UGC Sponsored National Seminar

'ENERGY CRISIS-CAUSES, EFFECTS AND SOLUTIONS'

13–14 August 2015

SOUVENIR

50 Years Golden Jubilee

YEAR 2015

Organized by

DEPARTMENT OF PHYSICS

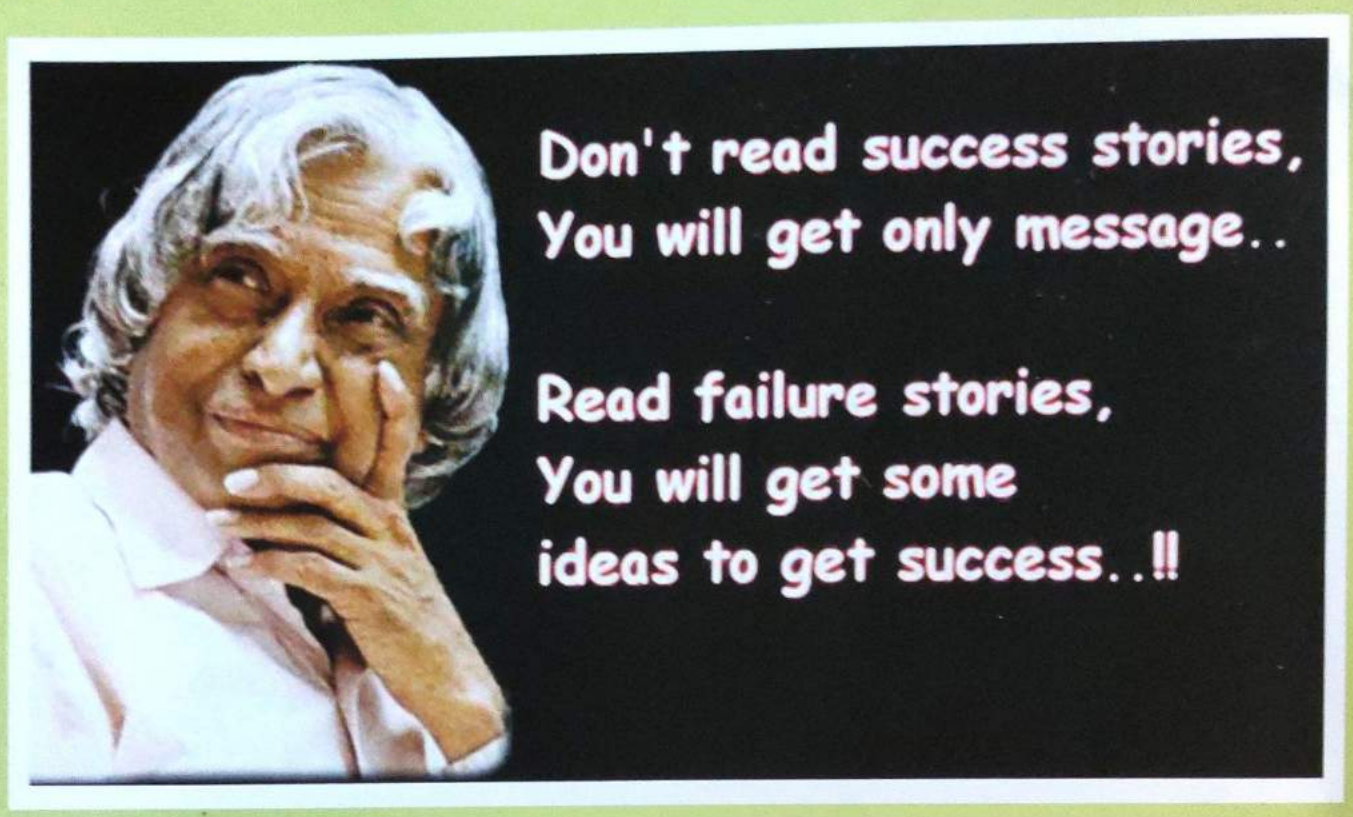
GOVINDRAM SEKSARIA SCIENCE COLLEGE, BELAGAVI

(Reaccredited by NAAC at A grade)

Dedicated to

Dr. A. P. J. Abdul Kalam

the 'Missile Man of India' who passed away while delivering a lecture at the Rajiv Gandhi Indian Institute of Management, Shillong on 27th July 2015.



(15 October 1931-27 July 2015)

We are all born with a divine fire in us. Our efforts should be to give wings to this fire and fill the world with the glow of its goodness.

— A.P.J. Abdul Kalam, Wings of Fire

As a bachelor, he was childless. But that is wrong. He was a father to every Indian Child; teaching, cajoling, urging, exciting, clearing darkness wherever he found it with the radiance of his vision and the passion of his involvement. He saw the future and showed the way.

-Narendra Modi, Prime Minister of India

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GOVINDRAM SEKSARIA SCIENCE COLLEGE, BELAGAVI

GOLDEN JUBILEE YEAR 2015

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D.Y. PATIL EDUCATION SOCIETY, KOLHAPUR
(Deemed to be UNIVERSITY Declared u/s 3 of the UGC Act 1956)

Prof. (Dr.) S. H. Pawar
(Emeritus Scientist)
M.Sc., Ph.D., F.I.C.C., F.M.A.Sc
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Accredited by NAAC with 'A' Grade

MESSAGE

It gives me a great pleasure to know that the G.S.S.College is organizing ***"National Seminar on Energy Crisis- Causes, Effects and Solutions"*** *on 13th-14th August 2015. This will provide a platform to bring together the experts from multidisciplinary fields involving Physics, Chemistry, Mathematics, Electronics, Engineering, Materials and Ethics. Interactions among these experts will help to bring out the variety of new materials with their very interesting and useful properties which will lead in the way to build the new devices and equipments. I am aware of the fact that such types of innovative programs have always been organized by G.S.S.College. I take this opportunity to appreciate the efforts of the Management of the College and congratulate the faculty of Department of Physics for organizing such an important Seminar. I wish a grand success to this National Seminar.*

Prof. (Dr.) S. H. Pawar (Emeritus Scientist)
Vice-Chancellor,
D. Y. Patil University, Kolhapur (M.S.) India

South Konkan Education Society

1st Floor, G.S.S. COLLEGE, OFFICE BUILDING, R.P.D. COLLEGE ROAD,
TILAKWADI, BELGAUM - 590 006.
PHONE : 2485910 (SKES) 2485193 (GSS) 2485079 (RPD)

MESSAGE

I am, indeed, very happy to know that the Department of Physics is organizing a UGC sponsored National Seminar on **'ENERGY CRISIS-CAUSES, EFFECTS AND SOLUTIONS'** on the 13th and 14th August 2015 as a part of the 'Golden Jubilee Year 2015' celebrations of Govindram Seksaria Science College.

S.K. E. Society has always been in the forefront to provide quality education. We always believe that the Seminars and Conferences of this kind not only help our students to understand the present world scenario but would also address the concerns of the society at large. In this context, the theme of the present seminar is very much relevant. Energy is known as the 'lifeblood of society' because of the essential role it plays in sustaining life on Earth and today, it is being exploited like never before. Therefore, it is necessary to find some sustainable solution to the energy crisis keeping in mind the future generations. I believe this seminar will provide an excellent and unique opportunity for the academicians, researchers, experts and students to discuss and deliberate on all the energy related issues.

On this occasion, I welcome all the distinguished guests, learned resource persons, delegates and students, and wish them a pleasant stay in our campus.

I congratulate the Department of Physics for its efforts and initiative in organizing this seminar, and I wish the seminar grand success.

R. D. Shanbhag
Chairman,
South Konkan Education Society

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MESSAGE

The year 2015 is being celebrated as the 'Golden Jubilee Year' of Govindram Seksaria Science College. It is, indeed, befitting that the Department of Physics is again taking lead to organize a UGC sponsored National Seminar on a burning issue **'ENERGY CRISIS-CAUSES, EFFECTS AND SOLUTIONS'** on the 13th and 14th August 2015. The management of S.K. E. Society has always supported and encouraged all our institutions in organizing such seminars and conferences that would bring scientists, academicians, researchers and students on a single platform to exchange their views and ideas for the betterment of the society.

The growth of an emerging India will be decided by how it meets its energy needs. During the last two decades, India has witnessed a phenomenal growth in scientific and technological research. The credit goes to the sincere efforts and ceaseless endeavors of our scientists, researchers and sponsorship of the government for the promotion of scientific culture in the country. The research work done in laboratories should reach the industries and also be used for the benefit of the society. I hope this seminar will motivate young and senior scholars to take up advanced research in various fields of energy, especially renewable energy sources that may possibly be the solution to the present energy crisis.

I congratulate the staff and students of Department of Physics for organizing this seminar. I wish the seminar every success.

S. V. Shanbhag,
Chairman,
G. S. S. College Managing Committee

South Konkan Education Society's
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RE-ACCREDITED AT 'A' GRADE BY NAAC

MESSAGE

Energy generation and use is one of the main indicators of a nation's development. In order to improve the quality of life of the common man our nation has to arrange large amount of 'green and clean energy'. Planners and scientists of our country are dealing with this issue and trying to come up with new thinking and innovative approaches.

It gives me great pleasure to inform you that GSS College Department of Physics is organizing a Two-Day National Seminar on 13 and 14 August 2015 on this crucial issue. The theme of the Seminar is "Energy Crisis: Causes, Effects and Solutions." Today there is a crisis in the energy sector not only in our country but across the world. India depends mainly on coal-based thermal power, and petroleum - 70% of which is imported and costs many billions of dollars in foreign exchange. Hydro-electricity and Atomic energy contribute to a small extent.

There are many misunderstandings about the true costs and dangers of different energy sources. For example, atomic energy is facing growing opposition. Our scientists are trying to find alternate, safer, and preferably renewable, sources of energy. We have to appreciate their efforts. I hope this two-day National Seminar will debate and discuss such issues with all the earnestness they deserve. It would be wonderful and heart-warming if new thinking and innovative methods emerge from the deliberations made in this Seminar.

I wish the National Seminar a grand success.

Anand K. Mense
Principal

MESSAGE

I am very happy to acknowledge the National Seminar on "Energy crises – causes, effects and solutions" on 13-14 August 2015.

Protection of the Environment and Climate, and their preservation for the generations to come is a demanding social, scientific and economical task. Utilization of renewable energy, efficient conversions of fossil fuel are not only environmentally and climatically beneficial, they also preserve the finite energy sources. The price jumps in the oil scenario, has surely made the scientific community know the importance of safe and secured energy supplies for the highly industrialized nations.

The whole issue of alternative energy sources took momentum from these discussions and realization of scientific community and people at large that finding alternative sources of energy is the only way to reduce the greenhouse gases. Scientists started looking to nature and technology for solutions. So started discussion of solar, wind, bio, tidal, nuclear and hydrogen energy as alternative to the fossil fuel.

Realizing the need for "Alternate Energy Sources" and to highlight the development in this field, G.S.S. College, Belgaum has organized a National Seminar.

My greetings and best wishes for all participants of the Seminar and success in their mission of promoting new ideas on energy crises.

S. K. Hukkeri
Convener and Head of the Department

MESSAGE

The world is moving towards a sustainable energy future with an emphasis on energy efficiency and use of renewable energy sources. Energy has always been a vital resource in the development of any nation. The prosperity of a nation is measured in terms of per capita energy consumption. A single planet with finite resources cannot support infinitely increasing consumption of resources and hence the motto of present times must be to "REDUCE, REUSE, RESPECT and RECYCLE". Hence, the United Nations Environmental Programme (UNEP) has appropriately come out with the theme of World Environment Day 2015 as **'Seven Billion Dreams. One Planet. Consume with Care'**.

This seminar aims to focus on the various means available for energy production – thermal, hydro, nuclear, wind, solar etc – each analyzed with their respective pros and cons. At the same time, it would discuss and debate the causes for the present energy crisis keeping in mind its effects. Further, the purpose of this seminar would also be to provide a platform for the young scientists and others working in the field of energy to deliberate upon the need to switch over to renewable energy production from fossil fuel based energy production as a possible solution to maintain a balance between 'economy and environment'. I am confident that the delegates would have a thread bare discussion on the theme of the seminar and come out with a sustainable solution to the energy crisis threatening the very existence of life on this planet earth.

On this occasion, I thank the University Grants Commission, South Western Regional Office, Bangaluru for sponsoring this seminar. I also acknowledge the support of the local sponsors and well wishers for being with us in organizing this seminar. My sincere thanks to the Hon. Chairman and members of S. K. E. Society for their constant support and encouragement in organizing such seminars and conferences. My heartfelt thanks to all my colleagues; both teaching and non-teaching, without whose overwhelming support this seminar on energy would not have seen the light of the day.

On behalf of the organizing committee, I extend a warm welcome to all the distinguished speakers, delegates and student friends.

Dr. Nagaraja D. Hegde
Organizing Secretary

S. K. E. Society:

South Konkan Education (S.K.E) Society was established in 1944 at Sawantwadi by a group of patriotic individuals who believed in education as the only means of development of the individuals and the Society. The Society's first educational institution, Rani Parvati Devi College was started in 1945 at Sawantwadi that offered courses in both the Arts and Science streams. Rani Parvati Devi College was relocated to Belagavi in 1948. In 1966 on the recommendation of Karnataka University, R.P.D College was bifurcated into two colleges namely Rani Parvati Devi College of Arts & Govindram Seksaria Science College. Presently, S. K. E. Society is running a full range of educational institutions in Belagavi. The institutions run by the society include several Primary Schools, High Schools and Colleges imparting quality education from kindergarten to post graduation under the Chairmanship of Shri R. D. Shanbhag. The Society is committed to make the campus a center of excellence in education.

G. S. S. College and Physics Department:

Govindram Seksaria Science (GSS) Degree College is known for quality education and all-round development of individuals making it the preferred centre of education in North Karnataka. It stands for academic excellence and endeavors to create an environment for holistic development of the students making them worthy members of society. This year it is celebrating its Golden Jubilee of its independent existence and has planned a series of events throughout the year to commemorate 50 years of excellence in importing quality education. It has been accredited at 'A' grade by NAAC and is going for the 3rd cycle of reaccreditation due in the month of September 2015.

Over more than 5 decades, the Physics department has maintained a highly competent faculty, good infrastructural facilities, and a consistent student-teacher ratio. The department is committed to achieving academic excellence, creativity, and all-round development of its students. The department is in the fore front of research activities too, having completed one UGC funded minor research project recently and with two projects ongoing. Presently, the department is catering to more than 500 students studying in the undergraduate programme in Physics.

Programme Schedule

DAY 1	***13 August 2015***
9.30am	Registration
10.30am	Inaugural
11.30am	Tea break
11.45am	Key Note Address: ***Energy Nanotech Grand Challenges for Clean Environment***
	Prof S. H. Pawar, *Hon. Vice-Chancellor, D. Y. Patil University, Kolhapur*
1.00pm	Lunch
2.00pm	Technical Session I: ***Biomass Energy for All Seasons***
	Sameer Kanabargi, *Phoenix Products, Belagavi*
3.15pm	Technical Session II: ***Nuclear Energy- A Clean Energy***
	K.R Mohan Ram, *Scientific Officer –G, NPCIL, Kaiga*
4.30pm	Tea Break
4.45pm	Paper Presentation I
6.00pm	Cultural Programme
DAY 2	***14 August 2015***
9.00am	Breakfast
9.30am	Paper Presentation II
10.30am	Technical Session III: ***Wind Energy as An Alternative***
	Rajanish Hiremath, *Sr. Manager, Suzlon Energy Limited*
11.30am	Tea Break
11.45am	Technical Session IV: ***Power Production and Population Explosion***
	Bipin Kulkarni, *Group Head, Strategy & Corp. Planning, Tata Power, Mumbai.*
1.00pm	Lunch
2.00pm	Technical Session V: ***Fuel cells-A New Approach***
	Dr. Rajeev Joshi, *Asst. Prof., Central University, Kalaburagi*
3.00pm	Technical Session VI: ***Me and Energy Crisis***
	S. Y. Prabhu, *Principal(Retd.), G. S. S College and Member, S. K. E. Society, Belagavi*
3.30pm	Tea Break
3.45pm	Feedback and Valedictory

ENERGY NANOTECH GRAND CHALLENGES FOR CLEAN ENVIRONMENT

S. H. Pawar

Centre for Interdisciplinary Research,

D. Y. Patil University, Kolhapur-416 006 (India)

Email: pawar_s_h@yahoo.com

Abstract:

The relationships between energy, the environment, and development are deep and complex. The International Energy Agency has noted that energy is deeply implicated in each of the economic, social and environmental dimensions of human development. Energy services provide an essential input to economic activity, contribute to social development, and help meet basic human needs. But energy production and use also has significant environmental implications that must be managed if countries are to meet their long term sustainable development goals. The purpose of this talk is to highlight the importance of environmental management and governance in the energy sector; to present environmental goals, requirements, entry points, and strategies/approaches to capacity development for the environment (CDE) in this sector; and to discuss implications for donors. The focus is on 'Make in India' in a global context.

The countries in the world are classified as developed, developing and underdeveloped based on the energy capita consumption. The developed countries consume more energy (fossil fuels) to enjoy the comforts and cause more damage to the environment. Reverse is true for developing & under developed countries. Golden means or new approach need to be derived for energy consumption pattern so that one can keep the environment clean and also enjoy the comforts.

The main energy resource till today is dominated by the conventional energy resources comprising fossil fuels. However, it has created the alarming threats both for environment and energy. The long range solution to these threats revealed in recent years is the energy nanotechnology. In the present talk, the role of nanotechnology in solar energy conversion will be discussed at length. Sun being the major energy resource to the globe and responsible for the quality of the global environment; the role of nanotechnology in solar energy conversion will be one of the key solutions for clean environment. Hence the energy nanotech is discussed at length in this talk to create the awareness amongst the environmentalists to meet the challenges of 21st century.

BIOMASS ENERGY FOR ALL SEASONS

Sameer S. Kanabargi

Phoenix Products, D-87, Industrial Estate, Udyambag, Belgaum - 590008

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phoenix_bgm@hotmail.com

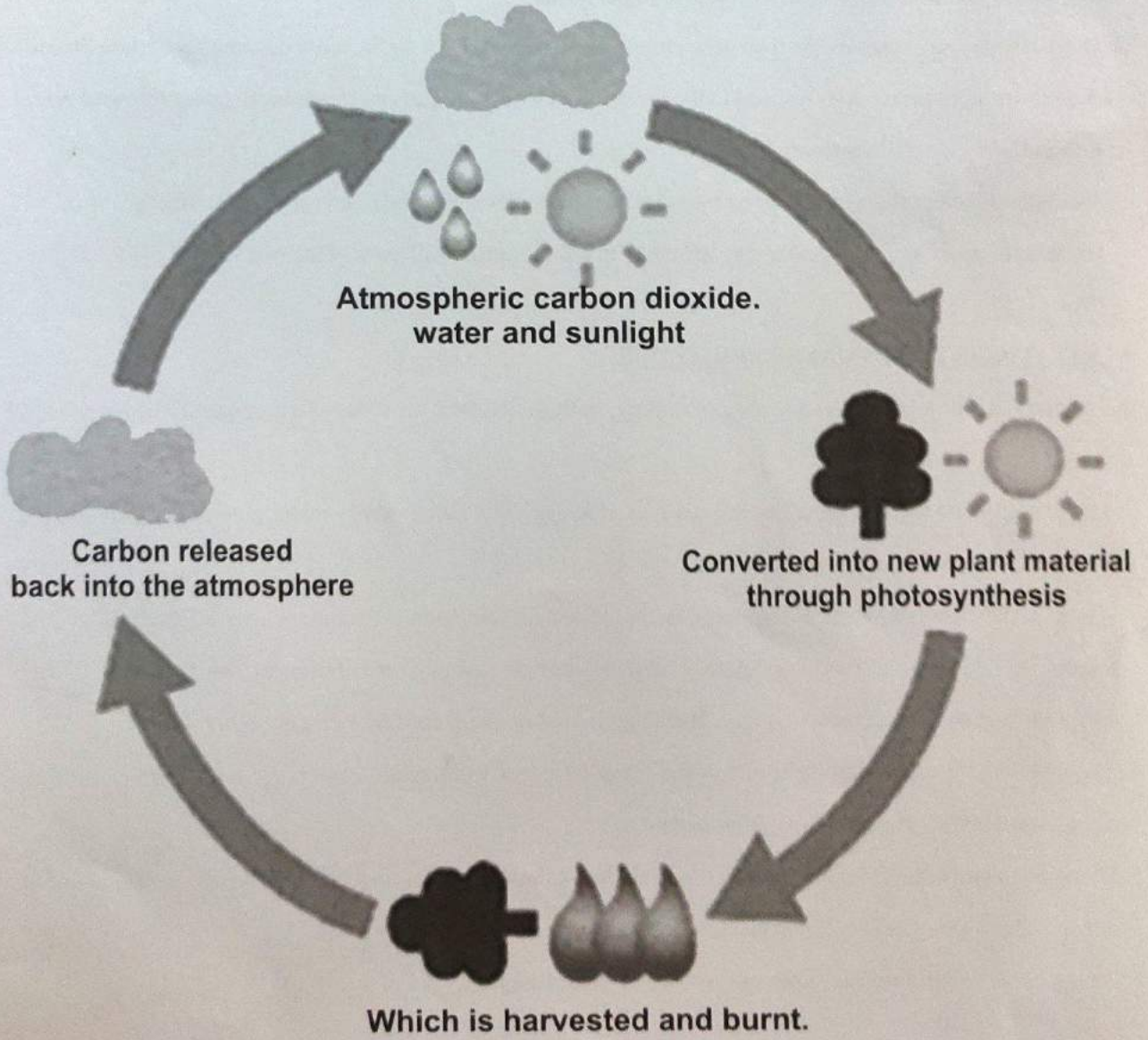
INTRODUCTION:

Biomass is a term used to describe all organic matter produced by photosynthesis, existing on the earth's surface. They include all water- and land-based vegetation and trees, and all waste biomass such as municipal solid waste (MSW), municipal bio solids (sewage), and animal wastes (manures), forestry and agricultural residues, and certain types of industrial wastes. The world's energy markets have relied heavily on the fossil fuels. Biomass is the only other naturally occurring energy-containing carbon resource that is large enough in quantity to be used as a substitute for fossil fuels. Through the process of photosynthesis, chlorophyll in plants captures the sun's energy by converting carbon dioxide from the air and water from the ground into carbohydrates, i.e., complex compounds composed of carbon, hydrogen, and oxygen. When these carbohydrates are burned, they turn back into carbon dioxide and water and release the sun's energy they contain. In this way, biomass functions as a sort of natural battery for storing solar energy.

The exploitation of energy from biomass has played a key role in the evolution of mankind. Until relatively recently it was the only form of energy which was usefully exploited by humans and is still the main source of energy for more than half the world's population for domestic energy needs. One of the simplest forms of biomass is a basic open fire used to provide heat for cooking, warming water or warming the air in our home. More sophisticated technologies exist for extracting this energy and converting it into useful heat or power in an efficient way. In the mid-1800s, biomass, principally wood biomass, supplied over 90% of energy and fuel needs, after which biomass energy usage began to decrease as fossil fuels became the preferred energy resources. This eventuality of fossil fuel and the adverse impact of fossil fuel usage on the environment are expected to be the driving forces that stimulate the transformation of biomass into one of the Dominant energy resources. Unlike fossil fuels, biomass is renewable in the sense that only a short period of time is needed to replace what is used as an energy resource. Biomass also is the only renewable energy source that

releases carbon dioxide in use. However the release is compensated by the fact that the biomass grown uses the carbon dioxide from the atmosphere to store energy during photosynthesis. If the biomass resource is being used sustainably, there are no net carbon emissions over the time frame of a cycle of biomass production. Figure shows a biomass energy cycle and the way biomass is utilized for energy generation in an environmentally friendly scheme.

CARBON NEUTRAL CYCLE:



BENEFITS OF BIOMASS ENERGY:

Some of the advantages of using biomass as a source of energy are illustrated below.

1. Biomass energy is an abundant, secure, environmental friendly and renewable source of energy. Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as a fuel.

2. One of the major advantages of biomass is that it can be used to generate electricity with the same equipment or in the same power plants that are now burning fossil fuels.

3. Biomass energy is not associated with environmental impacts such as acid rain, mine spoils, open pits, oil spills, radioactive waste disposal or the damming of rivers.

4. Biomass fuels are sustainable. The green plants from which biomass fuels are derived fix carbon dioxide as they grow, so their use does not add to the levels of atmospheric carbon. In addition, using refuse as a fuel avoids polluting landfill disposal.

5. Alcohols and other fuels produced by biomass are efficient, viable, and relatively clean burning.

6. Biomass is easily available and can be grown with relative ease in all parts of the world.

LIMITATIONS TO BIOMASS ENERGY USE:

1. Biomass is still an expensive source of energy, both in alcohols, as a very large quantity of biomass is needed.

2. On a small scale there is most likely a net loss of energy as a lot of energy must be used for growing the plant mass; biomass is difficult to store in the raw form.

3. One of the disadvantages of biomass is that direct combustion of biomass can be harmful to the environment as burning biomass releases carbon dioxide, which contributes to the warming of the atmosphere and possible climatic change. Burning also creates soot and other air pollutants.

4. Over-collecting wood can destroy forests. Soils bared of trees erode easily and do not hold rainfall. Increased runoff can cause flooding downstream.

5. When plant and animal wastes are used as fuel, they cannot be added to the soil as fertilizer. Soil without fertilizer is depleted of nutrients and produce fewer crops.

6. Biomass has less energy than a similar volume of fossil fuels.

NUCLEAR ENERGY – A CLEAN ENERGY

K. R. Mohan Ram

Scientific Officer–G, NPCIL, Kaiga

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1. INTRODUCTION

Nuclear Power is today a well established source of electricity, with about 16% of the total electricity generation in the world coming from this source. In France, as much as 80 percent of its electricity comes from nuclear power. In India, today about 3% of our installed electric capacity is nuclear. The nuclear power industry has traditionally given the utmost attention to safety, right from the time of the earliest reactors some 50 years ago. In all activities connected with nuclear power plants, including their design, construction, commissioning, as well as in operation, a major part of the total effort is devoted to ensure safety of operating personnel as well as the environment.

2. SAFETY DESIGN PRINCIPLES

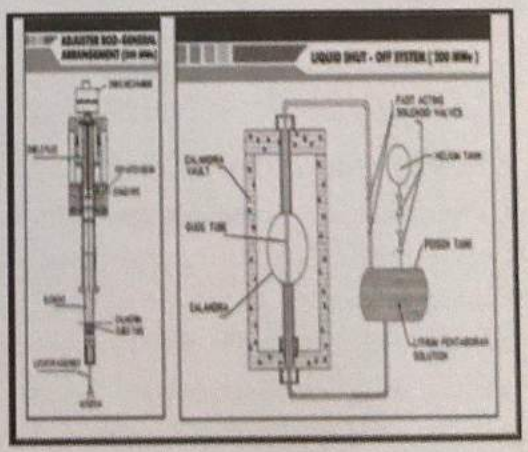
There are well-established safety design principles, which are applied in nuclear reactor technology to ensure that safety functions will be performed with a very high degree of reliability. A defense-in-depth approach is adopted. This approach is at the heart of safety philosophy, where there are several lines of defense, one backing another. More than one mean are provided for performing a safety function.

2.1 Redundancy and Diversity

High reliability often requires, in addition to high quality, the use of redundancy of, and, where appropriate diversity of structures, systems and components. Redundancy of equipments or components ensures that the failure of one barrier or level of defense still leaves others to perform the safety function. In the reactor regulating and reactor protection system of the nuclear power plants, some parts of the control system are in triplicate. An error in one component may then be out-voted by the other two. In a triply redundant system, the system has three sub components, all three of which must fail before the system fails. Since each one rarely fails, and the sub components are expected to fail independently, the probability of all three failing is calculated to be extremely small.

2.2 Independence

Reliability of systems can be improved by independence which means using functional isolation and physical separation. Functional isolation shall be used to reduce adverse interaction between equipment and components of redundant or connected systems resulting from normal/ abnormal operation or failure of any component in the system



2.3 Fail-safe

A fail-safe device is one that, in the event of failure, responds in a way that will cause no harm, or at least a minimum of harm, to other devices or danger to personnel.

2.4 Containment

A containment building, in its most common usage, is a structure enclosing a nuclear reactor. It is designed, in any emergency, to contain the escape of radiation. The containment is the final barrier to radioactive release. The containment structures are made of concrete. The primary containment is a pre-stressed concrete structure, consisting of a perimeter wall topped by a pre-stressed concrete dome. The outer or secondary containment is a reinforced concrete cylindrical wall topped by a reinforced concrete dome. The primary containment uses epoxy coating as liner on the inner surface for enhanced leak-tightness and ease while decontamination. Because of the use of double containment, incorporation of a steel liner is not considered necessary.

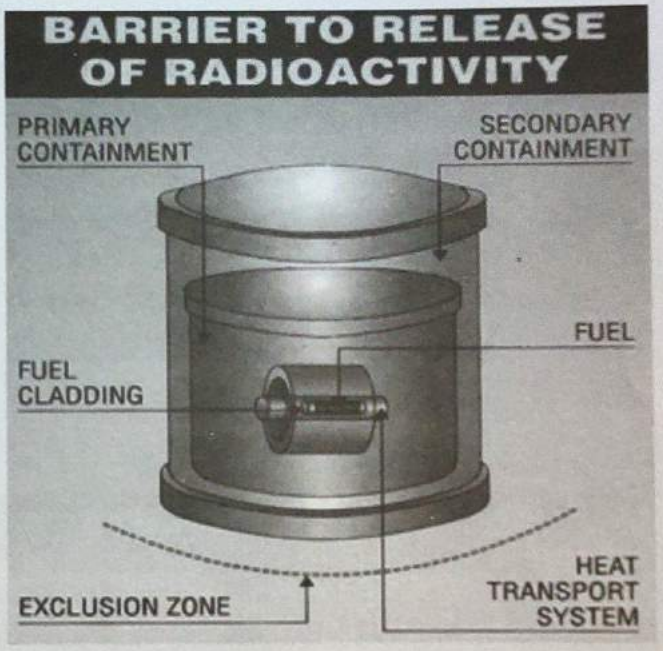


Fig 1. BARRIERS TO RELEASE OF RADIOACTIVITY

The radioactive fission products, which are produced as a result of the nuclear reaction process, are generated within the solid uranium dioxide fuel. A series of physical barriers are provided between the radioactive fission products and the environment, as depicted in Fig.1. Most of the fission products stay embedded in the uranium dioxide fuel pellets, where they are produced. These pellets are in turn sealed in metallic fuel tubes (cladding). Further, these tubes are themselves contained within a high integrity reactor coolant system. We adopt the highest quality standards in design, construction and operation to ensure that these systems will maintain their integrity with high degree of reliability. In addition, there are several features and systems built into the design whose purpose is to prevent deviations from normal mode of operation, which could affect the integrity of these barriers. In spite of all this, we still postulate unlikely failures and provide systems to cope with such postulated failures. One such system is the containment system, which is a massive concrete building housing the reactor, and designed to remain leak tight even under pressure. Further, an exclusion zone of about 1.6 km radius around the nuclear power reactors is also established as a measure of caution.

3. SAFETY DURING OPERATION

It is the combination of sound design and conservative operating practices that go to make a safe reactor. The policies and practices for operation of nuclear power stations in India recognize this fact. It is mandatory to strictly adhere to a document called the 'Technical Specifications for Plant Operation'. This document, approved by the regulatory authorities defines the safety limits for various systems parameters that must not be exceeded. It also sets down the requirements for minimum operable equipment of various systems prescribed actions to be taken by operating personnel, periodic surveillance, testing requirements and administrative controls.

Adequately trained manpower is an essential prerequisite for safe operation of nuclear stations. In recognition of this fact, we have adopted a comprehensive programme to select, train and qualify personnel with suitable academic

background for operation, maintenance and other functions at operating stations. Training simulators have been set up which are tailored to provide training on all aspects of operation of nuclear plant including handling of malfunctions and off-normal operations.

A unique feature of operations in the nuclear plants is the in-service inspection programme, in which health of various components is assessed during the service life of the plant to ensure that no incipient problem results in an actual failure of the component. Various techniques such as ultrasonic, acoustic emission, eddy current probing etc. are used to determine the condition of the equipment for this purpose. Finally, plant operations are subjected to a rigorous and multi-tiered review, at the station management level, corporate level as well as by regulatory authorities.

One of the guiding principles adopted in the nuclear power programme in India is to ensure that radiation doses to plant personnel and to members of the public are as low as reasonably achievable, and in any case not in excess of the prescribed limits. These limits, specified by the regulatory authorities, are more conservative than the international standards. Monitoring of the radiation exposures received by plant personnel is done by a special Health Physics Group, an agency which is independent of the plant management. Several measures are adopted in design and operations to ensure that exposures of plant personnel are very low. These include:

1. Provision of adequate radiation shielding, and control of access of personnel to high radiation areas. Areas intended for normal full time occupancy must have radiation dose levels below 0.001 milli sievert / hr.
2. A zoning system with contamination checks of personnel and equipment at exits from radioactive/ potentially radioactive zones.
3. A ventilation system designed to minimize airborne radioactivity in plant areas.
4. Use of protective clothing and respirators by plant personnel while entering potential contaminated areas.
5. Continuous monitoring of radiation levels in various plant areas.

4. SAFETY OF THE ENVIRONMENT

The regulatory authorities in India have prescribed dose limits for members of the public based on the recommendations of the International Commission on Radiological Protections (ICRP). Based on these limits, the radioactivity discharge limits have been worked out for individual nuclear power plants. These discharge limits are specified in the technical specifications for plant operation. Continuous monitoring of the radioactive liquid and gas discharges from the plant is done to ensure that the limits are never crossed. The actual releases are far lower than the limits. In addition, there is a routine programme of environmental monitoring extending up to 30 kilometers of site. This covers analysis of land, water, vegetation, foodstuffs etc. around each plant. This gives added assurance that impact of releases from the plant is indistinguishable from natural radiation.

All airborne and gaseous activity from the plant is routed to the atmosphere via a tall stack along with ventilation exhaust air. Before entry to the stack, the air is passed through high efficiency particulate air filters for removal of the particulate radioactivity.

The liquid wastes, after chemical treatment as required, are diluted with blow down from the cooling towers, (or with condenser cooling water) and then discharged into the appropriate water body, ensuring that the stipulated discharge concentration limit is not exceeded. The guiding principle for determining the discharge limits is that there will be no restriction on downstream water utilization. These limits take into account the prevalent water utilization practices and biological concentration factors for organisms, which may form food for the population. All the operating Nuclear Power Plants in India have been accorded ISO 14001 – Environmental Management System certification, which demonstrates our environmentally benign practices.

5. EMERGENCY PREPAREDNESS

The above-discussed features in design as well as in operation of nuclear power plants make the occurrence of a severe reactor accident a very low probability event. In spite of this, as a prudent measure, plans exist for dealing with emergency situations involving large release of radioactive materials from the plant. Such plans envisage the participation of both the station authorities as well as the local administration (the latter for situations involving off-site emergencies). Depending on the severity of the emergency as determined from an assessment of the accident and radiation surveys etc., protective measures defined in the plans range from instructions to the public to stay indoors, to evacuation of sections of population, or to control of food and water supplies. The plans specify, among other things, the mechanism for declaration of emergency, the duties and responsibilities of individuals and organizations once the emergency is declared, establishment of communications network for notification to concerned authorities and the public and delineation of pre-determined actions etc. The plan also contains detailed procedures for steps to maintain emergency preparedness, including training and periodic drills.

6. SAFETY REVIEW PROCESS

There is a well-organized safety review process for nuclear power projects right from the site selection stage through design, construction, commissioning and operation. Such reviews are carried out internally in NPCIL. Atomic Energy Regulatory Board (AERB) carries out independent Audits. AERB has a system of multi-tier reviews. For example, for review of design, the first level review is by a Design Safety Committee for the project; finding of this committee are put up to Advisory Committee for Project Safety Review (ACPSR). It consists of experts of different disciplines and not involved in the actual designing or building or operation of the plant, carries out a second level review and audit. The final review and consenting is done by the AERB.

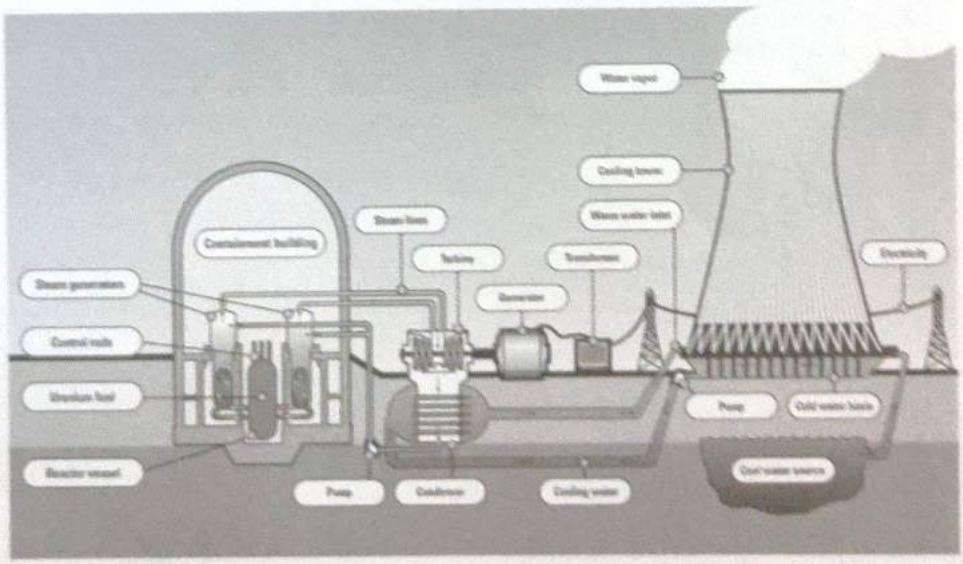
In the construction and operational phases also, reviews are carried out at three levels. The process of reviews results in a highly effective system of evaluation of designs and operating practices. Based on the reviews by the different safety committees, AERB makes stipulations, which the station management is obliged to carry out. These stipulations may call for modifications in design or changes in operating practices or even closure of a unit.

There is a system of keeping track of all significant events at operating plants. All significant events are systematically documented, reviewed and analyzed to find the cause of the incident and for taking corrective action by way of design modification, revision of operating procedure or replacement of a component with one having much higher reliability

and lower failure probability. This approach of analyzing all unusual occurrences has contributed in a greatly in making nuclear power production a safe activity.

7. CONCLUSIONS

1. In the years to come, nuclear energy will have an increasingly important role to play in the generation of electricity and in the overall development of the country. Needless to say, when pursuing such a programme, it is of paramount importance that health and safety of plant personnel and members of the public are fully ensured.
2. The current generation of nuclear power stations in India has several inherent safety features. The designs provide redundancy in protective and safety systems and adopt the concept of defense-in-depth. The double containment feature provides an added level of safety.
3. Operation of nuclear power plants is characterized by strict adherence to a set of prescribed limits and guidelines. The operations personnel are carefully selected, trained and qualified. Environmental releases and exposure of personnel are routinely monitored so as to ensure that they are within stipulated limits. The regulatory authorities critically review the design and procedures for manufacture, construction and operations, prior to issue of appropriate licenses. Scientific Studies have revealed that nuclear power is one of the most environmentally friendly sources of energy. Experience with the operating plants in the country has demonstrated that these reactors are capable of operation with high reliability while ensuring safety of plant personnel and the surrounding population, and with minimal impact on the environment.



WIND ENERGY AS AN ALTERNATIVE

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Abstract:

The present paper deals with the 'wind energy' as an alternative to the conventional energy resources as a possible solution to the existing energy crisis. The main focus of the presentation would be the following:

- A glimpse on current power situation.
- Why wind energy
- Wind energy - Overview and opportunities
- Proven end to end solutions offered by project developers
- Barriers for faster growth
- Future challenges and development areas

POWER PRODUCTION AND POPULATION EXPLOSION

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Abstract:

India has a total installed generation capacity of 275 GW on the grid along with an additional 41 GW of captive generation[1]. With total annual electricity generation of 1.2 trillion units, Indian power production ranks third in the world after China and the United States of America[2]. However, the country ranks among the lowest in the world in terms of per capita electricity consumption. Per capita annual electricity consumption in India stands at approximately 800 units today (after accounting for AT&C losses) against the world average of about 3,000 units[3]. Even today, over 20% of the population of the country does not have access to electricity[4] and a much larger population suffers from lack of reliable power supply. With a huge population, that continues to grow, there is obviously a huge latent demand for power that is currently not addressed by the sector.

For a country aspiring to be an economic powerhouse, a smoothly functioning power sector is critical as energy is the engine that drives the pace of the economy. The power sector in India however, is plagued by issues currently facing almost every part of the value chain:

- Continued issues with fuel supply
- Private and Public sector companies with their generation assets operating at sub-optimal levels
- Constraints with inter-regional transmission corridors
- Difficult financial situation of distribution companies
- Consumers faced with load shedding and irregular supply of power

With the Government of the day promising 24X7 power for all by 2019, there is a significant uphill task for all stakeholders of the industry.

The most critical issue in front of the country is how it plans to address energy security over the long term. Domestic coal production has not been able to keep up with the pace of growth in generation capacity. This has led to acute fuel shortage in power plants across the country. Significant capacity stands stranded due to shortage of domestic coal. Demand for costly imported coal is increasing alarmingly as a result. Similarly, decline in domestic natural gas production has severely constrained power generation from this source, leading to large number of stranded assets. The government is trying to address the coal shortage through allotment of coal blocks for captive production and also through augmentation of domestic coal production by CIL. Similarly, to stimulate gas based power generation, the Government has announced Power System Development Fund (PSDF) to support the assets that are stranded or have very low PLF. However, a lot more is still required to address all the issues that are core to this part of the value chain.

It is a myth that commissioned generation capacity in India is inadequate. While the total installed capacity is in excess of 275 GW, the peak load the country has ever witnessed has been around 150 GW. The difference is explained through a combination of factors including issue of fuel availability, inadequate transmission corridor and low off take by distribution companies. At the same time, augmentation of generation capacity, especially by private enterprise has been stymied by issues around land acquisition, Standard Bidding Documents, delays in regulatory clearances, fuel linkages and concerns of lender community.

Increasing congestion in inter-state transmission system is causing the market to become fragmented in spite of the presence of a national grid. Slow growth in intra state transmission capacity addition is also significantly affecting power movement. Over the next few years, the demand for transmission capacity is expected to increase dramatically, driven primarily by significant increases in generation capacity (20 GW per year versus 10 -12 GW per year in the past) and secondarily by the emerging requirements of open access, trading and inter-regional transfers. The key challenges in augmentation of transmission capacity are difficulties in obtaining land, right of way and statutory clearances for the project.

The country is witnessing a boom in renewable power segment. However, the ramp up of renewable generation capacity will be ineffective if transmission capacity is not sufficiently geared up to capture the renewable power. Hence, implementation of green corridor is of utmost importance for growth of renewable segment.

Distribution continues to be the weakest link in the entire value chain. The distribution companies are riddled with high losses and debt – stemming from tariffs not reflecting costs, and high AT&C losses of over 25%. The accumulated losses of distribution companies are estimated at Rs. 3.5-4.0 lakh crore[5] in March 2015, and these are largely funded through borrowings. Overall debt is estimated at Rs. 4.4 lakh crore. Owing to this, the distribution companies are shy of purchasing power to service the consumers 24X7. Restoration of the financial health of state electricity utilities and improvement in their operating performance continue to remain a critical issue for the sector. As such, accelerated distribution reforms with efficiency improvements and introduction of cost-reflective tariff are the need of the hour.

The electricity sector in India is thus riddled with several issues that need persistent effort from various stakeholders. One takes hope from the fact that the issues are acknowledged by key decision makers and efforts are on to resolve them, thereby moving the sector towards playing the role it is meant to in the growth story of India.

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3. IEA 2013 Report
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5. CRISIL estimates

FUEL CELLS- A NEW APPROACH

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Abstract:

'Energy crises' and 'Energy solutions' are the two antagonistic phrases which guide the economy, life style and the overall development of the country today[1]. Researchers and technologists have tried to address the crises mentioned above with all innovative and inventive methods. Starting from wind, solar to geothermal are few of the realms in which the development is taking pace. Fuel cell is one leading approach which is seen as one of the most promising solutions of future [2]. Conventionally, it is a battery which uses hydrogen and oxygen to produce electricity. Different combinations of electrodes, electrolytes and connectors attempted in fuel cells, decide the set of advantages over other technologies.

This paper would throw some light on the science of Fuel Cells, working principle, scope and advantages. It will also include a few new set of approaches adapted to make fuel cell a viable technology. Further, the different types of Fuel Cells and their limitations from the point of view of materials [2] will also be discussed with special stress on the 'Single Chamber Fuel Cell Technology' and its advantages [3], which is one of the latest innovations making fuel cell the leader in energy harvesting. At the end, the paper would present some part of the authors work in the development of low temperature (significantly!) single chamber Solid Oxide Fuel Cell [4] and its impact on growth of the field.

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ENERGY CRISIS AND ME

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Abstract:

Our world is beautiful, challenging and competitive. But the Energy Crisis will continue to become more and more serious. We have to live with acute energy shortage, and as wise human beings, we not only just live but live happily. And for happy living we should know the following:

- We should understand living system 'The mother EARTH' and also the history of life.
- Let's accept the fact that not only energy is in crisis, but the health of Earth is in crisis. She needs to be admitted to ICU.
- Energy indirectly puts tremendous pressure on natural resources.
- We need certain amount energy and natural resources to survive, but comfort and luxury consume huge quantity of energy and natural resources.
- Presently, we are not utilizing energy efficiently at all.
- We have to manage most with solar, wind, tidal, geothermal, hydel energy and use fossil fuel energy sparingly and with utmost care.

We will have to bring in certain changes in our life-style to cope up with energy crisis. These are as follows:

- Reduce as much as possible on fossil fuel energy .Refuse, reuse, reduce and recycle.
- Find new method of non conventional energy sources.
- Energy should be used very efficiently.
- Invent new environmentally friendly and healthy technologies to improve health of Mother Earth.
- Slight change in thinking process: from 'I WANT' to 'I WILL DO' for being more happy in life.

ENERGY CRISIS: PRESENT SENARIO AND FUTURE ALTERNATIVE

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Abstract

Energy has come to be known as a `strategic commodity' and any uncertainty about it's supply can threaten the functioning of the economy, particularly in developing economies. Energy sufficiency is the latest passport for the wellbeing of the country and a token for economic upliftment.

India currently generates more than 65% of its total electricity from non-renewable sources of energy such as coal, gas and oil. About 19% comes from hydro power, just over 2% from nuclear energy and 12% from other renewable sources. Analysts say that for India to be able to meet its growing demand it needs to start taking a serious look at other sources such as solar power, wind power etc... The power sector is also in urgent need of reform, not just in power generation but also transmission, distribution and the pricing of electricity.

The new government of India has decided to come up with a new national energy policy; it focuses on renewable energy and making India energy independent. The government estimates that the share of imported coal for generating power will increase to 30% by 2030 and that of fossil fuels will rise to 80%. "This could be a major bottleneck for sustaining economic growth. So, the focus of the new government is finding ways to encourage bio-fuels and have alternate energy sources to fossil fuels". Non-Renewable energy is the energy available on the earth in limited quantity and will vanish fifty-sixty years from now.

The present paper discusses the renewable energy as an alternative for the present energy crises , which is generated from natural sources i.e. sun, wind, rain, tides and can be generated again and again as and when required. Further it discusses "Dark Energy" as a Power Source a thought experiment.

NON-CONVENTIONAL ENERGY SOURCES–INDIAN ENERGY SCENARIO

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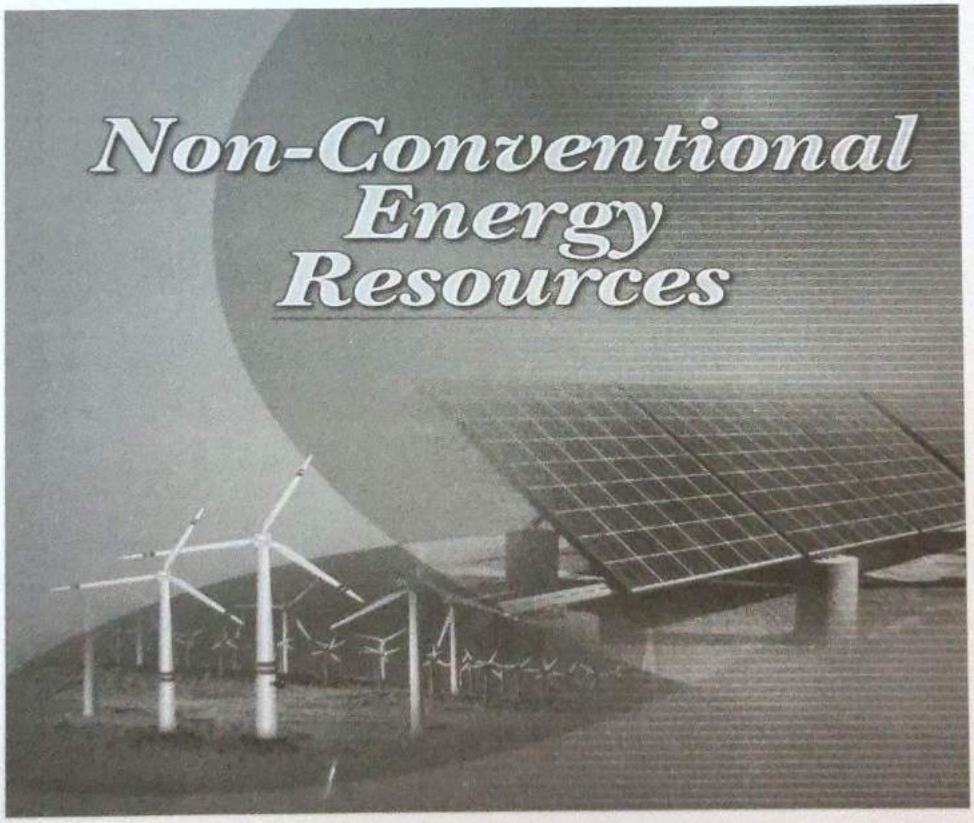
Abstract:

Energy is the key input to drive and improve the life cycle. Primarily, the various forms of Energy are the gift of nature to the mankind. The consumption of the energy is directly proportional to the progress of the mankind with ever-growing population, improvement in the living standard of the humanity, industrialization of the countries. Fossil fuel is the primary source of energy, however the finiteness of fossil fuel reserves and large scale environmental degradation caused by their widespread use, particularly global warming, air pollution and acid rain, strongly suggests that harnessing of non-conventional, renewable and environment friendly energy sources is vital for steering the global energy supplies towards a sustainable path. India's energy demand is on the rise, driven by high population growth, the modernization of lifestyles, higher electrification rates and a rapidly growing economy. Annual growth in energy demand reached 8% recently, doubling the historical average annual growth rates of the past 30 years.

Keeping in view the reserves of the fossil fuels and the economy concerns, these fuels are likely to dominate the world's primary energy supply for another decade but environmental scientists have warned that if the present trend is not checked then by 2100, the average temperature around the globe will rise by 1.4 to 5.8 degrees Celsius, which will cause a upsurge in the sea water levels drowning all lands at low elevation along the coastal lines. So the world has already made a beginning to bring about the infrastructure changes in the energy sector so as to be able to choose the renewable energy development trajectory. In developing countries, where a lot of new energy production capacity is to be added, the rapid increase of renewable is in principle, easier than in the industrial countries where existing capacity would need to be converted if a rapid change were to take place. That is, the developing countries could have the competitive advantage for driving the world market. However, strong participation of developed countries is needed

since majority of energy technologies in use in developing countries have been developed and commercialized in developed countries first. Nevertheless, India must give more thrust to the research and development in the field of non-conventional energy sources not only to mitigate greenhouse effect but also to lessen dependence on oil/gas import, which consumes major chunk of foreign exchange reserve. It is also clear that an integrated energy system consisting two or more renewable energy sources has the advantage of stability, reliability and are economically viable. Last but not the least, it is for the citizens also to believe in power of renewable energy sources, and understand its necessity and importance. This paper describes in brief the non-conventional energy sources and their usage in India.



SMART WINDOWS - A STEP TOWARDS ENERGY CONSERVATION

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Abstract:

Energy constitutes one of the most fundamental parts for our existence. Energy has come to be known as a `strategic commodity' and any uncertainty about its supply can threaten the functioning of the entire economy, particularly in developing countries. The demand and supply imbalance in energy sources is all-encompassing requiring serious efforts by various bodies to augment energy supplies and alleviate possible severe energy supply constraints.

The word ENERGY is associated with three major components: Conversion, conservation and storage. While the renewable energy conversion efficiency continues to remain poor, alternate methods need to be looked into in order to conserve the existing energy resources. Statistics show that a major part of energy loss is encountered in the transport and residential sector. Significant increases in residential and automobile energy efficiency are required to meet emerging global and national energy efficiency goals.

One of the ways to reduce the energy consumption and lessen carbon footprints is to make use of chromogenic devices for low emissivity windows or e-windows, skylighting, automobile sunroofs, building facades etc. In these devices, the double-paned, low emissivity (low-E) glass system minimizes solar heat gain and energy loss while penetration of natural light is maximized. The all-glass facade and use of large floor-to-ceiling panels allows for 90% of interior spaces to have daylight. Architects have realized this dream by constructing buildings with large windows and facades aptly named as smart windows which can change their colors like a chameleon to block the sun or provide instant privacy at the flip of a switch to suit the needs of the owner. These windows and facades not only add to the aesthetic appeal but can control the transmitted light in response to the applied stimulus. The application of such windows may lead towards a drastic reduction of the energy consumption of highly glazed buildings by reducing cooling, heating loads and the demand for electric lighting. In this work, different types of smart windows, their stimuli response and the corresponding change in optical properties have been discussed.

Keywords: smart windows, energy, chromogenic devices, glazing, facades

ENERGY AND ENVIRONMENT

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Abstract:

The energy produced by hydroelectric power, coal based thermal power, nuclear power, wind turbine and solar panels can be used to large extent. However, the wind turbine and solar panels have almost become environmentally friendly power generation. India has an ambitious plan to increase overall output from solar plants tenfold by 2020. Traditional hydroelectric power still offers large potential but in near future we cannot expect energy from this hydel power. In Asia alone there are plans to develop hydropower plants with a total output of 230 Gwatts by 2030. But these vast energy reserves often located far away from the urban centre, as a result there is more transmission loss and further the cost will be more. The average intensity of solar radiation received on India is 200 MW/sq.km with geographical area of 3.3 million sq.km, this amounts to 657 million MW. However, leaving aside land being used for agriculture, forests, housing and industry etc, only 12% of the land area can be used for solar energy installations. Thus the available solar energy would be 8 million MW which is equivalent to around 6000(mtoe) million tons of oil equivalent per year. It is estimated that our country's energy consumption could increase from 600 mtoe in 2010 to around 1800 mtoe in 2030.

In the similar way, in India the wind potential is about 65000 MW and can have two long term strategies. One is energy security wind power which can meet 10% of our long term energy requirement and another important is climate change response with close to zero emission of carbon. Both these objectives have long term positive impacts for our economy and we must act today to make this a reality in 2030. Further, it suggests that human being is responsible for the global warming, as a result the climate change. The two energy sources viz solar energy and wind power energy can produce zero carbon emission and hence it will be more practical in near future for the environment. The climate of the earth has changed a number of times since the origin of the earth. Impacts of climate change due to energy produced by so many ways are not only restricted to any particular region or country but will be felt across the globe.

ENERGY CRISIS: ISSUES AND ALTERNATIVE SOURCES

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Abstract:

Power shortage and load shedding is the common observation everywhere, but is quite significant in Karnataka. The technical problem or issue cited is shortage of coal. The most affected of the load shedding are the villages and the villagers indirectly are one of the causes of farmer suicides too. Honorable Prime ministers dream to make our villages the new engines of economic transformation under **"Make in India"** will be come true only if the energy supply is made 24/7 to all.

India is the 6th largest energy consumer of the WORLD. Where in most of the power generation is carried out by conventional energy sources- coal and mineral oil-based power plants which contribute heavily to greenhouse gases emission, which is an important issue to be taken care of. India's energy consumption has been increasing at a relatively fast rate due to population growth and economic development. With rapid urbanization, industrialization and improving standards of living, the demand is likely to grow significantly in future. The International Energy Agency says the world's energy needs could be 50% higher in 2030 than they are today.

Most of the present energy resources, which are being used, are non-renewable energy resources and the formation of these reserves in the earth has taken millions of years. The process of formation of oil and gas is an ongoing process but, will be available only after millions of years. It is the need of the day to go for the renewable energy resources and to achieve it over 90%.

The present paper discusses the energy crisis issues, alternative sources, national and international status, challenges ahead etc.

WIND ENERGY

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ABSTRACT:

Renewable energy or non conventional energy:

Renewable energy is energy which is generated from natural. Various forms of nonconventional energy sources are Solar Energy, Geothermal Energy, Wind Energy, Biomass Energy & (Water) Hydro Energy.

Non-renewable energy or conventional energy:

A nonrenewable resource is a natural resource that cannot be re-made or re-grown at a scale comparable to its consumption Non-renewable sources exist in the form of fossil fuels, natural gas, oil and coal.

Merits of renewable energy over non-renewable energy sources:

Renewable sources have low carbon emissions, therefore they are considered as green and environment friendly. The non-renewable sources of energy that we are using are limited and are bound to expire one day. Non renewable sources emits hazardous chemicals and gases for the mankind

Origin of wind power:

Winds are caused by two facts.

1. The absorption of solar energy on the earth's surface and in the atmosphere.
2. The rotation of the earth about its axis and its motion around the Sun.

Approximately 2% of the sun's energy reaching the earth is converted into wind energy. Wind is created by differential heating creating atmospheric.

The amount of power available in the wind is determined by the equation:

$$w = 1/2\ r\ A\ v^3$$

Where w is power, r is air density, A is the rotor area, and v is the wind speed. This equation states that the power is equal to one-half, times the air density, times the rotor area, times the cube of the wind speed. Air density varies according to elevation, temperature and weather fronts.

History of wind turbine:

The first windmills were made to automate the tasks of grain grinding and water pumping in Persia 500-900AD .The first use of a windmill to generate electricity was in Cleveland, Ohio in 1888 by Charles F. Brush. In 1891, Dane Poul la Cour made the first aerodynamically (low solidity, four bladed) designed system. By 1920, the la Cour system replaced all previous sail and fan systems. After WWII European Countries developed wind systems further when fossil fuel shortages led to high energy costs.

Classification of wind turbines: (On the bases of axis of rotation)

A wind mill converts the kinetic energy of moving air into Mechanical energy that can be either used directly to run the Machine or to run the generator to produce electricity.

- Horizontal axis wind turbine.
- Vertical axis wind turbine.

In Wind turbines (not windmills) use lift and drag principle, lift devices work like airplane wings this is why modern wind turbines have 3 blades.

Parts of wind turbines:

Important components of wind mill are: Anemometer, Blades, Brake, Controller, Gear Box, Generator Nacelle, Pitch, Rotor, and. Gear Box Tower.

ADVANTAGES: Wind power Units are quickly constructed. Wind generators are much smaller in size compared to other types of electrical generators. Small size allows wind power to be very versatile. It is a renewable resource. The more time spent researching makes each new wind turbine more efficient. Mass production of wind turbines drives down costs.

DISADVANTGES: Inefficient and unreliable, Hazard to bird migration. Access roads will follow the construction of a wind farm Houses too close to turbines will be disturbed by their noise. Turbines to be hit by lightning strikes. This can cause damage to the turbine, and also provoke forest fires. Propellers often fall off and are not repaired. Inefficient: 9,369 turbines only produce 1.7 % of Germany's power, No Wind = No Power.

Pros of the Project:-Replaces 113 million tons of oil can save per year. "Zero-emissions" of chemicals and gases like CO, CO_2 etc.

Cons of the Project:-Private companies take over of public/private land, May alter public use and access. Decrease in property values by politically influence like imposition of bills in the representative house No regulatory process to govern project. Potential hazard to wildlife.

Conclusion: Wind energy is a renewable and pollution-free energy which can help us to reduce the emissions of greenhouse gases. We believe that wind energy can become an important asset to solve climate change and global warming issues in the future. It can help to solve global issue of energy crises.

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RENEWABLE ENERGY SOURCES

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Abstract:

Energy is the capacity to do the work. There are different types of energies and number of categories are there in Energy sources. One of the categories of the energy sources is Non conventional energy sources. Some of them are mentioned below.

Solar energy can be a major source of power. Its potential is 178 billion MW which is about 20,000 time the world's demand. Since energy can be utilized as thermal & photovoltaic.

Energy of wind can be economically used for the generation of electrical energy. Wind energy uses the high wind velocity available in certain parts.

Biomass is renewable source of energy in the form of wood, agriculture residues, etc. Biomass may prove a useful fuel for localized power generation in rural area where electric transmission lines have not reached.

Tidal energy is the energy that can be trapped from sea. Tides are generated primarily by the gravitational attraction between the earth & the moon.

Geothermal energy derives the heat in the centre of the earth. Energy from seas can be utilized as wave, tidal or ocean thermal energy.

Band Gap Engineering Of Cu_2ZnSnS_4 Solar Cells—A Numerical Simulation Study

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Abstract:

Impact of Band gap changes in absorber layer of P-CZTS solar cells is done using a simulation programme called Solar Cell Capacitance Simulator(SCAPS-1D). The cell structure has p-CZTS as absorber layer,nCdS as buffer layer and i-Al_2O_3 as window element. Thickness of buffer layer n-CdS is held constant and thickness of p-CZTS is varied to get a cost effective thickness for the absorber layer. On deciding the optimum thickness for p-CZTS layer, the band gap of the absorber layer is varied to study the effect of this band gap variation on open circuit voltage V_{oc} and efficiency η at a fixed temperature. Simulation results indicate that optimal thickness is around 1.38μm and most effective band gap is in the region 1.39 to 1.40 eV.

Key words: Solar Cell, Simulation, Open circuit Voltage, efficiency, CZTS, CdS and band gap.

Introduction: These days world is consuming energy at the rate of ~ 5 X 10^{20} J/year, which is equivalent to (little higher than) 15 terrawatt. As the world population is increasing exponentially, this need for power is expected to double by year 2025. Though much of the present need is met through fossil fuels, burning of the fossil fuel is causing much environmental problems. And again fossil fuels are not going to last forever. Hence the need of the hour is to find and exploit renewable and eco friendly sources of energy. Out of different renewable energy sources known today, solar energy is one of the most abundant, clean energy source known.

Over recent years ,a good amount of efforts have been made to study the Cu_2ZnSnS_4 based thin film solar cells. Cu_2ZnSnS_4 is a quaternary semiconductor which has high coefficient of absorption and a direct band gap of about 1.5 eV. More over all the chemical elements in CZTS are abundant and non toxic. CZTS based solar cells are becoming excellent low cost alternatives.

Numerical simulation is an efficient way to predict the effect of changes in properties. It helps in assessing potential merits of cell structures and leads to optimization of cell structure.

At present, there is dearth of information about band gap engineering of CZTS solar cell. Therefore in this work, a numerical simulation based on SCAPS-1D is carried out.

Initially, optimum thickness of p-CZTS absorber layer is found out using SCAPS. And with this thickness further work is carried out.

Methodology, Cell structure and Parameters used: SCAPS -1D is one dimensional solar cell simulator developed at Department of Electronics and Information system at Gents University. As compared to other simulation softwares available, SCAPS calculates larger number of AC

and DC electrical parameters including short circuit current density (*Jsc*), fill factor (*FF*), open circuit voltage (*Voc*), conversion efficiency (η), quantum efficiency (*QE*), spectral response, generation and recombination profile. Calculations are based on hole and electron continuity equations along with Poisson equation. Good agreement between experimental results and SCAPS simulation results is reported in literature (15-17)

Structure of the solar Cell used for the purpose of simulation is n -ZnO, n-CdS and p-CZTS. Incident light travels through n –Zn and n-CdS and gets absorbed in p-CZTS leading to generation of hole-electron pair. The baseline values of different parameters used are given in table 1.

Table- 1 Values of various parameters used in the simulation

Parameter	nZnO	nCdS	pCZTS
Thickness (μm)	0.04	0.03	1.8-3.4
Band gap(eV)	3.3	2.42	1.5
Electron Affinity(eV)	4.65	4.35	4.5
Diele.Permittivity(rel)	9.0	10.0	10.0
Eff. Den of States CB (1/cm^3)	2.2E+18	2.2E+18	2.2E+18
Eff. Den of States VB(1/cm^3)	1.8E+19	1.8E+19	1.8E+19
Thermal. Vel. (elec) (cm/s)	1.0E+07	1.0E+07	1.0E+07
Thermal.Vel. (hole) (cm/s)	1.0E+07	1.0E+07	1.0E+07
Mobility(elec)(cm^2/Vs)	1.0E+02	1.0E+02	1.0E+02
Mobility(hole) cm^2/Vs)	2.5E+01	2.5E+01	2.5E+01
N_D	1.0E+17	1.0E+17	0.0E00
N_A	0.0E00	0.0E00	1.0E+17
Abs.Coeff. A	1.0E+05	1.0E+05	1.0E+05
Abs.Coeff. B	0.0E00	0.0E00	0.0E00

Values, nature and concentration of the defects incorporated in this study for n-ZnO, n-CdS,interface are picked up from the numos baseline example provided with **SCAPS**. Values of these parameters for p-CZTS are taken from the paper of Peijie Lin. Et.al.(X1)

Initially keeping all other parameters constant, thickness is varied to get an optimum value for efficiency.

This value of thickness is then kept constant and band gap of p-CZTS is tuned to get optimum value for efficiency.

Results and Discussions:

At the start of the simulation, the thickness of the CZTS layer is changed from 1.4 to 3.2 μm to study the influence of absorber layer thickness in the cell performance, while other material parameters of different layers are kept unchanged. The cell performance with varied CZTS absorber layer thickness is tabulated below. It can be found from table 2 that both the J_{sc} and V_{oc} of the solar cell are increased with the increasing thickness of CZTS layer. This is mainly because that the thicker absorber layer will absorb more photons with longer wavelength, which will in turn make a contribution to the generation of electron-hole pairs. but it has a much slower increasing rate when the layer thickness is over2200 nm, which means that the thickness of 2200 nm is enough to absorb most of the incident photons. Therefore, if one takes the processing times and material usage into account, fabricating the CZTS solar cells with thick absorber layer will not be very cost effective.

Thickness(μm)	V_{oc}(V)	J_{sc}(ma/cm^2)	Fill Factor (%)	Efficiency ((η)
1.4	1.041	25.605	85.79	22.89
1.5	1.043	25.777	85.98	23.13
1.6	1.045	25.930	86.15	23.36
1.7	1.047	26.060	86.30	23.56
1.8	1.048	26.189	86.43	23.74
1.9	1.050	26.300	86.55	23.91
2.0	1.051	26.400	86.65	24.06
2.1	1.053	26.492	86.75	24.21
2.2	1.054	26.576	86.83	24.34
2.3	1.056	26.650	86.90	24.46
2.4	1.057	26.724	86.97	24.57
2.5	1.058	26.790	87.03	24.68
2.6	1.059	26.852	87.09	24.78
2.7	1.060	26.909	87.15	24.88
2.8	1.061	26.962	87.22	24.97
2.9	1.062	27.012	87.28	25.05
3.0	1.063	27.058	87.33	25.13
3.1	1.064	27.240	87.34	25.04
3.2	1.065	27.281	87.40	25.12

On finalizing the thickness of absorber layer, the effect of band gap was systematically studied. By changing the concentration of Cu/Zn the band gap of CZTS can be varied. The result of this study is presented in table 3. As seen from the table, open circuit voltage V_{oc} increases linearly as the end of CZTS in contact with the the back contact goes on increases but short circuit current J_{sc} decreases. Best conversion efficiency is achieved when band gap difference is just 0.1 eV.

Band Gap(eV)		V_{oc}(V)	J_{sc}(ma/cm^2)	Fill Factor (%)	Efficiency ((η)
Edge A	Edge B				
1.35	1.4	0.913	32.33	84.45	24.95
1.36	1.4	0.923	31.90	84.58	24.91
1.37	1.4	0.932	31.189	84.72	24.64
1.38	1.4	0.9142	31.101	84.79	24.85
1.39	1.4	0.952	30.977	84.92	25.04
1.40	1.4	0.962	30.766	84.98	25.16
1.41	1.4	0.971	29.766	85.13	24.60
1.42	1.4	0.981	29.65	85.15	24.79
1.43	1.4	0.990	29.49	85.30	24.93
1.44	1.4	1.000	29.06	85.37	24.83
1.45	1.4	1.009	28.444	85.50	24.56
1.46	1.4	1.020	28.333	85.55	24.73
1.47	1.4	1.029	28.12	85.67	24.81
1.48	1.4	1.039	27.48	85.74	24.50
1.49	1.4	1.048	27.07	85.86	24.38
1.50	1.4	1.058	26.926	85.92	24.50

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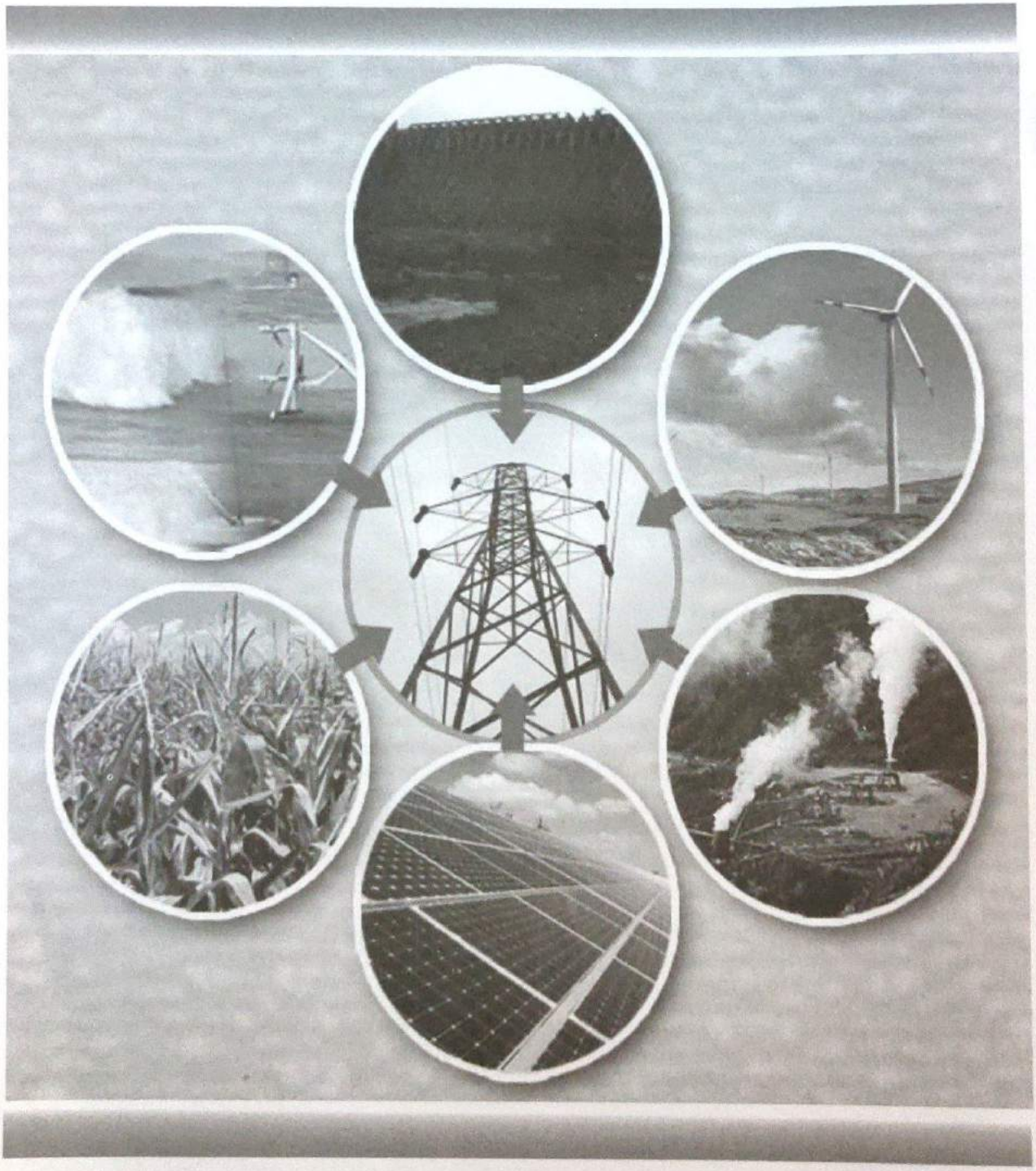

STUDENTS SPEAK

ENERGY CRISIS- A CURSE DUE TO OUR LUXURY

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Abstract:

"IF YOU WISH TO MOVE MOUNTAINS TOMMORROW, YOU MUST START BY LIFTING STONES TODAY."

This single proverb says everything what we are trying to express in our entire presentation. As we are all familiar to the fact that what disasters we are doing today, mother earth will in turn pay us back in a more horrifying way and we are already seeing this change in our lives today and will be worse in our future.

So, who is responsible for all this and what can help us out ???

The answer is **WE** ourselves and so the above proverb says if you want a happy tomorrow then you will have to start your job today. This paper would discuss our role in saving our mother earth and our own resources. It would further focus on some of the solutions such as better use of solar energy and also the optical fibers. Certain issues like physiological effect of light and human mentality also forms a part of this paper.

ENERGY AND THE DEVELOPED SOCIETY

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Abstract:

As nation is moving from agriculture based villages to industrial based city, the energy consumption has enormously increased. This has lead to the shortage of energy and hence the crisis. The increasing population and transformation from joint family to nuclear family system has further added to the energy crisis. In addition, the power production is limited due to the fewer number of generating stations and also the non availability of raw materials for the existing plants. The transmission and distribution loss is another area of concern where lot of energy is wasted. The focus of this paper would be to discuss the possible solutions in terms of renewable energy sources such as solar energy, wind energy, geothermal energy, tidal energy, bio-on garbage and bio mass energy. It will also focus on proper utilization, avoiding high power domestic utilities and living in joint family system.

ENVIRONMENTALISM - FROM VEDIC PERSPECTIVE

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Abstract:

India is one of the fastest growing economies after China. While growth in GDP has been looked at as a good sign for economic sustainability, concerns have been raised over environmental sustainability over the past few decades. A sustainable energy system should be cost-efficient, reliable, and environment-friendly which can help to overcome the issue of energy crisis. Mythological references to various aspects of environment have been a tradition of the Indian society. The Vedas have enmeshed several environmentally sensitive concepts in them that are linked to spiritual thoughts. With the increasing demand for energy, effective management and conservation of the same has become the need of the hour. The present study looks at the energy conservation opportunities and also the measures to maximize these opportunities. It focuses on the energy conservation measures considered in industrial setup, residential buildings etc. It suggests that we must consider energy use for its own sake, separate from our ability to buy and use it. It also suggests, use of locally available energy efficient products and networks will give a hope of getting through the energy-crisis condition. Shifting our attitude from energy-wasting to energy-conserving will help to build sustainable, long-term, energy future in the country.

ENERGY AND DEVELOPED SOCIETY

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Abstract:

Energy has become one of the basic needs of man ever since his advent on this planet 'EARTH'. At present it is very difficult to imagine life without adequate amount of energy. We have now been habituated to a society which is lavishly filled with all the gadgets to live a life free from hectic household chores or other official works. Well, we learned how to harness energy and convert electrons and their energy to things like computer monitors, televisions, mobiles etc..with use of energy we have reached to such a state where everyone are of the wish to own a skyscraper but have you ever thought of the need of energy in maintaining a life at skyscrapers? It's too tedious to manage the energy expenses and its consumption. Today we live in the developed society only because of the use of energy. We run automobiles as a result of fuel consumption i.e. energy consumption, we communicate within a fraction of second due to use of energy. A Developed society is because of the development in the consumption of energy. The development of 'Nuclear Energy', 'Tidal Energy', 'Electrical Energy', 'Solar Energy', 'Wind Energy' has all lead us to approach a developed society. Whether it may be agricultural progress, scientific progress, Educational development, development in the schooling and the lifestyle is all by virtue of energy. At the end we must also think the way to minimize the excess use of energy because if we now carelessly use energy then its too hard to live in developed society. With the concern towards the coming future we will have to follow some ways to reduce the energy wastage.

RENEWABLE ENERGY: PRESENT SCENARIO & FUTURE FOCUS

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Abstract:

We all have learnt that 'the ability to do work is called Energy'. Everything what happens in the world is flow of energy in one of its forms to the other. Energy is broadly classified into two categories i.e., Renewable & Non-renewable energy.

India's substantial & sustained economic growth is placing enormous demand on its energy resources. Economic growth, increasing prosperity & urbanization, per capita consumption are the factors likely to substantially increase the total demand for electricity. Renewable energy is becoming a key part of solutions to the nation's energy needs. In April 2002, renewable energy based power generation installed capacity was only 3475 MW which was 2% of total installed capacity in India. Today it is no longer alternate energy source, but it is playing lead role in production of electricity. Renewable energy sources contribute about 30% in India's primary energy supply. In upcoming years we can increase its contribution by using many innovative ideas related to use of abundant natural resources. There are numerous projects of renewable energy which are now undergoing in India.

In this paper, the focus is on **C**oncentrated **S**olar **T**echnologies (CST) that has been found to be quite suitable for cooking food for thousands of people in community kitchens. We also would discuss how we can make use of this abundant supply of energy from sun with new innovative ideas that help in India's energy saving. We believe that such projects we can undertake at village level so that it will compensate the energy consumption in future.

ENERGY CRISIS AND ENVIRONMENT

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Energy is capacity to do work. Energy crisis is defined as the shortage of energy supply when the demand is high. This is the serious problem faced by the people all over the globe. The energy crisis is a broad complex topic. Since energy is the basic component to perform day today activity the problem of its crisis is creating a huge impact on human society. Most of the people don't feel connected to its reality unless the prices of the gases, petrol, diesel, kerosene etc. goes up. The energy crisis is ongoing and getting worse as we are heading towards future. There are several causes for energy crisis so it is very difficult to declare who is the real culprit. It would be easy to point a finger at one practice or industry and lay the blame for the entire energy crisis at their door but this would be a very unrealistic interpretation of the cause of the crisis. The Energy crisis is the great shortfall in the supply of energy resources to an economy. It is generally referred to the shortage of oil, electricity, and other natural resources. This is a current major world crisis. The energy crisis exists because there is less cheap oil available. Due to shortage of cheap oil, technological innovation has become difficult and challenging. The crisis not only affects our lifestyle, but also the environment. The burning of fossil fuels like oil releases carbon dioxide into the atmosphere. The carbon dioxide prevents the sun rays from leaving the earth causing the earth to heat up. This phenomenon is called "global warming". Global warming is a threat to more than just our lifestyle, it endangers our planet. Excess heat on the planet has already melted some of the polar ice caps causing sea level to rise.

The coming times of scarce energy reserves will be very hard for everyone here but it will be even harder if it is not anticipated. It is important that the public and all the people who make decisions understand all the facts about the energy crisis we are about to face. An energy crisis is any great hurdle in the supply of energy resources to an economy. The energy crisis is caused by various factors: first of all, the gap between supply and demand is biggest obstacle. Currently 7500 MEGAWATTS of electricity is being produced which is nearly only 40% of the nation's demand. Secondly, circular debt is another major problem. According to economist magazine about $880m is causing blockage in the smooth running of energy's machinery causing hurdle in the generation and fair distribution of energy. Thirdly, lack of planning and technology to harness natural resources. This crisis of conventional energy source is standing on the way of socio-economic growth in the developing and underdeveloped countries. Of petroleum products, diesel and kerosene are much more extensively used in India to run pump-sets and tractors in agricultural fields and domestic usages. At the present rate of consumption, the source of all conventional energy are depleting at a faster rate. The impact of energy crisis doesn't affect human being directly but the outcome of the crisis tends to destroy the balance of

the environment. And the future generation has to face a huge problem because of this crisis. Due to Energy crisis there will be lots of uncertainty around the whole world. Because its effects will be both on Flora and Fauna, apart it will bring destruction to the human society residing both near coastal areas, urban and drought dry areas too. This precipitation pattern will change causing some areas to have drought and at a same time heavy rain, storms and snow may cause flooding in other areas. This will also increase the availability and quality of fresh water in many different part of the world.

It is heartening to note that scientists and technologists have taken steps to face the crisis. They are advising both short and long term measures. In the rural areas people are being advised to use more firewood, agricultural wastes and cow-dung. Biogas plants should have to be encouraged for cooking and lighting purpose. Hydroelectric power stations, though they produce only 12% of the total power in India, should be encouraged further. Geological explorations are to be intensified for locating deposits of natural gas. But the most interesting is that in this moment of crisis scientists have already started work to preserve atomic and solar energy, an endless source of energy. They have already developed solar cooking range though not commercially. India has also built some nuclear power stations for power generation. The best way to save energy is to create awareness among the people and importance of saving Energy.

As the temperature increases the demand for cooling also increases. This results in heavy demand for energy. Warmer temperatures increase cooling demands but it also decreases the heating requirements. Fewer disruptions of winter transportation may occur, but water transport may be affected by increased flooding or lowered river levels. An estimated 50cm rise in sea level by the year 2100 could inundate more than 5,000 miles of dry land. Higher temperatures and precipitation changes could increase forest susceptibility to fire, disease and insect damage.

- Proper care should be taken that we can reduce and eliminate the green house gases which are affecting and disturbing our climate and provide many other benefits as well.
- Use of CFC gases should be banned completely since it destroys our ozone layer.
- Bio fuels including ethanol and biodiesel could substantially cut down the carbon dioxide emission from automobiles.
- Awareness of Global warming and its impact should be spread at all parts of the world.
- Creation of compact and complete communities that recall the best of traditional towns and neighbourhoods make driving less necessary and walking and cycling much easier.
- Besides protecting the climate, the above carbon dioxide emission control techniques dramatically reduce other air pollution, provide communities with a higher quality of life and build new business with the potential to create thousands of new family wage jobs. Climate protection solution works for all of us, making a better world today and ensuring a healthy tomorrow for future generations.
- Conservation and energy efficiency yield energy that causes no environmental damage and costs

less than building new power plants. They lower electricity bills and reduce constraints on our energy system.

- Creating awareness among people about importance of trees, hence promoting aforestation, because forests are the natural lungs of the earth purifying air and ultimately playing a key role in reducing global warming.
- Make use of 3 R's; REDUCE, REUSE, RECYCLE

CONCLUSION:

In conclusion, our planet is a complex ecosystem with dynamic interactions but we all breathe the same air and drink the same water. The issue of climate change impacts your life no matter where you are and it's up to all of us to be a part of the solution. Everyone on earth is affected.

Energy Crisis!!!!!
ITS NOT A JOKE...!!!
Helping the earth is helping
Yourself and all of us.
Do something for our Planet
NOW
.....before its too late!
Global warming is OUR problem!
This Planet is our home,
And if we don't do something to
Protect it...who will?????
THINK OVER IT....

SAVE EARTH, SAVE LIFE....!!!! GO GREEN...!!!

TEETER POWER

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Abstract:

In physics, energy is a property of objects which can be transferred to other objects or converted into different forms, but cannot be created or destroyed. This is an innovative project which converts mechanical energy into electrical energy .The mechanical energy is the sum of potential energy and kinetic energy. It is the associated with the motion and position of an object .The principal conversation of mechanical energy states that in an isolated system that is only subject to conservative forces the mechanical energy is constant. If an object is moved in opposite direction of a conservative net force, the potential energy will increase and if the speed of the object is changed as well. Many modern devices are used today to convert mechanical energy into electrical energy as in common and simple is "Dynamo". A dynamo is an electrical generator that produces direct current with the use of a commutator, a kind of electric motor working in reverse that converts ordinary energy into electricity. Electric motor is essentially just a tight coil of copper wire wrapped around an iron core that's free to rotate at high speed inside a powerful, permanent magnet which converts mechanical energy into electrical energy. In this paper we are describing an innovative system such as a see-saw or a swing used to produce electricity. This is a project that makes kids happy and the outcome is also profitable and eco-friendly.

UNLOCKING THE POTENTIAL OF 'RENEWABLES'

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Abstract:

We are extremely dependant on energy today. Every aspect of human life depends on technology which is run by electricity, fossil fuels, coal etc. But in meeting the power demands of the world today, we are exhausting our resources. We are running out of coal and crude oil. So what next? How do we produce power now? Pop comes the word "renewables!" which collectively means all the renewable sources of energy.

This paper aims to throw light on some of the renewables such as solar energy, wind energy, bio fuels, tidal energy and hydrogen fuel cells which offer alternatives to conventional forms of energy.

Despite all this, the challenge of meeting the energy demands of this country still remains. Although renewables have a lot of potential for energy production, harnessing them economically is difficult. Almost all power plants set up to harness renewable energy are capital intensive. The technologies in place are still in infancy and a lot of research needs to be done to make use of sources available. It is important to produce power in economical and commercially viable way. But nevertheless, the right use of these renewable resources will ensure that we will have energy for everyone in the future.

WIND POWER AND WIND ENERGY

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Introduction:

Wind is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow, or motion energy, when harvested by modern wind turbines, can be used to generate electricity.

How Wind Power Is Generated

The terms wind energy or wind power describes the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity to power homes, businesses, schools, and the like.

Wind Turbines

Wind turbines, like aircraft propeller blades, turn in the moving air and power an electric generator that supplies an electric current. Simply stated, a wind turbine is the opposite of a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity. The wind turns the blades, which spin a shaft, which connects to a generator and makes electricity.

Wind Turbine Types

Modern wind turbines fall into two basic groups; the horizontal-axis variety, like the traditional farm windmills used for pumping water, and the vertical-axis design, like the eggbeater-style Darrieus model, named after its French inventor. Most large modern wind turbines are horizontal-axis turbines.

Turbine Components

Horizontal turbine components include:

- blade or rotor, which converts the energy in the wind to rotational shaft energy;
- a drive train, usually including a gearbox and a generator;
- a tower that supports the rotor and drive train; and
- other equipment, including controls, electrical cables, ground support equipment, and interconnection equipment.

Turbine Configurations

Wind turbines are often grouped together into a single wind power plant, also known as a wind farm, and generate bulk electrical power. Electricity from these turbines is fed into a utility grid and distributed to customers, just as with conventional power plants.

Wind Turbine Size and Power Ratings

Wind turbines are available in a variety of sizes, and therefore power ratings. The largest machine has blades that span more than the length of a football field, stands 20 building stories high, and produces enough electricity to power 1,400 homes. A small home-sized wind machine has rotors between 8 and 25 feet in diameter and stands upwards of 30 feet and can supply the power needs of an all-electric home or small business. Utility-scale turbines range in size from 50 to 750 kilowatts. Single small turbines, below 50 kilowatts, are used for homes, telecommunications dishes, or water pumping.

Advantages and Disadvantages of Wind-Generated Electricity

Wind energy is a free, renewable resource, so no matter how much is used today, there will still be the same supply in the future. Wind energy is also a source of clean, non-polluting, electricity. Unlike conventional power plants, wind plants emit no air pollutants or greenhouse gases. According to the U.S. Department of Energy, in 1990, California's wind power plants offset the emission of more than 2.5 billion pounds of carbon dioxide, and 15 million pounds of other pollutants that would have otherwise been produced. It would take a forest of 90 million to 175 million trees to provide the same air quality.

RENEWABLE ENERGY SOURCES – IMPORTANCE AND USES

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Abstract:

Energy is the basic necessity for life. The energy crisis we often talk about is not about the shortage of energy. Several countries have adopted ambitions plan to obtain their power from renewable energy installations, but are also integrating renewable into their existing infrastructure to reach a 100% renewable energy mix. There are many forms of renewable energy. Most of these renewable energies depend in one way or another on sunlight. Wind and hydroelectric power are the direct result of differential heating of the Earth's surface which leads to air moving about (wind) and precipitation forming as the air is lifted. The energy crisis we often talk about is not about the shortage of energy. In fact, there is more than enough energy around us.

We all know that energy is providing us light and comfort. All means of transport need energy. We all talk about the energy crisis and the need to conserve it, but the energy is conserved in nature; it can neither be created nor destroyed. Energy is a concept in science. The concept of energy has helped to understand, explain and correlate various natural phenomena we come across and experience. Renewable energy is generally defined as energy that comes from resources while are naturally replenished. ***Dr. A. P. J. Abdul Kalam*** said "We can achieve energy independence by 2030, if we focus on renewable energy sources."

There are many forms of renewable energy. Most of these renewable energies depend in one way or another on sunlight. Wind and hydroelectric power are the direct result of differential heating of the Earth's surface which leads to air moving about (wind) and precipitation forming as the air is lifted. Solar energy is the direct conversion of sunlight using panels or collectors. Biomass energy is stored, sunlight contained in plants. Other renewable energies that do not depend on sunlight are geothermal energy, which is a result of radioactive decay in the crust combined with the original heat of accreting the earth, and tidal energy, which is a conversion of gravitation energy.

Waste-to-energy plants offer two important benefits of environmentally safe waste management and disposal as well as the generation of clean electric power. Waste-to-energy facilities produce clean, renewable energy through thermo chemical, biochemical and physicochemical method. The growing use of waste to energy as a method to dispose of solid and liquid waste and generate power has greatly reduced environmental impact of municipal solid waste management, including emission of greenhouse gases. Waste to energy conversion reduces green house gases emission in two ways.

In this paper we are presenting various means of renewable energy resources with their advantages over non-renewable energy sources.

ENERGY CRISIS- POSSIBLE REMEDIES

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Introduction:

Today's major problem is energy crisis. There are number of experiments were conducted in order to come with solution for the energy crisis. The energy crisis is the concern that the world's demands on the limited natural resources that are used to power industrial society are diminishing as the demand rises. These natural resources are in limited supply. While they do occur naturally, it can take hundreds of thousands of years to replenish the stores. Governments and concerned individuals working to make the use of renewable resources a priority, and to lessen the irresponsible use of natural supplies through increased conservation. The energy crisis is broad and complex topic. It is something that is ongoing and getting worse, despite.

Causes of the energy crisis:

It would be easy to point a finger at one industry and lay the blame for entire energy crisis at their door, but that would be a very unrealistic interpretation of the causes of the crisis.

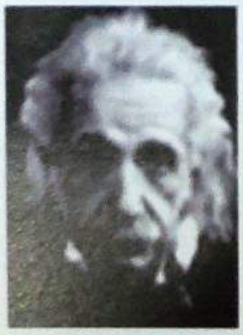
1. **Overconsumption**- The energy crisis is result of many different strains on our natural resources, not just one. There is strain on fossils fuels such as oil, gas and coal due to overconsumption.
2. **Overpopulation**- Another cause of crisis has been the steady increase in the world's population and its demand for fuel and product.
3. **Poor infrastructure-** Aging infrastructure of power generating equipment is yet another reason for energy shortage. Most of the industry uses outdated equipment which results into wastage of energy. So we have to use upgraded infrastructure.
4. **Unexplored Renewable Energy Options-** Renewable energy still remains unused in most of countries. Renewable energy sources can reduce our dependant on fossils, fuels and helps to reduce greenhouse gas emissions.
5. **Delay in commissioning of power plants**-In few countries, there is a significant delay in commissioning of new power plants that can fill the gap between demand and supply of energy. It results is old plants come under huge stress to meet the daily demand for power.
6. **Wastage of energy-** in most parts of the world, people do not realize the importance of conserving energy. It is only limited to books, internet, newspaper ads, lip service and seminars. We have save energy as possible as and it has to start from our home.
7. **Poor distribution system-** sometimes poor distribution or leakage may leads to energy shortage.
8. **Major Accidents and natural calamities-** Major accidents like pipelines burst and natural calamities like eruption of volcanoes etc can interruption to energy supplies.

9. **Wars and attacks**-wars between countries can also hamper supply of energy.
10. **Miscellaneous Factors**- Tax, hikes, strikes can definitely cause an energy crisis.

Possible solutions of the energy crisis

There are many solutions, but they have not been widely adopted:

1. **Move Towards Renewable Resources-** The best possible solution is to reduce the world's dependence on nonrenewable resources and to improve overall conservation efforts. Therefore we have to move towards the Renewable resources.
2. **Buy Energy Efficient Products**-Replace the traditional bulbs with CFL's. Use less watts of electricity bulbs.
3. **Lighting controls-** There are number of new technologies out there that make lighting controls.
4. **Easier Grid Access-** Using Renewable resources like solar panels we conserve energy.
5. **Energy simulation-** Energy simulation software can be used by big corporate and corporations to redesign building unit and this reduce carbon footprint.
6. **Perform Energy Audit-** It energy audit is process that helps you to identify the areas where your home or office is losing energy and what steps you can take to improve energy efficiency.



The only thing that you absolutely have to know, is the location of the library.

— Albert Einstein

Other Institutions of S. K. E. Society

- R. P. D. College of Arts and Commerce
- R. P. D. PU College of Arts and Commerce
- R. P. D. College of Business Management (BBA)
- G. S. College of Computer Applications (BCA)
- Thalakwadi High School
- Swadhyaya Vidya Mandir High School
- Vaikunt Mukund Shanbhag Marathi School
- Shri Mohanlal Rampal Bhandari Kannada School