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Energy And Sustainable Development: Means Of Energy Conservation

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Abstract:This paper is concerned with the role of energy in the sustainable development. Energy is central to improve social and economic well-being, and is indispensable to most industrial and commercial wealth generation. It is the key for relieving poverty, improving human welfare and raising living standards. But, however, essential it may be for development, energy is only a means to an end. The energy supply sector can best advance sustainable development by producing and delivering secure and environmentally-friendly sources of energy and by increasing the efficiency of energy use. Greater use of clean energy obviously contributes to sustainability of the development process, and this issue will become more important in the years that lie ahead. Developing countries account for 82 per cent of the world's population and they use 55 per cent of the available global supply of energy. They must aim at faster growth of their GDP to improve the living standards of their populations and this will entail an expanded demand for energy. If they follow the industrialized countries in meeting their energy requirements through fossil fuel based energy, the impact on the global climate would be simply unsustainable. This poses a global challenge. The author tries to discuss the means of energy conservation which include energy taxes, consumer products, energy renewal and perspectives of energy conservation. The role of Himachal Pradesh in energy conservation is also discussed in the paper.

Keywords: Energy, energy conservation, energy renewal, sustainable development.

INTRODUCTION:

Sustainable development is an equitable, empowering, need-oriented, self-reliant, environmentally sound and economically viable process of growth. It involves successful management of natural resources for various developmental processes to satisfy the changing needs of humans while maintaining and enhancing the quality of the environment. Energy is the most important indicator of sustainable development. Hence the key to sustainable development lies substantially in designing energy strategies (R., Shailja, 2002). 'Sustainable development' has been defined best by the Brundtland Commission as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED).

The world is unique for every human being, but, in general, women's lives vary greatly from those of men because of patterns of socialization related to gender. In terms of the environment, women around the world play distinct roles: in managing plants and animals in forests, dry lands, wetlands and agriculture; in collecting water, fuel and fodder for domestic use and income generation; and in overseeing land and water resources. By so doing, they contribute time, energy, skills and personal visions to family and community development. Women's extensive experience makes them an invaluable source of knowledge and expertise on environmental management and appropriate actions (Julekha, Begum). Current demographic, economic, social, and technological trends – if not counterbalanced by strong new government policies – pose major challenges regarding the long-term sustainability of the global energy system. If governments not implement policies beyond those already planned between now and 2030, it is projected that:

energy consumption will increase by over half (53%);
the energy mix will remain fairly stable and dominated by fossil fuels (80% share);
energy-related CO2 emissions will increase by over half (55%); and
large populations of the world's poor will continue to lack access to electricity (about 1.5 billion) and modern cooking and heating services (about 2.5 billion).

In this scenario, energy consumption increases from 11200 Mtoe (millions tons of oil equivalent) in 2004 to 17200 Mtoe in 2030. Over 70% this growth is expected to come from developing countries, which undertake Organization for Economic Co-operation and Development (OECD) countries as energy consumers sometime around 2014. Nearly half of the increase in global primary energy use goes to generating electricity and one-fifth of the increase (almost entirely in the form of oil based fuels) to

meet transport needs (OECD, 2007).

Adequate and affordable energy supplies have key to economic development and the transition from subsistence agricultural economies to modern industrial and service-oriented societies. Energy is central to improve social and economic well-being, and is indispensable to most industrial and commercial wealth generation. It is the key for relieving poverty, improving human welfare and raising living standards. But, however, essential it may be for development, energy is only a means to an end. The end is good health, high living standards, a sustainable economy and a clean environment. No form of energy — coal, solar, nuclear, wind or any other — is good or bad in itself, and each is only valuable in as far as it can deliver this end. Much of the current energy supply and use, based, as it is, on limited resources of fossil fuels, is deemed to be environmentally unsustainable. There is no energy production or conversion technology without risk or without waste. Somewhere along all energy chains — from resource extraction to the provision of energy services — pollutants are produced, emitted or disposed of, often with severe health and environmental impacts. Even if a technology does not emit harmful substances at the point of use, emissions and wastes may be associated with its manufacture or other parts of its life cycle. Combustion of fossil fuels is chiefly responsible for urban air pollution, regional acidification and the risk of human-induced climate change. The use of nuclear power has created a number of concerns, such as the storage or disposal of high-level radioactive waste and the proliferation of nuclear weapons. The noncommercial use of biomass in some developing countries contributes to desertification and loss of biodiversity (IAEA). This creates a need for the energy security.

Energy Security: It is a broad concept that focuses on energy availability and pricing. Specifically, it refers to the ability of the energy supply system – suppliers, transporters, distributors and regulatory, financial and R&D institutions – to deliver the amount of competitively-priced energy that customers demand, within accepted standards of reliability, timeliness, quality, safety and environmental impacts, under a wide range of geopolitical, economic, social, technological and weather circumstances. Traditionally, energy security has been defined in the context of the geopolitical risks to external oil supplies. Today, it is a broader concept, encompassing all energy forms, all the external (foreign) and internal (domestic) links bringing the energy to the final consumer, and all the many ways energy supplies can be disrupted – including equipment malfunctions, system design flaws, operator errors, malicious computer activities, deficient market and regulatory frameworks, corporate financial problems, labour actions and natural events, aggressive acts (e.g. war, terrorism and sabotage), and geopolitical disruptions. In practice, the most worrisome disruptions or potential disruptions are those linked to:

1) Extreme weather events;
2) Mismatched electricity supply and demand;
3) Regulatory failures; and
4) Concentration of oil and gas resources in certain regions of the world.

Insecure energy supplies inhibit development by raising energy costs and imposing expensive (sometimes life threatening) cuts in services when disruptions actually occur. The energy supply sector can best advance sustainable development by producing and delivering secure and environmentally-friendly sources of energy and by increasing the efficiency of energy use. These overarching qualities are frequently stated in terms of the 3E's – energy security, economic development and environmental protection. The current methods of meeting these criteria involve ensuring fuel diversity, supplier diversity, sound transmission and distribution infrastructure, efficient conversion and delivery technologies, and low- and zero-carbon technologies. Policies encouraging more efficient production and use of energy could contribute almost 80% of the avoided CO emissions in 2030, with the remainder gained from fuel substitution. More efficient use of fuels, mainly by cars and trucks, accounts for almost 36% of avoided emissions; more 2 efficient use of electricity in a wide range of applications (e.g. lighting, air-conditioning, appliances and industrial motors) for 30%; greater efficiency in energy production for 13%; renewable and bio fuels for 12%; and nuclear for the remaining 10%.

Co-ordinating Relevant Policy Fields: Energy contributes to and detracts from sustainable development according to an elaborate interplay of markets, technological development, government policies, social norms and individual behaviour, not just in the energy sector but in many other sectors as well. The relationship between energy and sustainable development is complex, both positive and negative. On the positive side, it is the services that energy enables, not the energy itself, that most directly advance sustainable development. Better cooking, lighting, space conditioning, transportation, communications, income generating processes and other services are the means by which energy improves human, social, economic and environmental conditions. On the negative side, energy can be produced and deployed in ways that pollute the environment and increase greenhouse gas emissions. The development of various energy sources, including oil, gas and coal, can disrupt ecosystems if not carefully planned. Energy is vital to providing an array of necessary services, but the nature of its contribution is not fixed. It is possible to alter the end-use devices, methods, infrastructure and behaviour that deliver these services to become more energy efficient or to use alternative types of energy. There are opportunities and barriers to developing and deploying more sustainable energy supplies and end-uses in various sectors, which are influenced by the:

availability, affordability, security, reliability and safety of energy supplies in the energy system;
environmental friendliness of energy supplies in the energy system;
planning, design, construction, operation, financing and pricing of energy-using buildings, industrial processes, transport systems, etc. in end-use sectors;
social and cultural norms regarding behaviour in end-use

sectors;
access to alternative technologies and energy sources; and
investment assistance to develop and deploy energy services.

Government policies are key to ensuring that the energy sector advances sustainable development. There are many policy domains – including environment, development, industry, transport, construction, agriculture, investment, science and technology and education as well as energy itself – where policies influence how and how much energy is produced, converted, transported, distributed and used. Ensuring that energy systems develop in a way that best supports and accords with sustainable development requires communication and co-ordination among all relevant policy areas at all levels of government (i.e. local, regional, national, international). Full communication and co-ordination across all policy domains affecting the development and use of energy are still rare, just as they are in many other fields. Addressing energy challenges requires an integrated sustainable development approach based on increased co-ordination among diverse fields and stakeholders. A wide range of government departments and agencies should be involved in the formulation and implementation of energy policies in various sectors. At a minimum, the policy toolbox for promoting energy for sustainable development should include:

1) Regulations and standards – agreed government norms for the production and use of energy and protection of the environment.
2) Economic instruments – market-based instruments (e.g., taxes, tradable permits) to internalize externalities and promote the cost effectiveness of energy and environmental policies and measures.
3) Subsidies – phase-out of unproductive and distortive government subsidies (e.g. to energy, transport) and provision of transition supports where needed to ease environmental and social costs of change.
4) Investment – establishment of undistorted, cost-reflective prices in the energy market and conducive investment conditions to send the right signals to private investors.
5) Partnerships and voluntary agreements – joint public/private programmes to develop and deploy sustainable energy approaches with industry.
6) Research and development – government R&D and incentives to private R&D to promote innovation on energy for sustainable development.
7) Information and communications – campaigns to promote better understanding by the general public of the national and international energy and environment situation and future challenges.
8) Assessments and scenarios – sustainability assessments which identify synergies and trade-off across the economic, environmental and social impacts of energy policy options.
9) National strategies – good governance approaches based on whole-of government decision-making, transparency, and understanding of the political economy of promoting change in energy systems.

Meeting Growing Energy Demand: Energy contributes to a virtuous cycle of human, economic and social improvements that are essential to sustainable development in developing countries (Figure 1a).

Sufficient supplies of clean energy are the basis for raising standards of living, improving the quality and quantity of human capital, enhancing the business and natural environment, and increasing the efficiency of government policies. However, energy poverty remains a major problem for human health, economic development and environmental sustainability in many parts of the world. Approximately 1.6 billion people – mostly in the rural areas of Sub-Saharan Africa, South and East Asia, and Latin America – lack access to electricity, and 2.5 billion people rely on traditional biomass for cooking and heating. About 1.3 million people – mostly women and children – die prematurely every year because of exposure to indoor air pollution from cooking and heating with traditional, inefficient biomass stoves.

Demand for energy is growing exponentially in developing countries due to rapid population growth (especially in Africa) and rapid economic expansion (especially in China and India). This is projected to lead to a near doubling in primary energy use, much of it unsustainable, by developing countries in the next two decades. As a result of this growth, developing countries will account for 50% of primary energy use and 52% of energy related CO emissions by the year 2030.

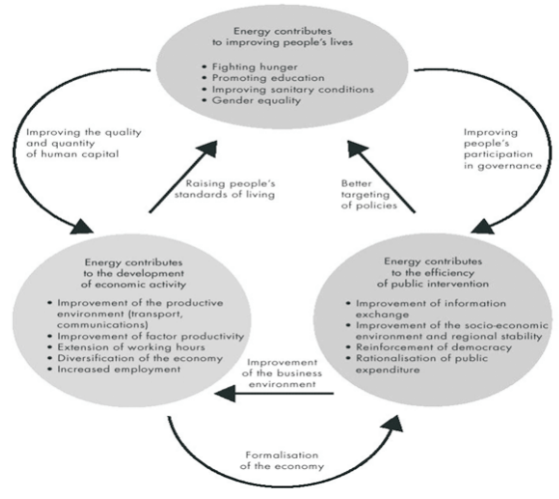

Figure 1a: Links between energy and human, economic and social development

Source: African Economic Outlook (OECD/ADB, 2004).

Energy Conservation and Means of Energy Conservation: The world's population is continued to grow from few decades at the faster rates. Energy demand is likely to increase even faster, and the proportion supplied by electricity will also grow faster still. However, opinions diverge as to whether the electricity demand will continue to be served predominantly by extensive grid systems, or

whether there will be a strong trend to distributed generation (close to the points of use). That is an important policy question itself, but either way, it will not obviate the need for more large-scale grid-supplied power especially in urbanised areas over the next several decades. Much demand is for continuous, reliable supply, and this qualitative consideration will continue to dominate. The key question is how we generate that electricity. Today, worldwide, 64% comes from fossil fuels, 16% from nuclear fission and 19% from hydro, with very little from other renewables. There is no prospect that we can do without any of these (energylinx.co.uk).

In a scenario where India tries to accelerate its development process and cope with increasing energy demands, conservation and energy efficiency measures are to play a central role in our energy policy. A national movement for energy conservation can significantly reduce the need for fresh investment in energy supply systems in coming years. It is imperative that all-out efforts are made to realize this potential. Energy conservation is an objective to which all the citizen in the country can contribute. Whether a household or a factory, a small shop or a large commercial building, a farmer or an office worker, every user and producer of energy can and must make this effort for his own benefit, as well as that of the nation.

It is reduction in the amount of energy consumed in a process or system, or by an organization or society, through economy, elimination of waste, and rational use (businessdictionary.com). Energy conservation refers to reducing energy through using less of an energy service. Energy conservation differs from efficient energy use, which refers to using less energy for a constant service. For example, driving less is an example of energy conservation. Driving the same amount with a higher mileage vehicle is an example of energy efficiency. Energy conservation and efficiency are both energy reduction techniques. Even though energy conservation reduces energy services, it can result in increased financial capital, environmental quality, national security, and personal financial security (Unintended Consequences of Green Technologies). According to Zehner, Ozzie (2012), individuals and organizations that are direct consumers of energy may choose to conserve energy to reduce energy costs, promote economic security, or maximize profit. However, this can lead to unintended rebound effects, which can negate environmental benefits of conservation unless backstops are instituted to prevent overall consumption increases.

Energy Taxes: Some countries employ energy or carbon taxes to motivate energy users to reduce their consumption. As detailed in the book, Green Illusions, carbon taxes can allow consumption to shift to nuclear power and other alternatives that carry a different set of environmental side effects and limitations. Meanwhile, taxes on all energy consumption stand to reduce energy use across the board, while reducing a broader array of environmental consequences arising from energy production. The State of California employs a tiered energy tax whereby every consumer receives a baseline energy allowance that carries a low tax. As usage increases above that baseline, the tax increases dramatically. Such programs aim to protect poorer households while creating a larger tax burden for high energy consumers (Zehner, Ozzie, 2012).

Consumer Products: Consumers are often poorly informed of the savings of energy efficient products. The research one must put into conserving energy often is too time consuming and costly when there are cheaper products and technology available using today's fossil fuels. Some governments and NGOs are attempting to reduce this complexity with eco labels that make differences in energy efficiency easy to research while shopping (Breukers, Heiskanen, et al., 2009). To provide the kind of information and support people need to invest money, time and effort in energy conservation, it is important to understand and link to people's topical concerns. For instance, some retailers argue that bright lighting stimulates purchasing. However, health studies have demonstrated that headache, stress, blood pressure, fatigue and worker error all generally increase with the common over-illumination present in many workplace and retail settings (Scott Davis, Dana K. Mirick, Richard G. Stevens, 2001). It has been shown that natural daylighting increases productivity levels of workers, while reducing energy consumption.

Energy Conservation and Renewal: Kinden provides a complete range of integrated services — from energy conservation evaluation and diagnosis, equipment evaluation and diagnosis and trouble investigation to analysis and evaluation of survey results, improvement proposals, improvement design, implementation and inspection. Kinden's Comprehensive Equipment Diagnostic System, for instance, provides an overall, integrated assessment of equipment energy conservation capabilities and deterioration renewal. It is a total system designed to achieve optimal energy conservation in the interests of streamlining business efficiency and operations. Kinden's Comprehensive Equipment Diagnostic Program is a “total service program” that offers services from studies and diagnosis to energy conservation proposals for the purpose of maintaining equipment systems at maximum operating capability. The users operate these systems with complete confidence throughout the equipment's life cycle (Figure 1). Features of Kinden's Energy Conservation Diagnosis and Proposals: In particular, precise energy conservation measures and policies are needed in the Operations Division of the industry sector, which will be transferred from a 2nd Class to 1st Class Energy Management Designated Plant. Kinden's Comprehensive Equipment Diagnostic Program aims at realizing optimum energy conservation measures through the implementation of energy conservation diagnosis and equipment evaluation, and facility management business from renewal proposals, design and implementation to inspection and maintenance (kinden.co.jp).

Among Mitsubishi Electric's many production sites, the Air Conditioning & Refrigeration Systems Works is particularly focused on environmental conservation. From early on, they have incorporated energy conservation initiatives into just-in-time activities and promoted various improvements to ensure the necessary item is in the

necessary place at the necessary time by conducting energy usage inspections from six perspectives (Figure 2: change, quit, stop, lower, fix and reuse). These activities produced remarkable results, which were recognized with two first prize awards for factory excellence at our internal improvement activities announcement, which is attended by representatives from each site (mitsubishielectric.com).

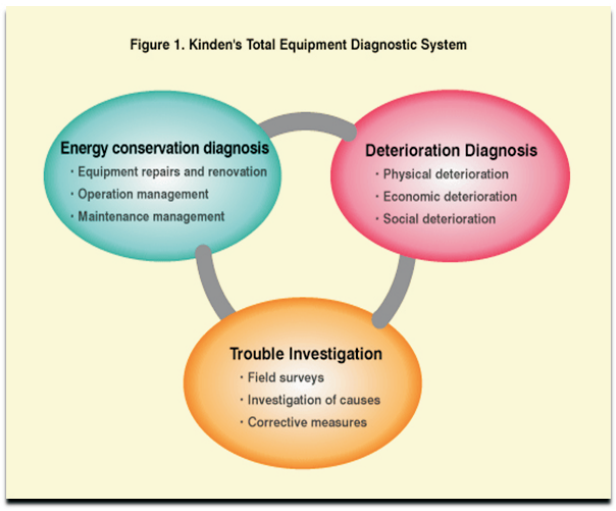

Figure 1: Comprehensive Equipment Diagnostic Program (kinden.co.jp)

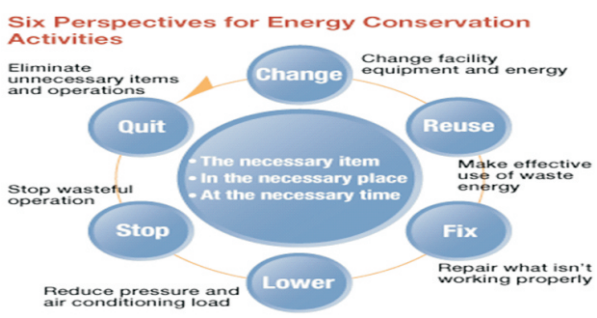

Figure 2: Six Perspectives of Energy Conservation

Energy conservation Projects in India: India is one of the largest growing economies in the world with economic growth rate of 8.9%. Commensurate with economic growth, urbanization in India is growing fast. The construction sector in India is witnessing high growth due to increased demands for housing, strong demographic impetus, expansion of organized retail, and increased demand for commercial office spaces by multinationals and IT hubs. With a near consistent 8% rise in annual energy consumption in the residential and commercial sectors, overall energy consumption in buildings has seen an increase from a low of 14% in the 1970s to nearly 33% in 2004/05. This is directly related to higher greenhouse gas emissions. Thus, it is the need of the hour to design and construct High Performance Energy Efficient Buildings.

To fulfill this objective, TERI, in association with BEE (Bureau of Energy Efficiency), Ministry of Power, Government of India, and White Box Technologies, USA, has undertaken a project 'High Performance Commercial Buildings in India' to make commercial buildings in India energy efficient.'

The project aims at establishing the relevance and impacts of low-energy passive strategies and ECBC (Energy Conservation Building Code) -recommended measures on improving energy performance of commercial buildings in five climatic zones of India. ECBC was launched by the BEE in 2007. It sets minimum energy performance standards for the design and construction of large commercial buildings. The project further targets fully air-conditioned new commercial buildings and aims at mainstreaming high performance buildings through large scale adoption of energy efficient building design strategies and the ECBC. Commercial buildings from different eras in India are being analysed under the project. First, the existing commercial buildings are being analysed for their Energy Performance Index (EPI), comfort levels, construction, and equipments installed.

The second era is the pre-ECBC era, in which commercial buildings were designed with solar passive design features. In these buildings, designers are able to achieve satisfactory energy savings through the adoption of low-energy/solar passive design strategies and reduce energy consumption and meet required thermal/visual comfort norms as per Indian codes and standards. These buildings, however, do not comply with the ECBC. These buildings are documented and analysed as case studies in this project. ECBC-compliant, new commercial buildings are the next set of buildings that are studied under this project.

Therefore, persistent efforts for adopting low-cost alternative passive strategies for energy saving is what lies at the core of the project (teriin.org). The various energy conservation projects of India are enlisted as follows and the various stages of the project are shown in Figure 3.

1.Air Pre Heaters & Economizer on Boilers - Thermopack, Ovens, Furnaces - Fuel Saving up to 5%.
2.Fuel Saving Devices - Guranteed Fuel Saving upto 10 %.
3.F.O. Emulsification System - Mixing of water in F.O. up to 10 % with emulsifying agent gives complete Combustion of F.O. - Resulting F. O. Saving upto 10 %.
4.Conversion of Electrical Heating to fuel firing (Thermal Heating) - gives saving up to 40%.
5.Heat repellant coating from Inner surfaces of ovens & furnace - gives saving upto 10%.
6.F. O. Conversion Systems - With proper heating &filtering system, any HSD or LDO fired burner can be converted to FO. Firing - gives saving upto 25% in fuel cost.
7.Thermal Insulation Project- We can conduct thermal insulation audit for the heating system & reinsulate the system to avoid Heat losses - gives saving up to 5%.
8.Design manufacturing, installation and commissioning of all type of thermal heating systems with performance guarantee. (Steam, Thermic Fluid, Hot Water, Hot Air).
9.Solar Steam generation plant - for industrial process heating applications.
10.Industrial food waste bio gas plants. - For canteen waste.

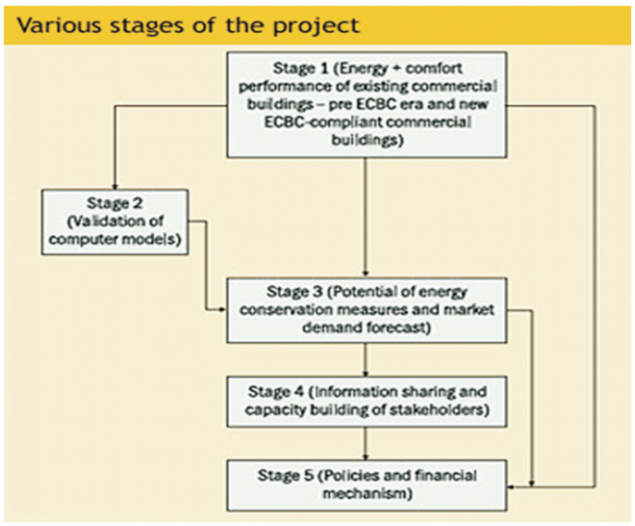

Figure 3: Various Stages of the Project

Overall Energy Saving: Overall energy-saving refers to the methodical planning of energy, the overall energy-saving program, the comprehensive utilization of resources, recycling resource utilization, all-round technological innovation, highly-efficient equipment allocation, optimal system operation, effective service, smart control of energy efficiency, and the development and application of new energy. Overall energy-saving comes from scientific theories of thought energy-saving, management energy-saving, technology energy-saving, innovation energy-saving and financing energy-saving, covering the areas of green buildings, green industries and green cities. This will maximize energy saving and utilize resources through the collection, audit and evaluation of energy consumption, the design of overall energy-saving programs, and the implementation of project engineering, and efficiency valuation. Overall energy-saving is the opposite to single energy-saving and equipment energy-saving. The implementation of overall energy-saving requires energy-saving service companies to be equipped with powerful economic backup and technical strength (Figure 4). Therefore, overall energy-saving is a new knowledge- and fund-intensive type of service industry, which takes an all-round, harmonious and scientifically sustainable view of energy-saving development (zhonglincn.com).

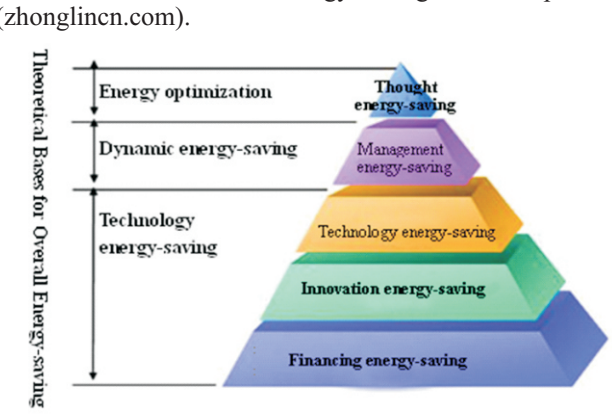

Figure 4: Bases for Overall Energy Saving.

In India Petroleum Conservation Research Association (PCRA) is an Indian government body created in 1977 and engaged in promoting energy efficiency and conservation in every walk of life. In the recent past PCRA has done mass media campaigns in television, radio & print media. An impact assessment survey by a third party revealed that due to these mega campaigns by PCRA, overall awareness level have gone up leading to saving of fossil fuels worth crores of rupees besides reducing pollution. Bureau of Energy Efficiency is an Indian governmental organization created in 2001 responsible for promoting energy efficiency and conservation (www.pcra.org).

India has made rapid strides towards economic self-reliance over the last few years. Impressive progress has been made in the fields of industry, agriculture, communication, transport and other sectors necessitating growing consumption of energy for developmental and economic activities. If India is to achieve the targeted growth in GDP, it would need commensurate input of energy, mainly commercial energy in the form of coal, oil, gas and electricity. However, India's fossil fuel reserves are limited. The known reserves of oil and natural gas may last hardly for 18 and 26 years respectively at the current reserves to production ratio. India has huge proven coal reserves (84 billion tonnes), which may last for about 200 years but the increasing ash content in Indian Coal as well as associated greenhouse gas emissions are the major concern. Energy being an important element of the infrastructure sector has to be ensured its availability on sustainable basis. On the other hand, the demand for energy is growing manifold and the energy sources are becoming scarce and costlier. Among the various strategies to be evolved for meeting energy demand, efficient use of energy and its conservation emerges out to be the least cost option in any given strategies, apart from being environmentally benign. The steps to create sustainable energy system begin with the wise use of resources; energy efficiency is the mantra that leads to sustainable energy management (Sayeed, P. M., 2005).

Indian Renewable Energy and Energy Efficiency Policy Database (IREEED):

Energy is a fundamental aspect of human existence: it is the principal means for providing access to basic needs such as food and water and it facilitates various opportunities for the achievement of a decent quality of life. Access to affordable, adequate, and appropriate energy services is therefore a prerequisite for sustainable development, and for achieving the Millenium Development Goals adopted by the governments of the world, including the goal of reducing poverty and hunger. Perhaps the most critical challenge related to energy for sustainable development is how to increase access to affordable, modern energy services, while also ensuring that the energy services provided do not cause further adverse environmental and socio-economic impacts (e4sd.org/home.htm).

There is abundant coal in many parts of the world, but with the constraints imposed by concern about global warming, it is likely that these will increasingly be seen as chemical feedstock and their large-scale use for electricity production will be scaled down. Current proposals for "clean

coal" technologies may change this outlook. The main technology involves using the coal to make hydrogen from water by a two-stage gasification process, then burying the carbon dioxide and burning the hydrogen. Elements of the technology are proven but the challenge is to bring the cost of this down sufficiently to compete with nuclear power. Natural gas is also reasonably abundant but is so valuable for direct use after being reticulated to the point where heat is required, and as a chemical feedstock, that its large-scale use for power generation makes little sense and is arguably unsustainable. Fuel for nuclear power is abundant, and if well-proven but currently uneconomic fast breeder technology is used, or thorium becomes a nuclear fuel, the supply is almost limitless (energylinx.co.uk).

The Ministry of New and Renewable Energy (MNRE), Government of India and the US Department of Energy (DOE) have collaborated under the India - US Energy Dialogue to develop an online Indian Renewable Energy and Energy Efficiency Policy Database (IREEED) that aims at disseminating information on the renewable energy and energy efficiency policy and regulatory framework in India. IREEED provides succinct summaries in a clear and simple format of renewable energy and energy efficiency policies, regulations and incentive programmes at the union government and state government level for the benefit of project developers, businesses, industry and consumers.

The Beta version of IREEED website was launched during the fourth Clean Energy Ministerial on 18 April 2013 (website http://www.ireeed.org/index.php). It includes information in respect of Gujarat, Rajasthan, and Maharashtra. The final version will be released on 30 September, 2013 and will include policies, regulations, and incentive programs offered by the central government and all states for both energy efficiency and renewable energy. From 1 October 2013 onward this website will form part of the Ministry of New and Renewable Energy's web portal and will be managed and updated by the Ministry.

Ministry seeks views on IREEED's present format, suggestions for improvement and additional formats etc from all sections of the society including academia, research institutions, NGOs, individuals etc. These will help in revising, updating and finalizing the websites, so that it becomes more informative and user-friendly (mnre.gov.in/). Wastes both those produced and those avoided, are a major concern in any consideration of sustainable development. Burning fossil fuels produces primarily carbon dioxide as waste, which is inevitably dumped into the atmosphere. With black coal, approximately one tonne of carbon dioxide results from every thousand kilowatt hours generated. Natural gas contributes about half as much as coal from actual combustion, and also some (including methane leakage) from its distribution. Oil and gas burned in transport adds to the global total. As yet, there is no satisfactory way to avoid or dispose of the greenhouse gases which result from fossil fuel combustion.

Hydrogen is expected to come into great demand as a transport fuel which does not contribute to global warming. It may be used in fuel cells to produce electricity or directly in internal combustion motors. Fuel cells are at an early stage of technological development and still require substantial, research and development input, although they will be an important technology in the future. Hydrogen may be provided by steam reforming of natural gas (in which case CO 2 has to be taken into account), by thermonuclear processes, or by electrolysis of water. Some new types of nuclear reactor such as high-temperature gas cooled reactors, operating at around 950-1000°C have the potential for producing hydrogen from water by thermochemical means, without using natural gas. Large-scale use of electrolysis would mean a considerable increase in electricity demand. (However, this need not be continuous base-load supply, as hydrogen can be accumulated and stored, and solar or wind generation may well serve the purpose.)

Himachal Pradesh Government is helping to promote the development of an economically and environmentally sound eco-system and energy conservation while endeavoring to improve the living standards of the people in the State. The Govt. is conscious of the intrinsic value of the environment, energy conservation and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values thereof. Further, it realizes the importance of environment for evolution and for maintaining life sustaining systems (himachal.nic.in). The ex-chief minister Prof. Prem Kumar Dhumal appealed to the public in general to make energy conservation as their way of life and minimize the use of oil and gas by disciplining life style in an eco-friendly manner. He said that energy consumption in United States was highest at 20 tonnes compared to 1.5 tonnes in India and 0.04 tonnes in Himachal Pradesh. He said that greater the energy consumption, greater would be environmental hazards. Prof. Dhumal said that there was need to reduce the number of oil and gas operated vehicles on road and minimize its use besides manufacturing energy efficient vehicles. He emphasized the need for relocating the vehicle workshops away from the national and state highways which too had been contributing towards the environmental hazards immensely besides causing road accidents.

State Government had successfully implemented Atal Bijli Bachat Yojna which had saved 270 lakh million units of electricity in one year valued at over Rs. 100 crore. He said that each of the 16.5 lakh domestic consumers of the State were provided energy efficient four CFL bulbs free of cost by spending Rs. 80 crore over the same. He commended the endeavour of the Oil Industry for launching Oil and Gas Conservation Fortnight to educate people about the drastic impact of the increasing use of oil and gas in their daily life. Chief Minister also administered Pledge to the audience to save oil and gas and motivate others to join the movement to make the planet earth worth living (nvonews.com).

Conclusion: It is concluded in this study that energy is the most important factor that interlinks various components like livestock, vegetation, water and humans, particularly in a rural ecosystem. It is, therefore, necessary to keep in mind all these inter linkages and interdependence while formulating energy strategies in order to achieve sustainable development. Energy planning is a crucial process in sustainable development, involving the estimation of future energy demands and identification and combination

of appropriate energy resources and technologies. It includes both energy generation and saving options. Different approaches and various levels of involvement are necessary in energy planning. The approach should be multi-disciplinary, involving scientific, technical, educational, economic, cultural and administrative dimensions.

Access to sustainable sources of clean, reliable and affordable energy has a profound impact on multiple aspects of human development; it relates not only to physical infrastructure (e.g. electricity grids), but also to energy affordability, reliability and commercial viability. In practical terms, this means delivering energy services to households and businesses that are in line with consumers' ability to pay. Investing in clean, efficient, affordable and reliable energy systems is indispensable for a prosperous, environmentally sustainable future. According to Kainth, G. S., (2013) Ensuring energy security will require diversification of types and sources of energy, with increasing focus on consumer needs, on indigenous energy supplies, energy efficiency and regional interconnections. Greater use of clean energy obviously contributes to sustainability of the development process, and this issue will become more important in the years that lie ahead. Developing countries account for 82 per cent of the world's population and they use 55 per cent of the available global supply of energy. They must aim at faster growth of their GDP to improve the living standards of their populations and this will entail an expanded demand for energy. If they follow the industrialized countries in meeting their energy requirements through fossil fuel based energy, the impact on the global climate would be simply unsustainable. This poses a global challenge. We can only meet the challenge by responding in two ways. First, we must contain the total growth in energy associated with the growth of GDP by improving energy efficiency. Second, we can work to shift from conventional to non-conventional or clean energy. India has been experiencing sustained high economic growth in the recent years. However, there still exists substantial amount of unacceptable poverty among the people in the region. The expressions of symptoms of such poverty include among others inadequate educational and health attainment of the people and lack of access to basic amenities like modern clean energy, safe water and sanitation, which are crucial determinants of human capability development. It's great that biotechnology has developed powerful approaches to find cures to diseases, curb climate change and reduce reliance on foreign oil. Synthetic biology promises to change the world by making biology easier to engineer and enabling solutions to some of the world's most difficult problems. Bio technology is to be at the forefront of the emerging field of advanced bio fuels production to develop scientific breakthroughs to help solve the energy crisis. Latest techniques in plant science, molecular biology and chemical engineering has to be developed to produce affordable, sustainable, carbon-neutral fuels identical to gasoline, diesel and jet fuel.

The present pattern of energy use, in which conventional energy sources play an important role, is non-sustainable, leading to economic and foreign exchange problems, environmental degradation, and social and gender inequity. It is not a self-reliant system. Women in rural India play a major Role in biomass management, leading to sustainable development. Hence, it is important to redefine sustainable Development and redesign the strategies to achieve it. Appropriate management of bio resources leads to afforestation, and thereby reclamation of degraded land. It also promotes and protects biodiversity. It is also reduces Net carbon emissions. In addition, atmospheric carbon would get fixed in the soil and standing biomass. We depend on energy for almost everything in our lives. We wish to make our lives comfortable, productive and enjoyable. Hence, even if the outside temperature rises a little, we immediately switch on the air conditioner to keep our house cool. This is again using up of energy. Unfortunately, what we do not realize is that we have starting taking things for granted and we have started wasting energy unnecessarily. Most of us forget that energy is available in abundance but it is limited and hence to maintain the quality of life, it is important that we use our energy resources wisely (humantouchofchemistry.com). If we do not conserve energy, the energy will exhaust and we will have nothing to use. Also, energy conservation is also important when it comes to climate change. Currently, erratic climates and climatic changes are the greatest threats that we are facing today. Hence, it is important to conserve energy for the sustainable development of the country.

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