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Energy Conservation, Generation, Utilization

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Abstract: Energy Conservation is unquestionably of great importance to all of us, since we rely on energy for everything we do every single day. Energy supplies are limited and, to maintain a good quality of life, we must find ways to use energy wisely. Reducing the amount of energy that we use is a good way to save money, and there are also other benefits to decreasing energy consumption. For example, a large portion of the energy we use is derived from oil. Some experts claim that we will run out of oil in just a few decades. As natural resources used to produce energy become scarce, the cost of energy will most likely increase. Also, toxins and pollution are released into the atmosphere during the production and consumption of energy. Not only we are running out of some valuable natural resources, but we are also destroying the environment in the Process of using them. Generation of power of good quality and transmitting those generated power without interruption of the power supply plays a major role in reaching the consumers demand. The paper presents the results of how energy is generated and managed practical studies in development of energy conservation system. The practical results show that the developed energy conservation is capable of maintaining the energy according to consumers demand.

KEY WORDS: Energy Conservation, Energy Management, Energy Audit, Generation, Utilization, Load and Consumer demand.

1. Introduction:

Economic growth is desirable for developing countries, and energy is essential for economic growth. 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. 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 tones) may last for about 200 years but the increasing ash content in Indian Coal as well as associated greenhouse gas emission are the major concern. In the business as usual scenario, the exploitable coal may last for about less than 100 years. On the energy demand and supply side, India is facing severe shortages 70% of the total petroleum product demand is being met by imports, imposing a heavy burden on foreign exchange. Country is also facing electric Power Shortages Peak shortage –11% Average shortages – 7%. Energy conservation measures can reduce peak and average demand. The fundamental goal of energy Management is to produce goods and provide services with the least cost and least environmental effect. The term energy management means many things to many people. Energy management is defined as "The judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions". The objective of energy management is to achieve and maintain optimum energy procurement and utilization, throughout the organization and To minimize energy costs/ waste without affecting production and quality To minimize environmental effects.

2. Different Forms of Generation:

There are four forms of generating the power. Those are:

i. Thermal power generation
ii. Hydro Electric Power Station
iii. power generation
iv. Nuclear power generation.
v. Diesel power generation.

The overall efficiency of thermal power station is about 29%. Based on different types of sources we can generate

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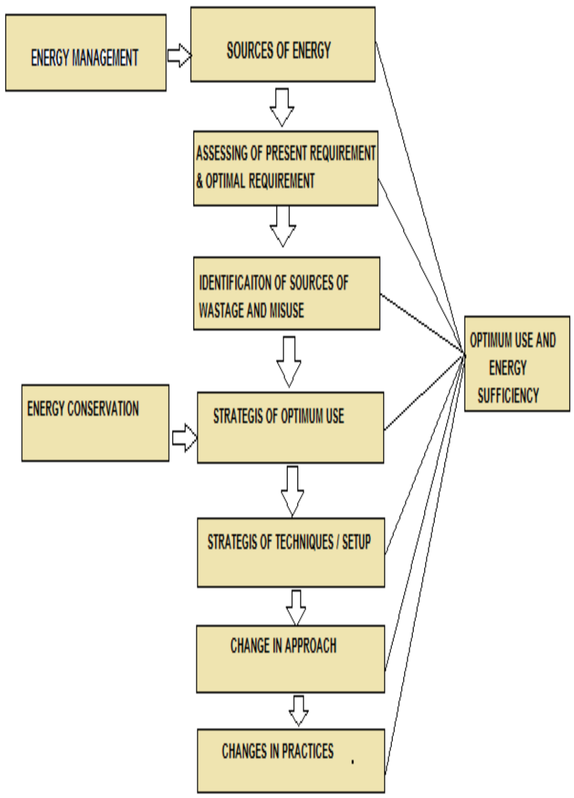
the energy. In thermal plant by using the coal we are producing the power.

2.1 STRUCTURE OF ENERGY MANAGEMENT:



2.2 Importance of Energy Conservation:

Energy Conservation is unquestionably of great importance to all of us, since we rely on energy for everything we do every single day. Energy supplies are limited and, to maintain a good quality of life, we must find ways to use energy wisely. Reducing the amount of energy that we use is a good way to save money, and there are also other benefits to decreasing energy consumption. For example, a large portion of the energy we use is derived from oil. Some experts claim that we will run out of oil in just a few decades. As natural resources used to produce energy become scarce, the cost of energy will most likely increase. Also, toxins and pollution are released into the atmosphere during the production and consumption of energy. Not only we are running out of some valuable natural resources, but we are also destroying the environment in the process of using them! Embrace energy conservation by making small changes that will lead to a significant difference in our overall energy consumption. Your efforts, combined with those of others who have chosen to make a few small changes too, will benefit your life and the lives of future generations, as well as our environment.

3. Energy Conservation

Energy, irrespective of its form is a scarce commodity and a most valuable resource. However, if we look at the predicted future human population figures and consider the probability that the individual life expectation will increase, we see that energy could, in the future, be in short supply. Unless that supply is increased, it will be a source of friction in human affairs. Energy Conservation is the deliberate practice or an attempt to save electricity, fuel oil or gas or any other combustible material, to be able to put to additional use for additional productivity without spending any additional resources or money.

3.1. Objective

Broadly energy conservation program initiated at micro or macro level will have the following objectives:

a. To reduce the imports of energy and reduce the drain on foreign exchange.

b. To improve exports of manufactured goods (either lower process or increased availability helping sales)
or of energy, or both.

c. To reduce environmental pollution per unit of industrial output - as carbon dioxide, smoke, sulphurdioxide, dust, grit or as coal mine discard

3.2. What is Energy Conservation?

Energy conservation is achieved when growth of energy consumption is reduced, measured in physical terms. Energy conservation can, therefore, be the result of several processes or developments, such as productivity increase or technological progress. Energy conservation and Energy Efficiency are separate, but related concepts.

3.3 Energy Efficiency

Energy Efficiency is achieved when energy intensity in a specific product, process or area of production or consumption is reduced without effecting output, consumption or comfort levels. Promotion of energy efficiency will contribute to energy conservation and is therefore an integral part of energy conservation promotional policies. For example, replacing traditional light bulbs with Compact Fluorescent Lamps (CFL) (which use only 1/4th of the energy to
same light output). Light Emitting Diode (LED) lamps are also used for the same purpose.

4. Energy Management

The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect.

4.1 Definition

Energy management is a process that not only manages the energy production from different energy harvesting resources (solar, nuclear, fossil fuel) but also concerns optimal utilization at the consumer devices. Another comprehensive definition is "The judicious and effective use of energy to maximise profits (minimize costs) and enhance competitive positions".

4.2. Objective

The objective of Energy Management is to achieve and maintain optimum energy procurement and utilization, throughout the organization and: To minimize energy costs / waste without affecting production, comfort and quality. To minimize the environmental effects.

5. Energy Audit

Energy Audit is the key aspect of energy conservation and management.

5.1. Definition

Energy audit is defined as "The Verification, Monitoring and Analysis of use of energy including submission of Technical Report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".

5.2. Energy Accounting

Energy accounting simply means record of energy used in an establishment for comparison against a budget or another standard of performance.

5.3. Systematic Approach To Decision Making

Energy Audit is the key to systematic approach for decision making in the areas of energy management. It attempts to balance the total energy inputs with its use and serves to identify all the energy streams in a

Facility. It quantities the energy usage according to its discrete functions.

5.4. Effective Tool for Energy Management

Energy Audit is an effective tool in defining and pursuing comprehensive energy management program me. In this field also, the basic functions of management like planning, decision making, organizing and controlling, apply equally as in any other management subject.

5.5. Ways of Usage of Energy

Energy Audit will help to understand more about the ways energy and fuel are used in any establishment, and help in identifying the areas where waste can occur and where scope for improvement exists.

5.6. Construction and Stream Lining

The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control program me which are vital for production and utility activities.

5.7. Ideas and Feasible Solution

In general, Energy Audit is the translation of conservation ideas into realities, by blending technically feasible solutions with economic and other organizational considerations within a specified time frame.

In brief energy audit is an in-depth study of a facility to determine how and where energy is being used or converted from one form to another, to identify opportunities to reduce energy usage, to evaluate the economics and technical practicability of implementing these reductions and to formulate prioritized recommendations for implementing measures to save energy.

5.8. Scope of Energy Audit

1. Analyze present consumption and past trends in detail.
2. Review energy uses requirements
3. Consider sub-metering
4. Compare standard consumption to actual
5. Produce an energy balance diagram for the establishment
6. Review existing energy recording systems
7. Compare consumption with other locations, other establishments, previous period, norms.
8. Check capacities and efficiencies of equipment.
9. Consider users' training
10. Review new projects with respect to energy use.
11. Consider changing the management information system to include energy parameters.
12. Develop energy use indices to compare performance/ productivity.

5.9. Effectiveness of Energy Utilisation:

I. Indian industrial sector accounts for half of the commercial energy used in the country

II. Wide variation in energy consumption co-efficient among different units in the same industry using comparable technologies (30-150%)

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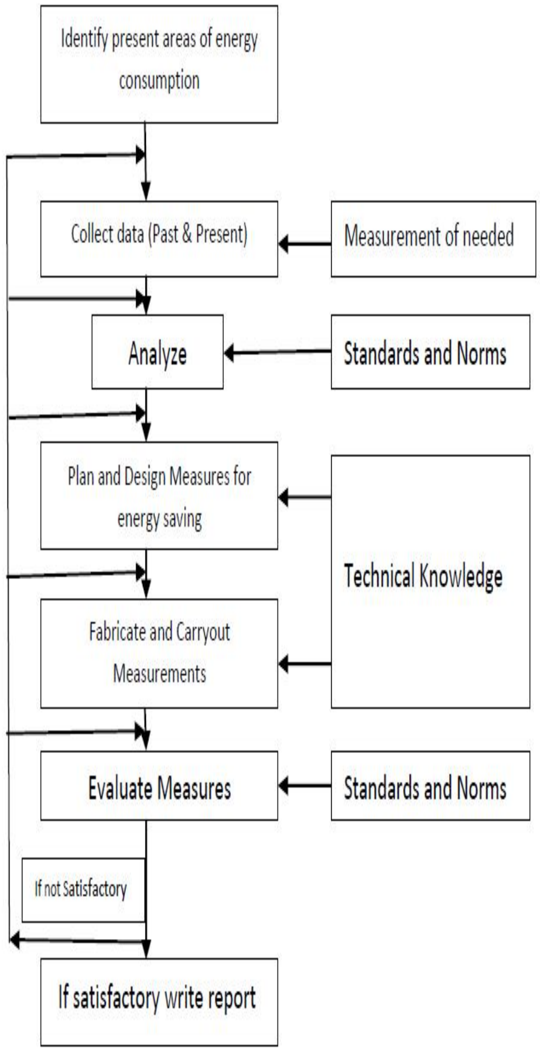
III. Energy efficient units improving their specific energy consumption year after year

IV. Vast specification of industry to still improve their energy efficiency

Chart showing energy utilization:.



6. NEED OF ENERGY EFFICIENT TECHNOLOGIES USE IN ENERGY INTENSIVE INDUSTRY OF INDIA:

1. Industry is the major energy consumer utilizing about 50% of the total commercial energy use in India
2. The six key industries – namely aluminum , cement ,fertilizers, pulp& paper, petrochemicals and steel - consumes about 65% of the total energy use in India
3. The energy intensity in some of these industries is reported to be higher than the industries in developed countries
4. One of the main reasons for higher energy use is the presence of obsolete and energy inefficient technologies in some of these sectors
5. To promote faster penetration of energy efficient technologies, they are planned to be notified as designated consumers under the Energy Conservation Act.
6. By complying with various provisions of EC Act, as applicable to designated consumers- namely meeting specific energy consumption norms, conduct of regular energy audits and implementation of techno economic viable recommendations and establishment of energy management system through appointment of certified energy manager -is expected to boost adoption of energy efficient technologies

6.1 Aluminium

Production of aluminium is extremely power intensive. On an average, Indian smelters consume 15,000-16,500 KWH per ton of aluminium as against 14,000-14,500 KWH per ton consumed by global smelters. Aluminium industry consumes more than 15% of electricity consumed by Industry in abroad.

Energy accounts for nearly 40% of aluminium production costs. Smelting process accounts for more than 90% of the total electricity consumption The annual energy cost in terms of the sales turnover of the units ranges from 40 to 50%. High electrical energy saving potential exists in the smelter section for the production of aluminium. The technologies adopted both in India and abroad are same but they differ in energy efficiency as some of the units are still using self-baking anodes instead of multiple prebaked anodes.

Technology Penetration (Aluminium)
The technology improvements made in India and practiced in developed countries are listed below.

1) High degree of mechanization and scientific operating practices such as automation in cell operation by introducing microprocessor control and computers, for energy efficiency.

2) Multiple prebaked anodes used in Hall – Heroult Process.

3) Improved anode design and increasing anode area by redesigning the existing cell.

4) Improved techniques in cathode lining and cell design.

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5) Efficient gas cleaning system and recovery of fluorides for dry gas-scrubbing system.

6) New energy efficient technologies such as ALCOA, Carbothermic are being tested abroad.

7) R&D efforts are being carried out to improve existing process operations, development of new processes, quality improvement, and environment management.

6.2 Cement

Cement industry accounts for around 10 % of the coal and 6 % of the electricity consumed by the Indian industrial sector. In general, to produce 1 tonne of cement, 120 to 150 kg of imported coal or 200 to 220 kg of domestic coal is needed. Power consumption for the same is 65 to 90 kWh in new and 95 to 120 kWh in old plants. The new generation plants installed in India have excellent energy efficiency norms comparable with the best and most energy efficient plants in the World. This shows the deep penetration of advanced technologies in India. The best specific electrical energy consumption reported is in the range of 60 to 70 kWh/ tonne where as the specific thermal energy consumption is 690 to 700 Kcal/ kg of clinker. The annual energy cost in terms of the sales turnover of the units ranges from 20 to 60%.

Technology Penetration (Cement)

1. The technology penetration is very high and the energy efficiency norms are comparable to the best energy efficient plants in the World.
2. Following is the list of *energy efficient technology* penetrations made in India for improved dry process:
3. Raw material preparation section – gyratory crushers and mobile crushers, VRM (Vertical Roller Mills), external recirculation systems in VRM’s, adoption of roller press technology and high efficiency separators in the grinding circuits.
4. Cement grinding – VRM with high efficiency separators and high-pressure roller press in various modes of operation, static V separators along with dynamic separators.
5. Pyro processing Section – Installation of precalcinators and 5/6 stage preheaters with low pressure drop cyclones, short kilns having lower L/D ratio, new generation coolers having better heat recovery potential.
6. Low pressure drop suspension preheaters (5~6 stages).
7. Multi channel burners.
8. High efficiency separators and vertical roller mills.
9. Waste heat utilisation systems.
10. Computerized process control.
11. Oxygen rich air for combustion.
12. Secondary firing system.
13. R&D efforts are high to improve the energy efficiency levels, product improvements, etc**.**

6.3 Fertilizers

There are mainly four types of fertilizer’s, namely nitrogenous, phosphatic, potassic and complex. Of the total fertilizer production in India, nitrogenous fertilizers constitute more than 80 % and phosphatic fertilizers account for most of the remaining 20%. Urea, ammonium sulphate (AS), calcium ammonium nitrate (CAN) and ammonium chloride (ACl.) are some of the important nitrogenous fertilizers. Of these, urea occupies the largest share of nearly 82.9%. India does not produce potassic fertilisers. Ammonia (NH3) is the basic raw material used in nitrogenous fertiliser production and is synthesized from hydrocarbon feedstock. The feedstock for the production of Ammonia and Urea varies from naphtha to natural gas to furnace oil/LSHS to the combination of above and hence; the specific consumption norms vary accordingly. The specific electrical energy consumption for the furnace oil/LSHS is in the range of 360 to 375 kWh/tonne and the thermal energy consumption is in the range of 4 to 7 M.kCal/tonne. The specific electrical energy consumption for the Naphtha /Natural gas or mixed feedstock is in the range of 90 to 200 kWh/tonne.

Technology Penetration (Fertilizers)

1. The technology penetration is improving considerably due to recent advances in process technologies and catalysts
2. Internal heat recovery system have resulted in lower energy intensity and most of the technologies available abroad are already in operation in India.
3. The various energy efficient technologies available for this sector are as follows
4. *Ammonia plants* Reformer tubes of superior material Adiabatic pre-reformer Low steam/carbon ratio Purge gas recovery unit Make up gas chiller at suction Synthesis converter revamp Computer control and Optimisation for process

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5. *Urea plants* Urea hydrolyses stripper Trays inside the reactor Coils to feed the reactants from the top of the reactor Internal heat recovery system Vacuum pre-concentrator
6. R&D is mainly focused on the new processes, simulation models and in the development of bio-fertilizers.

6.4 Iron and Steel

The iron and steel industry is the largest consumer of energy in the Indian industrial sector consuming about 10% of electricity and 27% of coal consumed by the Indian industry. The energy costs constitute nearly 30 to 35% of this sector's production costs. The primary sources of energy for the ISPs are coking coal, non-coking coal, liquid hydrocarbons and electricity, of which coking coal accounts for around 65 to 80%. The process of making iron in blast furnaces accounts for nearly 70% of the total energy consumption at the plant. The technological performance of the Indian steel plants is considerably lower than existing international standards. This is due to the inefficient use of technology, obsolete technology, and incompatibility of Indian input materials with imported technology Indian industries consume nearly 7.2 ~ 8.2 Million kCal to produce one tonne of steel, while industries in the West take around 5 MkCal. The thermal energy cost contributes the maximum to the total energy cost. Some of the Indian Steel plants are already undergoing a process of modernization and are adopting more energy efficient practices. The annual energy cost in terms of the sales turnover of the units ranges from 25 to 30%.

Technology Penetration (Iron &Steel)

The technology penetration is quite progressive in this sector and various energy efficient practices being followed are as follows.

1. Basic oxygen furnace (BOFs) are replacing the Open hearth (OH) based method of steel production.

2. Continuous Casting (CC) is replacing traditional ingot casting.

3. SAIL already produces 70% of steel through the BOF and 20% through the CC route. It is expected that after the ongoing modernization, about 80% of SAIL steel will be produced through BOF and 55% by the CC route.

4. The technology improvement progress in Indian industry is positive and the steel making process employs many technologies for coke making, sintering, pre reduction, smelting, casting, rolling and annealing processes.

5. Furnaces consume the maximum amount of energy in the steel making process. Apart from replacement of OH furnaces by the BOFs, other improvements incorporated in the Integrated Steel Plant are listed as follows:

6. Replacing ingot casting with continuous casting - Improvement in sinter quality and its use up to 80% in the blast furnace burden

7. Improvements in blast furnace practices like coal dust Injection.

8. Increased blast pressure and temperatures.

9. Several improvements in the rolling mills like direct charging of hot slabs, automation, rolling to strict tolerances, controlled cooling and automatic gauge control.

10. R&D efforts are good in the areas of coal utilisation, new grades of steel and many technology improvements have been carried out.

6.5 Petrochemicals

Petrochemical industry is a capital intensive and high volumes industry. The minimum economic size of an integrated plant is around 1mn TPA of end product, which entails an investment of Rs100 billion. The industry is a technology intensive industry. The obsolescence of technology is quite rapid. Plants should have the adaptability to absorb new technology and should be upgraded and/or modernized constantly. The demand for petrochemicals is directly related with the economic growth of the country. Polymers which drive 70% of the demand, have grown at 14% in 90's. The demand elasticity is high in petrochemicals. With the fall in prices of petrochemicals the demand increases and vice-versa. The product range is wide and includes petrochemicals, polymers, and other specialty chemicals and hence, the production capacities vary widely. The specific electrical energy consumption is in the range of 350 to 1,380 kWh/tonne and the specific thermal energy consumption is in the range of 1.1 to 5.5 M.kCal/tonne desponding upon the type of product manufactured. The annual energy cost in terms of the sales turnover of the units ranges from 5 to 20%. Most of the energy conservation measures have been implemented in the process section. Many of the technologies are sourced from abroad mainly from US and U.K and import

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substitution has been made on many of the products. R&D efforts are very specific to product-wise development.

6.6 Pulp and Paper

The Indian pulp and paper industry is the sixth largest energy consumer in the Indian industrial sector and its energy cost accounts for about 30% of the total manufacturing cost. In order to produce one ton of dried pulp, around 0.215 MkCal of power & 6.5 tonne of steam is used in the Kraft with black liquor recovery process while1.45 tonne of steam and around 3.5 MkCal Power is used in the Acid Sulphite Process. Paper is made from wood, agricultural residues or waste paper. The present share of these technologies is 37%, 31%, and 32% respectively. The production of pulp and paper involves three major steps- *pulping, bleaching and paper productions*. The type of pulping and amount of bleaching used depend on the nature of the feedstock and the desired quality of the product. Kraft (Sulphate) pulping and Sulphite pulping are the two main pulping processes. Kraft pulping is the most widely used process. This is because of the long fibres in Kraft pulp and the fact that the chemicals used are not so harsh in their action, that make possible the production of very strong paper. Sulphite process is a newer process. It is used in the manufacture of some of the finest papers, including bond. The sulphite pulp is easy to bleach but the fibres are weak. The specific electrical energy consumption of writing and printing is in the range of 1,010 to 1,650 kWh/ tonne, 1,298 to 1,728 kWh/tonne for Paper and Board, 1,884 to 2,138 kWh/tonne for News Print and 659 to 1,014 kWh for Kraft units. The thermal energy consumption of the units are in the range of 7.8 to 7.9 M.kCal/tonne for Kraft, 4.7 to 8 for Writing and Printing, 4.3 to 4.8 for Paper board, 2.4 to 3.5 for News print units. The reported National best value for electrical and thermal energy is in the range of 1,092 kWh/tonne and 4.32 M.kCal/tonne, whereas the International values are around 650 kWh/tonne and 2.9 M.kCal/tonne respectively. Electrical energy cost contributes the maximum to the total energy cost The annual energy cost in terms of the sales turnover of the units ranges from 10 to 25% There is an international shift towards the use of wastepaper whereas wood still continues to be the basic raw material for the Indian industry.

Technology Need in Paper and Pulp:

Technology updating is positive in the Indian paper sector with a variety product range, which is classified as paper and paperboard segment and newsprint segment. There are various technical options, which can improve the energy efficiency of the paper industry and details are mentioned below:

1) Continuous digesters instead of present batch digesters for the digestion of wood.

2) Displacement bleaching system for bleaching of pulp.

3) Falling film type evaporators in the conversion of pulp into paper 4) R&D efforts were carried out mainly to improve the quality of the product and environment.

7. Energy Saving Tips:

1. By replacing all high pressure mercury vapor Lamp fittings in street lighting with high pressure sodium vapor lamps with slightly lower wattage, savings of 20-25% can be achieved. By conducting awareness programs on consumption of power Utilization of power should be in a proper way based on consumer's requirements.

2. Energy managers and energy auditors should be sufficient to Indian Energy Policy.

8. Conclusion:

The practical studies in development of energy conservation system are showed. In this way energy can be managed and is capable of maintaining the energy according to consumer's requirements. This paper showed the practical results about energy conservation, generation and utilization. It is applicable for every system and industries and we can save the energy.

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References

1. Aubin, Christophe, Denis Fougere, Emmanuel Husson, and Marc Ivaldi (1995). "Real-Time Pricing of Electricity for Residential Customers: Econometric Analysis of an Experiment." Journal of Applied Econometrics, Vol. 10 (December), pages S171-S191.
2. Abrahamse, Wokje, Linda Steg, Charles Vlek, and Talib Rothengatter (2005). .A Review of Intervention Studies Aimed at Household Energy Conservation..Journal of Environmental Psychology, Vol. 25, No.3 (September), pages 273-291.
3. Aigner, Dennis (1984). "The Welfare Econometrics of Peak-Load Pricing for Electricity." Journal of Econometrics, Vol. 26, No. 1-2, pages 1-15.
4. Allcott, Hunt (2009). "Rethinking Real Time Electricity Pricing." MIT Center for Energy and Environmental Policy Working Paper 2009-015 (October).
5. Gillingham, Kenneth, Richard Newell, and Karen Palmer (2006). "Energy E¢ ciency Policies: A Retrospective Examination." Annual Review of Environment and Resources, Vol. 31, pages 161-192.
6. V.S.Verma, "Energy efficient technologies use in India-an overview", director general bureau of energy efficiency, 20th august, 2004.
7. Ministry of New and Renewable Energy, http://www.mnre.gov.in/related-links/
8. Ministry of Power India, http://www.mnre.gov.in/related-links/
9. CPRI, http://www.cpri.in/about-us/annual-report.html

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