



# ELECTRICAL

## INSTALLATION ENGINEER

### NEWS LETTER

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

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# EVENTS

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MONDAY 28 Oct	TUESDAY 29 Oct	WEDNESDAY 30 Oct	THURSDAY 31 Oct	FRIDAY 1 Nov
SIEW Opening Keynote Address	Asia Smart Grid / Electromobility Conference		Thinktank Roundtables	Thinktank Roundtables
	APVIA – PV Asia Pacific Conference			
Singapore Energy Summit (SES)	Asia Future Energy Forum			
	Singapore Electricity Roundtable	Downstream Asia		
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Venue: Sands Expo and Convention Centre, Marina Bay Sands, Singapore.

Website: <http://siew.sg/conference-venues#sthash.tFMozvfl.dpuf>

## POWER-GEN ASIA

**Event Profile:** POWER-GEN Asia, collocated with Renewable Energy World Asia, is the leading force in delivering a platform for the power industry to meet, share information on the challenges facing the power industry and discuss solutions for advancing Asia's energy future.

**Date:** 2<sup>nd</sup> – 4<sup>th</sup> October 2013

**Venue:** IMPACT Exhibition & Convention Centre, Bangkok, Thailand

**Website:** <http://www.powergenasia.com/index.html>

## Asia-Pacific Nuclear Energy Congress 2013

Asia - Pacific's Premier Nuclear Energy Congress: Clean and Safe Nuclear Energy promotes economic prosperity!



**Event Profile:** Asia Pacific Nuclear Energy Congress 2013 (ANEC 2013)

ANEC 2013 focuses global Emerging Nuclear Market, such as Vietnam, Indonesia, Malaysia, Thailand, Philippines, India, Turkey and Pakistan nuclear energy markets. Malaysia Radiation Protection Association (MARPA) has been ANEC's endorser

**Date:** 24<sup>th</sup> – 25<sup>th</sup> October 2013 **Venue:** Kuala Lumpur, Malaysia

**Website:** <http://www.cdmc.org.cn/2013/anec>



**Event Profile:** Established in 1986, EP China is organized by the most authoritative organization, China Electricity Council, and fully supported by all major Power Group Corporations and Power Grid

Corporations in China. Over 27 years successful track record and experience, it has become the largest and the most reputable electric power exhibition endorsed by UFI Approved Event in China and has been widely recognized by global market leaders and international trade associations.

**Date:** 30<sup>th</sup> Oct - 1<sup>st</sup> Nov 2013 **Venue:** Shanghai World Expo Exhibition & Convention Center, Shanghai, PR China

**Organizer:** China Electricity Council

**Website:** <http://www.epchinashow.com/EP13/Main/lang-eng/Information.aspx>

## EDITORIAL

Dear Members, Fellow Professionals and Friends

*SEASONS GREETINGS TO ONE AND ALL!*

*“HAPPY ENGINEERS’ DAY”*

The Month of August that just went by has been memorable in so many ways including festivity and joy and a Technical Seminar organized by our Association on the Important Topic of “Power Generation, Monitoring & Utilization”, seminar at Salem on the 10<sup>th</sup> of August.

One of the important events of September concerning our profession is the Engineers Day Celebrations. September 15<sup>th</sup> is celebrated as Engineers Day every year by the Engineering Fraternity **to commemorate the birthday of the legendary engineer Sir M.Visvesvarayya, who was an eminent Indian engineer and statesman and due to his outstanding contribution to the society, Government of India conferred “Bharat Ratna” on this legend in the year 1955. He was also called the precursor of economic planning in India.** We take pleasure in publishing a write up on the ‘Theme’ of Engineers Day for the year, “Frugal Engineering – Achieving More with Fewer Resources”, in this issue. (*Page No.36*)

Growth of Engineering ensures Growth of Civilization and Growth of Prosperity, but it is the duty of the Engineers to ensure utmost Safety and Welfare of Society and the minimum use of resources. The Basics for reduction in use of resources comprise of Reduce, Re Use, and Re Cycle Concepts. Energy, which is an important resource has to be addressed in both dimensions of minimum use of Energy for Production and minimum use of Energy by those Equipments which use or handle Energy. In essence, “Efficiency” alone can ensure Excellence and Engineering has to be directed for achieving Excellence.

Reduction in use of resources has to necessarily deal with Energy as at present, the World at large depends very highly on Fossils like Coal, Oil and Natural Gas for production of various forms of Energy like Heat, Fuel and Electricity. The reserves of Fossils have been depleting very fast and it is even feared that we may run out of some of the resources like Crude Oil within a few decades. Problem with our Country is more serious as we largely depend on Imports of both Oil and Coal. Engineering Efforts are therefore directed towards Alternatives, Renewable Resources, and better all round Efficiencies.

In the Economic front, we are facing serious problems of all dimensions at present and undeservingly, we seem to be more affected than the rest of the World. Some of the analysis point towards curtailing Imports and improving Exports as a solution to the problem. We come back to Energy and resources again, as our huge burden of imports is Oil and Coal and exports can go up only with better productivity and competitiveness. Energy, therefore has to be available more and at cheaper costs which is really the challenge for Engineering. One important example of Oil will be relevant. As an alternative to Petroleum - Bio Diesel, Ethanol, Bio CNG, Bio Crude etc have all been researched and tried all over the World. Today, proven and cost effective technologies seem to be available in many countries, which have to be Engineered and adapted for our Country in the light of large availability of Renewable Resources like Biomass in our country.

Science, Engineering and Management believe in ‘Continuous Education’ and it is apt that we celebrate Teachers Day and Literacy Day during the month.

*We thank all those members who have helped us by participating in the advertisements appearing for the issue August 2013 – K-Lite Industries, Pentagon Switchgear Pvt Ltd., Prolite Autoglo Ltd., Power Links, Universal Earthing Systems Pvt. Ltd., Hensel Electric India Pvt. Ltd., Electrotherm (India) Ltd., Cape Electric Pvt Ltd., Abirami Electricals, Jef Techno Solutions Pvt Ltd., Wilson Power and Distribution Technologies Pvt. Ltd., Intrans Electro Components Pvt. Ltd., OBO Bettermann India Pvt. Ltd., Galaxy Earthing Electrodes Pvt. Ltd., Ashlok Safe Earthing Electrode Ltd.*

*EDITOR*

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308. Base Electrical & Electronic Solutions P. Ltd (2012-14)  
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## POWER LINKS

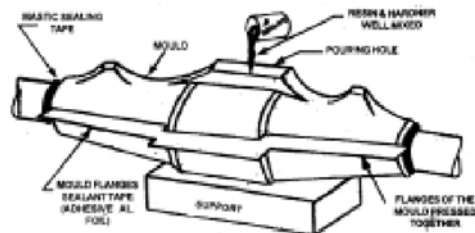
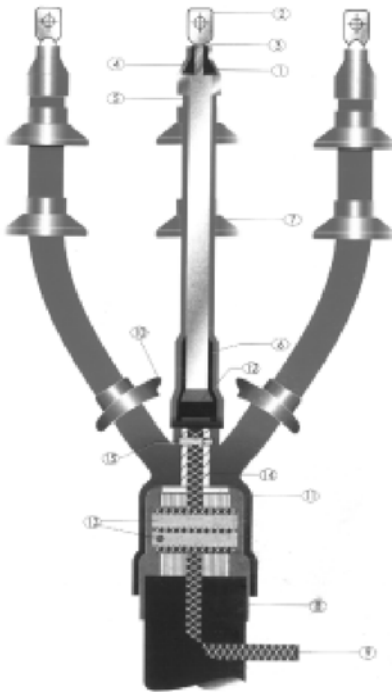
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## KNOW THY POWER NETWORK – 72

**5.1** Let us reconnect again. Before picking up the threads from the previous article, let me take you to the topic “Asset Management” once again. As I collect some useful information from “Electra-June 2013 issue” of “CIGRE”, France, I would like to share them with you all. The topic “Asset Management accompanied with a critical decision making process” assumes significance wherever a transition takes place from the “existing one” to a “ a new one” (e.g) *change over or transition of “Electrical utilities” from their “vertically integrated structures” to “market oriented small segments or organizations” in the last decade.* This had happened all over the world that included “Tamilnadu” also. [TNEB is dismantled and separated into several small companies like TANGEDCO and Tamilnadu Transmission Co.] During this change over, many companies resorted to the Asset management Organizational structure and implemented risk based asset management decision making process. The main asset management topics that got attention during this transition process are,

- Condition assessment and monitoring
- End of life issues
- Asset Management Decision making and Risk Management
- Grid Development
- Maintenance Processes and
- Decision making, collection of asset data and information.

Thus, we find that “**Asset Management**” is a “**Total Business Concept**” that covers the management of risks for the business values that arise not only from the asset base but also from an inadequate response to the changes in the environment. It includes sustainment as well as system planning aspects. Thus the activities of a Asset Manager comprises,

- *Optimal management of assets and their associated performance*
- *Management of risks and expenditures over their life cycle and*
- *Achieving the required quality of service in the most effective manner.*

**5.2** The impact of industrial activities on environment play an active role in the Asset Management process. It is particularly noticed in the transmission of electrical energy over long distances at EHV levels. The severity of events that can adversely impact the business values can be assessed using a combination of likelihood and the magnitude of the event. The Co<sub>2</sub> footprint is also considered a part of the impact. Other cases of environmental impacts that have a relation to electricity generation and transmission are,

- S<sub>f</sub><sub>6</sub> gas handling
- Oil spillages from transformers and oil filled HV cables.

**5.3** We have seen that the key objectives/goals of Asset Manager in an electricity grid is to optimize the balance of cost, risk and performance of the electricity grid and to get these goals, the organizations generally apply risk based decision making process through the application of risk indicators

### **Risk indicators:**

- They provide the measures of the level of risks of a particular activity.
- They also furnish information about risk performance or risk exposure of equipment/ system. They may be related to the prediction of future performance (leading) and the study of past performance (lagging).
- It can be specific to an equipment items or class of items or can be system wide.
- The system risk indicators provide a measure of the possibilities that the grid will be able to serve its assigned duty viz. to supply customers reliably in a cost effective way. The development of an Integrated Risk Indicator combine measures of past performance, present conditions, equipment condition and regulatory violations.
- Equipment risk indicators measure the likelihood of the failure of an individual item of equipment or a group of similar equipment with adverse consequences. [it measures and furnishes the equipment condition and the risks associated with it.]

**5.4** To sum up the items that are essential for the Asset managers to get a valid risk assessment and available risk treatment options are,

- Relevant data that include asset data useful information on internal and external developments such as asset condition and operation factors like its loading and maintenance history and
- Those parameters that depict the potential risks for the assets of the Organization concerned.

## 6 SAFETY

6.1 Now it is time for us to turn our attention or focus on “Safety” aspects that relate to Asset Management and Reliability. When “safety” is focused, a big challenge comes before us. It is nothing but the cultivation of the culture of Safety in an organization. It demands the time and commitment of all those working in the organization. To nurture this culture of safety, the utilities,

- *Should keep their safety manuals upto date and adhere to them*
- *See their staff and officers follow the safety standards and safety practices.*
- *Conduct regular safety meetings and perform safety/ disaster drills.*
- *Investigate accidents and make an analysis*
- *File report on near-misses to mitigate reoccurrence of accidents.*
- *Calculate the safety levels in the organization and compare them with the available bench marks.*

Now it is time for me to sign off. Kindly stay tuned.

*(To be continued...)*

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## INNOVATIVE SWITCHGEAR BY SIEMENS



The Low & Medium Voltage Division of Siemens AG has developed a new gas insulated medium-voltage switchgear, 8DJH Compact, for secondary distribution systems up to 24kV. This type-tested switchgear, which conforms to IEC 62271200, is about a third smaller in size than a comparable model. New urban local transformer substations, for example, can now be built on a smaller scale and therefore at lower cost using 8DJH Compact. The new switchgear is especially suitable for modernizing existing compact substations, as well as for intelligent local transformer substations being components of Smart Grids. The extra space made available can be used for additional low-voltage feeders, medium-voltage feeders, or Smart Grid functionalities such as integration of monitoring systems or telecontrol units. The new 8DJH Compact is maintenance-free, resulting in reduced operating costs.

***Thanks to its compact dimensions, 8DJH Compact can be readily installed in new local transformer substations, and is the ideal retrofit switchgear for existing compact substations.***

Factory-assembled, type-tested 8DJH Compact is a three-pole metal-enclosed, single-busbar switchgear designed for indoor installation, and providing all the functionalities of other switchgear in the 8DJH product family. The medium voltage switchgear is used in public and industrial power systems of the secondary distribution level, for example in local transformer substations of power supply companies, or in medium-voltage in-feeds of infrastructure projects.

*(Source-SiemensAG)*

*Courtesy: Electrical Monitor, August 2013*

***NEVER lie to someone who trusts you. NEVER trust someone who lies to you.***



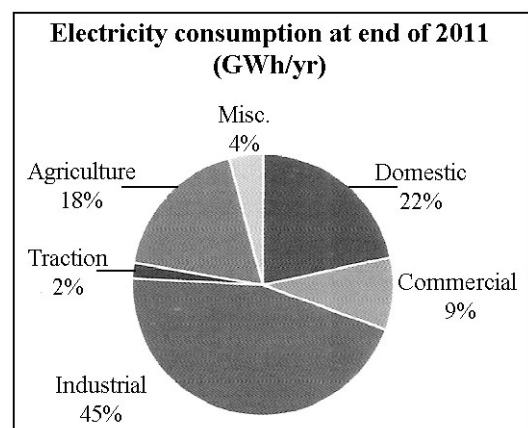
# THERMAL MANAGEMENT OF LEDs FOR LIGHTING SOLUTION

Lighting is rapidly transitioning from conventional lamp resource such as high-pressure sodium, metal halide, mercury vapour, and fluorescent to high brightness light-emitting diodes. Standard incandescent lamp have luminous efficacy as 16 lm/W, whereas LEDs are expected to be 90 to 140 lm/W, with the life of LEDs to be 50,000 hrs. As efficiency and drive current increase, the total lumens per emitter increases, reducing the initial cost of light and by providing energy savings. In LED lighting about 30% energy is distorted in light, whereas 70% is parting as heat. The junction to ambient resistance can be varied by using active cooling systems. Also the term used is Enhancement Factor (EF) of the active cooling devices. Good scope is observed in deviation of material and their combinations for effective thermal investigation. Variety of active and passive heat removal techniques are reported and hybrid systems are evolving. A range of aspects of thermal management, its need and scope is presented in view of developing LED lighting solutions for general household and corporation applications, which will be of great help for saving nation's wealth, by saving power utilization in lighting the country.

**Keywords:** Lighting, Standard incandescent lamp, LEDs, Enhancement factor (EF) and HBLEDs.

## 1.0 POWER SECTOR AND LED

By combined state, central and private sector 210 GW of electricity is produced in India (March 2012) and per capita energy consumption is 823 kWh in 2011, which is important to think on [1]. In spite of this, BPL households' electrification of more than 50000 houses is to be achieved by satisfying growing demand of electricity at the end of 2011; total utilization of electricity in India is shown in Figure 1. The basic electrification in villages and energy conservation in urban area are the main challenges in spite of growth in technology. As per World Bank report of 2009, total power consumption in India will change from 40,000 GWh/yr to 1,20,000 GWh/yr for lighting applications only [2]. Lighting is rapidly transitional from traditional lamp sources such as high-pressure sodium, metal halide, mercury vapor, and fluorescent to high brightness light-emitting diodes (HB LEDs). Standard incandescent lamp have luminous efficacy as 16 lm/W, whereas LEDs are expected to be 90 to 140 lm/W [3]. It makes it clear that use of LEDs will save enormous amount of energy. In spite of their introduction in market, HBLEDs still have a long way to go to attain their full potential. Process and packaging give way, life span and power efficiencies to be enhanced, more light output per chip, at a lower cost are some challenges.



## 2.0 SCOPE OF LED FOR LIGHTING

If also various lighting systems are available with their advantages and disadvantages, LEDs market is permanently growing for various applications like spot lamps, decoration lamps, flood lights, post lamps, residential lamps, etc. Large dimming ranges without efficiency loss are expected to be available in market and can be substitute to incandescent and fluorescent lamps. It has its own advantages as unlimited colour control, rapid brightness and colour changes, cold source, compact optics designs, better light distribution efficiency, longest lamp life, best power conversion efficiency, competitive life-time system cost, options available for lighting.

As efficiency and drive current increase, the total lumens per emitter increases, reducing the initial cost of light in addition to providing energy savings [3]. The optical and light related theory will be one of the important factors, which cannot be neglected. The maximum luminous efficacies of radiation is given by

$$K_{\max} = 400 \text{ lm/W} - 0.876 (Ra - 85) - 0.0179 (CCT - 3800 \text{ K}) + 2.08 \times 10^{-7} (CCT - 3800 \text{ K})^2$$

A light source at a given Ra and CCT having a luminous efficacy of radiation K lower than the  $K_{\max}$  can be said to have a spectral efficiency of  $K/K_{\max}$ .

It is stated that none of the individual loss are overwhelmingly dominant, although clearly the net efficiency of the blue LED pump (33%) is lower than those of the (phosphor + package) (54%) and the spectral match to the human visual system (78%). But because these losses are cumulative, and the efficiencies multiplicative, their product, the cumulative efficiency of the white lamp, is relatively low [4].

The light emitted depends on various parameters of individual LED and LED Lamp Assembly design. Design of thermal and optical considerations can be considered separately and are different areas to work. The general design parameters with thermal base design include: material of substrate component, combined material and



thickness effect of die attach material, copper slug's thickness, material effect of lamp structure, amount of lamp's fin array [5]. LED Lamp Assembly indicates various PCBs on which LEDs are mounted, fixture and its parametric properties. Initial applications gave insufficient attention for heat removal, which led to overheating and 'unexpected' shortening of the LED and product lifetimes. LEDs operate at relatively low temperatures (compared to incandescent lamps), but as light output per unit area and duty cycles increase, the thermal management and heat removal from the package becomes more and more important in order to keep junction temperatures at acceptable levels [6]. Different placement method on a printed circuit board (PCB) assembly design also affects on thermal performance of LEDs. By optimizing the placement design, the average surface temperature of the LED array achieved a decrease of about 20%, from 120°C to 100°C. A significant drop in the surface temperature of the LEDs was found when the triangular and arithmetic pacing placement methods were used [7].

### 3.0 METHODS OF INVESTIGATION AND LED LIFE

For achieving higher luminous efficacy, an ideal solution would be improvement of the internal and external quantum efficiency; practically lowering the LED junction temperature. The lifetime of the luminaries is determined by the lumen maintenance of LED and the reduction of the fixture efficiency, which can be expressed as

$$t_{\text{life}} = f(g_{\text{LED}(t)}, F_{\text{fixture}(t)})$$

Where  $t_{\text{life}}$  is the luminaries lifetime at the lumen maintenance of 70%,  $g_{\text{LED}}$  is lumen maintenance of LED, and  $F_{\text{fixture}}$  is fixture efficiency. The lumen maintenance of LED is:

$$L_{\text{LED}} = L_0 g_{\text{LED}}(t) = L_0 e^{-a(T_j)t}$$

Where,  $a$  is the junction temperature-dependent light output degradation rate,  $t$  is the operation time measured in hours, and  $L_0$  is the initial light output in lumen [8]. To understand performance of LED lighting system, various methodologies are used. For heat transfer analysis also the structure function is used, which can be obtained by direct mathematical transformations from the thermal transient response curve. The cumulative structure function provides a map of the cumulative thermal capacitance of the one-dimensional heat flow path with respect to the thermal resistance from LED junction to ambient. The differential structure function is defined as the derivative of the cumulative thermal capacitance with respect to the cumulative thermal resistance [9]. Major analysis was performed by using software like ANSYS, CFD, etc. The analysis was also made by transient thermal measurement and thermal simulation using the Finite Volume Method [10].

The software used can give simulated results, but after manufacturing LED lamps, testing is to be performed. There is no exact test that can predict performance and reliability under all environmental conditions for every conceivable luminaries design. All types of hot-cold, dry-humid, vibrations, rainy environments are to be tested in practice. However, by simulating worst case specific environmental conditions that occur during the expected life one can gain confidence in applications. Parameters in Highly Accelerated Life Testing (HALT) can be tested using shocks, bump tests, Dust effect, Rain effect, freezing rain effect, etc [11]. Table 1 shows operating parameters during test of LED. The temperature and heat are the most important areas to focus to raise life of LEDs.

**TABLE 1**  
**SUMMARY OF OPERATING AND DESTRUCT LIMITS OF LED TESTING**

Stress Type	Chamber Set point level
Temperature Lower Operating Limit	-60°C
Temperature Lower Destruct Limit	<-100°C
Temperature Upper Operating Limit	+120°C
Temperature Upper Destruct Limit	>+130°C
Thermal Transitions (°C)	>+50°C/minute
Vibration Operating Limit	45g
Vibration Destruct Limit	45g
Combined Operating Limit	60gs and 115°C to -60°C
Combined Destruct Limit	65g and -60°C

### 4.0 ENERGY CONVERSIONS IN LED LIGHTING

In LED lighting about 30% energy is transformed in light, whereas 70% is leaving as heat [12]. However, its low electro-optical translation efficiency can stimulate a high percentage of input power that convert into surplus

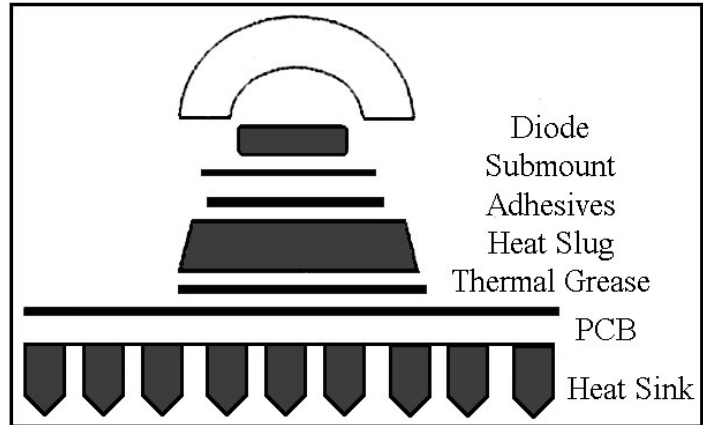
heat, growing the junction temperature [13]. The heat can be removed and junction temperature can be lowered by using natural and / or forced convection or conduction. It is to be made clear that it is difficult to satisfy the requirement of heat dissipation for HPLED using natural convective heat transfer. That is there is no option for forced convection or other methods of heat transfer [14]. The impact of LED array density, LED power density, and active versus passive cooling methods on device operation were calculated. In order to help understand the role of various thermal resistances in cooling such compact arrays, the thermal resistance network was analyzed in order to estimate the contributions from materials as well as active and passive cooling schemes [15].

Energy generated in LEDs depends on current supplied to system. For brighter light output, more current is supplied; it will in turn result in higher junction temperature, and lead to robust design, which indirectly will go for high cost. If low thermal resistance material is preferred, it will again lead to higher cost [16].

### 5.0 STRUCTURE AND JUNCTION TEMPERATURE FOR LED

The structure of general LED is shown in Figure 2, for which various materials can be used for subcomponents, and equivalent thermal resistance is calculated for analysis of junction temperature.

The thermal resistance of high-power LEDs can be divided into three parts: 1) junction-to-heat slug 2) slug-to-board and 3) board-to-air. Heat generated from the LED die flows from the junction to the solder balls, which connect the LED die to the submount, the thermally conductive adhesive, and the heat slug [17]. At junction temperatures above 100°C, the efficiency of these LEDs suffers significantly in comparison to InGaN-based LEDs [3]. The maximum junction temperature is stated as 120°C always, which is difficult to measure in actual practice. It is suggested to take solder point temperature in consideration by correction factor  $T_c$  [12], which is function of that LED.



$$T_c = R_{th} \cdot I_f \cdot V_f$$

$$T_{solder,max} = T_{jmax} - T_c$$

Where,  $T_c$  is correction factor,  $R_{th}$  is thermal resistance of LED,  $I_f$  is forward current,  $V_f$  is forward voltage,  $T_{solder,max}$  is maximum allowed solder temperature,  $T_{jmax}$  is standard junction temperature.

The electrical power dissipated by a LED depends on the injected current into the diode and also on its voltage drop. The essential effect can be modeled as an ideal diode. The junction temperature ( $T_j$ ) depends on both the electric power and also on the ambient temperature  $T_a$  and on the junction to ambient thermal resistance [18]. The junction to ambient resistance can be varied by using active cooling system. Also the term used is enhancement factor (EF) of the active cooling device, which is defined as the ratio of heat removed with an active cooling device ( $Q_{active}$ ) to the heat removed through passive means, largely through natural convection ( $Q_{nc}$ ), at the same temperature [8]. The junction temperature is expressed as

$$T_j = T(T_a, R_{cond}, I_f, EF)$$

Where  $T_a$  is ambient temperature,  $R_{cond}$  is internal conduction resistance of LED,  $I_f$  is forward current in diode.

### 6.0 MATERIAL FOR LEDS

Varieties of material combinations are observed in LED making as stated in 5.0 above. To manufacture LED is a critical process itself. It has variations in materials in lens, solder, submount, adhesives, heat slug, PCBs, and heat sink. Huge scope is observed in variation of these. E.g. only adhesives can be studied as thickness, material, conductivity additions, area exposed [16]. During package design ultra high thermal conductivity composites are recommended. Examples like composites and ceramic materials, Copper matrix/diamond particles can be used with conductivities up to 700 W/m<sup>2</sup> K [15]. But cost is main stumbling block.

Heat dissipation increases when a thin layer of copper is added to chip packaging. Although a slightly larger reduction in temperature was noted for a slightly wider layer of copper between the LED and substrate [19]. Material like Ceramic filled thermo Silicone and graphite foils are suggested in assembly of LEDs for electrical insulation application with higher conductivity and lower thermal resistance. With chip packaging, heat slug is also one of the important components used in LED. Heat slugs of Fe, Cu and Carbon nano tubes are tested with natural convection and its effect with forced convection. The natural and forced convection efficiency was noted in range of 13 and 18% respectively [20]. CNTs are also reported by [21] and stated strongly that it will affect on reduction in thermal resistance.



Various die-attach materials - silver paste, Sn-Ag-Cu (SAC305) solder, and SAC305 solder with a small amount of carbon nanotubes (CNTs) are used. Use of CNTs into the SAC305 solder reduces thermal resistance [22]. The silver epoxy of 30 microns is used in between Sapphire and aluminum board in FEM as well as experimental analysis [23]. LED modules were fabricated by sintering nanosilver paste as die-attach material, which is as an environment friendly alternative die-attached solution and has potential in high power LED packaging [24]. Positive effect on junction temperature by variation in substrate (Copper, SiC, and Sapphire) and die attached material, thickness effect of Cu slug is stated. [5]. The thermally designed LED module with thermal grease between the PCB and the aluminum case and with a heat sink structure exhibited about 20% decrease in junction temperature compared with a basic structure before thermal design [10]. Various TIMs are reported [25]. Material plays very important role in heat dissipation in LEDs. Figure 3 shows various micro area of work for heat dissipation.

### 7.0 REVIEW OF COOLING SYSTEM

It is more stressed from above discussion that LEDs are important for long run with high life, but it can be achieved by improving thermal performance of LEDs and packaging system. The thermal engineers are having this leading challenge to make it possible for typically Indian power sector.

In order to increase the luminous flux for compact HPLED arrays, attention must be on improving the packaging design by providing the highest convective heat transfer coefficients possible. For all types of such systems, energy consumption is the important constraints. Thus, the methods such as flat heat pipes, forced air convection, and liquid cooling will be of primary importance [15]. Figure 4 gives such type of cooling techniques use/observed in LED cooling. The degradation mechanism of the active cooling device will also greatly affect on the useful lifetime of the luminaries. This leads to use of synthetic jets with its in built features, such as no rotating parts, they are expected to meet the required life [8]. Vibrating Piezoelectric Fins shows perform better than traditional fins on heat dissipation due to the lower convective obstacle and strongly affected by length, vibrating frequency, pitch, and amplitude of the fins [26].

Only piezoelectric jet is not important to get effective cooling system, but the flow contour, and patterns are equally important to make them effective. A typical cooler is designed to pump air from the inlet (20 mm x 20 mm) to the two outlets (35 mm x 5 mm). The piezo-fan blade is positioned inside the cooler, and it works as the driving component of this air pump. When the fan blade moves up, and down, air above the fan blade is pumped out and in [21].

Whatsoever may be developments, the interest of thermal designers are with heat sink till date with its passive pattern of heat removal. The performance of a honeycomb heat sink was investigated by experimentation and numerical models, which can reduce weight for application in high-power LED street lamps. Honeycomb heat sink can be improved by increasing the number of cells, aspect ratio, and the proper rib-space ratio at the fixed cylindrical radius, also the factors like thermal resistance and flow resistance are important [27]. The high-power 100 W LED spot lamp for optimizing design of the heat sink of LED spot lamp by varying fin width and numbers and optimizing it related to weight and convection coefficient. It is observed that the weight of the heat sink is decreased to 46.1 % of that for the initial structure. The LED junction temperature can be written as a function of ambient temperature with the relation  $T_j = t + 60$  ( $t$  is the ambient temperature) [28]. In [5] also 1 W x 3 LED

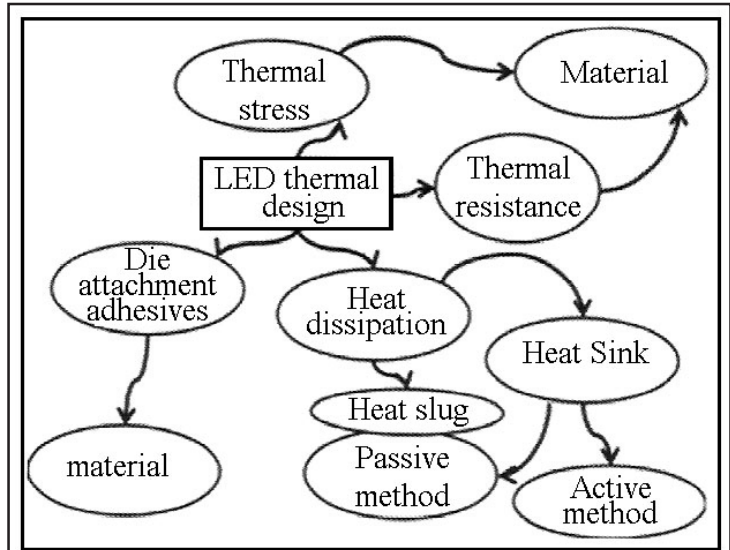


Fig.3: Areas of LEDs Thermal Design

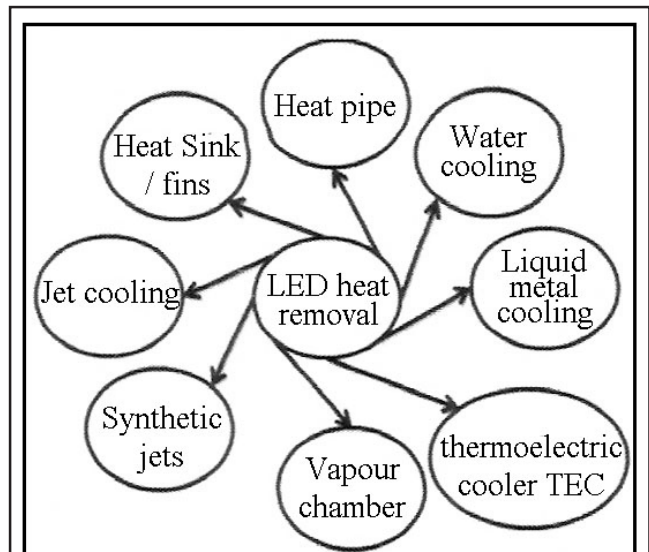


Fig.4: LED Heat removal at system level

lamps tested with 30, 36, 45 fins and there is almost a 10°C reduction of thermal performance and 4% improvement for luminous flux when the lamp is increased six fins. Design protocols are also stated in [16]. The simulation results by [5] of Philips and Cree (1 W x 3) LED lamps make public that the junction temperature can be reduced, and the light output can be improved successfully by rising the number of fin-array, and the cavity radius of the lamp.

The convective heat transfer coefficient with fins affects for higher heat dissipation. For heat dissipation improvement in a 10- LED array stage with an enclosed channel, a longitudinal multi-fin heat sink with different heat transfer coefficients was studied. With  $h = 20 \text{ W/m}^2 \text{ K}$ , and typical fins will lead to maximum temperature of 82.3°C, from original of 123.9°C [29]. A different type of porous micro heat sink with circulation of fluid in it is proposed for the thermal management of high power LEDs. Even at the heat flux of 200 W/cm<sup>2</sup>, the heated surface temperature is about 55.2°C. Increasing inlet fluid velocity can decrease the temperature in the micro heat sink and the heated surface temperature [30].

A heat pipe is one of the promising techniques for heat removal with advantages of compact construction, low thermal resistance, light weight, low cost, and anti-ash-deposition, but higher cost. Good heat dissipation was noted for a 27 W LED illumination system equipped with a horizontal heat pipe filled with water, with a steady temperature 50°C maintained at all pipe rotation angles between 0-90. According to results, fins added to each side of the cooling section of heat pipe were ineffective for heat dissipation [19]. With use of heat pipe radiator, the junction temperatures with the flat heat pipe radiator is noted as 52.5°C compared with earlier 75.2°C for forward current of 0.35A. A heat pipe coming out of substrate of LED with number of fins mounted at heat rejection end is reported [31]. Even aluminum plate oscillating heat pipes (OHPs) consisting of parallel square channels for LED heat sink design are reported [32].

A thermoelectric cooler (TEC) is used in electronic packaging, with the heat sink and the fan. The thermal resistances of TEC, thermal interface material (TIM) and heat sink are analyzed by thermal resistance network method in the situation of different chip power, different TEC input current and different wind speed caused by the fan. The result shows that when the surface wind speed of heat sink is 3.6 m/s, the performance of TEC + heat sink + fan method is better if chip power is less than 35 W [33]. TEC is also investigated for the 6 x 3 W LEDs in two rows. The temperature of the substrate of LEDs decreases by 17°C. Heat flows from chip-substrate-TEC-Fins-air through fan. The combined system is demonstrated. For higher input power to TEC, junction temperature reduces by good cooling effect [34].

An Electro-hydrodynamic (EHD) approach, where the forced convection of air is achieved by the ion wind due to gas discharge phenomenon can offer a heat transfer coefficient seven times larger than that of natural convection. EHD approach seems to be very promising for the thermal management of LED devices [35].

Phase change heat transfer will have higher heat transfer coefficients. For which various types of fluids are tested. Thermo-fluid (FC-72) characteristics of two-phase micro-gap (110 μm - 500μm) coolers used in HPLED cooling [17]. The two-phase flow heat transfer device of the vapor chamber has better thermal performance than heat sink. This principle is used in vapor chamber results, and show that the effective thermal conductivities of the vapor chamber are many times higher (965 W/m°C at 187.5 W/cm<sup>2</sup>) [36]. Vapor chamber is coupled to fin heat sink, which is applied to high power LED light source. The fin heat sink assembled on vapor chamber demonstrated good heat removal capacity, indicating an overall thermal resistance of 0.654 K/W at the ambient temperature of 27°C for stated case [37]. Various fluids like air, water, and even liquid metal are reported in forced convective heat carrying equipments. Liquid metal's very high thermal conductivity will reflect in a greater convective heat transfer coefficient and a smaller convective thermal resistance when compared with water as cooling fluid [38].

## 8.0 CONCLUSION

The junction temperature of LEDs affects on the life as well as lumens produced by lightning. The thermal analysis is to be carried out at LED level as well as at system-fixture level. Combined materials can be tried for thermal analysis to reduce thermal resistances. When heat is coming out from system focus can be on third resistance i.e. board to air. To achieve higher convective heat transfer coefficient, various techniques can be tried. Scope is on to the use of hybrid systems. Special care is to be taken while using active cooling system, hence its life will affect on LEDs life. But for very high power LEDs mast active system is the only option. Organic LED devices are very efficient in material use, and a scope for optical research for this is observed. For general household, corporation applications, till date LED technology has not reached the ground level. Its cost is the main obstacle. If it could be achieved, it will be of great help to the nation by saving power utilization in lighting the country.

*Courtesy: Ingole Sunil B and Sundaram K K; Cpri journal, December, 2012*



# INTEGRATING RENEWABLE ENERGY WITH GRID

In order to alleviate global warming by reducing greenhouse gas emission from combustion of fossil fuel, a good number of countries are committed to curb 40-50 per cent carbon emission and increase the share of renewable energy to about 15 per cent of the total energy generated by 2020. Hence green energy and its efficient distribution receives heightened attention presently. On paper, wind and sun could supply most of the energy requirement of USA, India and many other countries. However both sources are too erratic to supply more than 20% of total energy capacity. Beyond that point, balancing supply and demand becomes too difficult. What are needed are, cheap and efficient ways of storing power, to be utilized later, when winds are whistling and the sun is scorching. The sun does not shine at night and the wind does not always blow. If renewable energy and fusion energy is going to take off, we need good ways of storing it for the times when the sun is not shining, wind is not blowing and the consumer demand is low. Denmark is a small nation. But it has some of the World's largest wind farms. Yet when the winds blow hardest, statistics shows consumer demand for electricity is lowest. So Denmark as to sell its excess electricity at a throwaway price to neighboring countries and has to buy electricity at a very high price during peak demand. The result is, Dens have to spend electricity bill which is one of the highest in the World. So methods to store large amounts of energy for downtimes have been developed to meet the demand at the peak period. Certain technologies such as superconducting magnets, super capacitors, and advanced flywheels, although quite feasible, are quite expensive or cannot hold efficiently power for extended periods. However the following technologies can meet the requirement in terms of efficiency, reliability and cost-effectiveness. Each of them could store, for days, the amounts of energy needed to keep an entire big city running.

## Uphill Reservoir

Many countries including India already store considerable energy in uphill reservoir using pumped hydro. USA stores about 20 gigawatts in this method. In fact this is a century old technique which is basically a hydroelectric dam that can operate in reverse. When the demand is low excess electricity is used to pump water from a low reservoir to one at a higher elevation, from where it can later fall to turn turbines to generate electricity when demand rises. The energy that can be recovered after losses is as high as 80%. The scheme is shown in Fig 1. The system comprises of an underground power station having reversible turbine connected to generator cum motor. When demand is high water from higher reservoir falls through the turbine through a system of water pipework and is collected in the lower reservoir. The turbine rotates the generator producing electric current. The process is reversed when there is excess grid power. The generator then acts as a motor and excess power pumps water uphill for storage. The topography of a country limit the growth of this technology. All you need is an elevation difference and some water. Japan stores about 10% of country's electrical generating capacity, Europe and USA's share is about 5% and 2% respectively. Among the most ambitious plans is the Eagle Mountain pumped storage project in California, USA where two reservoirs would be built out of abandoned iron surface mine to store regional wind and solar farms and it is designed to generate 1.3 gigawatts of power - as much as a large nuclear power station. Some countries like Denmark and Holland are just too flat. But they are very near to Sea. Holland has come up with an alternative idea.

In this concept, an artificial lagoon in a shallow sea with a circular wall would be built from landfill. Excess electricity would pump seawater out of the lagoon into the surrounding ocean. When energy is needed, water from the sea would flow back inside, through tunnels in the Wall, passing through turbines. The ocean acts as the upper reservoir.

## Blasting Air

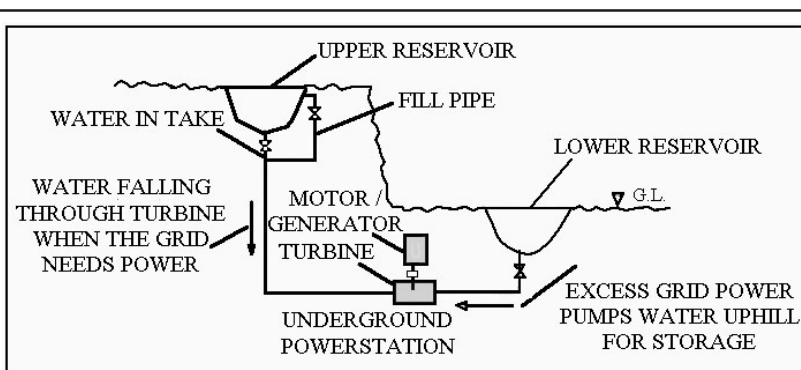
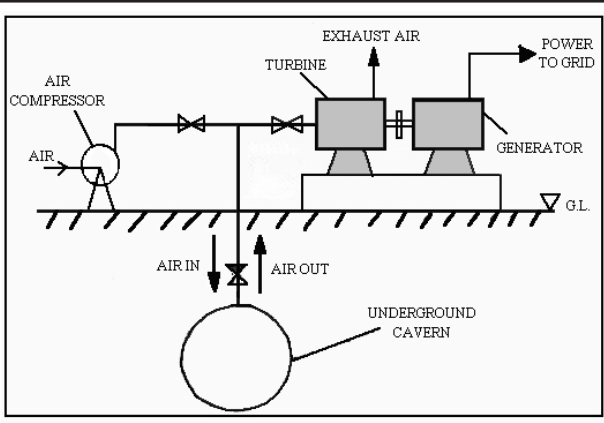


Fig.1: Uphill Reservoir

As shown in Fig 2 powerful electric compressor at ground level injects air at high pressure into the underground cavern when electricity supply exceeds demands. When the power demand is high, some of that compressed air is let out, blasting through turbines coupled to generator which generates electricity meeting the peak demand. Many countries including India have geologic formations of one kind or other, including natural caverns, underground salt deposit, depleted Oil/gas fields that could hold compressed air. However it requires detailed study about the



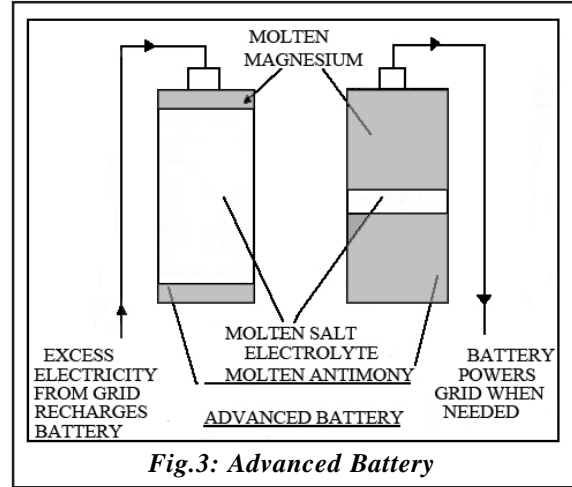
**Fig.2: Blasting Air**

rock formation. As sandstone formation is permeable it is not suitable for compressed air storage. Underground salt deposit is plentiful in Southern USA Power South Corporation McIntosh, Alabama created a cavern by slowly dissolving an underground salt deposit with water which is half in size of Empire State Building. This facility can provide about 110 megawatts for upto 26 hours. This compressed air system has been operating successfully for the last 20 years. One practical problem is that air heats up when it is compressed. Again it gets chilled when it is expanded. This means some of the energy that goes into compression is lost as waste heat. And during decompression air gets so cold that everything in contact with it freezes. The first victim will be turbine blades which under freezing temperature would become brittle and break down. The simplest way is to burn

natural gas to warm the cold air as it expands into turbine. However this will reduce overall efficiency and release carbon dioxide which undermines the benefits of green energy. As a countermeasure one option is to insulate the cavern so that the air stays warm. Another option is to transfer heat to a solid or liquid through heat exchanger or regenerator. The heated reservoir could later reheat the expanding air. The third option is to spray water into the air just after compression. The water will be heated and stored in an insulated tank. The hot water is later sprayed back into expanding air, warming it.

**Advanced Batteries**

Batteries are the ideal storage medium for intermittent power sources. They charge readily, turn on and off instantly and can be scaled up easily. For many decades batteries have been used as backup power. AES a power company in USA have installed lithium-ion batteries of 30 megawatts capacity to back up its 98 megawatts of wind turbines. But if batteries are to compete, their cost must drop considerably. At the Massachusetts Institute of Technology, a battery of uncommon design has been developed. It is very simple hence cost effective. The scheme is shown in Fig. 3. It is a cylindrical vessel kept at high temperature filled with two molten metals i.e., molten magnesium at +ve end and molten antimony at -ve end separated by salt in between them. The liquid metals are not soluble in molten salt electrolyte. As these metals and salt have different densities they stack on top of each other naturally according to their densities. When the two metals are connected via an external circuit, an electric current flows. Ions of each metal dissolve into the molten salt, thickening that layer. To recharge the battery, excess current from the grid runs the process in reverse, forcing the dissolved ions back into their respective layers. Another option is flow batteries developed by same MIT, USA which contains a storage medium which is essentially a fluid containing nanoparticles which can store a lot of energy. Energy density is a measure of how much energy a battery can store. The prototype of this battery made at MIT has the energy density of today's best lithium-ion batteries. The flow batteries have several advantages. It operates at room temperature, unlike the liquid metal batteries, which must be heated up. To scale up, just make bigger tank and make larger electrodes, or add more containers. The storage medium is a black slurry of nanoscale Particles and grains of energy storing metals, under electron microscope if the storage medium is seen one can see dust size particles made of the same material that make up the negative and positive -electrodes of Li-ion batteries, e.g. lithium cobalt oxide for the positive electrode and graphite for the negative one. In between those relatively large particles suspended in a liquid, would be the nanoscale particles made of carbon. Clumping together into a spongelike network, they form tree flowing wires that connect the larger grains of the battery, where ions and electrons are stored. The result is a liquid that flows, even as its nanoscale components constantly maintain pathways for electrons to travel between grains of energy storage medium.



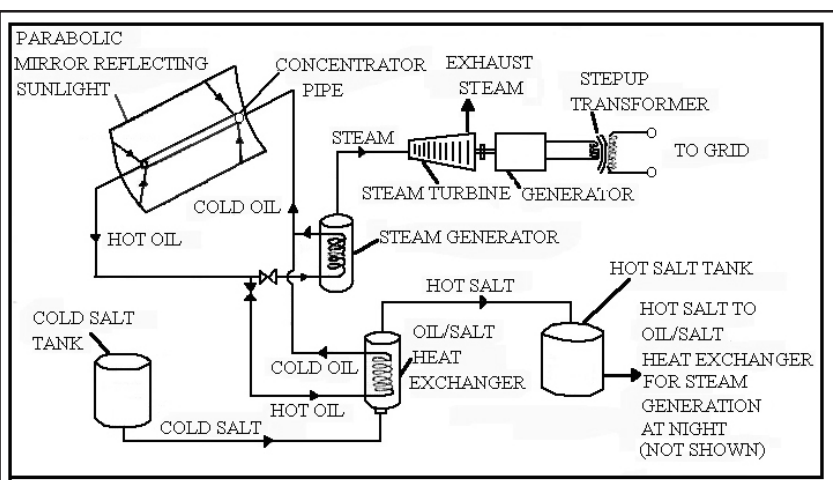
**Fig.3: Advanced Battery**

**Thermal Storage**

In Thar Desert, Rajasthan there is plentiful sunshine. In this region photovoltaic (PV) cells can be very successfully utilized for generation of electricity. However at night there will be no generation. This problem can be easily addressed by installing concentrated solar power stations which can an economical way to generate power



during daytime as well as store Sun's energy which can be utilized at night for electricity generation. Power from today's concentrated solar power plants at present is about twice as expensive, as that from a natural gas plant. Yet considering the increasing cost of fossil fuel, industry road map predicts that by selecting suitable plant design including chemistry of fluid, concentrated solar energy could become competitive within 5 years, especially if plants are built in Rajasthan and Gujarat in India and Sahara Desert that rarely see clouds and if the fluid selected is salt. The scheme is shown in Fig 4. Rows of parabolic mirrors focus sunlight on long concentrator pipe that run parallel to rows,

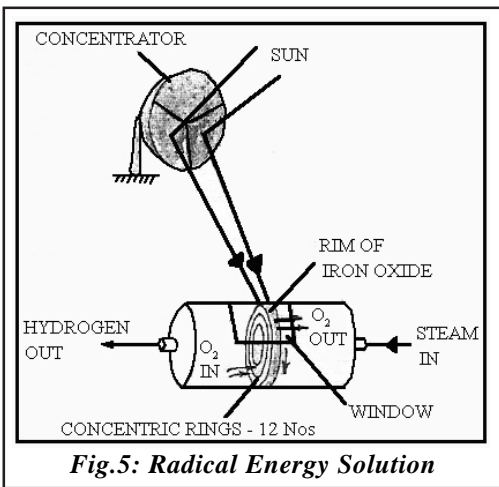


**Fig.4: Thermal Storage**

heating a fluid such as mineral oil inside the pipe. A part of the hot oil travels to boiler where its heat converts water into steam, which turns a turbine to generate electricity. Remaining part of the hot oil simultaneously goes to the oil/salt heat exchanger where cold salt is heated to hot molten salt. The hot salt is stored in a hot salt tank to be used when there is no sunshine. At night the hot salt heats cold oil in a oil/salt heat exchanger (not shown in the sketch) and the hot oil then travels to the steam generator to generate steam for power generation. Molten salt can be heated to nearly 550 degrees C compared with 400 degrees C for oil, so it can create more steam for more hours after sundown. 5 cubic meters of molten salt can store one megawatt-hour of energy compared with 12 cubic meters of oil. In Italy in the town of Syracuse in Sicily and in Andalusia, Spain plant has been built on this concept using molten salt which has been operating since 2008. And in June 2011, after overcoming the teething trouble, the Spanish plant achieved the milestone of 24-hour uninterrupted solar electric generation.

**Radical Energy solution**

One radical effort at Sandia National Laboratories, USA has been done to capture sun's energy to convert steam into hydrogen and Oxygen. The Prototype has been working successfully and has very high potential impact on energy supply. The pilot plant has been built in the New Mexico desert in USA and consists of a 6 meter wide dish of mirrors. It concentrates the sun's rays on a half-meter-long cylindrical machine, shaped like a beer keg that is mounted in front of the dish as shown in Fig 5. The mirrors focus sunlight through a window in the drum's wall on a dozen of concentric rings that rotates at a speed of once a minute. The ring is provided with a rim which is made of iron oxide or cerium oxide and rotates in the region of focused beam of the sun, thereby heating to about 1500°C. That heat drives the oxygen out of the iron oxide. At the same time steam is injected inside the drum. As the ring rotates back into cooler dark side of the reacting vessel, they suck oxygen back out of steam leaving behind hydrogen. Thus from this end of the reactor, hydrogen fuel comes out which is stored in storage vessel. At night when there is no sunlight, the stored hydrogen, being very pure can be utilized very easily in fuel cell to generate electricity efficiently. Instead of steam, carbon-di-oxide can also be used as a raw material in which case energy rich carbon monoxide can be generated for subsequent use in a gas fired power plant. The process could also absorb as much CO<sub>2</sub> as is emitted during burning of synthesized CO in the gas fired power plant. This means clean fuel supply, greater energy-security, carbon dioxide reduction and less climate change. The main problem in this technology is that the iron oxide rim with use gets cracked due to thermal spalling i.e., cycling back and forth from 1500 degrees to 900 degrees. The problem is addressed by making the rim with nanomaterial. The high cost of mirror would also have to drop.



**Fig.5: Radical Energy Solution**

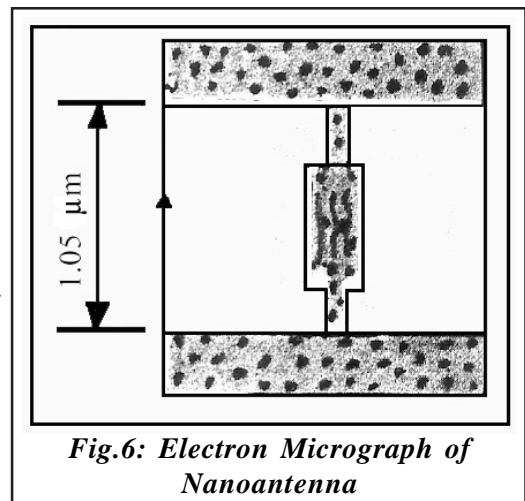
**Solar Cells capturing energy at night**

A solar cell that works at night - it sounds like an oxymoron, but a new breed of light sensitive solar cells have been developed that can harvest energy round the clock. The key to these devices is their ability to harvest radiation including infrared. Beyond the red end of the visible range of sun's energy, but frequencies higher than of radar waves and microwaves, is the infrared region of the electromagnetic spectrum between 10<sup>12</sup> and

$5 \times 10^{14}$  Hz frequencies (or wavelengths from 0.1 to  $7.5 \times 10^{-5}$  centimetre). Nearly 50% of sun's radiant energy is emitted in the infrared region, with the rest is primarily in the visible range. The overall efficiency of the most modern silicon solar cells is limited to 25%. If the orientation of the panel is wrong with respect to the sun's position, light reflects off the solar panel instead of being absorbed and the efficiency drops down drastically. A new breed of electronic solar cells with billions of multiple layers of tiny antennas - with each layer tuned to a different optical frequency have been assembled that could capture both visible and infrared radiation. Infrared is reemitted by earth's surface after the sun goes down, meaning that these new-generation solar cell antennae also capture some energy even at night in addition day time power generation. Unlike photovoltaic (PV) cells, which use photons to liberate electrons, the antennas of the new breed of cells resonate when hit by light waves, generating an alternating current that can be harnessed. Under ideal conditions, solar arrays of billions of tiny antennae can harvest 84% of incoming photons. However considering all losses it has been seen that this new generation of cells can easily achieve the efficiency of 46%. Most important, it can supplement the grid with power at night. For building these new generation of photovoltaic cells two technological parameters are to be fulfilled. First, the length of the antennas must be close to the size of the wavelength being captured, which in the case of the solar spectrum can be very small - from millimetres down to a few hundred nanometers. Second, the currents produced will be alternating at frequencies too high to be of use unless they are first converted into a steady current. The problem here is that silicon diodes, which are crucial to the conversion, typically don't operate at the high frequencies required. Both of these barriers are now broken down by developing a technique for creating arrays of billions of antennas small enough to work with mid, near infrared and far end of the infrared spectrum. Current conversion problem has been tackled by creating novel diodes capable of handling high optical frequencies. Semiconductor diodes act like valves, converting alternating current into direct current. To work with the new generation of antennas they have to operate at the AC frequencies being received and match the conductive properties of the antenna. Semiconductors are ill suited for this, as they tend to become less conductive when shrunk to the size of the antennas. It is found that physical geometry of the device influences current flow. The aforesaid problem is addressed by creating asymmetry in the geometry of the diodes which funnels electrons to flow only in one way. Nanoantennas are optical collection devices which are designed to absorb specific Wavelengths that are proportional to the size and shape of nanoantenna. Just like their bigger RF counterparts, they have the advantage of limiting the incoming radiation to one mode with one polarization. Several different types of nanoantennas have been used to generate power from optical radiation such as dipole, bowtie, spiral and log-periodic nanoantennas or microstrip antennas to suit the specific wavelength. They can be used in the visible and infrared ranges.

A nanoantenna is fabricated using electron-beam lithography and lift-off technique. A typical dipole antenna element is made of 100 nm-thick evaporated gold and a bolometer made of nickel is patterned at the feed-end of the nanoantenna to serve as the detection mechanism.

A pair of 200  $\mu\text{m}$  bond pads are patterned on both ends of the dipole antenna in order to provide biasing and to obtain the electricity. The device is fabricated on a silicon wafer with 200nm of thermally grown  $\text{SiO}_2$ . The device is shown in Fig. 6.



**Fig.6: Electron Micrograph of Nanoantenna**

*by Rathindra Nath Biswas, Kolkata; Courtesy: Ieema Journal, July 2013*

## ELECTRICITY GENERATION FROM CATTLE WASTE

A project for electricity generation from cattle dung is currently being run at the Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana.

The University has been encouraging farmers to use cattle dung for both bio gas generation and electricity production.

As a demo model the University set up a plant with a capacity of 4,500 kg (daily) cattle dung in its campus for farmers to see for themselves.

### Present generation

As of now the plant generates 240 KW hours of energy daily and with this a 40 KW bio gas operated generator is being run for six hours daily to produce electricity.

The electricity is being used for chaffing green fodder, machine milking, operating the fans, coolers and foggers installed inside the animal sheds.

The waste slurry obtained from the bio gas plant is used as manure for crops. The slurry is a better fertilizer than the farm yard manure for crops.

A tractor operated vacuum tank of 8,000 litre capacity removes the slurry from the unit and spreads it on the fields. This results in more green fodder yield and reduced dependence on chemical fertilizers for growing the crops.

*Courtesy: The Hindu, dt:22.08.2013*

# STATE-OF-ART SOLUTIONS FOR CONTROLLING HARMONICS

**Introduction:** Harmonics are the multiples of fundamental frequencies. They are generated due to non-linear loads. Non-linear loads, by definition are the equipments which draw non-sinusoidal current even from a sinusoidal voltage source. The examples of non-linear loads are Rectifiers, Induction furnaces, UPS Systems, Variable frequency drives and so on. The adverse effects of harmonics in industrial plant are well known:

**Effects Of Harmonics:**

The harmonics adversely affect almost all the components of any industrial plant:

- Power factor improvement capacitors draw excessively high current if voltage is contaminated with harmonics.
- The magnetic equipments like motors, generators and transformers are abnormally heated up due to harmonics. This is due to increased copper loss, hysteresis loss and eddy current loss.
- Fuses, Circuit breakers, Protective relays malfunction due to harmonic currents.
- Neutral cables get over heated due to addition of zero-phase sequence triplen harmonic current.

Due to the adverse effects of the harmonics, harmonics needs to be controlled.

There are two philosophies of harmonic control.

- To eliminate or reduce the harmonics by taking care in the equipment design. This is essentially in the “Green Power Technology”.
- Elimination or reduction of harmonics which are already generated by the non-linear equipment which was not designed to take care of harmonics.

In industries both these philosophies are prevalent for harmonics control.

**Prevention of Harmonics By Design**

**1. Multipulse Converter**

3-phase rectifier consisting of 6-diodes having 6-pulse design is shown in Fig-1. This is a basic building block of variable frequency drives, UPS systems, battery chargers and so on... This rectifier has typically 62% current distortion (THD).

Please refer Fig-2 showing the input current waveform. In order to reduce this current distortion by design multi-pulse converters are commonly used.

Please refer to Fig-3 showing schematic of 12-pulse rectifier. It consists of 12 diodes instead of 6 diodes. The two 6-pulse converters are connected to two secondaries of input transformer. One secondary is star connected and other secondary is delta connected to give 30° phase shift. The current distortion is reduced from 62% to about 8% in this configuration. The input current waveform of 12-pulse rectifier is shown in Fig-4. This technology is further extended to 18-pulse or 24-pulse converters to further reduce the current distortion. This technique is used in high power rectifiers.

For example in HVDC transmission (High Voltage Direct Current transmission) multiple converters are used. However, multi-pulse converters have disadvantage of using more number of devices leading to relatively poor efficiency.

They also required intricate transformer design and balancing required for current sharing by multiple converters. Hence the state-of-art technology in converters is PWM converter.

**2. PWM Converter**

The schematic of PWM converter is shown in Fig-5. It uses 6-IGBTs in place of 6-diodes. PWM converter has following advantages.

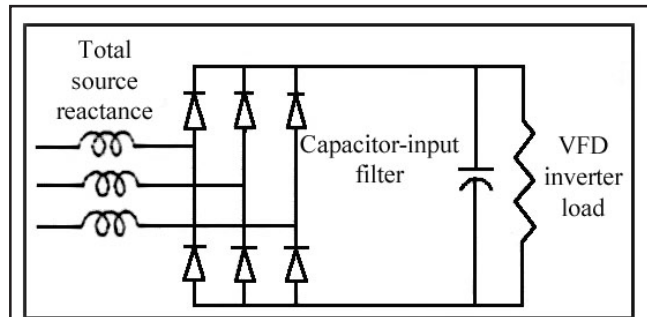


FIG.1: 6 PULSE CONVERTER SCHEMATIC

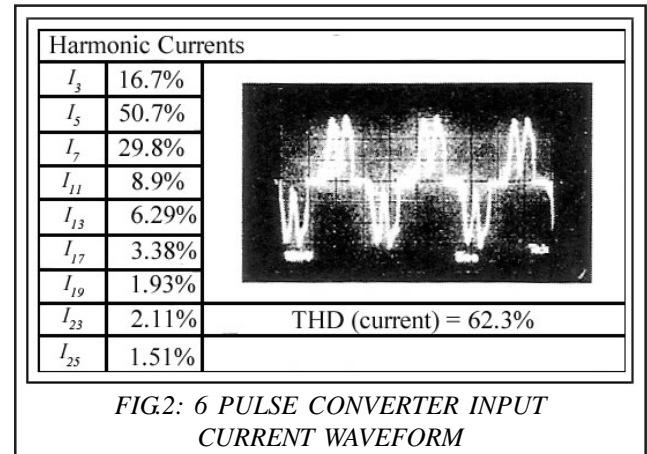


FIG.2: 6 PULSE CONVERTER INPUT CURRENT WAVEFORM



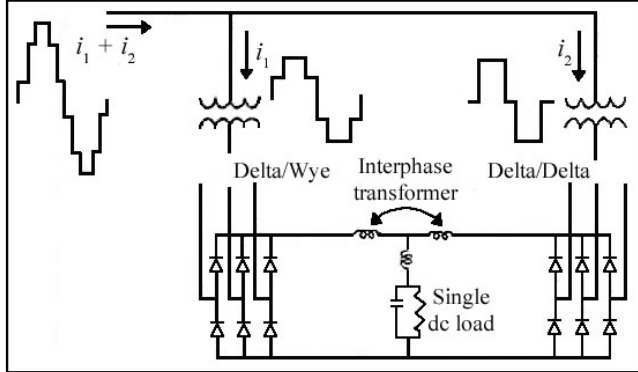
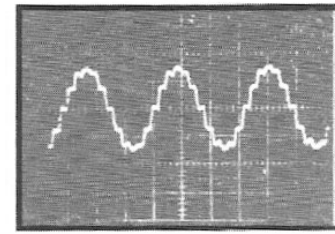


FIG.3: 12 PULSE CONVERTER SCHEMATIC

Harmonic Currents

$I_3$	1.2%
$I_5$	1.2%
$I_7$	0.6%
$I_{11}$	7.6%
$I_{13}$	1.1%
$I_{17}$	0.3%
$I_{19}$	0.3%
$I_{23}$	1.3%
$I_{25}$	1.1%



THD (current) = 8.1%

FIG.4: 12 PULSE RECTIFIER INPUT CURRENT WAVEFORM

- It reduces the input current distortion to less than 5%.
- It can work at unity power factor and it can also be made to operate at leading power factor to compensate for the poor power factor created by other lagging power factor loads.
- It can work in both ways i.e. it can transfer the power from mains input to output as well as it can feed back power from regenerative loads to mains. Thus it can lead to energy conservation in case of some applications like Centrifuge.
- It can stabilize DC link output voltage against fluctuations in mains input voltage.

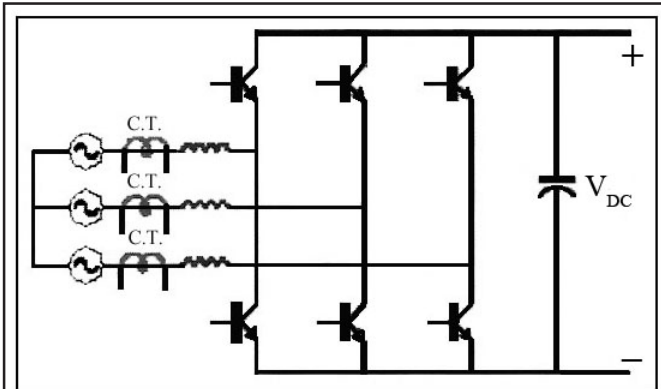


FIG.5: PWM CONVERTER SCHEMATIC

All the above techniques of harmonics control are the examples of harmonics controlled by design. However, these techniques cannot take care of existing harmonics in the plant. The equipments which controlled the existing level of harmonics are given in the following session.

### 1. Passive Harmonic Filter:

Passive harmonic filter consists of inductor and capacitor in series. This combination is tuned to the harmonics to be eliminated. The schematic of passive harmonic filter is shown in Fig-6.

The passive harmonic filter is simple and economical. It is very effective for applications where the load configuration is fixed and supply frequency is relatively constant. However, these filters have the following limitations.

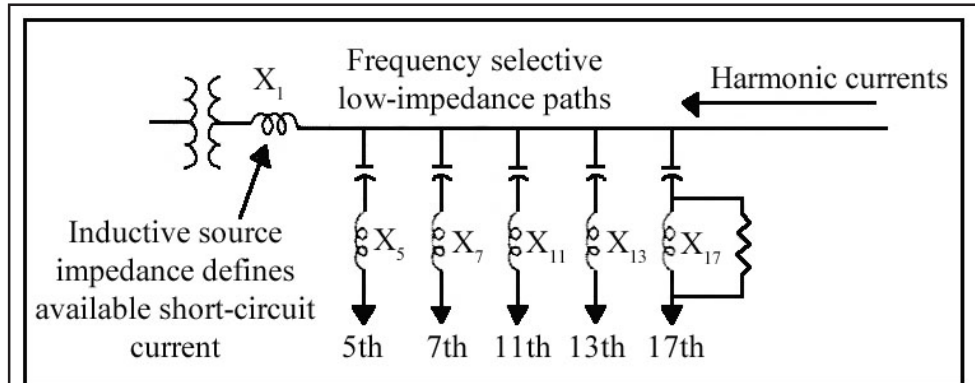


FIG.6: PASSIVE FILTER SCHEMATIC

- These filters can be over loaded due to harmonic inrush current coming from some other load which can damage the filter.
- This filter becomes less effective if the supply frequency varies.
- If the load configuration changes this filter cannot effectively filter the harmonics.
- The inductor and capacitor used in the filter can resonate with power factor improvement capacitor used in the plant at some harmonic frequency.

To overcome these limitations Active Harmonic Filter is invented.

## 2. Active Harmonic Filter:

The schematic of active harmonic filter is shown in Fig -7.

Active harmonic filter has a current sensor connected in series with a non-linear load which is to be compensated to reduce the harmonics.

The harmonic components of current in the non-linear load is sensed and equal and opposite current is generated by active harmonic filter. The current of active harmonic filter cancels the harmonic current of the non-linear load. As a result the source current is pure sinusoidal which does not contain harmonics.

### Advantages of active harmonic filter

- It reduces the harmonic current distortion by eliminating the harmonics.
- The harmonics can be selectively eliminated by configuring the active harmonic filter in user programmable manner.
- Like passive harmonic filter this filter does not resonate with any components of industrial plant.
- This filter is dynamic by design and can adapt to changes in load configuration.
- This filter can compensate for lagging power factor and it can also take care of 3-phase current balancing.

Thus active harmonic filter is a state of art solution for harmonic mitigation.

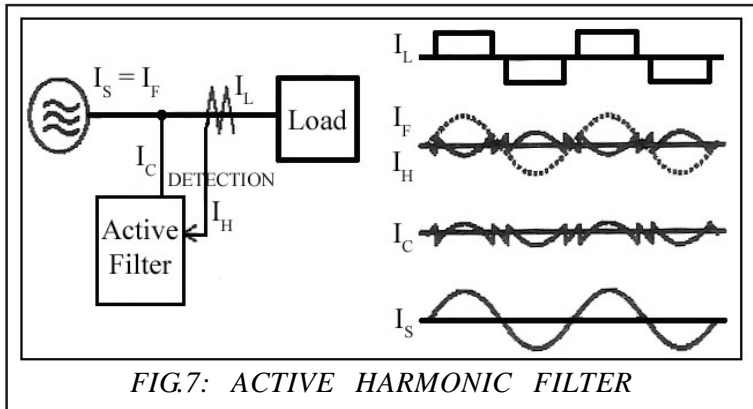
### Conclusion:

Use of more and more non-linear loads is becoming common in today's industrial plants. Therefore, harmonic elimination has become the necessity of the day. Depending upon the equipment used in the industrial plant different harmonic elimination techniques can be adopted.

Whenever any new equipment is to be designed it should be designed to take care of harmonics by using multiple converter or PWM converter whereas, if the existing harmonics are to be taken care of either passive filter or active filter can be used.

*The author Mr. S.B. Mahajani is working with M/s. Amtech Electronics (India) Ltd, as Dy. General Manager. AMTECH is the leading manufacturer of Variable Frequency Drives and Soft Starters. AMTECH also provides Automation Products and Power Quality Improvement Products like Harmonic Filters.*

*Courtesy: Industrial Showcase, July 2013*



## MILLIMETER WAVES MAY BE THE FUTURE OF 5G PHONES

### Samsung's millimeter-wave transceiver technology could enable ultrafast mobile broadband by 2020

What will these "5G" technologies look like? It's too early to know for sure, but engineers at Samsung and at New York University say they're onto a promising solution. The South Korea-based electronics giant generated some buzz when it announced a new 5G beam-forming antenna that could send and receive mobile data faster than 1 gigabit per second over distances as great as 2 kilometers. Although the 5G label is premature, the technology could help pave the road to more-advanced mobile applications and faster data transfers.

Samsung's technology is appealing because it's designed to operate at or near "millimeter-wave" frequencies (3 to 300 gigahertz). Cellular networks have always occupied bands lower on the spectrum, where carrier waves tens of centimeters long (hundreds of megahertz) pass easily around obstacles and through the air. But this coveted spectrum is heavily used, making it difficult for operators to acquire more of it. Meanwhile, 4G networks have just about reached the theoretical limit on how many bits they can squeeze into a given amount of spectrum.

So some engineers have begun looking toward higher frequencies, where radio use is lighter. Engineers at Samsung estimate that government regulators could free as much as 100 GHz of millimeter-wave spectrum for mobile communications—about 200 times what mobile networks use today. This glut of spectrum would allow for larger bandwidth channels and greater data speeds.

Wireless products that use millimeter waves already exist for fixed, line-of-sight transmissions. And a new indoor wireless standard known as WiGig will soon allow multigigabit data transfers between devices in the same room. But there are reasons engineers have long avoided millimeter waves for broader mobile coverage.

***Energy Efficiency is a journey; not a destination***

## PRODUCT OF THE MONTH

### SOLAR MAXIMISER HELIOS SERIES

**BTM's Solar Maximiser** enables households and business to be solar powered with minimal hardware investment. The device enables you to use existing infrastructure such as inverters, batteries, while purchasing just solar panels and cables. The Solar Maximiser is sleek and wall mountable. Unlike traditional solar hybrid inverters, the intelligence built into this device enables you to maximize use of solar power generated. With the included **Battery Sensor**, the user can now selected a desired battery reserve that needs to be maintained depending on the usage pattern.

#### Use all of solar power you generate

With our improved intelligent power source selection algorithm and built-in High efficiency low loss solar charge controller, all the solar power generated is used to either provide for your load or store them in batteries for future use. Helps reduce your electricity bill and your return on investment is faster.

#### Power through longer power cuts

Unlike traditional solar hybrid inverters, the BTM Solar Maximiser with its user selectable battery reserve selection, keep your batteries are charged using solar / grid power when available to ensure that you have power during load shedding.

#### Best in class solar management at the lowest cost

The intelligence built into the Solar Maximiser, you can power your existing inverters using solar thereby eliminating the need to purchase new solar inverters thus reducing your initial investment. The system is user friendly with excellent performance monitoring such as Battery-top up and PV cleaning reminders. PV Energy metering (optional).

#### Fully featured

The Solar Maximiser provides best in class features not found in other competitive products:

- Compatible with any make / model UPS or Inverter
- Fully automatic operation, just set the battery reserve you need
- With included **Battery Sensor** measure and display Battery Voltage, Battery State of charge, Charging and dis-charging current
- Mains Over-voltage protection to protect your valuable appliances.
- Spark free changeover improves reliability of the product
- Monitors all electrical parameters – Mains Voltage, PV Voltage, and current source of power to your load
- Works with 12/24V DC system
- Future expandable design – works with any battery capacity providing the ability to size up your system at any time with no additional investment
- Powers up to a load rating of 3 KVA

#### Comparison to traditional Solar Hybrid Inverters

Feature	BTM – Solar Maximiser	Solar Hybrid Inverters
<b>Mounting</b>	Sleek, wall mountable	Large Form Factor
<b>Priority Settings</b>	User Selectable Battery Reserve with intelligence to maximize use of solar <b>AND</b> provide reserve capacity in battery	Either manage battery reserve where solar energy is left unused, or use solar power but battery is left discharged
<b>Display Options</b>	LCD displays Mains (V); Battery (V); PV Solar (V); Charging (I); Discharging (I); State of Charge (%), Present source of Power. Over voltage cut-off, Reserve limit, PV Power, PV Energy (cum, with non volatile memory)	Small systems do not have any monitoring; only simple LED indicators, large systems do not have SoC measurement
<b>Expansion of solar capacity</b>	Expandable in the future	No expansion possible without entirely new hardware
<b>Expansion of battery capacity</b>	In case of shared battery bank can connect multiple inverters/UPS	Only 1 inverter/UPS per system



Automatic Power Source Selection Scheme							
Possible Scenarios					Operation Mode		
Sl. No.	Mains	Solar	Bat < Reserv	Bat <0.5 Reserv	EB.Chrg	Load	Source
1	Not Available	Not Available	Not Available	Not Available	off	Inv	Battery
2	Not Available	Not Available	Available	Not Available	off	Inv	Battery
3	Not Available	Not Available	Available	Available	off	Inv	Battery
4	Not Available	Available	Not Available	Not Available	off	Inv	Solar
5	Not Available	Available	Available	Not Available	off	Inv	Solar
6	Not Available	Available	Available	Available	off	Inv	Solar
7	Available	Not Available	Not Available	Not Available	off	Inv	Battery
8	Available	Not Available	Available	Not Available	off	Mains	EB
9	Available	Not Available	Available	Available	ON	Inv	EB
10	Available	Available	Not Available	Not Available	off	Inv	Solar
11	Available	Available	Available	Not Available	off	Mains	Solar+EB
12	Available	Available	Available	Available	ON	Inv	Solar+EB

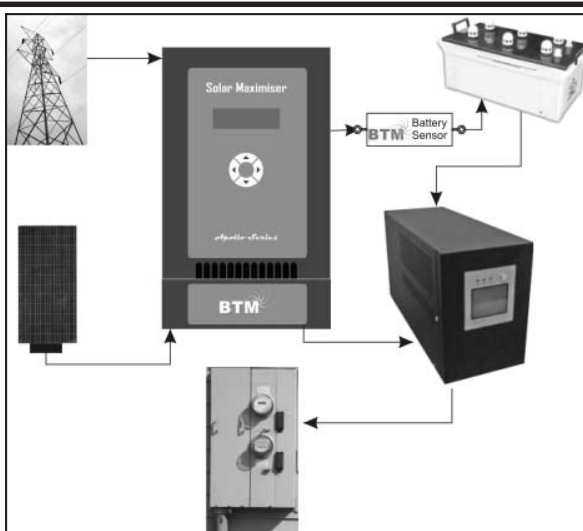
**Note:**

1. Out of the 12 different possibilities, the battery is charged from Mains only during 2 events – Reduces Power consumption from mains.
2. Out of the 12 different possibilities, the load is driven from Mains only during 2 events – Reduces EB bill.
3. In one third of the possibilities, the load are operated from solar

**Description of Intelligent Source Selection**

Scenario	If Battery is greater than reserve	If Battery is less than reserve
Minimal Usage During the day (keeping battery reserve as low as possible)	* Solar provides power to load and charges battery to 100% with remaining. MAINS Not Used	** Solar charges battery. MAINS used for load
Maximum usage during the day (keeping battery reserve at 50%)	* Solar and battery provides power to load simultaneously. MAINS Not Used	** Solar charges battery. MAINS used for load
Severe Load Shedding During the day (keeping battery reserve high)	* Solar provides power to load and charges battery with remaining.	* Solar Charges Battery and Battery provides power to LOAD
Night time (keeping battery reserve at 50%)	* Battery provides power to load. MAINS Not Used	*** MAINS Provides power to load and charges battery
Severe Load Shedding During the night (keeping battery reserve at 90%)	* Battery provides power to load.	* Battery provides power to load

**System Architecture**



- \* Solar or battery only used
- \*\* A mix of solar and MAINS used
- \*\*\* Only MAINS used

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## ENERCON'S E126 WIND TURBINE CAN GENERATE 7.5 MW, WHICH MAKES IT THE MOST POWERFUL TURBINE IN THE WORLD

An Enercon E-126 7.5 MW wind turbine may be installed at Le Havre, on the coast of France. The WIN I test site there is an onshore location designed to test and certify wind turbines for both on and offshore use. It is rare for there to be no wind in this area, and a high wind speed of 112 mph was recorded in 1987. This site is also appropriate for a reason unrelated to winds, but directly connected to environmental awareness. Le Havre is the least polluted of France's urban centers. Many of the world's largest wind turbines are designed for offshore use, but the E126 is for onshore power generation.

Each E-126 tower consists of thirty-five tapering concrete rings and one steel yaw bearing connector. The tower foot diameter measures 14.5 metres and narrows to 4.1 metres on top. The bottom rings are manufactured in 120-degree sections for transport-logistical reasons. Smaller diameter rings comprise 180-degree halves, and the upper rings a full circle. All elements are post-tensioned with steel cables passing through holes in the concrete tower wall.

A box type structure inside the tower base contains four modular medium-voltage transformers and switchgear cabinets. The modular design enables continued operation at reduced output level after module failure.

### Technical Data

Rated power:	7,580 kW
Rotor diameter:	127 m
Hub height:	135 m
Wind zone (DiBt):	WZ III
Wind class (IEC):	IEC/NVN IA
<b>Turbine concept:</b>	Gearless, variable speed, single blade adjustment

### Rotor

Type:	Upwind rotor with active pitch control
Rotational direction:	Clockwise
No. of blades:	3
Swept area:	12,668 m <sup>2</sup>
Blade material:	GRP (epoxy resin); integrated lightning protection
Rotational speed:	variable, 5 – 11.7 rpm
Pitch control:	ENERCON single blade pitch system, one independent pitch system per rotor blade with allocated emergency supply

### Drive train with generator

Main bearing:	Double-row tapered / cylindrical roller bearings
Generator:	ENERCON direct-drive annular generator
<b>Grid feeding:</b>	ENERCON inverter
<b>Brake systems:</b>	3 independent pitch control systems with emergency power supply, rotor brake, rotor lock
<b>Yaw control:</b>	Active via adjustment gears, load-dependent damping
<b>Cut-out wind speed:</b>	28 - 34 m/s (with ENERCON storm control)
<b>Remote monitoring:</b>	ENERCON SCADA

Enercon turbines operate at 400V AC-voltage. This is converted to DC inside the nacelle and fed down the tower into several cabinets with in-house manufactured 300kW inverters at the tower base first floor. Here the DC-power is converted again into grid compliant AC-power to feed into the transformers.

Outside the carrier a platform provides access to twelve yaw motor drives and a 12-metre generator. The stator is electrically subdivided into four 90-degree generator sections and each section feeds power into a separate rectifier box, two on the left and two on the right.

Up until around 5MW output the generator relies on natural air-cooling. Air is pulled through the generator and leaves the nacelle again enabled by a circular gap between the rotating spinner and by the nacelle cover.

With increased output, but depending on ambient temperature and other variables, electric fans in the nacelle floor add to the cooling system's performance.

# ELECTRICAL SHORT CIRCUIT AND FIRES

---

We hear whenever a fire occurs it is attributed to electrical short circuit. Cause of electrical fires are many. 1. Due to carelessness, 2. Wrong design of electrical wiring, 3. Bad workmanship.

**1. Due to carelessness:** For example if one is ironing clothes, and leave the iron on the cloth and forgets to switch off the iron it will cause a minor fire and if not attended to leads to a major fire. In one evening at a work site one workman used an immersion heater in a bucket of water for bathing purpose, power failed and workman locked the door and went away, when power resumed the water boiled, evaporated, some cartons nearby caught fire and smoke emanated through a window, luckily it was on the ground floor, a watchman noticed, the window was broken and the fire was put out, otherwise it would have become a major fire. This was investigated by the author. Many such fires go unreported. The above is an example of carelessness.

**2. Wrong design of electrical wiring:** a) wires should be of adequate size to carry the current required by the equipment it feeds, if not the wires get heated leading to short circuit. It is a safe practice provide to 25 % over capacity for any future loads, it happens in a newly built houses, where the occupant installs new equipment in due course of time. Protection of wires against over currents: all wires have a certain safe current carrying capacity, for example insulated copper wire of 1 sq mm has a safe current carrying capacity of 11 amperes, 1.5 sq mm, 17 amperes and so on. Depending on the load, size of wires has to be selected. Similarly the light control switches, 5A sockets and 5 amps lamp holder could carry 5/6 ampere, if these carry more than the rated capacity, they may get heated and burn. A wire fuse of 5 amps (35 SWG TC wire) or an m.c.b (miniature circuit breaker) should be connected in the circuit of these wires and in case the current in these wires exceed 6 amperes the wire fuse will melt or the m.c.b will trip and thus protect the wires and switches from burning (in fact these work at 1 ½ times the rated current and the wires and switches withstand 1 ½ times the rated current). Lighting circuits emanate from what are called fuse or m.c.b circuit distribution boards with a 5 ampere fuse or 6 ampere m.c.b and the lights are wired with 1sq.mm or 1.5 sq insulated copper wires through 6 amps light control switches and 5 amps three pin sockets. As mentioned before the rated current of these wires are 11 amps and 17 amps respectively. The light control switches are of 6 amps rating, in fact the wire size have more current carrying capacity then required. In olden days 1/18 insulated copper wires were used whose current carrying capacity is 5 amps. After the advent of stranded copper wires the minimum cross-section, available is 1 sq.mm whose rated current carrying capacity is 11 amps (since 0.75 sq.mm wires are not easily available, hence 1 sq.mm wires are being used, the rated current of 0.75 sq.mm wire is 7 amps) but the rating of switches are 6 amps only through which current passes to lamps and 5 amps 3 pin sockets. Note it is mandatory all 5 amps and 15 amps socket shall be controlled by a 6 amps and 15 amps switch respectively nearby. Similarly rated capacity of light lamp holders shall be of 5 amps capacity.

Here, the catch in safety, most contractors use a 15 amps fuse or a 16 amps m.c.b in the lighting circuits, here 1 sq. mm insulated copper wire (rated at 11 amps) but 5 amps switches and lamp holders are not enough. If a short circuit were to occur in the lamp holder of 5 amps and the 5 amps switch may get heated and burn and cause a fire. As per IS norms, in the final lighting sub-circuits, not more than 10 points (light, fans and 5 amps sockets) should be connected or the total load in the circuit should not exceed 800 watts, taking into consideration of power factor, the current flow at 230V will not exceed 5 amps. Hence in case of short circuit the 5A fuse or m.c.b will protect against any fire. Most of the contractors use 15 amps fuse (25SWG TC wire) or 16 amps m.c.b, which is against the principles of safety.

Another mistake committed by electricians, while wiring single phase circuits from the DB they draw four wires for the four circuits and one wire for neutral, they think neutral wire will not carry much current, which is wrong. They do not know the single neutral wire will carry total current of all the circuit wires. This also may cause fire.

Same principle shall be applied for power circuits. For 15 amps three pin socket, a 15 amps fuse or 16 amps m.c.b with adequate size of insulated wire of 4 sq mm with a current carrying capacity of 24 amps shall be used.(a 2.5 sq mm wire with a current carrying capacity, of 19 amps could also be used but there may be a voltage drop hence a 4 sq mm wire). Lighting circuits and power circuits shall be run in separate conduits and mix up of different phases in the same conduit is not permitted. The size of earth wire shall be the same size of the main wire coming all the way from the fuse or m.c.b distribution board or DB (refer IS 732). Similarly the current carrying capacity of switches, main switches, circuit breakers in electrical distributions shall be selected according to the load they have to carry. All wire joints shall be with mechanical connectors and twisting joints shall not be permitted. There are several IS codes specifying safety principles. For electrical wiring there IS 732 code of practice for electrical wiring and IS 3043 code of practice for earthing, IS 1646 code of practice for fire safety of buildings (General) electrical installation, apart from these, there are Indian electricity rules which are mandatory. These are safety rules, occupants of buildings should be aware of these rules.



Another bad practice is the use of 15/5 amps combined socket, the socket is backed up by a 15/16 amps fuse or an m.c.b, and when a short circuit occurs in the 5 amps cord while using a 5 amps plug top feeding an appliance, the 15/16 amps breaker will not trip until more than 15 amps flows, by which time 5 amps rated cord burns and causing a shock or fire. The safe way is to use this 15A/5A socket is to use 5 amps plug top with a 5A glass cartridge fuse. Such plug tops with 5A fuse are not readily available, and most appliances come with a 5 amps 3pin plug top without a fuse. Therefore it best to use separate 5 amps socket backed up with 5 amps fuse or m.c.b. Never use 15/5 amps sockets.

**3. Bad workmanship:** Even adequate rated electrical equipments are used, if loose contacts are overlooked at the time of installation heat may be generated which may lead to fire, therefore care should be taken at the time of installation. Regular maintenance work shall be done in large installation. Special care should to taken when connecting aluminum cables. Soldering or crimping method shall be adopted. While soldering special solder and special flux should be used, while crimping right size cable end sockets shall be used with special paste. Paste has a purpose.



Another important aspect is earthing for safety. All metal bodies of equipments shall be connected to an earth pipe or earth electrode with an adequate size of copper or GI wire (you can see this at all pole mounted transformers of Electricity Board (EB) in streets). Minimum size of bare copper wire shall be of 14 SWG size, and maximum size of 8 SWG shall be connected to earth pipe buried vertically in earth out side the building. A simple GI pipe of 40 mm dia 2.5meter length with holes along the length of pipe buried in earth surrounded with salt and charcoal powder is enough. This could be installed with an 9"dia earth auger. This simple earth pipe is as per IS recommendation. Surprisingly Indian Bureau of standards has not issued any specification for this important device but they have described in their code of practice for earthing IS 3043. In the market there are several branded earth pipes costing several thousand of rupees which do not follow IS recommendation, with hype they are selling these pipes. The one described is enough for large or small installations. As per Indian Electrical rules there should be one earth pipe for single phase equipments and two separate earth pipes (buried 3 meter apart) for three phase supplies. Metal bodies of single phase equipments shall be connected to one earth pipe and all three phase equipments to two earth pipes with separate wires (refer IS 3043).

All 5 amps and 15 socket's large pin should be connected with insulated copper wire of same size of phase or neutral wire. For 5A socket, 1 sq.mm and for 15 Amps a 4 sq.mm wire of green colour shall be connected. After installation, the continuity of these wires from the earth pin in each socket to the earth pipe shall be checked. In

the old edition of IS 3043 Code or practice for earthing, a schematic connection diagram of continuity checking device was given. By this device continuity (earth loop resistance) could be checked. But unfortunately the diagram in the new edition of IS 3043 code is omitted. The purpose of earthing electrical equipments is, in the event of a live wire touching the body of equipment, a person coming in contact with the equipments' body will not receive a shock because, if the current is large it will blow the wire fuse or trip the m.c.b or if it does not happen, an equipotential area around the equipment is created and the person do not receive shock. Earthing of electrical equipment is for safety. Use RCCB (residual current circuit breaker) which will break supply in the event of slight leakage of current. These breakers have sensitivities of 30, 100, 200 mill amps. Earthing of electrical equipments do not play a role in electrical fires.

**4. Fire in cars:** The present day cars' electrical system is as complicated as our regular electrical systems. Even though the voltage (12 V) is low, fire hazard is same as in our large electrical systems. The cars have an AC generator, rectifiers to convert AC into DC, a lead acid battery to store the current, self starter motor (with starting currents, up to 200 to 300 amps) wind screen wiper motor, AC blower motor, window motors, lights signals, lights, music systems, etc. All these items draw different values of current. Wiring of these equipment is as complicated if not more than in an industry. There are different ratings of wires and fuses. There are at least a dozen glass cartridge wire fuses of different ratings. Therefore one should use same rated cartridge fuse in the event of fuse blowout. Some for immediate lack of rated fuse, people bridge fuse holders with wire, or a metal strip and forget to replace with rated fuse later, which may cause fires in cars. Glass cartridge wire fuses are used, since m.c.b will not work due to heat from engine. Another danger is the central locking system of all doors, if for some reasons the central locking system malfunctions passengers cannot get out in an emergency. This incident happened recently in Delhi, one should be aware of this. In case of fire disconnect one of the battery terminals. Car makers should think of a means to disconnect one pole of the battery terminals incase of a fire either from the dash board or some remote place by a cable.



It is also suggested to keep a suitable fire extinguisher in the cars and also in basement garages. This should be a voluntary compliance then mandatory to prevent harassment by law enforcing authority.

*by B. Raja Rao, Electrical Consultant  
Mobile: 98402 08607; Email: brajaraoc@gmail.com*

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***Ensure fire safety, save life save property***

# GENERAL INFORMATION

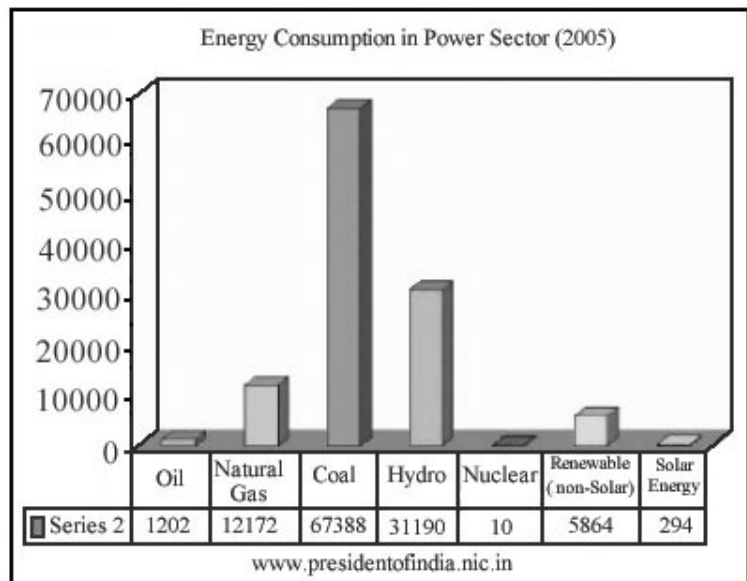
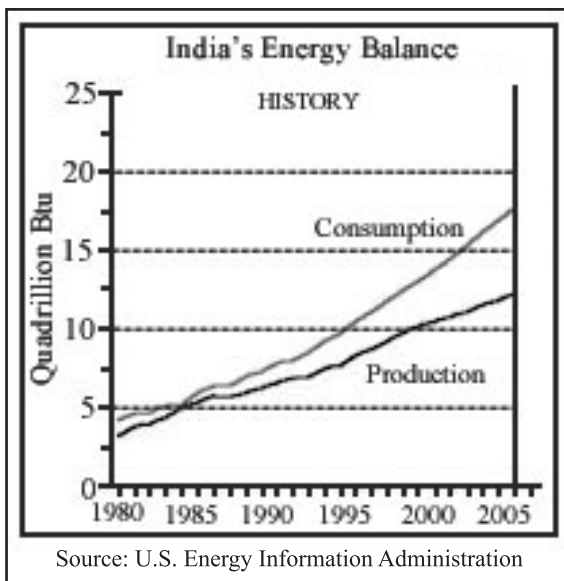
## WHAT ARE THE ENERGY TRENDS IN INDIA?

To better understand the current situation in India and the future of the renewable energies market, it is important to look at the trends in energy consumption, growth of the current grid, and the availability of transportation and equipment used there. Since thermal generation is based on burning coal or oil, increases in CO<sub>2</sub> emissions, which damage the environment and affect global warming, accompany this growth. As the graph below shows, it also increases the dependence on imports, which will continue into the future unless the policy changes.

### a) Energy consumption and production up to 2005:

Since the 1980's, and still currently, India has encountered a negative balance in overall energy consumption and production. This has resulted in the need to purchase energy from outside the country to supply and fulfil the needs of the entire country. As we will demonstrate later, the Government is more sensitive to renewable energy potential and has started to put reforms and projects, incentives and legislation in place to convince investors and companies to make the shift. These will be discussed in a later section.

India has had a negative Energy Balance for decades, which has forced the purchase of energy from outside the country.



### b) The breakdown of energy sources for power production of India in 2005:

India is a large consumer of coal, which makes up more than 57% of its total consumption. However, more than 1/3 of energy consumed comes from renewable resources, predominantly from large hydropower.

India relies heavily on coal energy to produce electricity. A strong second is hydro power, followed by natural gas. The consumption of all renewable energies represents fully one third of the total consumption. This is a significant figure, and we will see later that this sector has a great future. Following is a table of the actual plants and installations for producing power based on to renewable energies. We will show that only a small fraction of the potential capacity of renewable energies is currently being tapped. Capacity exists to shift towards more renewable energy, since only a fraction of the available renewable energy potential has been tapped.

### c) Distribution of the different kinds of plants and lines of transportation

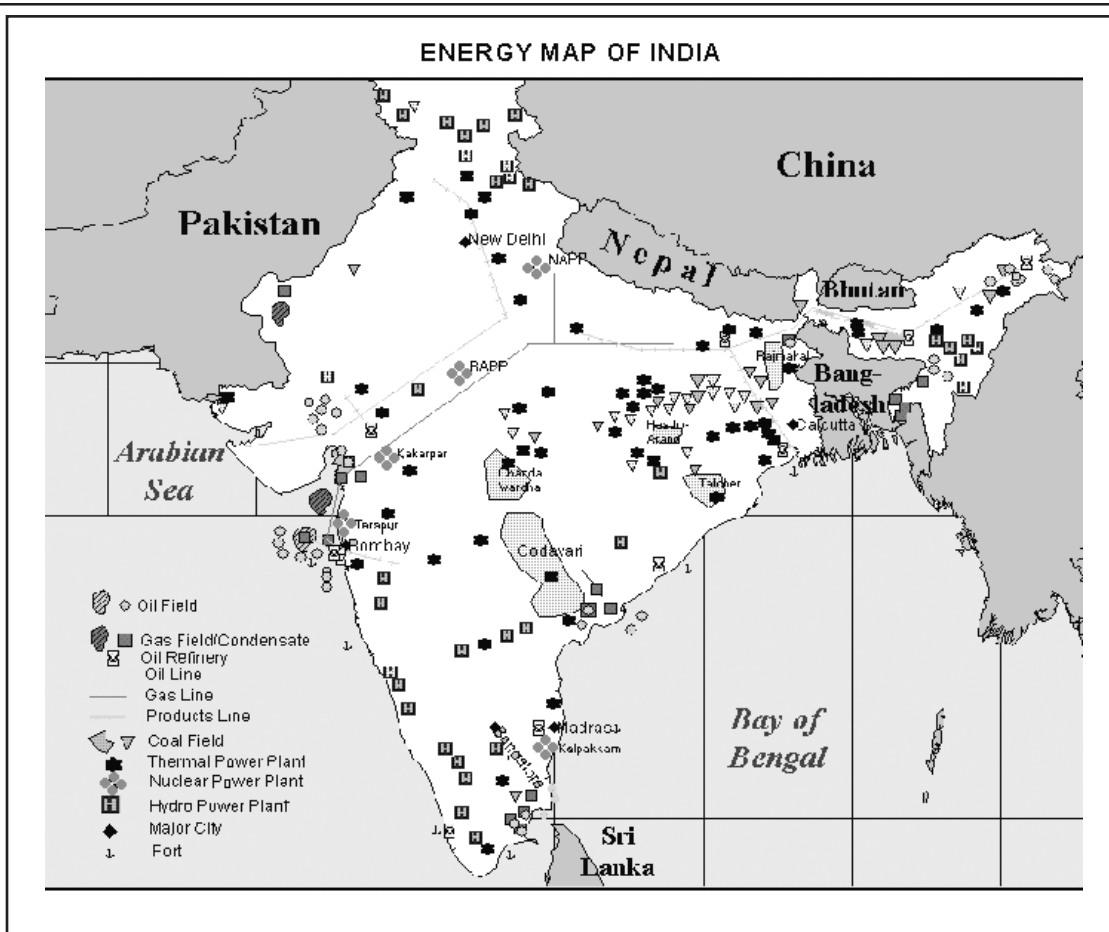
**As mentioned, India relies principally on coal for 57% of total energy consumption. As we can see on the map, coal production is extensive and is located in central and north-eastern parts of the country.**

Hydro power plants are distributed along the west coast from the southern tip to about ¾ the way up the coast, in the extreme north, and some in the east from rivers flowing from the Himalayas. Except for the fact that the gas and products line don't extend, the country has the largest railway network in Asia and the second largest in the world under a single management. Roads are taking developmental changes to the most remote corners of the country.

**Have a grown-up put safety caps on all unused electrical outlets.**

*Covering outlets will also help save energy by stopping cold drafts.*





**d) India Energy grid**

*Transmission of electricity is defined as bulk transfer of power over a long distance at a high voltage, generally of 132 kV and above. In India bulk transmission has increased from 3708 ckm in 1950 to more than 265,000 ckm today. The entire country has been divided into five regions for transmission systems, namely, Northern Region, North Eastern Region, Eastern Region, Southern Region and Western Region. The interconnected transmission system within each region is also called the regional grid.*



Nearly 85% of the villages have been electrified, and there is a nationwide grid for the transmission and distribution of power. The electric network is extensive throughout India with 440 kW or 750 kW power lines.

The main power grid is still concentrated in the north on a north-west/south-east axis, from Afghanistan to the Bay of Bengal and on a second axis from Bombay on the central west coast to the north-east of India, through Bhutan. The above map indicates that new 440kW power lines have been approved or proposed to expand the network further. Those proposed lines will be located mainly on the east coast.

*The total installed generating capacity in the country in year March 2004 was 1,12,058 MW and the total number of consumers was over 130 million. Apart from an extensive transmission system network at 400kV, 200kV, 132kV and 66kV which has developed to transmit the power from the generating stations to the grid substations, a vast network of subtransmission and distribution system has also come up for the utilization of the power by the ultimate consumers.*



*Courtesy: Bureau of Energy Efficiency Books - Energy Scenario*

## 46th ENGINEERS' DAY

### THEME: FRUGAL ENGINEERING Achieving More with Fewer Resources

Resources of the Mother Earth are dwindling at an alarming rate, with overconsumption, wastage, and of course, genuine use as well, by the ever increasing population. To face such a challenge, Frugal Engineering appears as a Mantra to be adapted in all walks of human activity to retain the world in sustainable form. Frugal Engineering, also called Frugal Innovation, refers to conducting the affairs of the world as per the age-old dictum: Do more with less, of course, without creating any hindrance to the development activities the world is always engaged in.

The term 'frugal engineering' was coined by Carlos Ghosn, the joint chief of Renault and Nissan, auto-majors. It is the process of reducing the complexity and cost of goods or services without sacrificing quality, and also making it affordable to all. Often, the Pareto Principle (Courtesy: Italian economist Vilfredo Pareto) or simply, the 80-20 Rule, can be applied in many of them. For example, in an automatic washing machine, there may be 50 or 60 wash-programmes, to suit the variety of dirty clothes it has to handle, including rare ones. But in a typical day, only 2 or 3 standard programmes will always be activated, leaving the remaining tens of them as unused. However, their incorporation would call for more materials and labour leading to overall higher cost for the machine. This is true of many other areas of human activity and re-look at them from frugal engineering angle may help to address the concerns of cost-conscious and eco-aware society, in general and consumers, in particular.

Frugal engineering will be of great relevance to developing countries, as a flexible approach that perceives resource constraints as a growth opportunity. According to Paul Polman, CEO of Unilever, at the current rate of consumption, by 2030 we would need two planets to supply the resources we need and to absorb our waste.

As engineers, in the service of the humanity enabling the citizens to enjoy a better quality of life, we have an added responsibility these days to find engineering solutions - of course, frugal - to problems thrown up by all sectors endangering the environment.

Such challenges to the engineering community are a plenty and this 46<sup>th</sup> Engineers' Day is the occasion to address them and come out with innovative solutions.

### SOME SIMPLE QUOTES ON "ENGINEERING"

*The engineer is the key figure in the material progress of the world. It is his engineering that makes a reality of the potential value of science by translating scientific knowledge into tools, resources, energy and labour to bring them into the service of man ... To make contributions of this kind the engineer requires the imagination to visualize the needs of society and to appreciate what is possible as well as the technological and broad social age understanding to bring his vision to reality.*

*Engineering is the professional art of applying science to the optimum conversion of natural resources to the benefit of man.*

*Engineering is a great profession. There is the satisfaction of watching a figment of the imagination emerge through the aid of science to a plan on paper. Then it moves to realisation in stone or metal or energy. Then it brings homes to men or women. Then it elevates the standard of living and adds to the comforts of life. This is the engineer's high privilege.*

*Engineering is the practice of safe and economic application of the scientific laws governing the forces and materials of nature by means of organization, design and construction, for the general benefit of mankind.*

*Engineering is an activity other than purely manual and physical work which brings about the utilization of the materials and laws of nature for the good of humanity.*

*The ideal engineer is a composite ... He is not a scientist, he is not a mathematician, he is not a sociologist or a writer; but he may use the knowledge and techniques of any or all of these disciplines in solving engineering problems.*

*Engineers participate in the activities which make the resources of nature available in a form beneficial to man and provide systems which will perform optimally and economically.*

## LEED CERTIFICATION

What is LEED? Leadership in Energy and Environmental Design (LEED) is basically a third-party certification program. It is a nationally accepted organization for design, operation and construction of high performance green buildings. This ensures the buildings are environmentally compatible, provide a healthy work environment and are profitable.

LEED certified buildings are commanding higher rental rates and great occupancy than the non-green buildings. This trend cannot help but impact the Investment community. The supply while gradually increasing is not keeping up with the demand for green buildings. LEED New Construction buildings are awarded points for sustainability for things like energy-efficient lighting, low-flow plumbing fixtures and collection of water to name a few.

Recycled construction materials and energy efficient appliances also impact the point rating system. In the political climate of today's world, as the earth's natural resources are being depleted at an alarming rate the construction industry is being compelled to look at alternatives to traditional construction materials and styles.

More and more legislation is being passed that impacts not only zoning but environmental impact for new construction. LEED New Construction certification and Energy Star ratings seem to be the future of construction projects. It's important to not only build beautiful buildings but buildings that are energy efficient, healthy for their occupants to exist within and that they not harm the environment.

Those of us who populate those buildings can feel good about the part we are doing to help the environment and preserve what is left of the environment after years and years of taking natural resources for granted. Green technology as it continues to catch on will generate additional jobs and challenge conventional wisdoms. Look what happened in the auto industry with the electric cars. It didn't really catch on despite the fact that many who had the opportunity to test drive them wanted to keep them. Instead they were basically scrapped because of big business. Now we have hybrids and more and more companies are looking for ways to create cars that are more environmentally friendly.

Interest in green technology will stimulate job-market growth, and open up new business venues as it continues to catch on. Just like any other market, competition is healthy and a monopoly is not. Increasing public awareness is crucial to the continued expansion of LEED New Construction certification and the advancement of green technology in construction projects.

### Indian Green building council

**“A green building is one which uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building.”**

### LEED® India

The Leadership in Energy and Environmental Design (LEED-INDIA) Green Building Rating System is a nationally and internationally accepted benchmark for the design, construction and operation of high performance green buildings.

LEED-INDIA provides building owners, architects, consultants, developers, facility managers and project managers the tools they need to design, construct and operate green buildings.

LEED-INDIA promotes a whole-building approach to sustainability by recognizing performance in the following five key areas: (i) Sustainable site development; (ii) Water savings; (iii) Energy efficiency; (iv) Materials selection and (v) Indoor environmental quality

LEED-INDIA rating system provides a roadmap for measuring and documenting success for every building type and phase of a building lifecycle.

## AP TO PERMIT MORE FIRMS TO SET UP SOLAR PHOTOVOLTAIC PLANTS

Andhra Pradesh Government has decided to permit any company to set up a solar photovoltaic unit in the State assuring them of Rs 6.49 paise per kWh.

Interested solar power developers have been told that they can submit applications within four weeks.

Chief Minister N. Kiran Kumar Reddy today approved the proposal of AP Transco to give opportunity to all solar power developers, even those who have not participated in the recently concluded competitive bidding for 1,000 MW. They were asked to submit their applications within four weeks.

They will be offered Rs 6.49 a unit as decided by Group of Ministers.

The decision comes in the backdrop of some solar power developers, who have not participated in the bidding process, evincing interest to supply solar power at this rate.

M. Sahoo, State Principal Secretary, Energy, while reviewing the progress of solar power projects bidding with AP Transco and New and Renewable Energy Development Corporation of Andhra Pradesh said the Government is committed to encourage setting up of non-renewable energy.

The latest decision of the Government is expected to help the State to tap the solar power attracting more developers.

Of the proposal to encourage 1,000 MW through the solar policy, 35 bidders, with a total capacity of about 418 MW, have accepted solar power purchase price of Rs 6.49 a unit.

*Courtesy: Business Line print edition dt: 11.07.2013*



## REDEFINES INTELLIGENT URBAN COMMUTING

VANMOOF is in the final stages of a development that will challenge everything you thought you knew about Cycling.

The world's first intelligent commuter bike, the "VANMOOF 10 Electrified" learns from advances in the car industry and combines GPS tracking, smart power control and a lightweight, integrated battery. The VANMOOF 10 Electrified represents the next leap forward in our VANMOOF mission to empower urban commuters worldwide.

### Specifications

- Frame : anodised Aluminium , size : 28" | 58 cm cc (rider's hight 170-205cm), Weight : 19 kg , Light : system : 40 lux / lumiring / high power LED, Drive chain : fully enclosed anti-rust chain , Brake : mechanical disk brakes front and rear Gearing : automatic 2 speed shifting , Motor: 250W front hub motor, Battery: integrated, 209Wh
- Range of 30km to 60km – depending on surface, weather conditions, rider weight and selected level of motor assistance.
- 3 hours of charging time, from completely empty to fully recharged.
- Freewheel function, so this bicycle rides just as smooth without electrical assistance as any other VANMOOF bike.

### Smart Power Assistance

*With the capacity to boost your own pedal power by an astonishing 80 per cent, the VANMOOF 10 Electrified is the first urban commuter bicycle to feature intelligent SMART POWER ASSISTANCE technology.*

*Specifically developed to address the demands of urban commuting, the bike's onboard computer monitors your cycling behaviour via a sensor, adjusting the bike's electric power – supplied via the small, lightweight motor in the bike's front wheel – accordingly. Whether you're going uphill, downhill on the flat, SMART POWER ASSISTANCE takes the sweat out of urban commuting, getting you around town more comfortably than ever, in characteristic VANMOOF style.*

### Complete control from a single dashboard

Integrated into the anodised aluminium frame of the VANMOOF 10 Electrified is a discreet dashboard that offers complete control of all of your bike's key functions. An intelligent interface between cyclist and machine, its display features both a battery indicator and a motor power indicator, allowing you to keep track of your progress at a glance.

What's more, the corresponding remote control allows you to turn your bike on and off as required.

### GPS tracking

#### Security as Standard

Who says cycle technology can't learn from the car industry? The VANMOOF 10 Electrified comes with an ingenious system to help you retrieve your bicycle in the event of loss or theft. GPS tracking systems are already widely used in the car industry; now it's part of your urban biking experience. VANMOOF 10 Electrified offers the solution to tracing the location of your bicycle, should it go astray. This is the Holy Grail for urban cycling, effectively rendering theft obsolete.

## AUTO PARTS MAKERS TO JOIN HANDS, SET UP SOLAR FARM NEAR MADURAI

Six auto component makers in Chennai are gearing up to set up a joint solar farm near Madurai, Tamil Nadu. It will be executed by Mahindra EPC (engineering, procurement and contract).

MM Forgings, Rane Group, Super Auto Forge, Natesan Industries, IM Gears and Swelect have formed a consortium for setting up this common solar facility, which will have an initial installed capacity of 10 MW (can go up to 40 MW). The facility entails an investment of around Rs 80 crore.

Though the power shutdown in Tamil Nadu has reduced (from two hours earlier to one hour a day in Chennai; and from eight hours to a couple of hours outside Chennai), thanks to wind power, power shortage is still plaguing the State; companies need to be self-sufficient and power-independent, says S. Muralishankar, Director (Technical), Super Auto Forge. "Nobody really knows when power from the Kudankulam nuclear reactor will actually reach us." Earlier, the consortium had looked at Sivaganga and Tuticorin for the farm.

Each company in the consortium will individually own specific assets, depending on its energy requirement. For instance, MM Forgings is looking at harnessing 2 MW, while Super Auto is looking at 1 MW. The consortium is eager to get more companies on board.

The solar plant is expected to start operations by the end of this financial year.

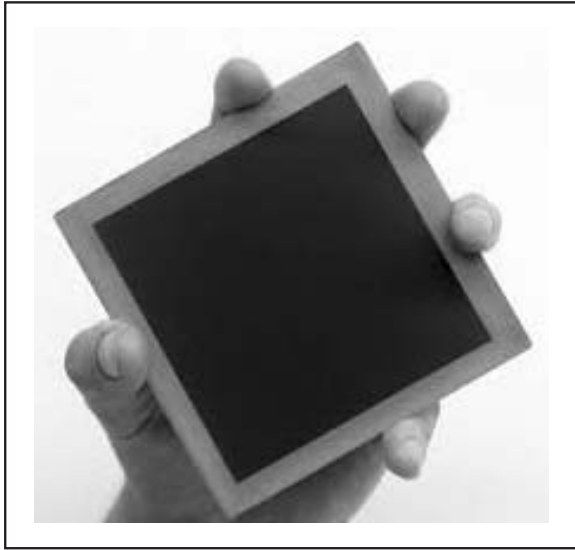
The consortium has held a couple of meetings with the Tamil Nadu Government. It is seeking clarity on wheeling charges (to transport power over transmission lines) and floor price (in case of third-party selling, after self-consumption).

*Courtesy: The Hindu, Business Line, dt: 22.07.2013*

## THE NEW REDOX POWER FUEL CELL

While lithium-ion batteries are current champs of the electric vehicle market, fuel cells are beginning to come on strong. If that trend continues it raises some intriguing future scenarios, namely, fuel cells could eventually squeeze out Li-ion batteries altogether, or both technologies could co-exist to some degree, engaging in a continuous battle for market share. There is also a third possibility, which is that the EV of the future will be an ultra long-range, super quick-charging model using a fuel cell in combination with a battery, and that's where a new fuel cell from the company Redox Power could come in.

Fuel cells use a variety of fuels to generate electricity through a chemical reaction, rather than by combustion. The result is lower emissions, greater fuel efficiency, and lower operating noise than a typical internal combustion engine.



Just two little problems have prevented fuel cells from breaking into the mainstream: high cost, and high operating temperature.

Redox Power, a company spun out of long term research at the University of Maryland Energy Research Center, has been tackling both issues head on and last week it announced the impending launch of its first market-ready product, the PowerSERG2-80, aka the Cube, in 2014.

First let's note for the record that the technology is not an EV product, at least not yet. The Cube is a modestly scaled, 25 kilowatt fuel cell about the size of a dish washing machine, designed to handle the energy load for a typical small business such as a gas station or a convenience-sized grocery store.

As for the innards, the Cube consists of stacks of solid oxide fuel cells, each about ten centimeters square. Solid oxide fuel cells use high tech ceramics as the electrolyte, which enhances efficiency and stability but presents a challenge in terms of temperature.

According to the Energy Research Center, typically a solid oxide fuel cell can reach operating temperatures up to 950 degrees Celsius. Redox Power has lowered that high mark to about 650 degrees, enabling the use of a relatively inexpensive steel platform compared to the special alloys required by higher temperatures (specs for the Cube list an operating temperature of 550 degrees). Operating performance also improves at lower temperatures, and Redox Power anticipates that with further tweaks it can get all the way down to 300 degrees.

The company's future plans include offering the Cube at scalable configurations ranging from 5 kW for a typical home, and up to 80 kW and more for other sites. Redox Power has also hinted that a fuel cell EV is in the future, too.

Redox Power has hinted that a fuel cell for EVs is in its future, and that's what brings to mind the idea of combining an EV with a fuel cell, which would act as a range extender.

## DIGITAL POWER FACTOR METER

'MECO-G' has introduced a unique 4-in-1 meter for the first time which has simultaneous measurements of Volts, Current, Frequency and Power Factor. This instrument has Rescaable facility for Volts, Amps and Frequency. This 4-in 1 meter reduces the cost using 4 separate meters and saves space on the panel. Wiring of cables is also reduced thus effecting tremendous saving in cost. This is an ideal instrument for Panel Builders.

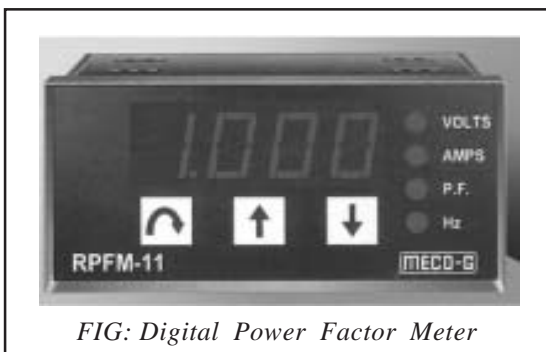


FIG: Digital Power Factor Meter

Micro Controller based design, High Quality Components, Stringent test during manufacture and strict quality control at all stages ensure accurate, reliable and consistent readings.

For details contact:

**Goliya Instruments Pvt Ltd.,**

311, Bharat Industrial Estate, T J Road, Sewree

Mumbai 400 015, India

TEL: 91-22-241 49657, 24179467

E-MAIL: [sales@goliyainstruments.com](mailto:sales@goliyainstruments.com); [info@goliyainstruments.com](mailto:info@goliyainstruments.com)

WEBSITE: [www.goliyainstruments.com](http://www.goliyainstruments.com)

Courtesy: *Jeema Journal*, August 2013

## BMW X5 eDRIVE COMING SOON...



While BMW has been dabbling in diesel sedans and readying **i3** and **i8** for their 2014 debut, the German automaker has not neglected those who would rather have a hybrid. Electrification of the powertrain allows BMW to unlock impressive potential for reducing fuel consumption and emissions. The BMW eDrive technology developed by the BMW Group to this end comes in various forms, each tailored precisely to the vehicle concept at hand. The BMW Group's first purely electrically powered vehicle to go into series production – the BMW i3 – celebrates its world premiere at the IAA 2013. And taking to the stage alongside the i3 will be the BMW Concept X5 eDrive, which follows in the tyre tracks of the BMW Concept Active Tourer unveiled in 2012 as the second plug-in hybrid vehicle to feature BMW eDrive.

BMW eDrive technology hooks up with the intelligent all-wheel-drive system BMW xDrive for the first time in the BMW Concept X5 eDrive. The new study vehicle offers superior driving characteristics underpinned by the electronically controlled and fully variable distribution of drive between its front and rear wheels. Regardless of the driving mode selected, the power generated by the electric motor, combustion engine or the two units together is channelled quickly and precisely to the wheels where it can be converted most effectively into propulsion. This allows the BMW Concept X5 eDrive to demonstrate the typical qualities of an SAV – assured traction and optimised stability in all weather and road conditions, coupled with increased agility through dynamically taken corners – in outstandingly efficient fashion. The versatile and sporty driving attributes of the BMW Concept X5 eDrive are complemented by average fuel consumption in the EU test cycle of 3.8 litres per 100 kilometre (74.3 mpg imp) and CO<sub>2</sub> emissions of under 90 grams per kilometre.

The electric motor in the BMW Concept X5 eDrive generates maximum output of 70 kW/95 hp and – thanks to impressive torque available from the word go – demonstrates the instantaneous power delivery that has become a hallmark of electric drive systems. All of which elevates driving pleasure and efficiency to another level. The synchronous electric motor developed by the BMW Group also maintains a steady flow of power into the upper reaches of its load range and keeps weight low. The motor alone can propel the BMW Concept X5 eDrive to a top speed of 120 km/h (75 mph). As part of the boost function, it can also be used to give the combustion engine a noticeable hit of extra energy during acceleration and during dynamic mid-range sprints. The BMW Concept X5 eDrive can complete the sprint from rest to 100 km/h (62 mph) in under 7.0 seconds.

*Courtesy: Clean Technica*

### WORLD'S LARGEST NUCLEAR REACTOR BEING BUILT BY CHINESE FIRM

Claims reactor can produce 1,750 MW. State-run Sichuan Province-based Dongfang Electrical Machinery Company Ltd said the 1,750 MW generator will soon be sent to the Taishan nuclear power plant in Guangdong Province from the company's production base in Deyang City, Sichuan Province. If confirmed, the reactor will be the world's biggest in terms of per-unit installed capacity.

DFEM will build two such reactors for the nuclear power plant. The company has produced 14 nuclear reactors so far with a total installed capacity of 15,790 MW. The Taishan nuclear power plant is a joint venture of China Guangdong Nuclear Power Holding Company Ltd and Electricite de France.

The two units of the first-phase project are to be put into commercial operation in 2013 and 2014, respectively, and will annually generate 26 billion kilowatt-hours on-grid energy when completed.

China had 15 operational nuclear power-generating units with a total installed capacity of 12.5 GW. Another 30 units are currently under construction which will add 32.81 GW.

**See more at:** <http://asian-power.com/project/news/world%E2%80%99s-largest-nuclear-reactor-being-built-chinese-firm#sthash.dkgeJA2N.dpuf>



## INDIA TO LAUNCH NATIONAL OFFSHORE WIND ENERGY AUTHORITY SOON

India is set to take a definite step towards opening the offshore wind energy sector to the developers. After deliberations for several months, the Ministry of New & Renewable Energy (MNRE) is set to launch the National Offshore Wind Energy Authority (NOWA) to proliferate deployment of offshore wind energy projects in the country.

The National Offshore Wind Energy Authority will be responsible for carrying out resource assessment along the country's coastline and survey potential project sites in the Exclusive Economic Zones in the territorial waters. India is the fifth largest wind energy market in the world, in terms of installed capacity, with over 19,500 MW capacity installed as of 30 June 2013, accounting for about 65% of the total installed renewable energy capacity in the country.

Scottish Development International had conducted offshore wind energy assessment in the southern state of Tamil Nadu and indicated that 1 GW wind energy projects could be installed off the coastal cities of Rameshwaram and Kanyakumari. The agency is believed to have estimated India's offshore wind energy resources at 350 GW. According to the Global Wind Energy Council (GWEC), Indian corporates like the Oil & Natural Gas Corporation (ONGC) and Tata Power have expressed interest in setting up offshore wind energy projects. Tata Power is believed to have submitted a formal request to set up a project off the coast of the western state of Gujarat. GWEC further reported that in June 2010 global giants like Areva, Siemens, and GE had announced plans to explore offshore wind energy opportunities in India.

Even though onshore wind energy is the most well-established renewable energy technology in India, offshore wind energy sector needs special attention to ensure sustainable growth. As noted by one of the members of India's Planning Commission, the capital cost requirements for offshore projects is substantially higher than onshore projects. Offshore wind energy projects would require a promotional tariff higher than that offered for onshore wind energy projects. The highest preferential tariff offered for onshore wind energy projects is around \$0.10 per kWh.

Another critical aspect related to offshore wind energy projects is security. As mentioned in an earlier article, the government has been talking to the Indian Coast Guard about this issue. There have been reports that the large wind farms pose security issues due to complications with radar imaging. India claims to have increased vigilance along its coastline since the 2008 Mumbai attacks and it surely doesn't want to take a step backwards.

Transmission of energy is another challenge. The government is planning to set up a dedicated transmission corridor for renewable energy projects. Preparations for setting up this corridor have begun with the implementation of the Renewable Regulatory Fund (RRF). Solar and wind energy project developers are now required to forecast the energy they are going to supply to the grid with a set level of accuracy. The developers would have to pay a penalty if the energy supplied deviates beyond the set limit.

The establishment of a dedicated offshore wind energy authority could not have come at a better time. The government recently reintroduced a crucial incentive scheme for the wind energy sector. The Generation-based Incentive scheme had been one of the most attractive incentives for project developers in the wind energy sector. In its absence, India's wind energy capacity addition fell to the lowest point in three years.

*Courtesy: Clean Technica*

### MESSAGE TO THINK!!!

### *Remember this...*

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Rs 20 looks <b>so big</b> amount when you have to give that to a poor<br/>But looks <b>small</b> when you giving it as a tip in HOTEL...</li> <li>2. Praying to God for <b>3 min</b> looks hard<br/>But <b>3 hrs</b> of movie is ok for us...</li> <li>3. After whole day of hard work, we have no problem to go to a <b>gym</b><br/>But doing house work and <b>helping mom</b> looks very tiring!!!</li> <li>4. We wait for <b>one full year</b> for Valentines's Day<br/>But when do mother's day comes <b>we never know...</b></li> </ol> | <ul style="list-style-type: none"> <li>➤ God won't ask what kind of car you drove, but He'll ask how many people you helped get where they needed to go.</li> <li>➤ God won't ask the square footage of your house, but He'll ask how many people you welcomed into your home.</li> <li>➤ God won't ask about the clothes you had in your closet, but He'll ask how many you helped to clothe.</li> <li>➤ God won't ask how many friends you had, but He'll ask how many people to whom you were a friend.</li> <li>➤ God won't ask in what neighbourhood you lived, but He'll ask how you treated your neighbours.</li> <li>➤ God won't ask about the colour of your skin, but He'll ask about the content of your character.</li> <li>➤ God won't ask why it took you so long to seek Salvation, but He'll lovingly take you to your mansion in Heaven, and not to the gates of hell.</li> </ul> |
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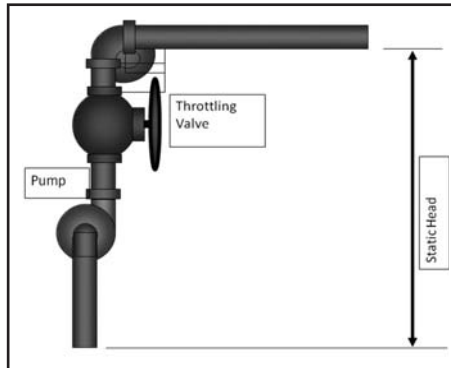
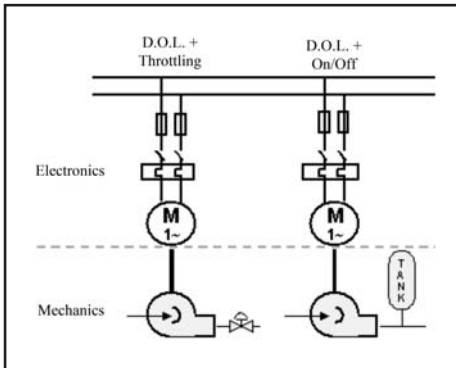
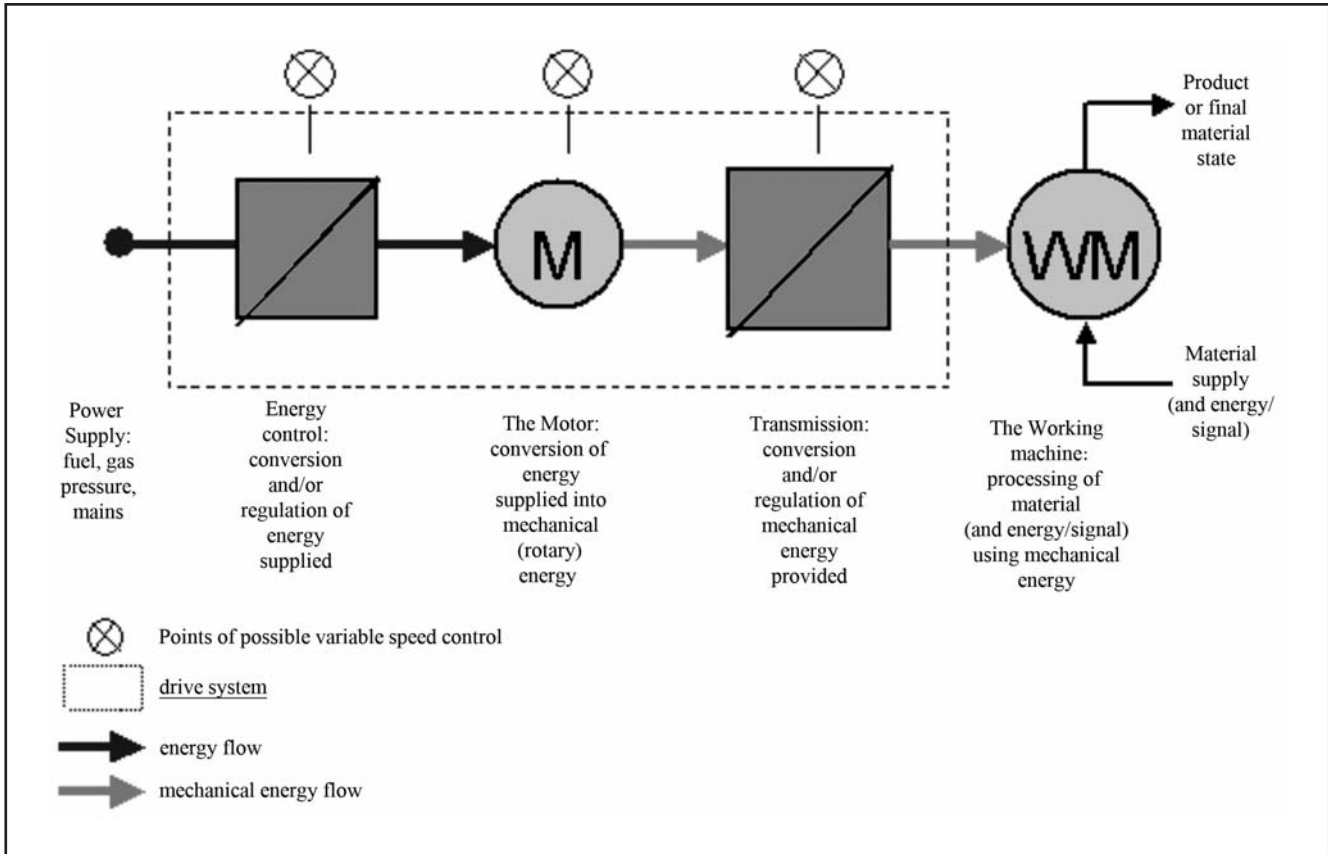
# ENERGY STORY

## ENERGY EFFICIENCY – THE FIFTH FUEL - PART 6

### EFFICIENT ELECTRICAL ENERGY UTILIZATION

#### End use Efficiency Factors:

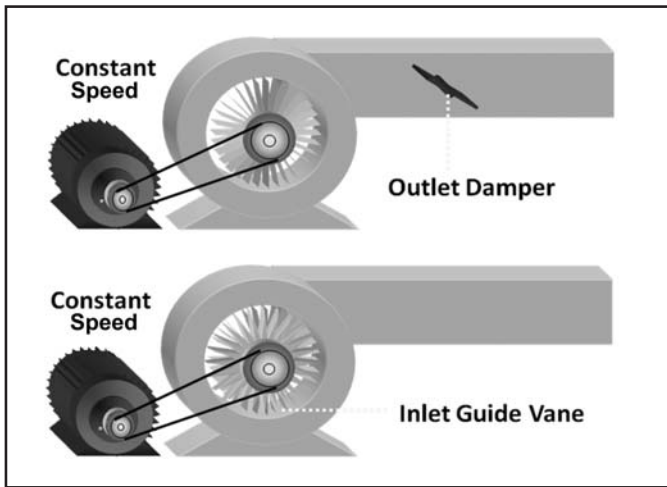
End use is the output requirement which is designed to be obtained through a Motor Driven System with associated controls and regulators. Energy losses are encountered at all stages of the Energy Transfer in the System.



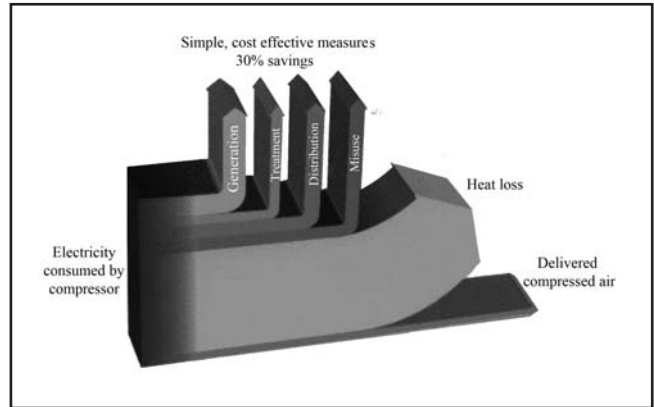
The End Use Efficiency or the overall efficiency of the System depends on Individual Efficiencies of each Equipment and stage in the System.

In a Pumping System, for example, the main equipments are Motor and Pump and if the Motor Efficiency is 80% and Pump Efficiency is 50%, the combined Efficiency is likely to be about 40%. There are other elements in the system like, Coupling, Transmission, Valves etc to control and regulate the output to exact requirements. All these tend to reduce the overall efficiency. Another complexity is that the Efficiencies of Equipments are different at different Loads etc, which further reduces the overall Efficiency. Therefore, it is not uncommon that the end use efficiencies are low.

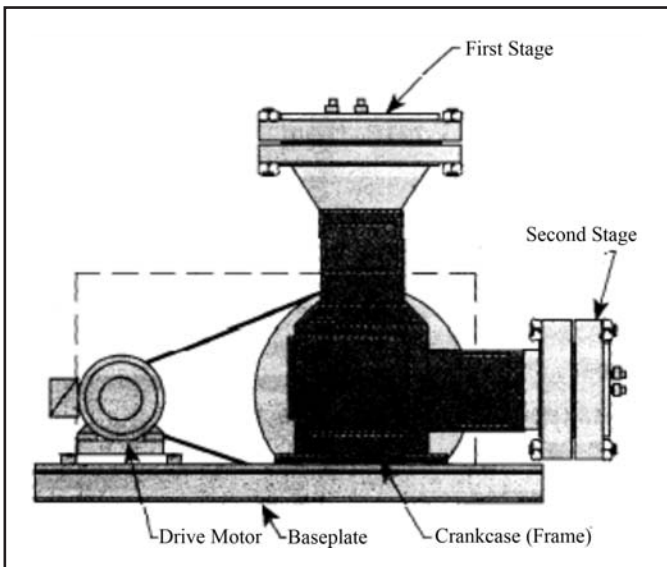
Blowers are another area of Application in Industries.



As shown in an illustration below, the overall Efficiency of Compressed Air System could be as low as 10%

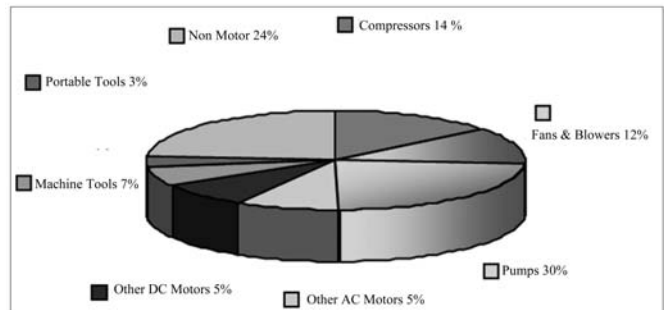


Compressors form another important area of application of Motors.



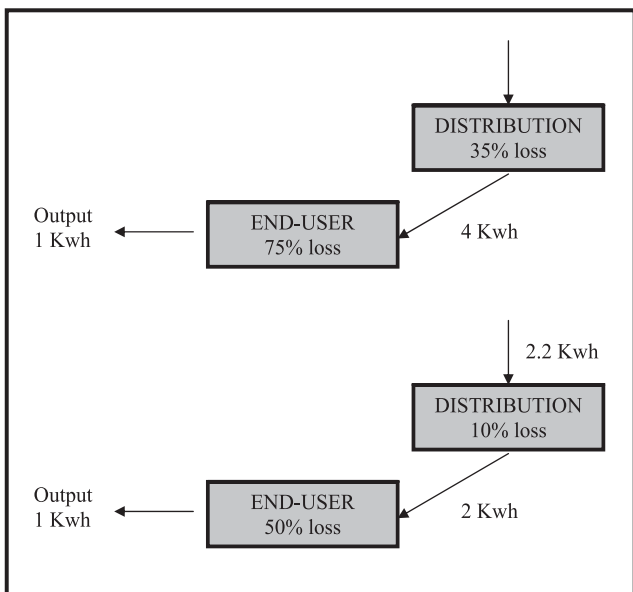
Approximately 10% gets to the point of use!!

Given below is a broad analysis of uses of Motors in Industries:



Efficiency Improvement and "Fifth Fuel"

The challenge therefore is to endeavor to achieve an End Use Efficiencies of around 50% as against the present general situation of around 25% or less in most of the cases and this can result in considerable reduction in the use of primary sources of Energy at Generation point.



This can be achieved through improved higher efficiencies of individual equipments and efficient design and use of controls with appropriate system to monitor and control the output to match with requirements and regulate the inputs tuning with the outputs.

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



# URGENT APPEAL FOR UTTARAKHAND FLOODS

As the magnitude of tragedy caused in Uttarakhand continues to unfold, **Prime Minister Dr. Manmohan Singh** has issued an appeal to the public for generous donations to support the victims who have suffered “**extensive devastation**”.

**“I appeal to all citizens to donate generously to the Prime Minister’s National Relief Fund,” he said.**

We request all our members to contribute to this noble cause.

Please send your contributions by way of Cheque or Demand Draft drawn in favour of “**The Chief Minister’s Relief Fund Uttarakhand**”

*Please send your Cheques to Association office before 30<sup>th</sup> September 2013 (Revised Date).*

*With the cheque or Demand Draft please enclose the following details.*

1. **Name** :
2. **PAN No.** :
3. **Address** :
4. **Mobile No.** :
5. **Tel No.** :

We shall acknowledge your contributions in the Newsletter.

*Please note that the receipt will be sent by Chief Minister’s Office to the Remitter directly to your address for claiming deduction u/s Section 80G of Income Tax Act, 1961.*

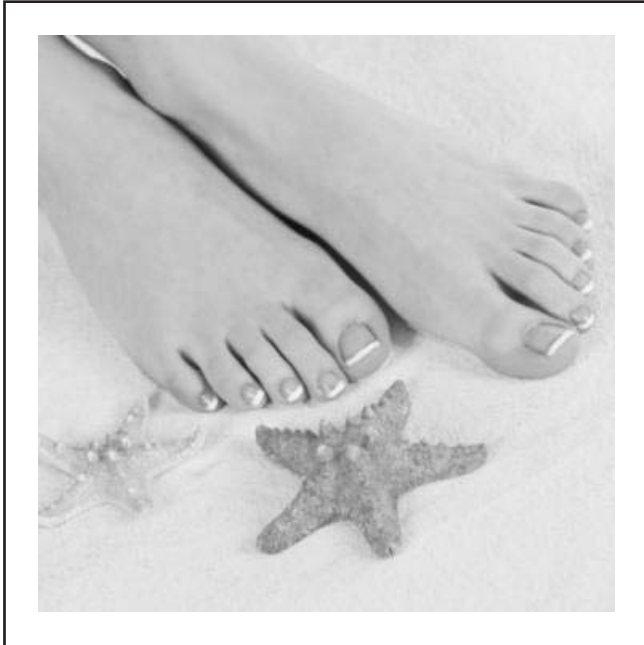
## CONTRIBUTIONS TO THE CHIEF MINISTER’S RELIEF FUND UTTARAKHAND

We glad to inform that the following members have contributed towards “*Chief Minister’s Relief Fund Uttarakhand*”:

- |   |             |
|---|-------------|
| 1. Er. M. Anantharaman B.E., Coimbatore ( <i>Sr. Electrical Inspector-Retd.</i> ) | Rs.3,000/-  |
| 2. Er. M. Vedachalam B.E., Chennai ( <i>Electrical Inspector-Retd.</i> )          | Rs.1,000/-  |
| 3. Subash Electrical, Ambur   | Rs.1,000/-  |
| 4. Emaar Electricals, Chennai   | Rs.4,000/-  |
| 5. Sudha Sudhan Engineers, Chennai  | Rs.5,000/-  |
| 6. Sivasakthi Electricals, Chennai  | Rs.10,000/- |

# FOOT CARE TIPS

## General Foot Care Tips



Agree with me or not, most of us give too little value to one of the complex parts of our body, our feet. A human foot is a body structure with 26 bones, 33 joints, and more than 100 tendons, muscles and ligaments that we rely for walking a thousand of kilometres each year, balance, relaxation, and stability.

Just like all other essential parts of human body, both men and women should keep it a habit to care for their feet at all times. Can you imagine how difficult lives would be without our happy and healthy feet? Our feet deserve special care and attention, keep it clean, fresh, and revitalized at all times. Here are some basic foot care tips that your feet will surely love, well of course, if you do.

### **Take care of your diabetes.**

Work with your health care team to keep your blood sugar within a good range.

### **Check your feet every day.**

Look at your bare feet every day for cuts, blisters, red spots, and swelling. Use a mirror to check the bottoms of your feet or ask a family member for help if you have trouble seeing.

### **Wash your feet every day.**

Wash your feet in warm, not hot, water every day. Dry your feet well. Be sure to dry between the toes. Keep the skin soft and smooth. Rub a thin coat of skin lotion over the tops and bottoms of your feet, but not between your toes. Smooth corns and calluses gently.

If your feet are at low risk for problems, use a pumice stone to smooth corns and calluses.

Don't use over-the-counter products or sharp objects on corns or calluses. If you can see and reach your toenails, trim them each week or when needed. Trim your toenails straight across and file the edges with an emery board or nail file. Wear shoes and socks at all times.

### **Never walk bare foot.**

Wear comfortable shoes that fit well and protect your feet. Feel inside your shoes before putting them on each time to make sure the lining is smooth and there are no objects inside.

Protect your feet from hot and cold. Wear shoes at the beach or on hot pavement. Wear socks at night if your feet get cold. Don't test bath water with your feet. Don't use hot water bottles or heating pads. Keep the blood flowing to your feet.

### **Wear the Right Shoes.**

When we say right, it simply means two things – the shoes fit you very well and wear the right shoe (e.g. basketball shoes for playing basketball and running shoes for running).

### **Relax Your Feet**

Massaging is one great way to relax our feet. At night before heading to bed, massage each foot with some oil to keep it relaxed and make them soft and supple. Foot spa is another thing, pamper your feet by going in a Foot Spa Salon or you can just buy a foot spa massager and do it at home.

### **Exercise**

If you've been sitting for a long time, get up in a while and stretch, do simple exercise such as moving and wiggling your toes. Walking is the best exercise. It maintains good blood circulation. Put your feet up when sitting. Don't cross your legs for long periods of time. Don't smoke. Be more active.

### **Go and see a Podiatrist**

When you experience foot pain and you feel that it's not normal anymore, better go and see a foot care specialist, a Podiatrist. A Podiatrist specializes in any conditions affecting the foot, ankle, and legs. Don't ignore the pain.

With these basic foot care tips, you're ready to show off your feet with confidence and you are sure to have happy and healthy feet.

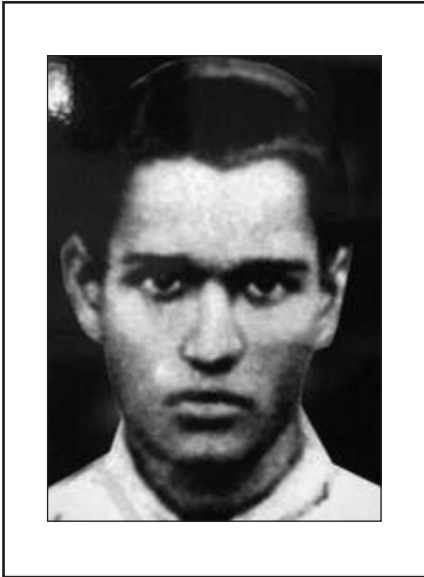
*Courtesy: [ndep.nih.gov/media/FootTips.pdf](http://ndep.nih.gov/media/FootTips.pdf),  
American pediatric medical association*

***Care and Affection is not a business where you give and you get.  
It is a beautiful feeling for someone where you like to give, even if you don't get...***

## VANCHINATHAN (1886 - 1911)



**Vanchinathan** (1886 – June 17, 1911), popularly known as Vanchi, was an Indian Tamil independence activist. He is best remembered for having shot dead Ashe, the Collector of Thirunelveli and having later committed suicide in order to evade arrest.



### Personal life

Vanchinathan was born in 1886 in Shenkottai to Raghupathy Iyer and Rukmani Ammal. His actual name was Shankaran. He did his schooling in Shenkottai and graduated in M.A. from Moolam Thirunal Maharaja College in Thiruvananthapuram. Even while in college, he married Ponnammal and got into a lucrative Government job.

### Freedom Movement

On June 17, 1911, Vanchi assassinated Ashe, the district collector of Tirunelveli, who was also known as Collector Dorai. He shot Ashe at point-blank range when Ashe's train had stopped at the Maniyachi station, en route to Madras. He committed suicide thereafter. The railway station has since been renamed Vanchi Maniyachi.

On that day, Ashe boarded the 9-30 a.m. Maniyachi Mail at Tirunelveli junction. With him was his wife, Mary Lillian Patterson, who had arrived from Ireland only a few days earlier. They had married on April 6, 1898, in Berhampore; Mary was about a year older than Ashe. They were on their way to Kodaikanal where their four children, Molly, Arthur, Sheila, and Herbert, lived in a rented bungalow. At 10-38 the train pulled in at Maniyachi. The Ceylon Boat Mail was due to arrive at 10-48. As the Ashes sat facing each other in the first class carriage, waiting for the Boat Mail to arrive, a neatly dressed man with tufted hair and another young man wearing a dhoti approached the carriage. The

former boarded the carriage and pulled out a Belgian-made Browning automatic pistol. The bullet hit Ashe in the chest and he collapsed. The sound of the pistol shot was absorbed by the howling wind. After the shooting the assassin ran along the platform and hid in the latrine. Some time later he was found dead, having shot himself in the mouth. In his pocket was found following letter:

*“The mlechas of England having captured our country, tread over the sanathana dharma of the Hindus and destroy them. Every Indian is trying to drive out the English and get swarajyam and restore sanathana dharma. Our Raman, Sivaji, Krishnan, Guru Govindan, Arjuna ruled our land protecting all dharmas and in this land they are making arrangements to crown George V, a mlecha, and one who eats the flesh of cows. Three thousand Madrasses have taken a vow to kill George V as soon as he lands in our country. In order to make others know our intention, I who am the least in the company, have done this deed this day. This is what everyone in Hindustan should consider it as his duty. sd/- R. Vanchi Aiyar, Shencottah”*

The contents of the letter indicated that the murder was political and caused great apprehension. The timing of the assassination indicated a protest against the impending coronation.

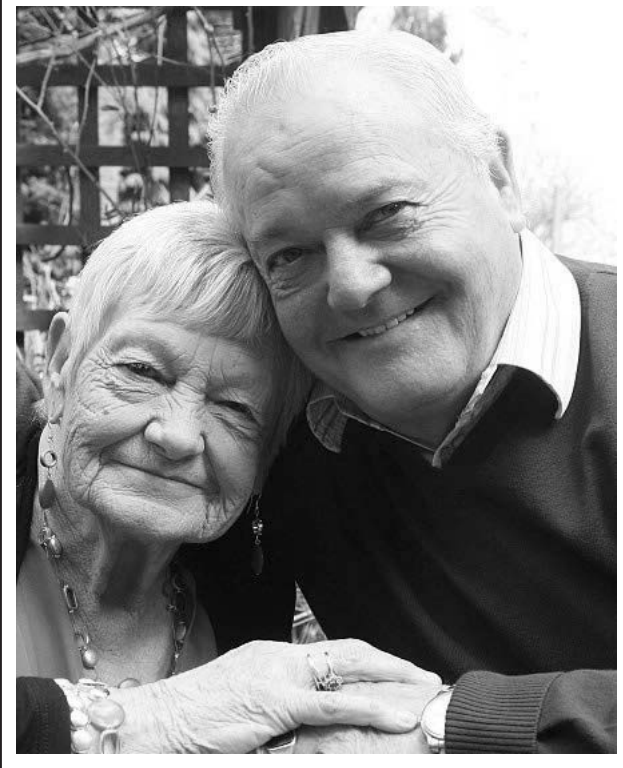


Statue at Shenkottai

Vanchi was a close collaborator of Varahaneri Venkatesa Subrahmanya Iyer (normally shortened to V.V.S. Aiyar or Va.Ve.Su Iyer), another freedom fighter who sought arms to defeat the British. He trained Vanchinathan to execute the plan in all perfection. They belonged to Bharatha matha Association. The Tamil Nadu Government has decided to build a memorial in Shenkottai the birthplace of this martyr.



# GRANDPARENTS' ANSWERING MACHINE



Good morning . . . At present we are not at home but, please leave your message after you hear the beep. Beeeeppp ...

If you are one of our children, dial 1 and then select the option from 1 to 5 in order of "arrival" so we know who it is.

If you need us to stay with the children, press 2

If you want to borrow the car, press 3

If you want us to wash your clothes and ironing, press 4

If you want the grandchildren to sleep here tonight, press 5

If you want us to pick up the kids at school, press 6

If you want us to prepare a meal for Sunday or to have it delivered to your home, press 7

If you want to come to eat here, press 8

If you need money, press 9

If you are going to invite us to dinner or taking us to the theatre, start talking we are listening !!!!!!!!!!!!!!!

If you are not a grandparent you will still love this. If you are, it shows how precious the babies are and what we mean to them.

## WHAT IS A GRANDPARENT?

(Taken from papers written by a class of 8-year-olds)

Grandparents are a lady and a man who have no little children of their own.

They like other people's.

A grandfather is a man and grandmother is a lady!

Grandparents don't have to do anything except be there when we come to see them. They are so old they shouldn't play hard or run. It is good if they drive us to the shops and give us money.

When they take us for walks, they slow down past things like pretty leaves and caterpillars.

They show us and talk to us about the colours of the flowers and also why we shouldn't step on 'cracks.'

They don't say, 'Hurry up.'

Usually grandmothers are fat, but not too fat to tie your shoes.

They wear glasses and funny underwear.

They can take their teeth and gums out.

Grandparents don't have to be smart.

They have to answer questions like 'Why isn't God married?' and 'How come dogs chase cats?'

When they read to us, they don't skip. They don't mind if we ask for the same story over again.

Everybody should try to have a grandmother, especially if you don't have television because they are the only grown-ups who like to spend time with us.

They know we should have snack time before bed time, and they say prayers with us and kiss us even when we've acted bad.

*A 6-YEAR-OLD WAS ASKED WHERE HIS GRANDMA LIVED. "OH," HE SAID, "SHE LIVES AT THE AIRPORT, AND WHEN WE WANT HER, WE JUST GO GET HER. THEN WHEN WE'RE DONE HAVING HER VISIT, WE TAKE HER BACK TO THE AIRPORT."*

*GRANDPA IS THE SMARTEST MAN ON EARTH! HE TEACHES ME GOOD THINGS, BUT I DON'T GET TO SEE HIM ENOUGH TO GET AS SMART AS HIM!*

*It's funny when they bend over; you hear gas leaks, and they blame their dog.*

## WHAT IS THE DIFFERENCE?

### Between DEVELOPMENT and GROWTH

**Growth** means increase in physical structure with reference to age of an object

**Development** means increasing of other factors such as mental, social, and secondary sexual character in an object, at which, we say person has some maturity.

## HUMOUR

### You passed

A soldier was asked to report to headquarters for assignment. The sergeant said: "We have a critical shortage of typists. I'll give you a little test. Type this," he ordered, giving him a pamphlet to copy and a sheet of paper, and pointing to a desk across the room that held a typewriter and an adding machine.

The man, quite reluctant to become a clerk typist, made a point of typing very slowly, and saw to it that his work contained as many errors as possible.

The sergeant gave the typed copy only a brief glance. "That's fine," he said; "Report for work at 8 tomorrow". "But aren't you going to check the test?" the prospective clerk asked.

The sergeant grinned. "You passed the test," he replied, "when you sat down at the typewriter instead of at the adding machine."

### Extra-terrestrial (Just a joke, not meant to insult)

For his entire working life, a dedicated and hardworking Astrophysicist tried in all earnest to find the existence of other being somewhere in the universe. After 58 years of constant effort, he finally receives a response from a planet 30 billion light years away.

"What is your planet like?" groaned the extraterrestrial from the other side of the Galaxy.

"It is 12,756 Kilometers in diameter, is 93,000,000 miles from the nearest star, our sun, has an average temperature of 72 degrees F. We breathe oxygen, live about 75 years, and have both men and women" answered the Physicist.

"Do you get along with the women on your planet?" the extraterrestrial asked slowly.

Puzzled by the question, but not wanting to insult the female Physicists answered "Why yes. We get along quite well here."

The extraterrestrial perked up "Can we send you ours?"

### Ten Laws Newton Forgot To State.

1. LAW OF QUEUE: If you change queues, the one you have left will start to move faster than the one you are in now.
2. LAW OF TELEPHONE: When you dial a wrong number, you never get an engaged one.
3. LAW OF MECHANICAL REPAIR: After your hands become coated with grease, your nose will begin to itch.
4. LAW OF THE WORKSHOP: Any tool, when dropped, will roll to the least accessible corner.
5. LAW OF THE ALIBI: If you tell the boss you were late for work because you had a flat tire, the next morning you will have a flat tire.
6. BATH THEOREM: When the body is immersed in water, the telephone rings.
7. LAW OF ENCOUNTERS: The probability of meeting someone you know increases when you are with someone you don't want to be seen with.
8. LAW OF THE RESULT: When you try to prove to someone that a machine won't work, it will!
9. LAW OF BIO-MECHANICS: The severity of the itch is inversely proportional to the reach.
10. LAW OF COFFEE: As soon as you sit down for a cup of hot coffee, your boss will ask you to do something which will last until the coffee is cold.

### How can Newton the greatest inventor of our times left behind.

NEWTON STRIKES BACK WITH LAW NO 11...

THE LAW OF MOTION.

LOOSE MOTION CANNOT BE DONE IN SLOW MOTION !!!

## POWER YOUR MIND

### TONIC FOR MIND

One who thinks  
He is going to die  
Is better than  
The one who thinks  
That he is going to live.  
For the first will  
Struggle to change  
But the other  
By chance may change.

Body is a tool  
To keep the mind cool



*Courtesy: Swami Srikantananda*

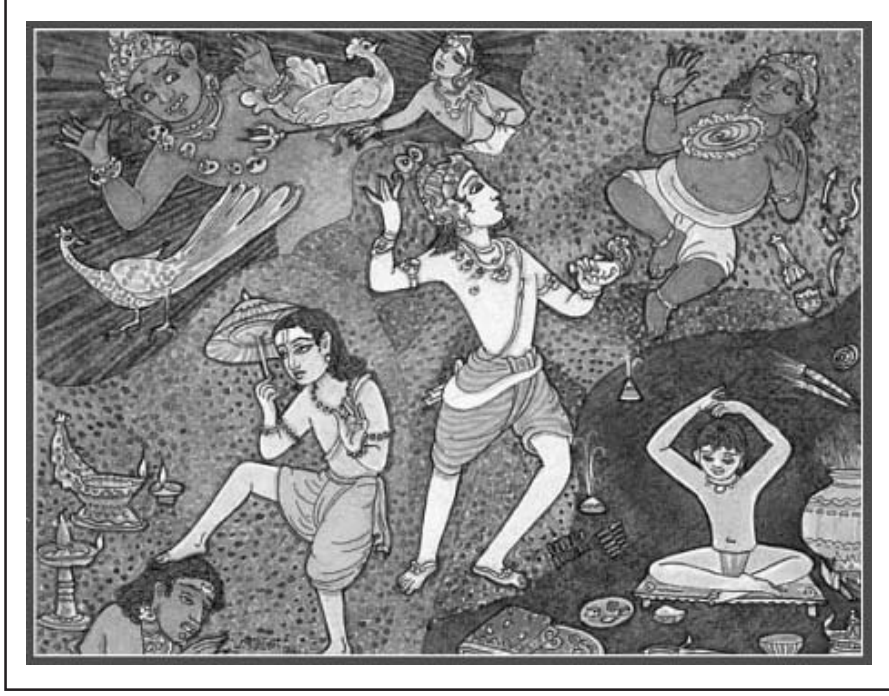
Never to be used like a bull  
To destroy peace and  
Happiness of those  
Who work under its rule.

### WHAT IS THINKING?

Thinking is not just  
A process of linking words  
Together to impress fools.  
But a process of diving deep  
Into the ocean of consciousness  
In search of gems of truth  
To enlighten the sinking souls.

# HOME FESTIVALS

Aippasi (October/November)



Skanda shasti is the first festival of this month, commemorating the victory of Lord Murugan over the demon Sura, of the higher, spiritual self over the lower nature. Dipavali is the major event of Aippasi, celebrated everywhere Hindus live and by Buddhists and Jains, too. In one story of its origins, Vamana, the dwarf avatar of Lord Vishnu, requests the amount of land from King Bali that he can cover in three steps. Granted the request, Vamana covers with his first step all of the Earth, with the second all of the sky, and then asks the king where to take the third step. The king offers his own head (lower left), and in commemoration of the king's humility, the day was established. In another story, Lord Vishnu (centre) kills the demon Nagagasvaran with His discus. The various observances (lower right) of Dipavali include an oil bath, gifts of new clothes, fireworks (sufficiently indulged in Chennai to rattle dishes off the kitchen shelves), oil lamps for display and abundant pots of delicious food. The early morning bath is always considered to be in the Ganga itself, so one greeting of the day is, "Did you have the Ganga bath?"

(To be continued)

## TIRUKKURAL AND MANAGEMENT IN A 'NUTSHELL' -5



Management revolves around Decision Making and Implementation. Decision making must be carried with due consideration and application of following "Senses"

\*Historical Sense – Dealing with the Historical back ground for the Problem or the Issue or Situation  
\*\* Social, Political and Economic Sense – Dealing with the Impacts

and how the organization will be impacted.

\*\*\* Common Sense – How the Decision appeals to common Sense.

Tiruvalluvar deals with this concept in the following Kural, that a proper and complete analysis must be preceded before decision and action and not after.

*Ēnnith thuniga Karumam; Thuninthapin  
Ennavam Enpathu Izhukku. Kural 467*

எண்ணித் துணிக கருமம்; துணிந்தபின்  
எண்ணுவம் என்பது இழுக்கு. குறள் 467

"Think and dare a proper deed  
Dare and think is bad in need."

In another Kural, Tiruvalluvar also points out that the Decision and Action Plan must include the course as well as the end result clearly.

*Āatrin Varuntha Varuththam Palarninru  
Potrinum Poththup padum Kural 468*

ஆற்றின் வருந்தா வருத்தம் பலர்நின்று  
போற்றிலும் பொத்துப் படும். குறள் 468

"Toil without a plan ahead  
Is doomed to fall though supported."



## THE WORLD'S LARGEST SOLAR POWERED SHIP

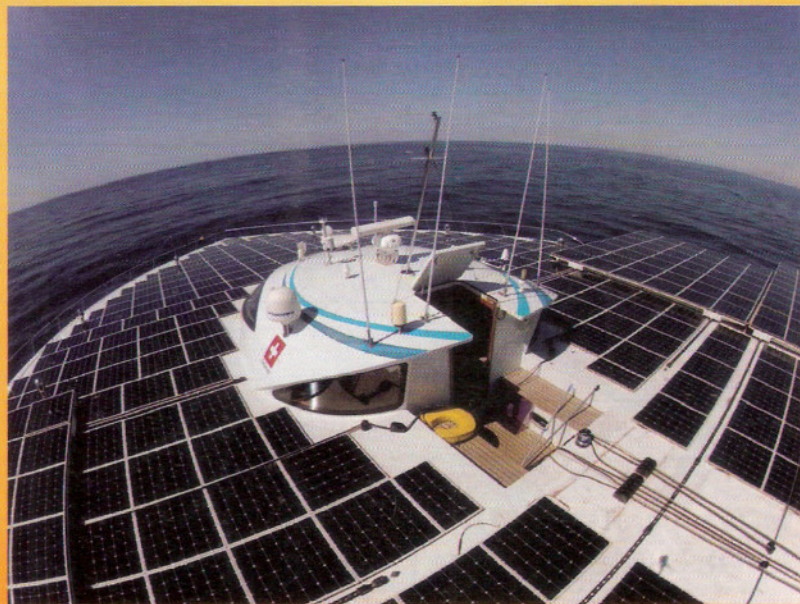
Global Energy crisis is a hot debate these days and scientists are coming up with alternative means to provide for the power requirements. We covered the flying wind mill a few days back and they keep coming up with new innovative methods for power generation. While some of them can be employed on a larger scale and may provide energy for more than one individual, some projects focus on individuals and deliver power for a single household or a vehicle. Solar power has been around for quite some time now and is proving to be very versatile and adaptable source of energy. Today we present the world's largest solar powered ship. As the name implies, the idea is not new. However, it is impressive because of the scale of things. PlanetSolar has come up with this ship that runs on solar power. The ship has a length of 31m and a width of 15m. Want to take a guess of how many kilowatts it can generate? Here's a hint, the engine requires around 20 kW. The ship is able to capture almost 103.4 kW of solar energy! That is five times more than what is required. The engine requires 20 kW to achieve a mean speed of 8 knots which is equal to 15 Kph or 9Mph and it is possible for the ship to go twice as fast. This marvelous solar powered ship weighs about 60 ton and costs \$24.4 million! The assembly of this ship was carried out at Knierim Yacht club in Kiel, Northern Germany. It took 14 months for this ship to be assembled and launched.

To ensure full maximum solar energy generation, solar cell covered flaps have been installed which are extended at the stern and amidships. Photovoltaic cells have been provided by SunPower and a huge number of 38,000 units have been installed on the ship. The company claims that these photovoltaic cells have an efficiency of 22 %, which renders them as the most efficient photovoltaic cells available in the market right now. The idea conceiver, Raphaël Domjan, is from Switzerland and along with Frenchman Gérard d'Aboville, made the world's first trip around the world that was powered by solar energy. They travelled more than 60,000 km and ended their trip on 4th May, 2012.

The PlanetSolar team stated that their invention is not intended to replace any traditional marine vehicles. However, they stressed that boating as a activity has been around for a long time and has become a source of pollution for the environment and people have forgotten how clean their transport can be. "Today the boat is the most used means of transport of goods. It represents single-handedly almost 1.4 billions of tons of carbon dioxide (in 2008), that is 6% of the total carbon dioxide emissions and twice more than the air transport." The project comes with zero environmental pollution and that is perhaps the most impressive feature of this world's largest solar powered ship.



# THE WORLD'S LARGEST SOLAR POWERED SHIP





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# 13

*Glorious Years of Earthing*

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