Budget 201
Solar city scheme gets big boost
Wind: Does cost per kilowat hour outweigh the benefit?
Global Wind Growth Hits All-time High
EU Emissions Trading System, And Carbon Markets Can Be Serious Business
SUSTAINABILITY IN BIOENERGY
95 biomass power plants built worldwide representing an installed base of 2.5 GWe.
POWER IN THE UK
TIDAL ENERGY AND WAVE
JTURE PROSPECTS FOR
Weighing the Advantages of Distributed and Centralized Energy Storage

SEED '15

Seeking Energy Efficient Deeds

Bureau of Ocean Energy Management issues first wind energy research lease in Federal offshore waters, report says

Designing Reliable, Cost-effective Wind Turbine Shaft Systems

N CLEAN ENERGY STOCKS
2015: MARCHING AHEAD

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MESSAGE FROM THE DIRECTOR

I am extremely excited that the students of DEE are pursuing their mission to spread the message on sustainable energy through "SEED (Seeking Energy Efficient Deeds)". The venture has been spreading this message for the past two years. The need for alternate energy sources are reminded by the theme – Power for future. I wish them all success and all the best for their future endeavours.

Dr. S. Sundarrajan
Director
National Institute of Technology
Tiruchirappalli

MESSAGE FROM THE HOD

I am glad that the students of DEE are bringing out another edition of "SEED (Seeking Energy Efficient Deeds)" with a mission to spread the message – Power for future. These kinds of works are platforms for students to express their concern on increasing exploitation of resources in an effective manner. I wish them all success.

M. Premalatha

Dr. M. Premalatha
HOD (DEE)
National Institute of Technology
Tiruchirappalli

Editorial

By our own arguments "KURUKSHETRA" is the biggest war the country has ever seen. But the real war is yet to begin, war for existence, the biggest the world is ever going to witness and the Earth calls for it. Years and years of exploitation have torn her apart, not even able to carry her own children. This is where the message or theme of this third edition of SEED becomes extremely relevant. Power for future, what does it imply? Is it the resources to be preserved for future or find out our own new ways to get power? It has a broad sense. The resources here are not to be destroyed, it should be handed over to the future generations. Explore not exploit, the Mother is wounded.

EDITORS

PRABHANJAN
GARGI
ANJANA
ANUPAM

DEPARTMENT OF ENERGY AND ENVIRONMENT

Department of energy and environment, formerly known as CEESAT was established as a Centre, under the protocol signed between the Government of India and United Kingdom in 1995 with the objective of strengthening the research activities and curriculum related with energy and environment. The department had been started as an interdisciplinary nodal centre to enhance the excellence in training, research and consultancy in Energy and Environmental Science. Main emphasis is given to the identification of appropriate technologies for the efficient production, distribution and use of energy.

ISO 9001:2008 CERTIFICATION

Labs Certified

1. **Testing and Analysis Lab I**
2. **Testing and Analysis Lab II**
3. **Algal Research & Biotechnology Lab**

ONGOING RESEARCH @ DEE

1.Simulation and experimentation on optical fibers for better utilization of solar energy for micro algae growth - C. Naveen

2. Bio treatment of distillery wastewater - Sankaran K

3. Experimentation on CO2 sequestration using microalgae – modeling and simulation with CFD technique - Nithiya E M

4. Experimentation on solar thermal energy – Solar cooker - Mande Amol Balu

5. CFD simulation to predict microalgae behavior - Ramakant Pandey

6. PV Panel-DC Micro Grid - SivaKrishna Rao

7. High performance electrode materials: solar powered energy storage applications - R Kiruthiga

8. Twin pronged approach for degradation of phenolic effluent of producer gas plant using peroxidase enzyme and micro algae - S Dayana Priyadharshini

9. Safe disposal of missile canister after missile firing - Sathiya Prabhakaran S P

FACILITIES @ DEE

Department of Energy and Environment has full-fledged research and consultation facilities:

1. TOC Analyser (Make & Model : Analytikjena / multi N/C 3100)
TOC is a highly sensitive, non-specific measurement of all organics present in a sample. It can be used to regulate the organic chemical discharge to the environment in a manufacturing plant.

2. Differential Scanning Calorimeter (Make / Model : M/s Perkin Elmer/ DSC 6000 with auto sampler)
DOC is a thermo analytical technique in which difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature. Generally the temperature program for a DSC analysis is designed such that the sample holder temperature increases linearly as a function of time.

3. CHNS/O Analyser (Make/Model: 2400 CHNS/O Series II System)
Elemental composition is highly required to find the energy content of the material and safe disposal of waste with respect to environment. Polymers, organic or inorganic chemicals, metals, semiconductors, metals and other common class of materials can be characterized.

4. BOMB CALORIMETER (Make/Model : IKA/C5000)
Bomb Calorimeter is suitable for study of combustion reaction. It measure the calorific value of all varieties of coal and coke, fuel oil, gasoline, all motor fuels, aviation type jet fuels, combustible wastes and refuse disposal, Food Stuffs and supplements for human nutrition, supplements of animal nutrition, explosives and heat powder, energy balance studies in ecology.

5. Thermal Gravimetric Analysis (Make /Model: M/s Perkin Elmer / TGA 4000)
TGA is the best tool to find the proximate analysis of any solid materials. Other than fuel samples it can also be used to find the thermal characteristics of any solid materials.

6. Refrigerated Centrifuge (HERMLE z383k)
The Z383 series of Lab net centrifuges accepts tubes up to 500 ml in a variety of swing out and angle rotors. In addition, the centrifuges will accept a variety of high speed angle rotors for tubes up to 85 ml. High speed capabilities and large capacity rotors make the Z383 and Z383K the ultimate in intelligent centrifuges.

7. SPECTROPHOTOMETER (Spectroquant Pharo 300)
The Spectroquant Pharo spectrophotometer with a wavelength range of 190 -1100 nm is suitable for use with all Spectroquant test kits and combines the benefits of a system photometer with the multitude of possibilities offered by a spectrophotometer. No matter whether you wish to program your own methods, measure concentrations or absorbance, record spectra or kinetic profiles, or make special multiwave-length measurements – all options are open to you now.

8. TURBIDIMETER (HACH,2100N Laboratory Turbidimeter, EPA, 115 Vac)
Turbidimeters are engineered to provide superior accuracy and sensitivity in any application. It is equipped with a stable halogen-filled tungsten filament lamp to meet the reporting requirements of EPA Method 180.1. This model is ideal for basic laboratory testing of samples up to 4000 NTU.

FACILITIES @ DEE.....

9. ULTRASONIC CLEANING SYSTEM (Microclean -103)
Microclean, the latest compact high efficiency ultrasonic cleaner for small and intricate parts. The machine is best suited for continuous operation in Indian atmospheric conditions. These equipments consist of a solid state ultrasonic generator and stainless steel tank, mounted with sandwich type ultrasonic transducers made of piezoelectric crystals specially made for cleaning applications.

10.UV/VIS/NIR SPECTROSCOPY (Make/Model : Perkin Elmer/Lambda 750)
Double-beam, double-monochromator design provides the highest stability coupled with the highest accuracy.
Integrating spheres, in combination with UV/Vis/NIR spectrophotometers are versatile accessories for reflectance and scattered transmittance measurements for solid or liquid. Application areas range from surface characterization of solids to the photometric analysis of turbid, colloidal, transparent and translucent samples.

11.FTIR (Make/Model: Perkin Elmer /Spectrum 2)
FTIR spectrometers (Fourier Transform Infrared Spectrometer) are widely used in organic synthesis, polymer science, pharmaceutical industry, polymer dielectrics, inorganic thin films, descuming, patterning, photolitho metallization, plasma etching, petrochemical engineering, sputtering, food analysis and rapid qualification of nutraceuticals.

12.Moisture analyser (Make/Model: Metrohm/870 KF Titrino Plus & Metrohm/870 KF Titrino Plus + 899 Portable Coulometer)
Moisture analysis covers a variety of methods for determining the moisture in low level down up to 1 ppm in liquid products such as Petroleum products and in solid products such as vegetables and food items. Moisture measurement is essential for estimating the calorific value of fuel or quality of material.

13.CALIBRATORS
Electrical Calibrator (Make/Model: FLUKE/5522A Multi product calibrator)
Temperature Calibrator (Make/Model: AMETEK/CTC-1200 A @ 650-B)
Pressure Calibrator (Make/Model: FLUKE/P3200 Dead weight tester)

Energy Storage Materials from Bio Wastes

Dr. C. Nithya
DST-INSPIRE Faculty Awardee, DEE, NIT, Trichy

Continuous depletion of fossil fuel, compulsion for energy security and increasing environmental pollution have significantly forced our attention to find efficient, clean and sustainable sources of energy storage devices and materials. Efficient energy storage materials and devices play a crucial role in the development of consumer electronics, automotive, aerospace, portable and stationary applications. Those efficient energy storage technologies are batteries, fuel cells and supercapacitors which satisfy our energy requirements; however, there is an urgent need to improve their performance in a large scale to meet the energy demands ranging from portable electronics to hybrid electric vehicles. Alkali ion (Li and Na ion based batteries and supercapacitors) based energy storage technologies possess outstanding energy (~250–730 Wh/L) and power densities (~250-340 W/kg) which meets our energy demands but the challenges are high cost for their production and raw material price. To overcome these challenges, recently energy storage materials are derived from natural wastes viz., rice husk, saw dust, tamarind fruit shells and peanut shells etc. These bio wastes derived energy storage materials are employed as an electrode material for alkali ion based batteries and supercapacitors which exhibit superior performance in the devices.

Rice is the second largest crop species cultivated world-wide next to corn, so rice husk (RH) is the highest volume agricultural waste. For every five tons of rice harvested, one ton of RH is produced resulting in 1.2 X 108 tons of RH per year across the world. Rice husk ash produced when RH burns in air, the organic matter decomposes and Silica, the major constituent surprisingly exists in the form of Nano particles. From this Nano SiO2, Nano Si has been derived through electrolysis process. This activated Si Nano particle is employed as an anode material for lithium ion batteries and delivers a reversible capacity of 1120 mAhg-1 at 1C (4.2 Ag-1) and 644 mAhg-1 at 2C (8.4 Ag-1) rates respectively (Scientific reports: DOI: 10.1038/srep01919).

Next to RH, Peanuts are a globally cultivated food material but the peanut shells do not possess economic value; its limited commercial uses are filler in animal food or as charcoal. This peanut shell derived carbons (Fig. 1) are employed as an electrode material for Sodium ion based hybrid supercapacitors. This hybrid ion capacitor is a new device which is an intermediate in energy and power between batteries and supercapacitors. The hybrid ion capacitor couples a high capacity bulk intercalation based battery-style negative electrode (anode) and a high rate surface adsorption based capacitor-style positive electrode (cathode). The assembled sodium ion capacitor was tested for 10,000 cycles between 1.5 to 3.5V (51. 2 Ag-1) delivered the energy/power densities of 8–20 Wh kg-1 at ~50,000 W/kg-1, retaining 88% and 78% of their capacity after 1,00,000 cycles at 25 and 65°C. From this we clearly understand that lot of agricultural waste products provide tremendous opportunities for large-scale energy storage applications.

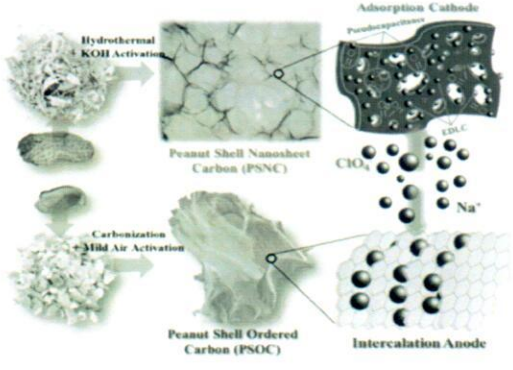

Fig. 1 Material synthesis process employed for each of the electrodes and the relevant cathode/anode charge storage mechanisms in the sodium ion capacitor (NIC) (Courtesy: Energy Environ. Sci. DOI: 10.1039/c4ee02986k).

Artificial Photosynthesis

Dr. Kamatchi Sankaranarayanan, DST-INSPIRE Faculty, DEE, NIT Trichy

Everyone is aware of the natural photosynthesis where plants convert the solar energy to the necessary chemical energy. But, can this happen in a lab, artificially? Can we replicate the same phenomenon in our lab environment? These questions pave way for researchers to work on 'Artificial Photosynthesis'. 2.4 billion years ago, photosynthetic cyanobacteria, or blue green algae as they are sometimes erroneously called, transformed our planet into the habitable oasis we have come to call Earth. They absorbed sunlight and carbon dioxide and released oxygen transforming Earth's reducing atmosphere into an oxidative one, shifting the balance of life in favor of more complex oxygen loving organisms like ourselves. Today, another organism is poised to shift that balance in the opposite direction. Humans and their penchant for burning fossil fuels have already unloaded an unprecedented amount of CO2 into the Earth's atmosphere. Since it was photosynthesis that instigated the climate change that gave our ancient aerobic ancestors a chance in the past, it is probably fitting that a little biomimicry could solve the climate and energy woes of today.

What is Artificial Photosynthesis?

Cyanobacteria and plants use photosynthesis to make their own fuel from nothing more than CO2, water, and the sun's rays. Artificial photosynthesis is therefore any process that attempts to mimic nature by chemically storing solar energy inside of a fuel. Artificial photosynthesis also includes any technologies that attempts to replicate any part of the photosynthetic process. The term is often used to describe a variety of technologies, including the photocatalytic splitting of water into hydrogen fuel and oxygen gas, the use of photosynthetic microorganisms for biofuels, or the complete biomimicry of the photosynthetic reaction process to create chemical fuels.

Why use Artificial Photosynthesis?

Conventional solar power, which involves the direct conversion of photons into DC current via the photovoltaic effect, is mired by costly materials, intermittency issues, cloudy weather, and the need to store electricity in a battery. Photosynthesis in nature may just hold the answers to all of these problems. The advantage to creating a fuel is the ability to use existing piping infrastructure, and easily store energy for use when sunlight is unavailable. The protein complexes from photosynthesis could also be used to replace costly rare earth metals used in conventional solar cells, driving costs down.

How does Photosynthesis Work?

The first step in biomimetics is to understand the phenomenon we are trying to replicate. Nature has devised a number nuanced ways to draw power from the sun, the most well-known being chloroplasts. Within the chloroplast are small disk-like structures called thylakoids surrounded by a fluid filled space called the stroma. Photosynthesis can be divided into two stages, light dependent reactions in the thylakoid and the light independent reactions which take place in the stroma. In most photoautotrophs, organisms that make their own food using sunlight and CO2, thylakoids capture energy from the sun using two types of photosynthetic reaction centers Photosystem I and Photosystem II.

These photosystems work in tandem to produce the energy that will later be used in the light independent reactions in the stroma to create fuel. The photosystems consist of a complex of specialized proteins, pigments, and other cofactors. The main cofactor in most photoautotrophs is chlorophyll, the pigment that makes leaves green and is responsible for absorbing red and blue light. When a photon strikes a chlorophyll molecule, it excites the electrons to a higher energy state allowing them to be scooped up by electron carrier proteins in the cell's electron transport chain. Let's take a closer look at the molecular machinery behind photosystems I and II. The names photosystem I and photosystem II are paradoxical, and are

only due to the order in which they were discovered. Since the electron pathway starts at photosystem II, we will be starting there first.

Photosystem II

When a photon hits photosystem II it excites an electron to a higher energy state causing it to leave the reaction center of photosystem II and enter the electron transport chain. The deficit in electrons is regenerated by an oxidative process called photolysis which strips electrons from water to create hydrogen and oxygen gas.

Electron Transport Chain

The high energy electrons that left photosystem II power the pumping of hydrogen ions from the stroma into the thylakoid to create a concentration gradient. This gradient powers a protein called ATP synthase which phosphorylates ADP to form ATP, an energy carrier that will be used in the light independent reactions. The energy depleted electrons leave the electron transport chain and enter photosystem I.

Photosystem I

When a photon strikes photosystem I, the electrons are re-energized and passed through the electron transport chain to a specialized protein called NADP reductase, which reduces NADP+ to NADPH, the second energy carrier molecule critical to the light independent step of photosynthesis

These nanosystems can be tapped to increase the efficiency of PV cells and a lot of research is going on in this aspect. Hope the future will have better solutions for empowering mankind.

Go fly a kite

Udayakumar, M Tech, DEE

Kites have been used for entertainment, radio experiments, military signalling, and even for hunting and meteorology. But can you imagine Kites being used for power generation? Guess what, it's possible! It is a fact that the wind flow is steadier as you go higher and higher. It is practically impossible to construct wind turbine tower as high as 800m, instead we can use Kite like structure to extract energy from such heights. Researchers in Italy have come up with a simple and innovative concept: the Kite wind generator (Kite Gen). It uses state of art kites. It moves like a yo-yo, when it goes up it generates energy that is transformed into electric power by the generator located on the ground. When it reaches its maximum height, it is placed in an aerodynamically non-lifting configuration, so that it can be pulled down at a very small energy cost. A control system on autopilot optimizes the flight pattern to maximize the power generated and a radar system can redirect kites within seconds in case of any interference such as small planes or even a single bird.

JUMBLED WORDS

1. Largest exporter of coal in the world
SIIAEONDN
2. Most commonly used material in photovoltaic panels
IINOSLC
3. A company famous for wind energy in India
SNLUZO
4. A greenhouse gas also called as marsh gas
TMHNAEE
5. Country having largest reserves of natural gas
SIRASU
6. The largest hydropower project in the world is constructed on this river
ZNTAYGE
7. This engine cycle has been effectively been connected to solar power
NRTIILSG
8. Largest importer of petroleum
AHCIN
9. Country which has the installed solar capacity
RYAGMEN
10. A colloid of fine solid particles or liquid droplets in a gas
LASROOE

Answers - Jumbled words
Indonesia, Silicon, Suzlon, Methane, Russia, Yangtze, Stirling, China, Germany, Aerosol

Nuclear power in India- Moving towards Thorium

Dr V.Gopalakrishnan,

Visiting Faculty, NIT, Trichy, Former Executive Director, BHEL, Trichy

1. Introduction: In 1947, at the time of Independence, India's installed capacity of electric power was roughly 1.5GW, which has now increased to 260 GW, (Feb, 2015), an impressive achievement by any standard. India generated nearly 1000 TWh of electric energy last year. This excludes the electricity generated from captive power plants, which is another 10% of energy. Currently, India is the world's third largest producer of electricity, with a 4.8% share in the global electricity generation. Only the USA and China are ahead of India in this respect. Both Japan and Russia produce less electricity than us.
Out of the 260 GW capacity, nearly 180 GW comes from thermal sources and 41 GW is accounted by hydro-power. The renewable energy's contribution is roughly 32 GW, of which the wind energy constitutes the bulk (2/3rd). Still, India's per capita electricity consumption is low - around 900 kWh per annum - which is nothing compared to similar figures for advanced countries. Some 5,000 kWh per capita per year—or a total capacity of 7,500 billion kWh per year for a population of 1.5 billion by 2050 will be a nice target.
However, out of the 260 GW of installed capacity, Nuclear energy's contribution as on date is only 5.8 GW or 5780 MW, to be precise.
2.Evolution of India's Nuclear Program: Surprisingly, Independent India started quite early in the deployment of nuclear energy. Its first research nuclear reactor, CIRUS (40 MW) achieved its first criticality in 1960. The agreement for India's first two nuclear power plants at Rajasthan - RAPP- 1&2 - were signed in 1963and 1966 respectively. The reactors were based on the CANDU reactor at Douglas Point, Canada, and began their operations in the seventies. (Due to technical problems, the reactors had to be down-rated to 100 MW, later).
PHWRs use natural uranium, which contains only 0.7% of the fissile isotope uranium-235. The rest is Uranium-238, which is not fissile but can be converted to the fissile Plutonium-239 in a reactor. Heavy water (Deuterium Oxide- D2O) is used as moderator and coolant.
Heavy Water Reactors (HWR) necessitated the creation of heavy water production facilities, but the advantage was the use of natural Uranium in these reactors. Light Water Reactors (LWRs) need enriched uranium, which is a more difficult process. At that time, PWHRs had the most efficient reactor design in terms of uranium utilization and Indian scientists and engineers were able to quickly and easily absorb the PHWR technology.
Subsequently, several 220 MW PHWRs have been installed in places like i. Kaiga, Karnataka, ii. Kakrapar, Gujarat, iii. Kalpakkam, Tamilnadu, iv. Narora, UP, and v. Kota, Rajasthan. The capital cost of PHWRs was in the range of Rs. 6-7 crore per MW, with a designed plant life of 40 years. Time required for construction has now come down to about 5 years. Tariffs of the operating plants are in the range of Rs. 1.75 to 2.80 per unit, depending on the life of the reactor.
Apart from the PHWRs, two boiling water reactors (BWR) of 210 MWe were installed in Tarapur, Maharashtra, in the early days, with aid from the USA. (They were later downgraded to 160 MWe due to technical difficulties). Two units of BWR of 540MW each were also added later, mostly with indigenous technology. Very recently, two Russian units based on VVER (WWER in Russian – water-water-Energetic Reactor) Pressurized Light Water Reactor of 1000MW each , have been installed in Kudankulam, Tamilnadu.
3.Current Scenario: As of 2015, India has 21 nuclear reactors in operation in 7 nuclear power plants, having an installed capacity of 5.8 GW and producing a total of 30 TWh of electricity. Despite the opposition to nuclear power in some quarters, the capacity factor of Indian reactors was at 79% in the year 2011-12 and nine reactors recorded an unprecedented 97% Capacity factor during the same period with an availability of 89%.

Another 4300MW are likely to be added before the end of 2016. Break-up: 2 more Russian VVER-1000 MW units at Kudankulam, Tamilnadu, 2 units of 700 MWe each (PHWRs) at both Kakrapar, Gujarat and Rawatbhata, Rajasthan, the first PFBR (Prototype Fast Breeder Reactor) in Kalpakkam, Tamilnadu. These additions will bring the total power capacity from nuclear plants to nearly 10 GW.

The design of India's first Prototype Fast Breeder Reactor (PFBR) was done by Indira Gandhi Centre for Atomic Research (IGCAR). Bharatiya Nabhikiya Vidyut Nigam Ltd (Bhavini), a public sector company under the Department of Atomic Energy (DAE), has been given the responsibility to build the fast breeder reactors in India. The construction of this PFBR at Kalpakkam will be completed in 2015.

4. Setback and Success: The United States and Canada terminated their assistance to India in the nuclear field, after the detonation of India's first nuclear explosion in 1974. For 3 decades, Indian civil nuclear program faced international isolation. However, since early 1990s, Russia became the major supplier of nuclear fuel to India. Due to dwindling domestic uranium reserves, electricity generation from nuclear power in India declined by 12.83% from 2006 to 2008, which only ended with the Indo-US Nuclear Deal and the Nuclear Suppliers Group (NSG) waiver in September 2008. After this, India could commence its international nuclear trade. Soon the country entered into several agreements with important countries and also has drawn up some ambitious plans to add another 30 GW capacity in the near future. A few details:
India has issued a Letter of Intent for purchasing 10 GW from the USA. However, liability concerns and a few other issues are preventing further progress on the issue. India may be eyeing GE-Hitachi's Economic Simplified Boiling Water Reactor (ESBWR) (there is a proposal to install it in Andhra (6x1594MW=9564 MW)) and Westinghouse, USA's AP1000 PWR, which it claims is the safest and most economical nuclear power plant in the world. (There is a proposal to put up 6x1100MW=6600MW in Viradi, Gujarat).

After two more VVER 1000 MW reactors at Kudankulam, Tamil Nadu, a 2008 agreement with Russia is thinking of an additional four third generation VVER-1200 reactors (Capacity 1170 MW each). Russia has assisted India in designing a nuclear plant for its submarine. Russia had never agreed to curb export of sensitive technology to India. A new accord signed in Dec 2009 gives India freedom to proceed with the closed-fuel-cycle, which includes mining, preparation of the fuel for use in reactors, and reprocessing of spent fuel.

France signed a nuclear agreement with India to set up 2 third-generation EPR reactors of 1650 MW each at Jaitapur, Maharashtra by the French company Areva. Ultimately, there will be of six planned reactors and the supply of nuclear fuel for 25 years. Because of regulatory issues, the contract is yet to be finalised.

The agreement with Canada will provide access for Canada's nuclear industry and also fuel for India's reactors. India has also signed technical collaboration agreements with the UK and South Korea.

Apart from all these, more indigenous 500 MW FBRs are being planned. At least one of these reactors will be operated with metallic fuel instead of oxide fuel, since the design will have the flexibility built into it.

India has also signed some agreements for Uranium imports. Among the major Uranium mining countries, Kazakhstan tops the list with 22000 T of production and accounting for 38% of the global output. It is followed by Canada (9000T, 15.7 %), Australia (6000T, 10.7 %), Niger (4500T, 7.6%), Namibia (4300T,7.3%), Russia (3100T,5.3%), Uzbekistan (2400T,4.0%), USA (1800T, 3.0%) and China (1500T, 2.5%). India is way behind. (385T,0.6%).

India has uranium supply agreements with Russia, Mongolia, Kazakhstan (would supply India with 2100T of uranium and was ready to do more), Argentina and Namibia. An Indian private company won a uranium exploration contract in Niger.

Without the implementation of fast breeders, the presently available uranium reserves of 5.5 MT can support 570 GWe till 2025. If the identified and undiscovered uranium reserves of 16 MT are brought online, the power availability can be extended till the end of the century. This makes Thorium an attractive proposition and calls for more research into thorium as an energy source.

5. Fresh problems: After the 2011 Fukushima nuclear disaster in Japan, perceptions about nuclear power changed a lot in India. There have been mass protests against the French-backed Jaitapur Nuclear Project in Maharashtra and the Russian-backed Kudankulam Nuclear Plant in Tamil Nadu. The state government

of West Bengal has also refused permission to a proposed 6000 MW facility near the town of Haripur that intended to host six Russian reactors.

A Public-interest litigation (PIL) has also been filed against the government's civil nuclear program at the Supreme Court. The PIL specifically asks for the "staying of all proposed nuclear power plants till satisfactory safety measures and cost-benefit analyses are completed by independent agencies". But the Supreme Court said it was not an expert in the nuclear field to issue a direction to the government on the nuclear liability issue.

6. India's Energy Security: How long will India's energy sources last? Leaving aside the renewable sources, India's coal reserves are estimated at 54BT, equivalent to a power potential of 11 TWe-years. The corresponding figures for hydrocarbons are 12 BT and 6 TWe-years, respectively.

India's Uranium reserves are estimated at 61,000 T. How long it will last depends on the technology used. If used in PHWRs, the power potential is only 0.4TWe. However, if used in FBRs, its potential increases to 16-54 TWe. The Tummalapalle mine in Kadapa District in Andhra is found to have some major reserves. (49 KT-150 KT). Indian uranium production is constrained by government investment decisions rather than by any shortage of ore.

Thorium was not economically viable until global uranium prices were much lower. Thorium produces 200 times more power per kilo than uranium. Further, thorium reactors can generate power from the plutonium residue left by uranium reactors. Thorium does not require significant refining, unlike uranium and has a higher neutron yield per neutron absorbed. Thorium by itself is not a fissile material, and thus cannot undergo fission to produce energy. Instead, it must first be converted into the fissile isotope uranium-233 by in a reactor fueled by other fissile materials.

India has the highest amount of Thorium deposits in the world. Thorium in India is in the readily extractable form. As per a 2011 report, India's reserves are estimated to be 963,000 T, obtained from 10.7 MT of monazite in beaches and river sands.. The figures for other countries are –the USA - 440,000 T, Australia - 300,000 T, Canada -100,000 T, South Africa - 35,000 T, Brazil- 16,000T, Malaysia -4,500 T, Other Countries- 90,000 T. (World - 1,913,000 T).

India's program is strategically focused on the use of thorium—the country has 40% of the world's thorium reserves but relatively little uranium. India has the world's only thorium-based experimental reactor at BARC, the 30 Kw Kamini reactor.

It is estimated that the country could produce 500 GWe for at least four centuries using just the country's economically extractable thorium reserves. That brings one to the country's indigenous three-stage program.

7. Dr. Homi Bhabha & his Thorium plans: Dr.Bhabaha wanted to use the thorium reserves on the coastal sands of South India in an optimum way and came up with India's three-stage nuclear power program in the 1950s. Bhabha presented his plan to Prime Minister Jawaharlal Nehru and soon the Indian government formally adopted the plan. India currently has six different configurations of power reactors in operation and under development, but these fall into a three-stage nuclear power program. The three stages are as follow

i) The first stage will use natural uranium-fueled heavy water reactors. They will produce Plutonium as a by-product.

ii) Plutonium-fueled fast breeder reactors form the second or intermediate step. The FBRs will use a mix of plutonium-239 (recovered from the first stage's spent fuel) and natural uranium. Plutonium-239 undergoes fission to produce energy, while the uranium-238 transmutes to additional plutonium-239. Thus, they "breed" more fuel than they consume.

Once the inventory of plutonium-239 is built up, thorium can be introduced as a blanket material in the reactor and converted into uranium-233 for use in the third stage.

The surplus plutonium bred in FBRs can be used to set up more such reactors, until the third stage reactor using thorium as fuel can be brought online. It may be possible once 50 GW of nuclear power capacity has been achieved.

iii) In the third stage, Thorium- converted into-U233 is used in thermal breeder reactors. They can be refueled – after its initial fuel charge – with naturally occurring thorium. They would produce more U-233 tha

they burn in the course of producing power.

According to the three-stage program, Indian nuclear energy could grow to about 10 GW through PHWRs fueled by domestic uranium, and the growth above that would have to come from FBRs till about 50GW. The third stage is to be deployed only after this capacity has been achieved. Large scale thorium deployment can be expected only 3 – 4 decades after the commercial operation of FBRs, with short doubling time

Doubling time in FBR refers to the time required to extract as output, double the amount of fissile fuel, which was fed as input into the breeder reactors. Bhabha in 1958 expected a doubling time of 5–6 years for breeding U-233 in the Th–U233 cycle. This estimate has now been revised to 70 years due to technical difficulties that were unforeseen at the time. It can be brought down to about 10 -20 years by choosing appropriate technologies with short doubling time. Full exploitation of India's domestic thorium reserves may occur only after 2050.

8.Parallel approaches: India is now looking at reactor designs that allow more direct use of thorium in parallel with the sequential three-stage program. Several options including the following are under consideration:

i) Accelerator Driven Systems (ADS)
ii) Advanced Heavy Water Reactor (AHWR)
iii) Compact High Temperature Reactor
iv) Molten Salt Reactor

i)Accelerator Driven Systems (ADS): The Accelerator-driven sub-critical reactor couples a subcritical nuclear reactor core with a high energy proton accelerator, which provides the extra neutrons needed for achieving criticality. It would use thorium as a fuel. One benefit of such reactors is the relatively short life of its waste products, which would be in the hundreds of years as opposed to millions of years for existing nuclear reactors. The high energy proton beam impacts a molten lead target inside the core, chipping or "spallating" neutrons from the lead nuclei. These neutrons convert fertile thorium to fissile uranium-233 and drive the fission reaction in the uranium.

ii) Advanced Heavy Water Reactor (AHWR): AHWR is a 300 MWe vertical pressure tube type, boiling light water cooled and heavy water moderated reactor, using Uranium233–Thorium MOX and Plutonium-Thorium MOX. It is expected to generate 65% of its power from thorium and can also be configured to accept other fuel types in full core including enriched uranium and uranium–plutonium MOX. It will be fueled with 20% low enriched uranium (LEU) (readily available on the world market) and 80% thorium.

iii) Compact High Temperature Reactor: Bhabha Atomic Research Centre (BARC) is designing prototype versions of two new reactors that will produce hydrogen for use as a fuel: the Compact High Temperature Reactor (CHTR) and the Indian High Temperature Reactor (IHTR). The CHTR produces hydrogen by thermochemically splitting water. The efficiency of the thermochemical splitting of water to produce hydrogen varies between 40% to 57%, according to BARC. By contrast, the efficiency of high-temperature steam electrolysis ranges from 27% to 48%, and the efficiency of electrolysis is about 27%. Both these reactors will have core temperatures of more than 1,000°C. (Current reactor temperatures ~ 300° C). The reactors will have capacities of 600 MW and will be capable of producing hydrogen by night when the demand for power drops.

iv) Molten Salt Reactor (MSR): Here, the primary coolant or, or even the fuel itself, is a molten salt mixture. MSRs run at higher temperatures than water-cooled reactors for higher efficiency, while staying at low vapour pressure. The nuclear fuel may be solid or dissolved in the coolant itself. In many designs the fuel is dissolved in the molten Flouride salt coolant as Uranium tetra fluoride (UF4). The fluid becomes critical in a graphite core which serves as the moderator. Solid fuel designs rely on ceramic fuel dispersed in a graphite matrix, with the molten salt providing low pressure, high temperature cooling. The salts are much more efficient than compressed helium at removing heat from the core, reducing the need for pumping and piping and reducing the size of the core.

9.Conclusion: The nation could generate up to 470 GW of power by 2050 if it managed the three-stage program well. According to plan, 30% of the Indian electricity in 2050 will be generated from thorium based reactors. Indian nuclear scientists estimate that the country could produce 500 GWe for at least four centuries using just the country's economically extractable thorium reserves.

Chemical Engineering and Sustainable Energy

Raghu, M-Tech, DEE

Sustainability principally means the direct and indirect natural dependence of each and every substance on the environment around us. It essentially helps in peaceful co-existence between humans and 'Mother Nature'. The increase in world population and improvements in living conditions have called for future demand of clean, affordable energy. Alternative, sustainable methods of generation and subsequent conversion of available, renewable energy sources should be accompanied with reduced greenhouse gas emissions. The wide range of core chemical engineering concepts include those focusing on multidisciplinary knowledge with complementary specialization electives with sustainable energy systems in particular. The latest research areas that are being connected to such a core discipline are geothermal sciences, photonic materials and solar energy capture, battery power, storage and its transmission and biomass conversion. The emerging research projects related to these specific areas may include:

• Chemical engineering processing for renewable, conventional energy extraction and carbon sequestration.

• Fabrication of next-generation solar cells and batteries from nanoscale building blocks.

• Production of energetic materials and fuels from biomass feedstock

A chemical engineering perspective often includes physical, chemical, biological mass and energy balances, design of materials for energy capture and storage, its process design, simulation and an in-depth knowledge of transport phenomena. Thus, it provides the ideal skill set required for solving a wide range of energy problems in a sustainable manner.

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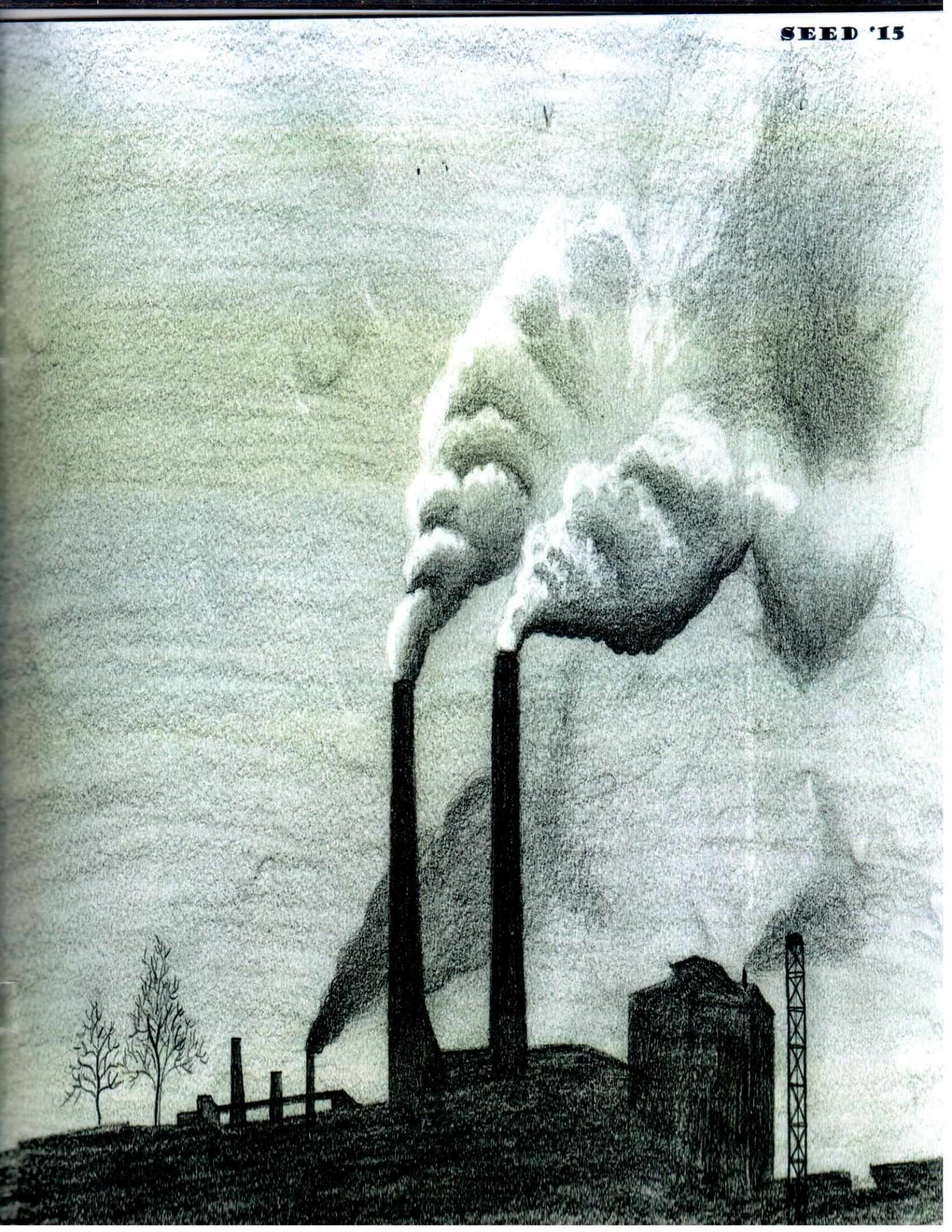
For example, there have been several i stances in the field of biomass-derived ener where the effect of cellulose microstructures enzymatic hydrolysis rates, thermo-chemic conversions using supercritical medium for co version of lingo-cellulosic and lipid-rich fee stock to liquid and gaseous hydrocarbon fu have been carried out using the aforesaid coml nation of ideas. Again, research focused on op cal properties for high performance solar ener capture, nanoscale particles for high-perf mance lithium-ion batteries and substitute ma rials for high capacity thermal energy stora are in a nascent stage but which have a high p tential to achieve the sustainable targets.

Hence, the need of the hour is to identify and a dress current and future chemical engineeri problems related to energy sources, generatic conversion and its production with a goal to sustainable in nature.

About 5,000 years ago, the energy people consumed for their survival averaged about 12,000 kilocalories per person each day. In AD 1400, each person was consuming about twice as much energy (26,000 kilocalories). After the Industrial Revolution, the demand almost tripled to an average of 77,000 kilocalories per person in 1875. By 1975, it had tripled again to 230,000 kilocalories per person.



Fight for our nature and future; A Social Initiative for "Nuclear free India"

Satyam Kumar, M-Tech, DEE

Let me make it very clear at the outset that we are for the development of the country and our people including the poor and oppressed. So should we support energy generating plans and projects?

We as energy engineers only say that let us generate required energy from renewable sources such as the sun,wind,waves,wastes and so forth without spoiling our land,water,air,sea ,cattle, crops etc. After allfood security,nutrition security,water security and air security are far more important than energy security.

But central government wants to set up nuclear power parks(six to ten plants) at so many locations all over India (Koodankulam and Kalpakkam,Tamil Nadu;Kovvadu,Andhra Pradesh; Pati,Sonapur, Odisha; Haripur, West Bengal;Kaiga,Karnataka;Jaitapur and Tarapur, Maharashtra;Mithi,Virdi, Gujarat; Bans Wada, Rajasthan; Gorakhpur, Haryana;Chutka, MadhyaPradesh etc.) with the help of the United States,Russia, France, Japan, SouthKoreaetc. TheUnited States has not built a new nuclear plant in recent years. Japan has shut down all its 52 nuclear power plants after the Fukushima accident in March 2011. Germany has decided to phase out its nuclear power plants. ShouldIndia be the dumpsite of this discredited nuclear technology?

Indian government wants to import uranium from Australia, Kazakhstan, and Namibia and so on. But none of these countries have a nuclear power plant there.But we do not have any authority to say so without logic. We as energy engineers should take into consideration following things:

Nuclear energy is not cheap. Consider the land acquisition cost, long construction period and cost escalation, bribery and corruption, security costs, decommissioning, waste disposal and management etc. Every step in nuclear power generation is very expensive and the government subsidizes all of them.

Nuclear energy is not clean. Consider the enormous amount of steel, cement, oil and electricity used in nuclear power plant construction and operation. All these come from polluting sources. Nuclear plants leave huge amounts of dangerous wastes that threaten us with radiation for 48,000 years. OMG!!What will the government do with all these wastes? Where will they store them in a crowded country?

Nuclear energy is not safe. India being a densely populated country, even a small incident in a nuclear plant may have disastrous consequences for millions of people. See the people of Bhopal who suffered an industrial disaster. Even after 30 long years of several governments, chief ministers and prime ministers, the people there are still left helpless without compensation, medical assistance or waste removal.

Nuclear energy is not healthy. Nuclear power plants dump enormous amounts of hot and mildly radioactive coolant water into the sea or river 24*7.That affects the seafood and groundwater. The nuclear plants emit radioactive Iodine, Caesium, Strontium, Tellurium etc. into the air. All these may cause pregnancy-related problems, birth defects in children, radiation illness, and cancers and so on.

Nuclear energy is not moral. What moral legitimacy do we have to spoil the nature and the future of our children and grandchildren just because we get electricity for 40 years .cioeconomic and political independence in the name of energy independence? Should we behave like slaves and recolonize our country all over again? Or should we think like leaders and solve our problems with originality and creativity?

So what is the solution of above said problems? Let's check it out.Solution is future technology based on green technology and also sustainable like biofuels, solar, wind energy, wave power, geothermal power, hydroelectricity etc.

In the future, civilization will be forced to research and develop alternative energy sources. Our current rate of fossil fuel usage will lead to an energy crisis this century. In order to survive the energy crisis many companies in the energy industry are inventing new ways to extract energy from renewable sources. While the rate of development is slow, mainstream awareness and government pressures are growing.
But good news is that several experiment has started on our globe, want to know?
Apple electric car, tulip shaped solar plants to be installed in Ethiopia, Japan close to harvesting solar energy from space, Goodyear releases electricity-generating tyre concept, Google bio dome etc.
As Mahatma Gandhi said: "The earth, the air, the land and the water is not an inheritance from our fore fathers but on loan from our children. So we have to handover it to them at least as it was handed over to us."
Come; let us strive for a 'nuclear free India' that has No Deals, No mines, No Reactors, No Dumps, and No Bombs.

MIRROR

Sravya, M Tech, DEE

It's me
My real self
A demolished identity
An unsaid fable
Yes it's me, I m a mirror...
I am a stratified composure of expressions unknown
In search of the answer for- "who am I..?"
Still live up life with alacrity
Without a crinkle or a sigh
I am a philanthropist
I do not seek a symbiotic bond
I just live for others
And help the fishes of my pond
People share themselves with me
And I become a passive listener that time
I make them see what exactly they are
And help their doubts sublime
Every t ime somebody looks at me
I observe the innocence of their serene soul
We share a talk in low murmurs
Glittering gold embedded in the black coal
Smiles, tears, laughs and cries
All I have seen crystal clear
I tend to forget my question now
Mingling more satisfaction and less fear

Soumya Joy, M Tech, DEE

FIPEL –THE NEW CFL

Tarun, M Tech, DEE

Remember those days when we used to talk about incandescent bulbs being replaced by fluorescent lamps?? Then came the era of LEDs and are quickly blowing out CFLs into extinction. Now there is a new kid in town.... The FIPEL lamps or field-induced polymer electroluminescent lamps is quickly moving into the consumer market. Researchers at Wake Forest University in North Carolina and Trinity College in Ireland have developed it and they're already working with a company called CeeLite to manufacture FIPEL lights and bring them into consumer market.

General Electric first introduced fluorescent lamps at the 1939 New York World's Fair. They were immediately a hit with industries because the lamps had a long life and therefore cost less to install and maintain. But they weren't so popular with ordinary people because of that darn light buzz and the harsh light the lamps emitted. This sound was due to a device called ballast which was placed in the lamp to prevent current from reaching dangerous levels. The ballast's magnetic field has a tendency to cause an effect called magnetostriction. That means that the magnetic field actually squeezes the ballast's core, altering its shape slightly. That makes your fluorescent fixture squeak over and over, about 120 times per second which gives the lamp its all annoying buzz.

Instead of mercury or the filaments in old-fashioned incandescent bulbs, FIPEL lights contain multiple layers of polymers – plastic—imbued with an iridium compound and a small number of carbon nanotubes. The latter are cylindrical structures, built in laboratories that are as minuscule as 1/10,000th the diameter of a human hair! Compared to conventional materials, these nanomaterials have a lot of novel characteristics, such as increased strength, chemical reactivity and/or conductivity. When electrical current flows into the FIPEL tube, it stimulates it to produce light just as electrical current passing through mercury in a fluorescent tube does. That energy is filtered through the polymers to create light.

Energy wise, the FIPEL light is twice as energy-efficient as a CFL, about the same as a LED. But it doesn't have any caustic chemicals like the CFL which contains a small amount of mercury. And because it is plastic, the FIPEL is easy to recycle. The bulb has a lifetime of 25,000 to 50,000 hours, about the same as LED. Wake Forest physics professor David Carroll, who's the inventor, said he's had a bulb burning in his lab for a decade.

Because they're made of plastic, FIPEL lights can be moulded into a wide variety of shapes -- from bulbs that fit into the old sockets designed for incandescent bulbs to large sheets or panels that could fit into the spaces above ceiling tiles and behind walls, so that a soft, unobtrusive light can be evenly spread throughout a room.

As for cost, a management consultant for CeeLite said the manufactured FIPEL bulbs should cost less than LEDs but a little more than CFLs. Critics questioned whether in fact FIPEL was actually a breakthrough, since warm white LEDs are already available (without the bluish tint) and CFLs have only a minuscule amount of mercury, too little to be much of an environmental hazard. But most of the reaction has been positive. The Web site Engadget, for example, called FIPEL the "super-bulb"

Only 10% of energy in a light bulb is used to create light. Ninety percent of a light bulb's energy creates heat. Compact fluorescent light bulbs (CFLs), on the other hand, use about 80% less electricity than conventional bulbs and last up to 12 times as long.

Fate of IC Engines: Powered Rebirth or History?

Shruthi, M Tech, DEE

Industrial greed leaked the Internal Combustion Engine onto civilian streets and with promises to take man further and faster. Since the advent of "The Great Leveller", it has just made us lazy. Once the last tank of fuel runs empty, we will again look upto our great minds for an impressive technology to covet. With electric vehicles on horizon and battery technology improving each year, a bright future for IC engine is becoming harder and harder to see.

As much as I know the ICE, it is not very efficient; most of the heat energy goes out the exhaust. On the other hand, electric motors are very efficient (twice as efficient as a internal combustion engine). However, the problem is the batteries. They just haven't reached the capacity to drive IC engine and most people feel uncomfortable driving an electric car full time. I think because of the same reason, the car manufactures are in a wait and see because they know at some point batteries will become better. I feel that in the coming 20 years, we will have electric cars having capability comparable to IC engine. However, whatever replaces the ICE, will have to meet certain criteria.

1. It has to be economical enough. If too expensive, people will never adopt it. This also applies to the infrastructure to support it. It will have to be cost effective to replace the gas stations etc. that supports the ICE.

Henry Ford made the automobile cheap enough for the masses. This represented a new freedom to travel that totally changed the society.

2. It has to match the ICE capabilities. For example, if new technology takes too long to refuel (or recharge) then that will be an obstacle to the very freedom of travel that people have grown to take for granted. They will reject it. It will have to be able to match the power of the ICE. For example, the rancher or the landscaper has to have enough power to pull trailers with animals or equipment.

If battery technology overcomes these issues, I would be glad to step up and buy an electric car.

Some people think that IC engines will phase out eventually while others think that it will only get better and better as the years roll on. But what I think is this optimistic approach on the subject of the fate of ICEs would not lead us anywhere. I am a huge fan of IC engines but sadly saying, it will be soon in yellow pages. What do you think?

On a hot summer afternoon, California consumes the entire output of two large nuclear reactors pumping water.

Without the atmosphere to create a greenhouse-type effect, the average temperature on Earth would be just 5° Fahrenheit (F).

Geologists believe sea levels could rise between seven and 23 inches by the end of the century if current warming trends continue.

The effects of global warming could destroy the habitats of and threaten extinction for over one million species of plants and animals.

The Sun produces an enormous amount of energy from its nuclear reactions that change hydrogen into helium. In the process, the Sun loses over 4 million tons of mass—every second.

Changing Paradigms

Prabhanjan, M-Tech, DEE

Dr Amartya Sen- a great economist and philosopher asserts we Indians have always been argumentative since antiquity. Many of our ancient sages and philosophers never fell prey to dogmas; they questioned authority and maintained free spirit within themselves. It's only before a couple of centuries; the world started seeing India as a country of people having no free spirit or independent thinking ability. People have a tendency to extrapolate past from present, therefore they think that Indians have always been superstitious, not bothering to investigate the paradigms. Today, for a few moments I shall unleash that part of me which is truly Indian and argumentative in nature, and analyse propensities, paradigms and dogmas in an Engineers life.

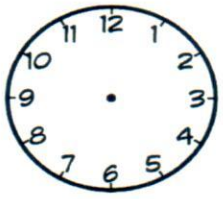
Imagine an M.tech student willing to pursue a degree in psychology, economics, or even arts after completing the M.tech. Most people will express blatant disapproval to this, calling it utter foolishness. Few would try to 'talk some sense into' him, asking 'how will it help your career? How will you earn money? Apart from such explicit or implicit naysayers, how many people will motivate the person who wants to play it his way? It's only after British left India, our views became materialistic, and we started favouring money over knowledge. As a child we all had that curiosity about everything, but where is it now? Why an engineer should not know about Geography, history,left India, our views became materialistic, and we started favouring money over knowledge. As a child we all had that curiosity about everything, but where is it now? Why an engineer should not know about Geography, history, geopolitics, psychology, theology, music, philosophy, literature. As we grew old and became engineers, in between this process, we gave away that child's curiosity and started doing only the things which are useful for us in immediate future. Most engineers only think about what they will do in semester exams, or about what will happen in placement interviews. They will procrastinate developing a good habit of reading, or exercising, because it won't help them in near future, it won't help them in semester exam. In most people, that child's curiosity, but they don't bother to take it to next level and read something about it, get insight into it- They don't do it because it's not going to help them in near future. How many of us engineers really think beyond 10...15 or 20 years? And how many are ready to persevere for that vision, instead of working for immediate prospects without having a visualization of future after it. How many of us have realized the need to thrive for self-perfection? How many are willing to think beyond just the pointer and a job?

This article is not meant to provide an answer, but instead to invoke questions in a rational mind. I hope if anyone disagrees with my views, he or she will still respect them as an open minded Indian.

Enough sunlight reaches the earth's surface each minute to satisfy the world's energy demands—for an entire year.

THE TIME, THE NEED AND THE GOD

Pranav, M Tech, DEE



The concept of god or any supernatural power has always been the fascinating topic of discussion all over the globe. No one really knows the origin of universe; some physicists have just tried to prove the birth of universe. We consider it as the birth of time as well. Does our imagination cease here? Is this the limit of our thinking? It is sometimes said that science stops here. Thoughts originate from the brain, one of the beautiful creations of the almighty. We think, we imagine, we sense, everything is controlled by this brain. But has the supernatural power restricted the brain and not to think beyond this? If this is true it's a question on the capability of our thinking. So this proves we are so small in this entire universe. From this point we start believing in some supernatural power that has created us. It is governing us and monitoring us in every possible way.

We have been given this one beautiful planet to live and we started exploiting its resources. The human race has been on this planet about half a million years ago. The timeline has kept changing since then; humans kept the foot on the path of progress and advancement have reached this most advanced and civilized state of living. Being the most intellectually dominant species on this globe, have used their brains to a large extent to increase the ease and comfort for living. The need has never decreased instead it kept increasing exponentially. The state of realization got delayed to invade the human brains. Now we have realized that we have exploited our mother earth to large extent and we will be out of resources in a few years. Now we have started using our brain at even higher extent to make it easy in limited resources. But there will be time called big crunch for earth where the time will be reversed and we will move backwards again. This is the beginning of it, now we again start depending on the supernatural power (the god). Let's understand the value of time , our thinking capability and also its limits. Even if something is free use it judiciously.

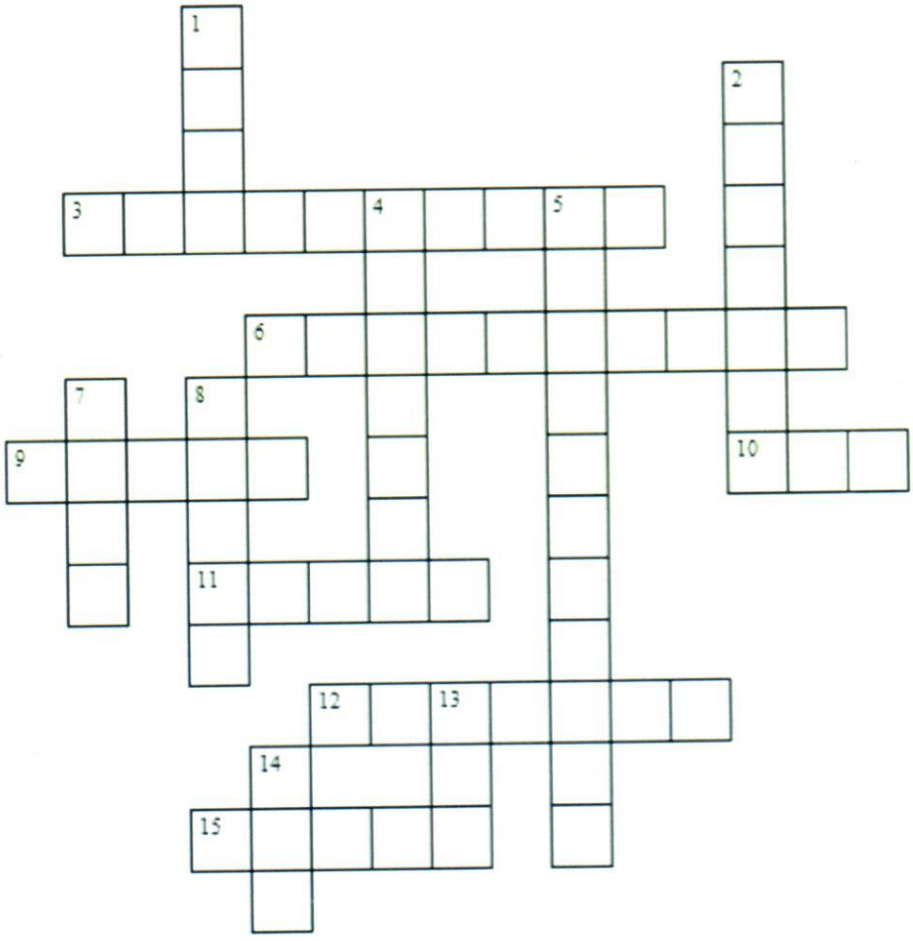
A hurricane releases 50 trillion to 200 trillion watts of heat energy. This is as much energy as a 10-megaton nuclear bomb exploding every 20 minutes.

If a person yelled for 8 years, 7 months, and 6 days, he or she would produce enough energy to heat one cup of coffee.

World coal consumption is more than 5.3 billion tons annually of which three quarters are used for generating electricity.

The top seven oil consumers combined use more than half of the

CROSSWORD



DOWN

1. Most common renewable energy in Tamil Nadu (4)
2. ("Life" Greek root) + (Force/acceleration) (7)
4. Third member of homologous series of alkanes (7)
5. Benjamin Franklin used kite to discover ---------- (11)
7. Primarily used solid fuel (4)
8. This comes between roman goddess of love and the roman god of wars (5)
13. This gift given to men is the most polluted (3)
14. Reduce recycle and reuse it (5)

ACROSS

3. Most widely used renewable energy in the world (10)
5. Explains the hot water springs (10)
6. Most domestic renewable energy source (5)
9. Natural fusion reactor (3)
10. Moon's gravitation causes this (5)
11. Element named after the 7th planet of solar system (7)
15. We pollute this because it is free (5)

Answers

Down

Wind, Biomass, Propane, Electricity, Coal, Earth, Air, Waste

Across

Hydropower, Geothermal, Solar, Sun, Tides, Uranium, Water

MAKE A STEP, CONSERVE ENERGY

Nivedita S, M Tech, DEE

On saving energy, it's not only about saving money, but also reducing the demand for such fossil fuels as coal, oil, and natural gas. Less burning of fossil fuels also means lower emissions of carbon dioxide (CO2), the primary contributor to global warming, and other pollutants.

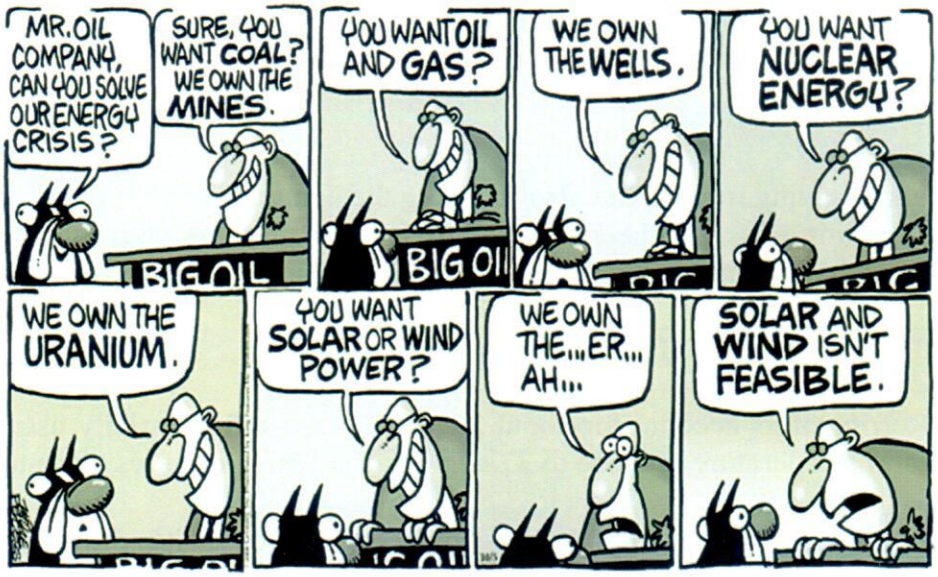
10 THINGS YOU CAN DO TO CONSERVE ENERGY

1. Turn your refrigerator off. Refrigerators account for about 20% of Household electricity use. Use a thermometer to set your refrigerator temperature as close to 37 degrees and your freezer as close to 3 degrees as possible.
2. Clean the coils at the back of the refrigerator as often as possible. Dirt built up makes the refrigerator waste energy and avoid placing freezers / refrigerators too close to the walls or in corners.
3. Use cooking utensils that are slightly bigger in diameter than the hot plate to prevent heat from escaping.
4. Avoid "long-life" bulbs. They are 20% less efficient than the standard bulbs and use high-pressure sodium or metal halide lamps for outdoor/external lighting.
5. Select the most energy-efficient models when you replace your old appliances.
6. Reduce the amount of waste you produce by buying minimally packaged goods, choosing reusable products over disposable ones, and recycling. Making products with recycled materials, instead of from scratch with raw materials, uses 30 to 55% less for paper products, 33% less for glass, and a whopping 90% less for aluminium.
7. Mobile phone chargers could also consume up to 10 watts if left on, even though the phone may not be connected.
8. Modern Audio and Video equipment such as TV, DVD, VCD, Stereo System and Video Recorders are equipped with remote control systems to ensure user comfort and convenience. They however consume power at the rate of 15 – 25 watts when they are in the standby mode.
9. Electronics and appliances continue sapping energy while they're plugged in, even when they're switched to "off." Make a habit of unplugging everything that's not in use, especially computers, TVs and sound systems, which use up most of the energy.
10. Plant shade trees as each tree directly absorb about 25 pounds of CO2 from the air annually.

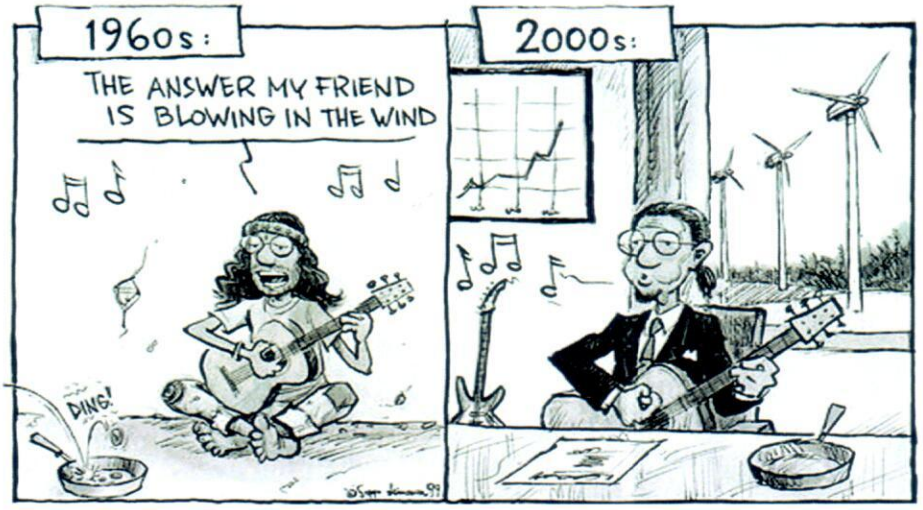
Approximately 30% of energy used in buildings is used inefficiently or unnecessarily.

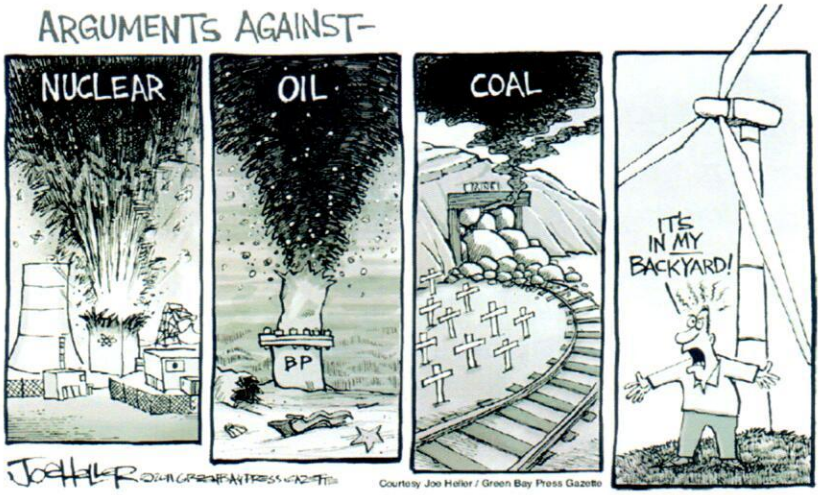
The most powerful hydroelectric project in the world is China's Three Gorges Dam. The controversial and enormous power plant brings power to millions of Chinese villagers and will generate more than 22,000 megawatts from six generators.

In the last 50 years, atmospheric CO2 has shot up to levels unprecedented in the previous 400,000 years. The man-made injection of CO2 into the atmosphere is primarily from the burning of fossil fuels.



webtalk





Courtesy Joe Heller / Green Bay Press Gazette

A New Horizon

GARGI, M Tech, DEE

Searching for a new horizon
Searching for a new day
With the same winds blowing the trees
And same footprints across the bay
I am not the way I was
I am t rying to find the rea l me
Hidden deep beneath the stratus of fake exhilaration
And veiling myself with the utmost disguise to let people see
It's been so long that I have not had a glance
Even the mirror shows false reflections now
Rainbows appear but that too with art ificial hues
Paralyzed by the pain but still managing to color, don't know how
I will wait for the day to come
I will wait for the clouds to scatter and fly
I want to feel the sun deep inside
And to learn between true and sly
Adversities made me learn from the blue
Not to let emotions turn glue
Expectations are the cause of dark shadows
Their fulfillment is a complete myth
Till whatever extent you try to run
This is the fact we have to live with
I am still on the road
And I know destination is not that far away
My search is driven by an optimistic approach
which reaches towards the suns first ray
Searching for a new horizon
Searching for a new day
With the same winds blowing the trees
And same footprints across the bay

Awakening

Above the grit
Below the sky
Secrs yet to be unfold
To differentiate truth from a lie
We are not a minute's creation
It has taken ages so long
Prosperous and symbiotic selves we are
Children of a foundation very strong
It starts with the mother liquor
which shaped the course of our evolution
Framed this earth to a perfect picture
And made life possible which was merely an illusion
Since the time unknown we have thrived on the gifts of nature
Worshipped it as the supreme God
But the days have gone when the grace was realized
Hearts have become of stones and brains solid as a steel rod
Everything in us has changed from hot to cold
But nature is still the same
An epitome of philanthropy it remains
Satisfying us being its only aim
There is a limit for everything
And so it is for endurance too
We cannot forever be mean
Because someday something nature will also do
It's time to wake up
It's time to bring back the golden era
It's time to join hands
It's time to sync to the Nature's opera

ILLUMINANT NEW STREET LIGHTS

Anjana, M-Tech, DEE

As centuries pass, faces of cities are changing due to abrupt growth in technologies. But old culture and tradition will have a touch in its growth. Such kind of a city has to be exploited with our own eyes to taste its impact in air even now. A dry arid region of temperature ranging from 25-400C and average sun shine of 9-13 hours with dry hot air blowing throughout the year in long sandy deserts is the general climatic condition of this town throughout the year. Even though normal life style is difficult here, highly efficient resources like solar, wind and fossil are widely available since the geographical condition is good. Arts, culture, tradition, religion and resources of the city have its own value from the very beginning of human life till now throughout the world. Richness in its arts and culture are reflected in the streets of the town with its rare scene of girls dancing with their elegant expressions, rich handicraft clothes and ornaments, which can be compared and amazed with nature's dance of illuminant lights when night falls on deserts. Arts, architecture and religion are blended to give nice texture to houses and religious centers that stand high with glass, wooden, gypsum ornamented doors in the very narrow streets, giving a cool breeze and shade throughout the pathway, also gives privacy to houses. The tall walls and north-south alignment of the streets are reason for air to flow continuously. A wind tunnel at the center of street is giving pleasant and cool breeze. It is a high raised tunnel with channels on the top that allow wind to flow inside, mix with water flushed on the top and then circulated to the streets to make them cool. An interesting fact about olden houses are that, they are square castellated buildings with walls made of mud, gypsum and coral stones, palm trunks on the roof, big courtyards at the center. All this aids in conditioning the house. The streets are well cleaned and maintained in good condition without any waste on streets. Recycling methods are employed for effective utilization of water throughout city to reduce wastage.

Even though climatic conditions remain the same, streets have changed. It has become a well-developed place in all aspects. But city is stepping forward to growth only after thinking about a future generation. The resources and earth are being saved for future generations to come. If our ancestors had forgot about us, we might be living in darkness today. Now cities are being designed so that they can sustain themselves depending only on renewable resources. Transportation, one of the prime fossil fuel consumers, are completely replaced by PRT's that are charged using solar panels alone, planes having inbuilt panels on wings, vehicles having solar roofs on top to charge them, using cycles for short distance and so on. Whole city is free from emission. Also fossil fuel utilization is limited well. Solar panels that have been mounted on top of buildings are the only power source for whole city. Along with being source they are projected outside the building in order to give them shade. Some concentrating collector arrangements and vacuum panels are utilized for cooling purposes. An optical tower system arrangement that uses heliostats to concentrate solar radiation on top of tower and secondary mirrors to intensify and concentrate to a point is one of the interesting attractions of this town. They use solar radiation to generate steam and use it in refrigeration cycles. The walls made of clay are insulated with Teflon coatings that act as air pillow to protect it from direct sun light. Sensors are employed in streets and buildings so that lights and water taps could be controlled reducing wastage. The waste materials produced during daily activities and building construction are recycled, reused and reprocessed in one or the other way within the city. Most controversial process is for plastics that are serious wastes; they are reused as furniture or for concreting roads. Water is used efficiently, reused and processed further. Designs of buildings are same as that of olden times with artistic holes on walls that helps in air circulation. Narrow pathways on streets keep the buildings on both sides closer thus giving shade to each other. Wind towers in the center are the icon of cooling system in the streets. Everything is being adopted from old city. For a development to rise, research is the foundation. Advanced labs and facilities are available for the scientists to study, test new inventions and analyze its future scope. A place of zero carbon, zero waste and zero fossil fuel are not only concentrating their studies in production but also conservation. If a city has sustained without pollution before development it needs to be the same even after it. The technology must also find a counterpart for reducing the cause. The town is a role model for the

the cities that are growing without seeing the future. Multi storied buildings are not a sign of development but the development should go hand in hand with all the available resources. Olden day techniques are not to be abandoned but must be improvised and tuned according to technologies requirement.
Techniques may change but not principles.

BEFORE DEMOLISHING US; FIND AN ALTERNATIVE YOURSELF

Deepthy, M Tech, DEE

We were living happily with big families in our own clean and comfortable houses deep inside the crusts of earth for the past millions of years. We travel from bottom to top and change our structure depending upon our age of life cycle. There was no earthquake, tsunami or not even a small disaster. But to our faithlessness, just like a nightmare one day a giant pipe pierced into one of the houses in our colony that sucked a small baby sleeping calmly, through the pipes' big dirty mouth with very high pressure that no one was able to pull down the baby. There started the era of destruction of our community. It was the end for our harmony life. Then the same process has continued and we started losing our members one by one. One day the destruction happened in my home also. My sweet little infants were caught in that giant baby eating machines, I tried harder and harder to pull them down, cried loudly for help, asked the superior power not to take them away, but what I was able to do is to see them being caught and taken away from me. Some said the new phenomena is due to deformation in earth that it is putting holes in its surface and we earth is throwing everything to space. Some gave reason that earth is getting hotter that makes it tear and one day we all will be thrown out. Everyone was counting their day, no one knows what is to happen the next moment, and we were scared to lose our life. This brutality is spreading everywhere.

Even that continued following us wherever we go. It is not far. My day has also come. When that ugly giant ghost started moving to my side then itself I was prepared to be eaten by it. When it sucked me, started moving inside that long holed tube with very high speed I can't even imagine. By the time I was travelling through long pipes I almost fainted, not able to breath, fully sophisticated, out of my mind. After a while, when my senses started working I was surrounded by high temperature burning condition with my skin tearing down that I was not even able to feel the pain. Then I started moving up I don't even know how. My body parts has been detached one by one at different levels, each part is moving in its own path, some stopped in the bottom, some move fast into the top, and some are in the middle. I was able to follow only one of my parts. Sometimes strange things are being added to me, sometimes it is too hot, other time I go through cooled pipe. Now I am freely flowing, even I can't control myself. After a long time I saw my old community members, I was so excited and thrilled to see them, even they are also in my state of free flow. We stand together, whatever happen let us face it, we decided.

Till now we were inside a very huge shell kind of thing that had different size, color and shape. Now we are shifted to another container that continuously moves fast, sometimes slow and stops finally. Then we are split into small groups and taken in small vessels. After a while some of us has been drifted to a hole and flushed out, there were a few creatures standing and saying something, in that I caught up with one word "diesel", I don't know why but that word is running through my mind again and again. Those creatures seem to be happy when they saw us. Then we flow into a tank that is somewhat hot. After some time a big noise was heard, suddenly a spark was there, we got ignited, compressed, expanded and flowed through pipes of different sizes and shapes, then finally into a space where no more containers were there. By that time we were moving very freely without any restrictions. This might be the Free State for us. The same creatures I saw few minutes before were there. Now I heard "smoke" and their faces are having some disgusting expressions. Wherever we go, the situation was same. We are in a strange side of a place where we cannot find our path to go back home or even don't know how our future life will be. We raise high, to the top, away from creatures, to emptiness, like aliens, a broad zone of harsh way ahead. We saw few others coming along with us. They also seemed to be sad; they might have also lost their home. I don't know how far and where, my path will lead me. Even if there is a life waiting for me here, it need not be the same as I lived till now. How many are following us, how many yet to start this voyage, how many can stay there. I don't know. But I am sure; those wretches will not stop hunting my place till all are massacred.

If someone is seeing or hearing me I just have to say stop this brutality, leave them free and save them.. You are thinking only about yourself, think about us also…

His Story

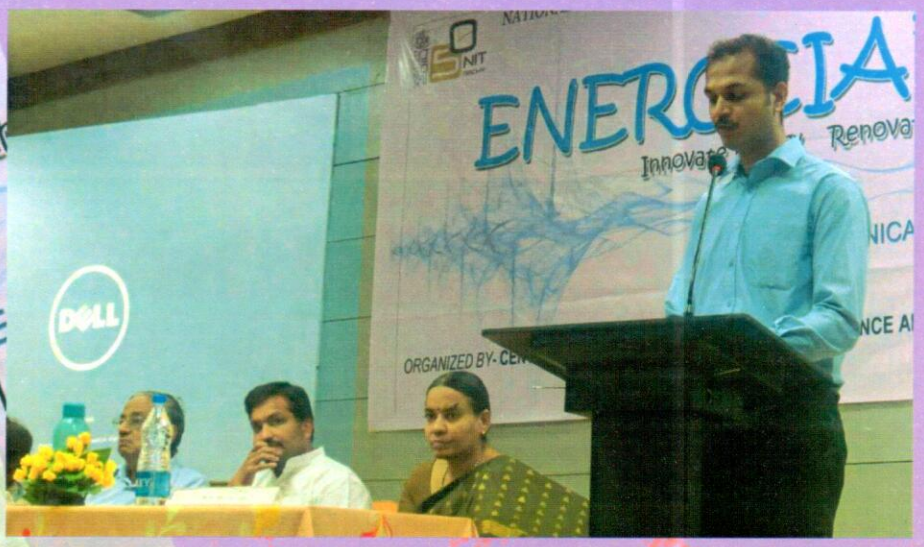
Akshay, M-Tech, DEE

'Awareness is the key' was one of the quotes he wrote on his wall. He liked collecting good quotes and writing them on the wall of his room. It was almost 7.15 in the morning when he woke up. Generally his day won't start at least 8 am- but on that day he woke up early. One could easily tell that something was bothering him, he was thinking about something. He looked at his laptop which was still running, because he fell asleep while contemplating. Then he realized something and got out of bed while checking whatsapp notifications. He had to get ready and have breakfast early, so that he could get some more time to think about the problem he was working on. He was perusing a master's degree in a well-known institute, and yesterday one of the professors had asked him to come up with a solid plan to survive energy crisis. After contemplating about some advanced engineering technologies- he still couldn't come up with a solid solution. Although he still had to verify few other things. He left his room hurriedly; He must have thought he was on the verge of getting an answer, so he wasted no time in switching off the tube and fan in his room. He could reach his institute within 20 min by bus, but he liked driving his bike more. On the bike he was still thinking about the crisis, he was a dedicated student, he never wasted his time in turning off the engine at traffic signals. He reached his institute earlier, therefore he went to canteen, he ate some chips, drank coke. For a moment he thought about joining that costly gym because his belly fat was increasing daily. At 9.15 he went to the class room. He was going to tell the professor how he contemplated about some advanced engineering techniques to solve Energy crisis. He entered the classroom. He turned on all the switches on the switch-board, because he had never really wasted his time in figuring out which switch was meant for the fan where he sat usually. Within 20 min his professor and few of his batchmates came. And they started discussing advanced engineering techniques to tackle energy crisis and save humanity.

22nd CENTURY

From the time he had read that story, his mind was confused. It was a small story on Lord Krishna. He was also a kid then, complained by everybody for the terror he caused among housewives but every time continued to grow adorable, just like me. But how is it possible? The boy's eyes grew in disbelieve not because of the magical powers they are saying the Lord possessed but the "PIPAL"!!! He sat the whole day in this tree and played his magical flute. Is there a tree in this name? He has heard of so many trees and even seen one of them, he felt proud when he was telling this thing among his friends, and most of them have failed to see a tree. They have seen the black sky, black waters, and humungous buildings midst those grey clouds but have never seen anything green at least for the past 10 years. Now here comes the PIPAL…what is that for a thing?? He was walking and at a swift pace. The sun was even hotter those days making him soaked in sweat. He wanted to search for a shade but was never able to find one now that he has reached the outskirts of the city, only barren lands are there as far as the eyes could reach. His father said it had lost its fertility. How does that feel when the MOTHER EARTH is not able to bear any child?? The land itself is thirsty and no water has slipped through the cracks which the Sun has produced. He hasn't seen that much of rain also. His teacher told him one day that an ancient continent named ANTARTICA was washed off by the melted glaciers, but where has all the water gone? Even the burning sun couldn't slow down him. There he finally stands, far away from the grey shades of the city midst the barren lands and in front of the oldest man he ever knew, Grandpa, waiting for an answer. Grandpa came close to him and asked him to watch his eyes closely, there lies the green valleys, trees, rivers, the clear blue sky, the ever enchanting dancing of peacocks, the flute, Lord Krishna and the "PIPAL".
The world 22nd century never knew. Enough is the exploitation he shouted, my MOM is hurt. Can't we worship the MOTHER which gave us everything???

Anupam Krishnan



Moments @ Energeia '14

drop of green for a revolution,...

DEE

NITT