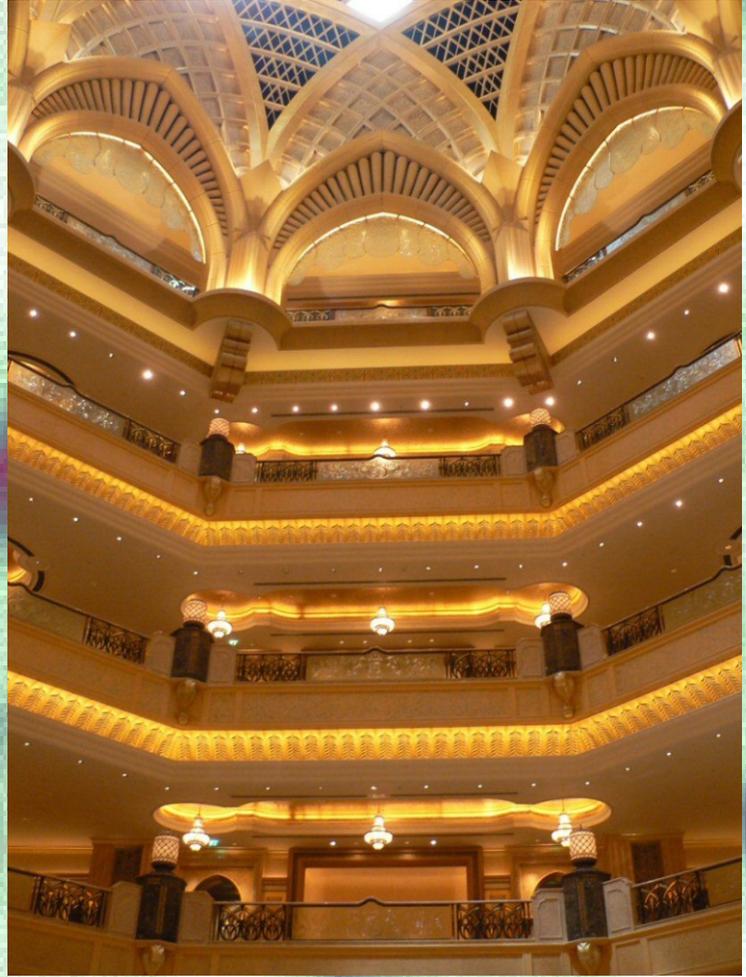
Burj Al Arab Restaurants

The so-called 7-star hotel is home to several world-class restaurants. A tour of the Burj Al Arab restaurants is sure to leave guests spoilt for choice. One of the most impressive dining destinations in the Dubai hotel is Al Mahara, which means “oyster shell” in Arabic. You might know this fine dining venue as the Burj Al Arab underwater restaurant. Guests reach the restaurant via a “simulated” journey in a submarine. Dive into seafood delicacies while watching exotic fish swim around you. If seafood is not to your taste, travel 200 meters above sea level at the Al Muntaha restaurant. Take the lift that moves at the rate of six meters per second. The glass walls offer spectacular views of Jumeirah beach, The Palm and World Islands. On the menu is modern European cuisine. While in Dubai, make sure you try Arabic cuisine at the Al Iwan restaurant. Located beside the lobby, this grand restaurant is at the center of the tallest atrium in the world.

While here, also check out the poolside café restaurant Baba Al Yam, try Cuban cigars and rare whiskies at the Juna Lounge, eat al fresco at the Majlis Al Bahar and so on.

A nation's culture resides in the hearts and in the soul of its people. - MAHATHMA GANDHI

SEVEN-STAR HOTEL, BURJ AL ARAB HOTEL, DUBAI





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