ENERGY CONSERVATION

INDEX

INTRODUCTION

Energy generation is the most important deciding factor for a developing country like India. The total installed power capacity in India is around 255.012GW as of end of November 2014, being the world's largest producer of electricity in the year 2013 surpassing Japan and Russia with a global share of 4.8% in power generation. Renewable Power plants constituted 28.43% of the total installed capacity and Non-Renewable Power plants constituted the remaining 71.57%. As of March 2013, the per capita total electricity consumption in India was 917.2kWh.

The 17th electric power survey of India report claims that over 2010–11, India's industrial demand accounted for 35% of electrical power requirement, domestic household use accounted for 28%, agriculture 21%, commercial lighting and other miscellaneous applications accounted for the rest. The electrical energy demand for 2016–17 is expected to be at least 1,392 Tera Watt Hours, with a peak electric demand of 218 GW. The electrical energy demand for 2021–22 is expected to be at least 1,915 Tera Watt Hours, with a peak electric demand of 298 GW. If current average transmission and distribution average losses remain same (32%), India needs to add about 135 GW of power generation capacity, before 2017, to satisfy the projected demand after losses. [1]

Energy conservation campaigns can be the better solutions for the ever raising energy demands. Energy conservation is reducing energy consumption using less of an energy service. Energy audit is an efficient service which investigates the possible ways of energy conservation in a building or a system without negative output.

The proposed work deals with energy audit, recommendations of energy efficient appliances and a simple sensor circuit to reduce energy consumption. The educational class room is taken into consideration as the fact the number of people involved is huge and the possibility of energy conservation is huge.

Efforts to significantly reduce carbon emissions as part of any national strategy to address climate change will require considerable improvements in energy efficiency. A recent study by the National Commission on Energy Policy and the Pew Center on Global Climate Change (2004) emphasized the need for improvements in energy efficiency as an important short-term strategy for reducing carbon emissions while waiting for more capital-intensive responses to come on-line in the longer-term. Pacala and Socolow (2004) present “stabilization wedges,” activities that reduce carbon emissions so as to achieve stabilization of atmospheric carbon concentrations at 500 ppm. Each wedge has the potential to reduce 1 GtC/year after fifty years and seven wedges are required for stabilization, according to the authors. They present fifteen wedge options, four of which involve energy efficiency improvements and conservation. In fact, the authors argue that improvements in efficiency and conservation probably offer the greatest potential to provide wedges" (p. 969). Energy efficiency improvements also factor into the Bush Administration's replacement of carbon emission targets with carbon intensity targets (carbon emissions relative to GDP). In 2002, the administration called for a reduction in carbon intensity of 18% over the decade. In a similar vein, the National Commission on Energy Policy (2004) recommended greenhouse gas emission reductions through the use of carbon emission intensity caps. In their proposal, the Commission recommends a gradual reduction in carbon intensity of 2.4% per year beginning in 2010. One of the key recommendations for reaching this goal is enhanced energy efficiency. The NCEP recommendations form the basis for the plan proposed by Senator Jeff Bingaman (D-NM) to reduce and potential for improvements in energy intensity in the United States. Using state-level data on energy consumptioncarbon emissions.1 Pizer (2005) makes an economic and political economy case for intensity targets for carbon emissions. Reductions in carbon intensity can be achieved in two ways: fuel switching and reductions in energy intensity. Energy intensity is the amount of energy consumed per dollar of GDP (more broadly, per unit of economic activity). I focus in this analysis on the economic forces affecting changes in energy intensity. To appreciate the importance of improvements in energy intensity as a contributor towards reducing reliance on fossil fuels, consider the following thought experiment. Imagine that the United States had the same energy intensity in 2003 that it had in 1970. At that energy intensity, the United States would have consumed 186.8 quadrillion BTUs of energy (or quads) in 2003. In actuality, the United States consumed 98.2 quads of energy in that year. This thought experiment suggests that we "conserved" 88.6 quads of energy in 2003 through reductions in energy intensity. IT compares these energy savings with domestic energy production in that year. Treating energy conservation as a supply substitute, Table 1 points out that it has held the 2003 United States's requirement for fossil, nuclear, and other supplies to less than half the amount had these economic changes not occurred. Of course, one cannot attribute all of the reductions in energy intensity to conservation and efficiency activities. Some of the reductions in energy intensity have come about due to shifts in economic activity (shifts from manufacturing, for example, to services) that have nothing to do with energy considerations. But the experiment is suggestive of the importance of energy conservation as a strategy for reducing energy consumption in general and carbon emissions in particular. The goal of this paper is to analyze in greater detail the sources of between 1970 and 2003, I investigate the role that income and prices play in influencing energy consumption. In addition, following Boyd and Roop (2004) I use a Fisher ideal index number methodology to decompose changes in energy intensity into efficiency and activity components. Efficiency refers to the reduced energy use per unit of economic activity within a particular sector (e.g. industrial sector) while activity refers to the changing mix of economic activity (shift from energy intensive economic activity towards non-energy intensive economic activity). This paper builds on Boyd and Roop's work in several ways. First, my analysis focuses on total energy consumption rather than consumption in the manufacturing sector alone. Moreover, I construct and analyze indexes at the state level over a much longer time period. And unlike previous work in this area, I use regression analysis to measure the impact of changes in economic and climate variables on the components of changes in energy intensity.2 I find that improvements in energy efficiency are responsible for between 2/3 and 3/4 of the decline in energy intensity since 1970. In addition, rising per capita income contributes to declines in energy intensity, primarily through improvements in energy efficiency. Finally, the price elasticity of energy intensity is between –0.1 and –0.6, again with price affecting energy intensity primarily through efficiency gains.

NEED

FOR

ENERGY

CONSREVATION

The earth provides enough to satisfy every man’s needs but not every man’s greed said Gandhiji. Hard facts on why energy conservation is a must are outlined below.

- We use energy faster than it can be produced - Coal, oil and natural gas - the most utilised sources take thousands of years for formation.
- Energy resources are limited - India has approximately 1% of the world's energy resources but it has 16% of the world population.
- Most of the energy sources we use cannot be reused and renewed - Non renewable energy sources constitute 80% of the fuel use. It is said that our energy resources may last only for another 40 years or so.
- We save the country a lot of money when we save energy - About 75 per cent of our crude oil needs are met from imports which would cost about Rs.1, 50,000 crore a year
- We save our money when we save energy - Imagine your savings if your LPG cylinder comes for an extra week or there is a cut in your electricity bills
- We save our energy when we save energy - When we use fuel wood efficiently, our fuel wood requirements are lower and so is our drudgery for its collection
- Energy saved is energy generated - When we save one unit of energy, it is equivalent to 2 units of energy produced
- Save energy to reduce pollution - Energy production and use account to large proportion of air pollution and more than 83 percent of greenhouse gas emissions

An old Indian saying describes it this way - The earth, water and the air are not a gift to us from our parents but a loan from our children. Hence we need to make energy conservation a habit.

We people waste a lot of energy in our daily usage either by not turning the lights off when not in use or by utilizing old and inefficient appliances that consume large amounts of energy or by not switching off the vehicle engine when the light is really long. Energy needs to be conserved not only to cut costs but also to preserve the resources for longer use. As of today, most of the energy is generated from coal powered power plants.

Need for energy conservation in India

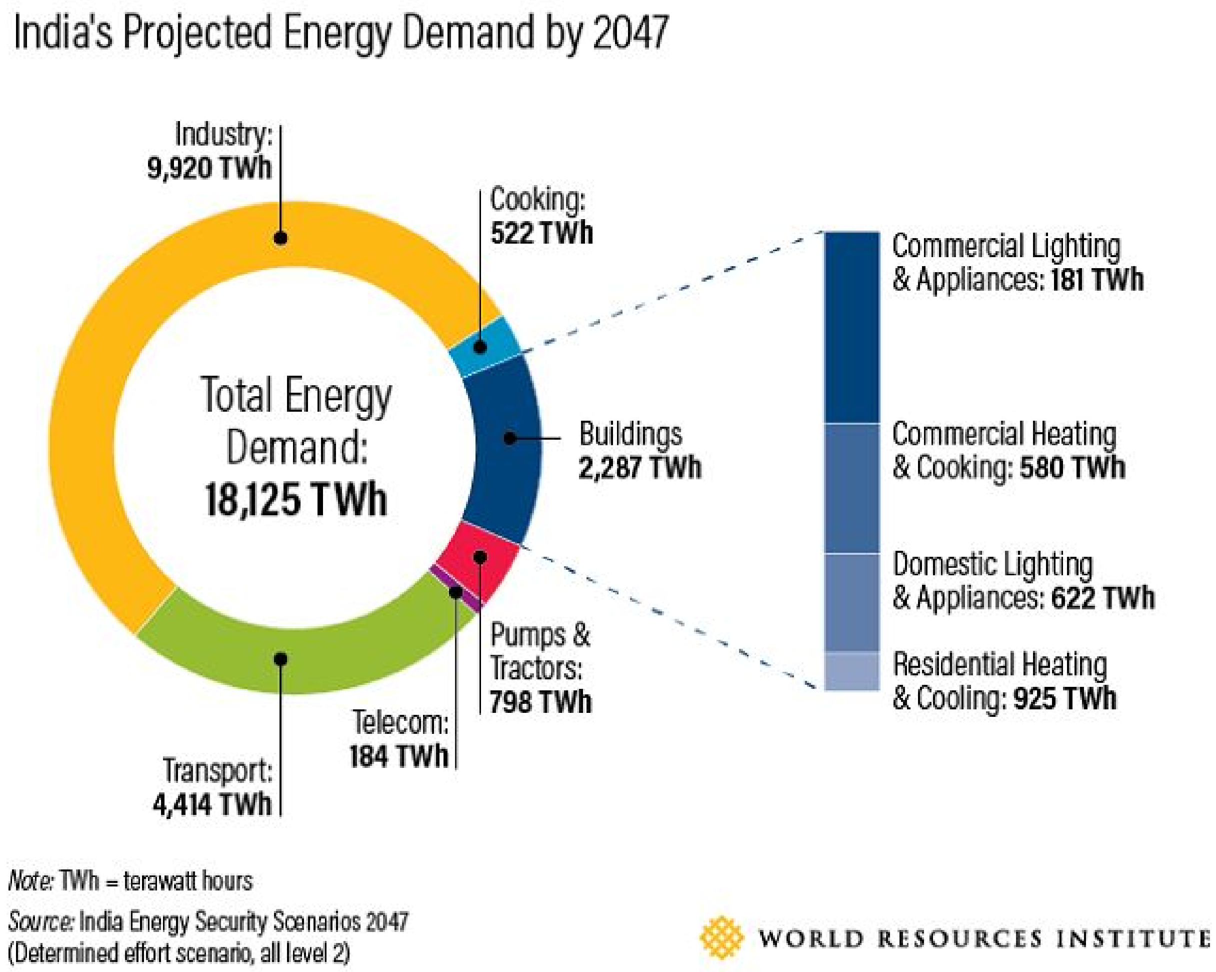
What has made productivity improve, including The increasing demand for power has led to considerable fossil fuels burning which has in turn had an adverse impact on the environment. In this context, efficient use of energy and its conservation is of paramount importance. It has been estimated that nearly 25,000 MW can be saved by implementing end-use energy efficiency and demand side management measures throughout India. Efficient use of energy and its conservation assumes even greater importance in view of the fact that one unit of energy saved at the consumption level reduces the need for fresh capacity creation by 2 times to 2.5 times. Further, such saving through efficient use of energy can be achieved at less than one-fifth the cost of fresh capacity creation. Energy efficiency would, therefore, significantly supplement our efforts to meet power requirements, apart from reducing fossil fuel consumption.

The economic development of a country is often closely linked to its consumption of energy. Although India ranks sixth in the world as far as total energy consumption is concerned, it still needs much more energy to keep pace with its development objectives. India's projected economic growth rate is slated at 7.4per cent during the period 1997-2012. This would necessitate commensurate growth in the requirement of commercial energy, most of which is expected to be from fossil fuels and electricity.

India's proven coal reserves may last for more than 200 years, but the limited known oil and natural gas reserves may last only 18 years to 26 years, which is a cause of concern. The continued trend of increasing share of petroleum fuels in the consumption of commercial energy is bound to lead to more dependence on imports and energy insecurity.

India's energy intensity per unit of GDP is higher as compared to Japan, U.S.A. and Asia by 3.7 times, 1.55 times and 1.47 times respectively. This indicates inefficient use of energy but also substantial scope for energy savings. The increasing global trade liberalisation and growing global competition energy cost reduction, an important benchmark for economic success. Therefore, a paradigm shift in our approach to energy policy issues is needed – a shift from a supply dominated one to an integrated approach. This integrated approach would have to incorporate a judicial mix of investment in the supply side capacity, operational efficiency improvements of existing power generating stations, reduction of losses in transmission and distribution, end-use efficiency and renewable technologies.

The policy goals and concepts would have to be shifted from “energy conservation” to “energy efficiency”, and from “energy inputs” to the “effectiveness of energy use” and “energy services”. Creation of new power generation capacity is costly and necessitates long gestation period whereas energy efficiency activities can make available additional power at comparatively low investments within a short period of time



Need of Energy Conservation in Maharashtra:

Energy conservation avoids wasteful use of energy without much investment. It can be termed as a new source of energy, which when available, can be readily used without any further loss or gestation period. It is the cheapest source of energy. In fact, it is the easiest solution to bridge the gap between demand and supply. Some other reasons are:

1. Increasing energy demand in India is a drain of the national economy. Besides, it is a major factor hindering the competitiveness of basic Indian industries in the global market. Thus, energy conservation is equally important for the nation and industrial firms. 2. Electrical power is one of the scarce resources in our country. Generation of electricity is very capital intensive. 1 MW of power generation costs approximately Rs. 4 crore because of the low plant load factor and high transmission losses prevalent in the country. The installed capacity of power station has to be therefore, 2.2 times the electrical load.

Energy saving achieved through energy efficiency and conservation also avoids capital investment in fuel, mining, transport, water and land required for power plant, thereby mitigating environmental pollution.

At present, there is a gap of 4000 MW between demand and supply of the electricity in the State of Maharashtra. To install 4000 MW capacity, the requirement of capital is of the order of approximately Rs.16,000 crore. Gestation period for setting up new power projects is of the order of approximately 4 years to 5 years. Hence, the energy conservation measures provide cheapest way to bridge the demand and supply gap with minimum capital investment. It also improves the plant load factor of generating stations which helps to reduce the cost of electricity.

Maharashtra is one of India's leading industrial states. It has about 29,562 industries of which around 10,000 HT industries are established within it. Also, Maharashtra is the largest producer of electricity in the country. Hence, there is a huge potential for energy saving in all sectors which is near about 3,000 MW

ENERGY EFFICIENCY OF INDIA

The primary energy demand in India has grown from about 450 million tons of oil equivalent (toe) in 2000 to about 770 million toe in 2012. This is expected to increase to about 1250 (estimated by International Energy Agency) to 1500 (estimated in the Integrated Energy Policy Report) million to 2030. This increase is driven by a number of factors, the most important of which are increasing incomes and economic growth which lead to greater demand for energy services such as lighting, cooking, space cooling, mobility, industrial production, office automation, etc. This growth is also reflective of the current very low level of energy supply in India: the average annual energy supply in India in 2011 was only 0.6 toe per capita; whereas the global average was 1.88 toe per capita. It may also be noted that no country in the world has been able to achieve a Human Development Index of 0.9 or more without an annual energy supply of at least 4 toe per capita.

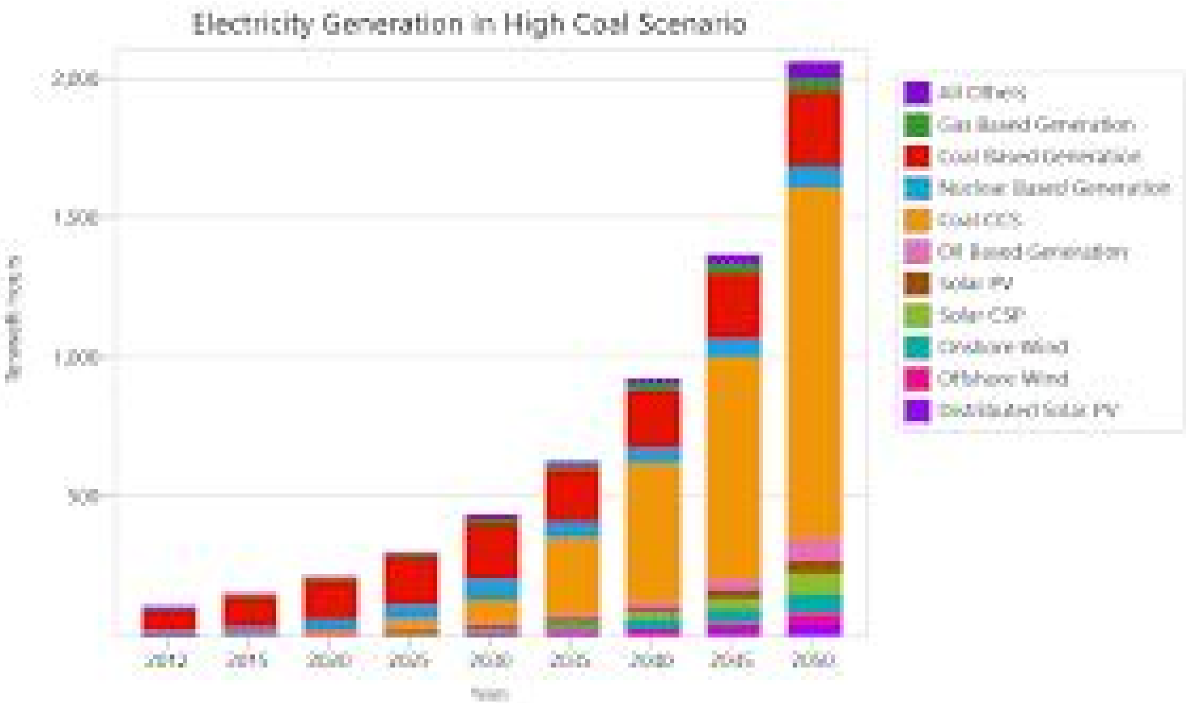
Consequently, there is a large latent demand for energy services that needs to be fulfilled in order for people to have reasonable incomes and a decent quality of life.

The Government of India has undertaken a two pronged approach to cater to the energy demand of its citizens while ensuring minimum growth in CO_2 emissions, so that the global emissions do not lead to an irreversible damage to the earth system. On one hand, in the generation side, the Government is promoting greater use of renewable energy in the energy mix mainly through solar and wind and at the same time shifting towards supercritical technologies for coal based power plants. On the other side, efforts are being made to efficiently use the energy in the demand side through various innovative policy measures under the overall ambit of Energy Conservation Act 2001.

The Energy Conservation Act (EC Act) was enacted in 2001 with the goal of reducing the energy intensity of Indian economy. Bureau of Energy Efficiency (BEE) was set up as the statutory body on 1st March 2002 at the central level to facilitate the implementation of the EC Act. The Act provides regulatory mandates for: standards & labeling of equipment and appliances; energy conservation building codes for commercial buildings; and energy consumption norms for energy intensive industries. In addition, the Act enjoins the Central Govt. and the Bureau to take steps to facilitate and promote energy efficiency in all sectors of the economy. The Act also directs states to designate agencies for the implementation of the Act and promotion of energy efficiency in the state. The EC Act was amended in 2010 and the main amendments of the Act are given below

- The Central Government may issue the energy savings certificate to the designated consumer whose energy consumption is less than the prescribed norms and standards in accordance with the procedure as may be prescribed
- The designated consumer whose energy consumption is more than the prescribed norms and standards shall be entitled to purchase the energy savings certificate to comply with the prescribed norms and standards
- The Central Government may, in consultation with the Bureau, prescribe the value of per metric ton of oil equivalent of energy consumed
- Commercial buildings which are having a connected load of 100 kW or contract demand of 120 kVA and above come under the purview of ECBC under EC Act.

Ministry of Power, through Bureau of Energy Efficiency (BEE), has initiated a number of energy efficiency initiatives in the areas of household lighting, commercial buildings, standards and labeling of appliances, demand side management in agriculture/municipalities, SMEs and large industries including the initiation of the process for development of energy consumption norms for industrial sub sectors, capacity building of SDA's etc. The target of energy savings against these schemes during the XI plan period was kept 10,000 MW of avoided generation capacity. These initiatives have resulted in an avoided capacity generation of 10836 MW during the XI plan period.



SCHEMES TO PROMOTE ENERGY CONSERVATION AND ENERGY EFFICIENCY

(i) Standards and Labeling

The Bureau initiated the Standards and Labeling programme for equipment and appliances in 2006 to provide the consumer an informed choice about the energy saving and thereby the cost saving potential of the relevant marketed product. The scheme is invoked for 19 equipment/appliances, i.e. Room Air Conditioners, Fluorescent Tube Lights, Frost Free Refrigerators, Distribution Transformers, Induction Motors, Direct Cool Refrigerator, electric storage type geyser, Ceiling fans, Color TVs, Agricultural pump sets, LPG stoves, Washing machine, Laptops, ballast, floor standing ACs, office automation products, Diesel Generating sets & Diesel operating pumpsets of which the first 4 products have been notified under mandatory labeling from 7th January, 2010. The other appliances are presently under voluntary labeling phase. The energy efficiency labeling programs under BEE are intended to reduce the energy consumption of appliances without diminishing the services it provides to consumers. Further, the standards and label for refrigerators and air-conditioners have been periodically made more stringent. As a result, the least-efficient products are removed from the market and more efficient products are introduced. The Corporate Average Fuel Consumption Standards (CAFC) for passenger cars was notified on 30th January, 2014. The most recent additions to the list of labeled products are Diesel Pumpsets & Diesel Generating Set.

During the XII plan, Standards and Labelling programme will target at least 3 more new equipments / appliances including up-gradation of energy performance standards for equipment/ appliances covered during XI Plan.

(ii) Energy Conservation Building Codes (ECBC)

The Energy Conservation Building Code (ECBC) was developed by Govt. of India for new commercial buildings on 27th May 2007. ECBC sets minimum energy standards for new commercial buildings having a connected load of 100kW or contract demand of 120 KVA and above. While the Central Government has powers under the EC Act 2001, the state governments have the flexibility to modify the code to suit local or regional needs and notify them. Currently eight States and Union Territories (Rajasthan, Odisha, UT of Puducherry, Uttrakhand, Punjab, Karnataka, Andhra Pradesh & Telangana) notified and adopted the code for their states. In order to promote a market pull for energy efficient buildings, the Bureau of Energy Efficiency developed a voluntary Star Rating Programme for buildings which is based on the actual performance of a building, in terms of energy usage in the building over its area expressed in kWh/sq. m/year. Currently, a Voluntary Star Labelling programme for 4 categories of buildings (day use office buildings/BPOs/Shopping malls/Hospitals) has been developed and put in public domain.

(iii) Demand Side Management (DSM) Scheme

(a) Agriculture DSM

In order to tap the energy saving potential, Agriculture Demand Side Management (AgDSM) program was initiated in XI plan by Bureau of Energy Efficiency with an objective to induce energy efficiency in agriculture sector by creating market based framework for implementation of few pilot projects and create awareness among end users & other stakeholders for adoption of energy efficient pumpsets (EEPS). Major milestone achievements of the scheme during XI plan were:

- 11 Detailed Project Reports (DPRs) have been prepared in 8 states for 11DISCOMs covering 20,750 pump sets connected on 87 feeders. Average 40% (96 MU) energy saving potential assessed.
- One pilot project in Solapur, Maharashtra is being implemented and reflects savings of 6.1 MU by efficiency up gradation of 2209pumpsets.Monitoring & Verification methodology have been prepared and is under implementation for realizing energy savings in Solapur pilot project.
- Punjab & Haryana mandated the use of BEE star rated pump sets for every new agricultural connection in the state. 67843 and 1599 pumps have been reported installed under the regulation in the state of Haryana and Punjab respectively.

During the XII plan, realizing the vast energy saving potential in the sector, BEE intends to continue the programme with an objective to build up the process of acceleration of sustainable energy efficiency in the plan through following interventions:

- Regulatory mechanism to mandate the use of BEE star labeled pump sets for new connections
- Facilitate implementation of DPRs and setting up monitoring & verification protocol
- Technical assistance and capacity development of all stakeholders

(b) Municipal DSM

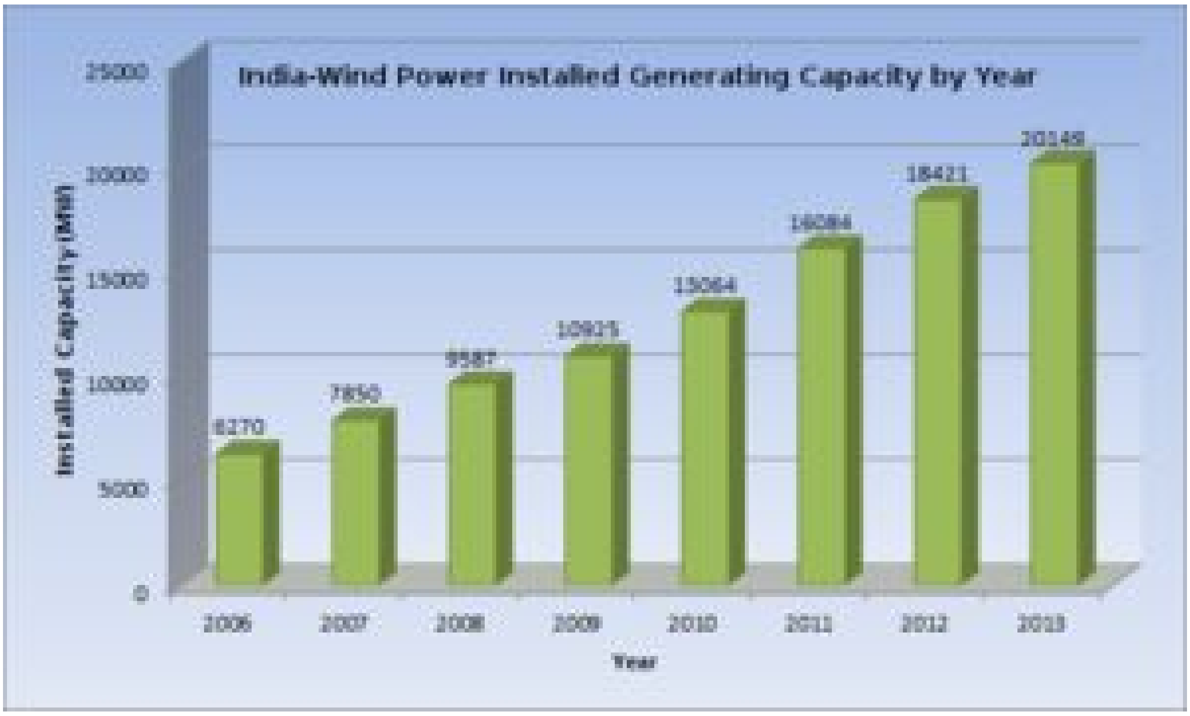
Identifying the immense energy saving potential in municipal sector, BEE initiated Municipal Demand Side Management (MuDSM) during XI plan. The basic objective of the project was to improve the overall energy efficiency of the ULBs, which could lead to substantial savings in the electricity consumption, thereby resulting in cost reduction/savings for the ULBs. The major achievements in the XI plan period are as follows.

- Situational survey was conducted in 175 ULBs across the country.
- In 134 ULBs, Bankable DPRs were prepared after taking up Investment Grade Energy Audit (IGEA). The overall potential saving of 120 MW is estimated as part of avoided generation capacity through energy efficiency projects in 134 ULBs.
- MuDSM web portal was developed under the programme. The portal consists of DPRs and knowledge materials developed under the programme.

Implementation of the project at the ground level is highly necessary which will create a market transformation among technology providers, implementing partners, financial institutions etc. In view of these facts, it is proposed that implementation of demo projects in 15 ULBs will be undertaken on pilot basis during XII plan. In addition, technical support will be provided to the ULBs by appointing technical experts to selected ULBs.

(c) Capacity Building of DISCOMS

The objective of the programme is capacity building of DISCOMs for carrying out load management programme, energy conservation programme, development of DSM action plan and implementation of DSM activities in their respective areas. This programme would help the DISCOMs for reducing peak electricity demand so that they can delay building further capacity.



(d) Energy Efficiency in Small and Medium Enterprises (SMEs) sector

To encourage the energy efficient technologies and operational practices in SME sectors in India, BEE has initiated the energy efficiency interventions in selected 25 SMEs clusters during the XI plan. A study was conducted to assess energy use and technology gap at unit level, development of the cluster specific energy efficiency manuals, preparation of Detailed Project

Reports (DPRs) on energy efficient technologies and capacity building and knowledge enhancement of man-force involved in SMEs. During the XII plan, implementations of 100 technology demonstration projects in 5 SME sectors are envisaged to facilitate large scale replication.

(iv) Strengthening Institutional Capacity of States

(a) Strengthening of State Designated Agency (SDAs)

As has been mentioned earlier, the implementation and enforcement of the provisions of the Energy Conservation Act in the states is to be carried out by SDAs. As on date, the SDAs have been set up in 32 states by designating one of the existing organizations as required under section 15 (d) of the Energy Conservation Act 2001. These agencies differ from State to State with the Renewable Energy Development Agency (44%), Electrical Inspectorate (25%), Distribution Companies (12%), Power Departments (16%) and others (3%).In order to kick start the energy conservation activities at the state level with an emphasis on building institutional capacities of the SDAs, Ministry of Power had approved the scheme of Providing financial assistance to the State Designated Agencies for strengthening their institutional capacities and capabilities during the XI plan. The major achievements were:

- The Internet platform was developed by 26 SDAs.
- 47 demonstration projects implemented in street lighting and water pumping stations.
- LED Village Campaign implemented by 28 States.
- Investment grade energy audit completed in 491 Govt. buildings.

During the XII plan, thrust will be on establishment of the enforcement machinery at the State level.

b) Contribution to State Energy Conservation Fund (SECF) Scheme

The State Energy Conservation Fund (SECF)is an instrument to overcome the major barriers for implementation of energy efficiency projects. The contribution under the State Energy Conservation Fund (SECF) was made to the State Govt. / UT Administration who have created their SECF and finalized the rules and regulations to operationalise the same. The scheme was for contribution to all the State/UTs with a maximum ceiling of Rs. 4.00 crores for any State/UT provided in two instalments of Rs. 2.00 crores each. The second instalment of contribution to SECF was released only after the states have provided a matching contribution to the BEE's first instalment. The terms and conditions for release of financial assistance under Contribution to SECF remains the same during the 12th plan, only with exemption for North Eastern States. The matching contribution by the State Government for North Eastern States is relaxed to Rs 25 lakhs instead of Rs 2.0 crores. Till date, an amount of Rs 82 crores has been disbursed to 26 states. Out of these, 15 states have provided matching contributions.

(v) School Education Program -

Considering the need to make the next generation more aware regarding efficient use of energy resources, it is necessary to introduce children during their school education. In this regard, promotion of energy efficiency in schools is being promoted through the establishment of Energy Clubs. The Bureau of Energy Efficiency is implementing the Students Capacity Building Programme under Energy Conservation awareness scheme for XII five year plan and intends to prepare the text/material on

Energy Efficiency and Conservation for its proposed incorporation in the existing science syllabi and science text books of NCERT for classes 6th to 10th. The following main activities are under progress:

- Review the existing science syllabi and science text books of NCERT for classes 6th to 10th and assess the need of level of information on energy efficiency and conservation proposed to be included.
- Develop separate and exclusive draft text module (English and Hindi version) for energy efficiency and conservation to be included in science syllabi and science text books of NCERT for classes 6th to 10th
- Development of training module (English and Hindi version) and conducting training of teaching staff

Through this project recommendations will also be made to the National Council of Education, Research and Training (NCERT) to update the science text books of classes VII to IX to include relevant chapters on Energy Efficiency in the school syllabus.

(vi) Human Resource Development (HRD) -

The potential for improvement of energy efficiency of processes and equipment through awareness creation is vast. A sound policy for creation, retention and up gradation of skills of Human Resources is very crucial for penetration of energy efficient technologies and practices in various sectors.The component under HRD comprises theory cum practice oriented training programme and providing Energy Audit Instrument Support.

(vii) National Mission for Enhanced Energy Efficiency (NMEEE)

The National Mission for Enhanced Energy Efficiency (NMEEE) is one of the eight missions under the National Action Plan on Climate Change (NAPCC). NMEEE aims to strengthen the market for energy efficiency by creating a conducive regulatory and policy regime and has envisaged fostering innovative and sustainable business models to the energy efficiency sector.

The Cabinet in its meeting held on 24/06/2010 had approved the NMEEE document, and funding for two years of the 11th Plan period (2010-12) with an outlay of Rs.235.50 crore. An amount of Rs. 15.00 crore was earmarked in the approved outlay of Rs. 235.50 crore towards augmentation of Bureau of Energy Efficiency (BEE)'s corpus to meet the additional establishment expenditure during 11th Plan. Continuation of NMEEE for the 12th Plan was approved by Cabinet on 6th August, 2014 with a total outlay of Rs. 775 crore .

The Mission seeks to upscale the efforts to unlock the market for energy efficiency which is estimated to be around Rs. 74,000 crore and help achieve total avoided capacity addition of 19,598 MW, fuel savings of around 23 million tonnes per year and greenhouse gas emissions reductions of 98.55 million tonnes per year at its full implementation stage.

The activities during the 11th Plan period created the institutional and regulatory infrastructure. The implementation framework of NMEEE was prepared after extensive stakeholders consultation with relevant Ministries of Government of India, Central Electricity Regulatory Commission (CERC), State Governments, Industry associations such as Federation of Indian Chambers of Commerce & Industry (FICCI), Confederation of Indian Industry (CII), etc., independent experts from academia such as IITs, research organizations, public and private financial institutions, NGOs etc. The NMEEE spelt out four initiatives to enhance energy efficiency in energy intensive industries which are as follows:

- **Perform Achieve and Trade Scheme (PAT)**, a market based mechanism to enhance the cost effectiveness in improving the Energy Efficiency in Energy Intensive industries through certification of energy saving which can be traded.
- **Market Transformation for Energy Efficiency (MTEE),** for accelerating the shift to energy efficient appliances in designated sectors through innovative measures to make the products more affordable.
- **Energy Efficiency Financing Platform (EEFP),** for creation of mechanisms that would help finance demand side management programmes in all sectors by capturing future energy savings.
- **Framework for Energy Efficient Economic Development (FEEED),** for development of fiscal instruments to promote energy efficiency.

1. Perform, Achieve and Trade (PAT): On 30th March, 2012 energy saving targets for 478 designated consumers belonging to 8 sectors were notified and on 4th June, 2012 the PAT was formally launched. Consultations are conducted regularly post notification at state and sector level to communicate and inform designated consumers about the PAT implementation process, and to seek their views and experiences.

In the first cycle of PAT (ending in year 2014-15), 478 industrial units in 8 sectors (Aluminum, Cement, Chlor- Alkali, Fertilizer, Iron & Steel, Paper & Pulp, Thermal Power, Textile) have been mandated to reduce their specific energy consumption (SEC) i.e. energy used per unit of production. The target reduction for each industrial unit is based on their current levels of energy efficiency, so that energy efficient units will have low target of percentage reduction, as compared to less energy efficient units which will have higher targets. Overall, the SEC reduction targets aim to secure 4.05% reduction in energy consumption in these industries totaling an energy saving of 6.686 million tonne of oil equivalent.

Units which are able to achieve SEC level that are lower than their targets can receive energy savings certificates (ESCerts) for their excess savings. The ESCerts could be traded on the Power Exchanges and bought by other units under PAT who can use them to meet their compliance requirements. Units that are unable to meet the targets either through their own actions or through purchase of ESCerts are liable to financial penalty under the Energy Conservation Act. This will be followed by 2nd and subsequent cycles with more number of industrial sectors and units participating with more stringent energy conservation norms and standards.

Large scale consultations with stakeholders of all the 8 sectors at national, regional, state and cluster level was carried out since 2011 onwards. Sectoral technical committees were constituted for each sector with members represented by nominees of respective ministries, sectoral research organizations, industry associations etc. for establishing the baseline and developing target setting methodology. Baseline energy audit of units under identified sectors has been undertaken.

Bureau of Energy Efficiency (BEE) has prepared Sector Specific Form-1 (annual energy return form) along with Sector specific Normalization Factors to streamline the monitoring and verification (M&V) process. The sector/ sub-sector specific Normalization Factors were developed to neutralize the effects on specific energy consumption (SEC) in the assessment year as well as baseline year so that undue advantages or disadvantages could not be imposed on any DCs while assessing the targets. For development of such factors, Committees/Subcommittees were formed for each sector/sub-sector with representation from DCs as well. Several rounds of meetings were held to identify and develop normalization factors.

BEE has put in place a process of accreditation of Energy Auditors who will be engaged to execute the M&V process of DCs to assess their performances. Preliminary work on the deepening of PAT towards identification of new DCs to be included in the

PAT Cycle II has already been started. Development of EScerts trading infrastructure is in process in collaboration with Central Electricity Regulatory Commission (CERC).

A cadre of professionally qualified energy managers and auditors with expertise in policy analysis, project management, financing and implementation of energy efficiency projects is being developed through a certification programme. BEE has been designing training modules and regularly conducting a National level examination for certified energy managers and energy auditors. Till date, 15 National Certification examinations for Energy Managers and Energy Auditors have successfully been conducted. India now has 12228 Certified Energy Managers, out of which 8536 are additionally qualified as Certified Energy Auditors till date. This is further supplemented by the accreditation of energy auditors through recommendations of "Accreditation Advisory Committee". Accredited energy auditors would undertake mandatory energy audits in the energy intensive industry as mandated in EC Act. As on date, there are 150 accredited energy auditors.

2. Market Transformation for Energy Efficiency (MTEE): Under MTEE, two programmes have been developed i.e. Bachat Lamp Yojana (BLY) and Super Efficient Equipment Programme (SEEP).

2.1 Bachat Lamp Yojana (BLY): It is a public-private partnership program comprising BEE, Distribution Companies (DISCOMs) and private investors to accelerate market transformation in energy efficient lighting. Under this program, over 29 million incandescent bulbs have been replaced by CFLs under this programme.

In the next phase of BLY, BEE will promote use of LED lights using the institutional structure of BLY Programme. BEE provides support to Rural Electrification Corporation (REC) for framing technical specification and monitoring and verification of the energy savings from the LED bulbs distributed under RGGVY scheme to BPL households. BEE will also undertake outreach activities to promote large scale adoption of LEDs.

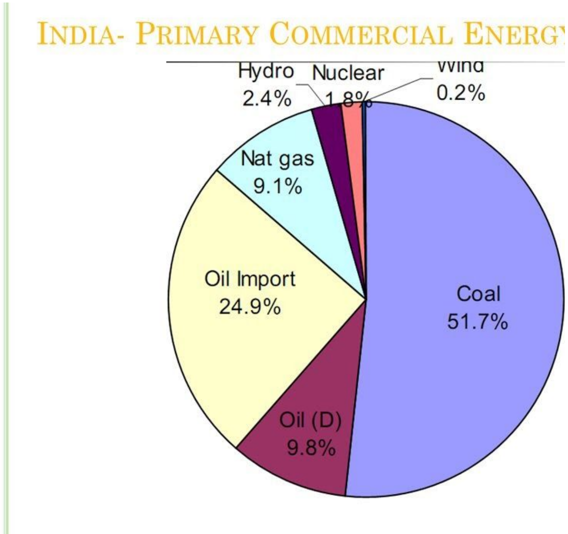
2.2 Super Efficient Equipment Programme (SEEP): The other component under EMTEE is a new programme called Super-Efficient Equipment Programme (SEEP). SEEP is a program designed to bring accelerated market transformation for super efficient appliances by providing financial stimulus innovatively at critical point/s of intervention. Under this program, ceiling fans have been identified as the first appliance to be adopted. SEEP for ceiling fans aims to leapfrog to an efficiency level which will be about 50% more efficient than market average by providing a time bound incentive to fan manufacturers to manufacture super efficient (SE) fans and sell the same at a discounted price. The goal is to support the introduction and deployment of super efficient 35W ceiling fans, as against the current average ceiling fan sold in Indian market with about 70W rating.

For the XII Plan, BEE has proposed SEEP for Ceiling Fans given the rationale that appliances like ceiling fans which has an average life of over 15 years are being deployed in the economy in huge volumes (of the tune of 30-35 million annually). To avoid inefficiency getting locked in economy for its life, this program aims to stimulate technological upgradation and their accelerated introduction by manufacturers through an incentive mechanism which would motivate manufacturers to manufacture such super efficient fans and sell at competitive price in a highly price sensitive fans market.

Consultation with main stakeholders of the program such as fan manufactures, technology providers, R&D institutions, academia and civil society organizations have been completed. Main technical specifications have been finalized. Assessment of testing capacity and development of testing protocols has been completed. Procurement of agency for monitoring and verification is under process.

3. Energy Efficiency Financing Platform (EEFP): Under this programme, MoUs have been signed with financial institutions to work together for the development of the energy efficiency market and for the identification of issues related to this market development.

MoUs with M/s, PTC India ltd, M/s. SIDBI, HSBC Bank, Tata Capital and IFCI ltd have been signed by BEE to promote financing for energy efficiency projects. BEE has developed training modules in collaboration with HSBC and also conducted few training programs for financial institutions on energy efficiency project financing.



4. Framework for Energy Efficient Economic Development (FEEED): Under this initiative two funds have been created viz. Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) and Venture Capital Fund for Energy Efficiency (VCFEE).

A. Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE)

Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) is a risk sharing mechanism to provide commercial banks with a partial coverage of risk involved in extending loans for energy efficiency projects. The amount paid out will be equal to the agreed-upon percentage of the outstanding principal and will not cover the interest or other fees owed to the bank. The Guarantee will not exceed Rs 3 crores per project or 50% of loan amount, whichever is less. Initially the support was provided to only government buildings and municipalities, however, in the twelfth plan it has been extended to cover SMEs and industries too.

Rules for operationalization of Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE) were approved in April 2012, subsequent to which the Supervisory Committee for PRGFEE has been constituted.

B. Venture Capital Fund for Energy Efficiency (VCFEE)

The Venture Capital Fund for Energy Efficiency (VCFEE) is a fund to provide equity capital for energy efficiency projects. A single investment by the fund shall not exceed INR 2 Crores. The Fund shall provide last mile equity support to specific energy efficiency projects, limited to a maximum of 15% of total equity required, through Special Purpose Vehicle (SPV) or INR 2 Crores, whichever is less. The support under VCFEE is limited to Government buildings and municipalities.

Rules for operationalization of Venture Capital Fund for Energy Efficiency (VCFEE) were approved in April 2012, subsequent to which Board of Trustees has been constituted for VCFEE Trust.

C. National Energy Conservation Award and Painting Competition

The National Energy Conservation Awards are presented to industry and other establishments and prizes to the winners of the annual Painting Competition on Energy Conservation for school children every year by the Ministry of Power with the objective of promoting energy conservation among all sectors of economy.

National Energy Conservation Awards

The annual energy conservation awards recognize innovation and achievements in energy conservation by the industries, buildings, zonal railways, state designated agencies; manufacturers of BEE star labeled appliances, electricity distribution companies, municipalities and raise awareness that energy conservation plays a big part in India's response to reducing global warming through energy savings. The awards are also recognition of their demonstrated commitment to energy conservation and efficiency. The scheme has motivated industry and other establishment to adopt energy efficiency measures.

39 sub-sectors of Industry, thermal power stations, office buildings, BPO buildings, hotels, hospitals, shopping malls, zonal railways, railway workshops, railway stations, municipalities, State Designated Agencies and manufacturers of BEE Star labeled appliances/equipment and electricity distribution companies are included in the Awards. In total there are 56 Sub-sectors from the above main sectors. The responses among the industrial and commercial units have become very encouraging as is evident from the increasing participation level (from 123 in 1999 to 1010 in 2014).

Encouraging response from Indian industry and other establishments in the national Energy Conservation Award scheme (1999-2014)

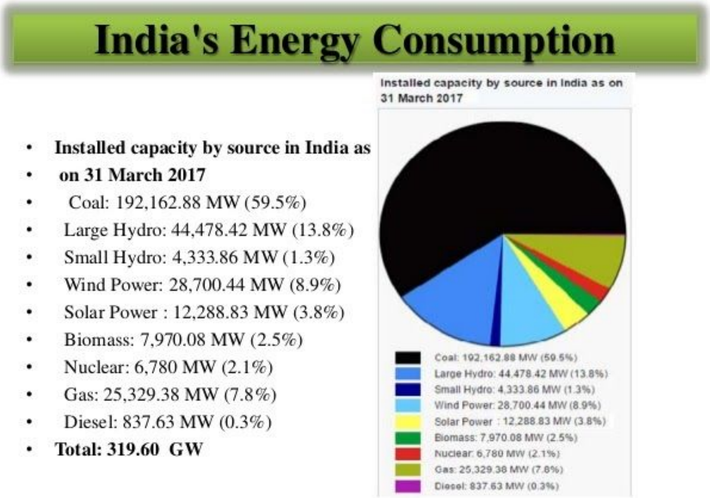
Electrical energy savings in terms of equivalent avoided capacity (mw) per year by the participating units through implementation of energy saving projects

Salient achievements of EC Award 2014:

- Participating units invested Rs. 9091 Crores in energy conservation measures, and achieved monetary savings of Rs. 4817 Crore.
- Participating units also saved electrical energy of 5197 Million kWh, which is equivalent to the energy generated form a 751 MW thermal power station.

- 22% increase in participation w.r.t. 2013
- All 41 Ordnance factories of India participated
- This year also saw excellent participation from Building Sector- 149 Office buildings, 9 BPOs, 32 Hotels, and 46 Hospitals
- 41 First prize,37 second prize and 44 units were selected for certificate of merit.

Hon'ble Minister of State (Independent Charge) for Power, Coal and New and Renewable Energy , Shri Piyush Goyal presented the awards to winners on 14th Dec, 2014 at Vigyan Bhawan.



Painting Competition on Energy Conservation for School Children

The habit of conservation is best introduced and inculcated at the school age. It has been seen that the Children are the best agents of change and in this case we need to equip them with the information and knowledge on energy conservation and create interest among them on this important subject.

In this regard, the Ministry of Power has taken an initiative and has been organizing a Painting competition on Energy Conservation for students since the year 2005. The competition has been held in three stages, namely, School, State and National Level since 2005. In order to strengthen the campaign, higher classes of 7th, 8th and 9th standards are also being included from this year onward in addition to existing classes of 4th, 5th and 6th Standards. Students of 4th, 5th & 6th standard students under Category 'A' and for 7th, 8th & 9th standard students under Category 'B' are eligible to participate in the competition.

The National Painting Competition on Energy Conservation 2014 was a resounding success. Across the country, about 60.17 lakhs students from all over the country have participated. This participation was about 33% higher than that in the previous year, which is being organized all over the country in association with the Bureau of Energy Efficiency and 11 CPSUs under Ministry of Power. 29 States/ UTs have surpassed student's participation figures of 2013.

The paintings drawn by children reflected their interest in the energy conservation activities and their concern about energy crises and climate change, and have effectively conveyed inspiring ideas in their impressing paintings. The vibrant designs, the confident depiction of the topic and remarkable composition seen in these paintings reflects clear understanding of the subject themes in the minds of these young children.

(The Minister of State (Independent Charge) for Power, Coal and New and Renewable Energy, Shri Piyush Goyal presenting the National Painting Competition Prize, at the National Energy Conservation Day function, in New Delhi on December 14, 2014.)

Interaction with Students

As part of the Government's efforts for promoting energy conservation, Shri Piyush Goyal, Minister of State (I/C) for Power, Coal and New & Renewable Energy interacted with school children across the country through video conferencing. Hon'ble Minister also launched a web portal called ''Energy Savers'' at the National Energy Conservation Day function on 14th December 2014. The portal provides tools to help children assess and improve energy usage in their schools and at their homes. The Hon'ble Minister hoped that they could then also influence their neighbors and friends so that a cascade of impact is set up. This "catch-them-young" strategy to influence the energy consuming behavior of the children would make them the ambassadors of Energy Conservation.

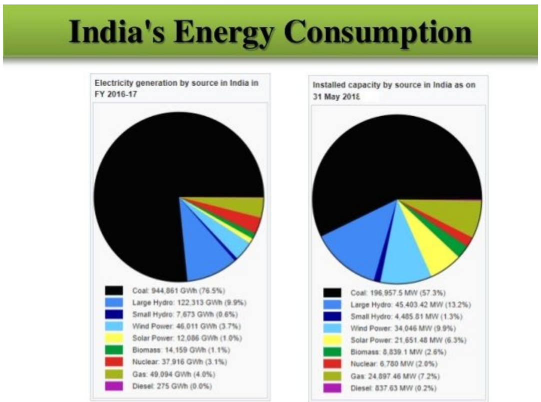
School children from 18 cities namely Bhubaneswar, Hyderabad. Shimla, Patna, Itanagar, Jalandhar, Lucknow, Pune, Bhopal, Raipur, Thiruvananthapuram, Bangalore, Agartala, Gandhinagar, Puducherry, Port Blair, Kavaratti and Haridwar participated in the interactive session.

implementation of Energy Efficiency Projects

- The implementation of energy efficiency projects is impeded by the lack of a successful implementing agency that can be a leader for new business models required for energy efficiency projects. In order to develop a viable ESCO industry, Ministry of Power has set up Energy Efficiency Services Limited (EESL), a Joint Venture of NTPC Limited, PFC, REC and POWERGRID to facilitate implementation of energy efficiency projects. EESL will work as ESCO, as Consultancy Organization for CDM, Energy Efficiency, etc.; as a Resource Centre for capacity building of SDAs, Utilities, financial institutions, etc. Major ongoing projects undertaken by M/s EESL:
- Energy Efficiency in Street Lighting:
- Energy Efficiency improvement projects in street lighting are being carried out by M/s EESL in 9 states replacing old in-efficient street lights with energy efficient LED based street lights on ESCO business model.
- Energy Efficiency in Water Pumping:
- Projects are being undertaken in 5 States and 8 States for energy efficiency improvement of water pumps in Agriculture and Municipal sector respectively.
- Promotion of Energy Efficient LED Bulbs:
- DELP proposes to overcome this first cost barrier to promote LEDs by using the basic architecture and best practices of BLY. DELP is designed to monetize the energy consumption reduction in the households sector and attract investments therein. It

also evolves a robust business model that secures commercial investment. The scheme has already launched in UT Puducherry and is under consideration for other States.

RELIANCE POWER LIMITED



An important division of the Reliance Anil Dhirubhai Ambani Group ofCompanies, Reliance Power has instituted the power plants in various parts of the Indian Territory. Some of the prominent sites of projects of Reliance Power are situated in North east India, West India, South India and North India, with an average turnout of 2,900MW, 12,200MW, 4,000MW and 9,080MW of electricity respectively .The power plants are tactically established near fuel
supply zones

Important Assignments of Reliance Power Limited Company

Reliance Power Limited aims to generate, transmit and distribute electrical energy in there modest corners of India. The Company has instituted several power plants for the purpose of generating power from hydro-power, wind energy, natural gas and coal. Presently, the company is involved in six projects through the use of coal .The estimated electricity production from the six project is expected to be 14,620 MW. The Krishna- Godavari Basin projects that aims to generate power through natural gas and the four projects through the use of hydroelectric power, three of which are in Arunachal Pradesh and the other Uttrakhand, estimates an average turnout of 10, 280 MW and 3,300 MW. Some of the other projects managed by Reliance Power are the projects at Krishnapatnam of Andhra Pradesh and Susan of Madhya Pradesh with an expected generation of 4,000MW of electricity. The Gas based power project at Dadri of UttarPradesh is another leading project in the area of power generation that generation average of 7,480MW of electrical energy.

Reliance Power Limited, in close collaboration with its business associates endeavors to set up many short and long term projects for generating power through the use of all available sources of energy.

Reliance energy won on competitive bidding last year for 280 MW urthing SOBLA HYDRO POWER PROJECT IN UTTARAKHAND. It has won two power projects to alling 1700 MW in Arunachal Pradesh.

Power Scenario in India:

1. India was the 4 th largest country consumer in world after china, U.S, Russia in 2011.

2. India became he world's 3 rd largest country of producer of electricity in year 2013 with 4.8% global share in electricity generation suppressing Japan & Russia.

3. The electricity sector in india had on installed capacity of 255.012GW as of end of November 2014 & generated around 703.1BU for period April-November2015.

4. Renewable power plant constituted 28.43% of total installed capacity & NonRenewable power plant constituted the remaining 71.57%.

5 .As per capita average annual domestic electricity consumption in India 2009

6 96KW in rural area &288KWH in Urban Area .The world wide per capital annual average of 2000KWH & 5,200KWH in European Union.

7. As of march 2013, per capital total electricity consumption in India was 917.2KWH..

Generation and Demand Scenario

In 1947 the maximum voltage level of transmission line was 132 kV which was subsequently increased to 220 kV in 1960 and 400 kV in 1977. To reduce right of way requirement for transmission lines and overcome con-straints in availability of land for substations, 765 kV transmission voltages is being increasingly adopted and gas insulated stations are being provided wherever availability of land is a problem. HVDC 500 kV back to back was

introduced in the year 2000. Recognizing the need for development of National Grid, thrust was given to the enhancement of the interregional capacity in a phased manner. The total inter-regional transmission capacity by the end of 10th plan was 14,050 MW which is now planned
to grow to about 25,650 MW by the 11th Plan end. The natural resources for electricity generation in India
are unevenly dispersed and concentrated in a few pockets. Hydro resources are located in the Himalayan foothill sand in the north-eastern region (NER). Coal reserves are con-centrated in Jharkhand, Orissa, West Bengal, Chhattisgarh, and parts of Madhya Pradesh, whereas lignite is located in Tamil Nadu and Gujarat. North Eastern Region, Sikkim and Bhutan have vast untapped hydro potential, estimated to be about 35,000 MW in NER, about 8,000 MW in Sikkim and about 15,000 MW in Bhutan. The distribution of energy resources and consumption centres are extremely unbalanced. The load centres are scattered at far-off places away from resource rich areas. Recent government initiatives for the establishment of special economic zones have also given rise to new potential load centres. Projects are proposed to be located mostly at pit head/resource areas with each location having capacities in the range of 5,000 to 10,000 MW. From the annual report of Ministry of Coal, Government of India, the Coal production in all over India during the period April, 2009 to January, 2010 has been 416.47 Mt (provisional) as compared to the production of 385.02 MT during the corresponding period of the previous
year indicating a growth of 8.17 %, as in The coal reserves of India up to the depth of 1,200 m have been estimated by the Geological survey of India to be 267.21 BT as on April 1, 2009. The 28 year history of
coal consumption and production is shown in ,respectively. Through sustained program of investment and great thrust on application of modern technologies, it has been possible to raise the production of coal from a level of about 70 MT at the time of nationalization of coal mines in early 1970’s to 365.09 MT in December 2009. It is observed that India consumes 7 % of coal of the world and among the top five countries in coal consumption World’ 68 % coal is consumed in electricity generation.

Electricity Demand and Supply

Electricity sector in India is growing at a rapid pace. The present peak demand is about 1,15,000 MW and the
Installed Capacity is 1,52,380 MW using generation from thermal (63 %), hydro (25 %), Nuclear (9 %) and renewables (9 %) sector as discussed in . The projected peak demand in 2012 is about 150 GW and in 2017 is more than 200 GW. The corresponding Installed capacity requirement in 2012 is about 220 GW and in 2017 is more than 300 GW. In 2007, India had approximately 159 GW of installed electric capacity and generated 761 billion kilo- watt hours. Nearly all electric power in India is generated with coal, oil or gas. Conventional thermal sources produced over 80 % of electricity in 2007. Hydroelectricity, a seasonally dependent power source in India, accounted for nearly 16 % of power generated in 2007. Finally, nuclear energy produced roughly 2 % of electricity during the same year, while geothermal and other renewable sources accounted for approximately 2 %

Future Outlook for Changing Indian Power Sector

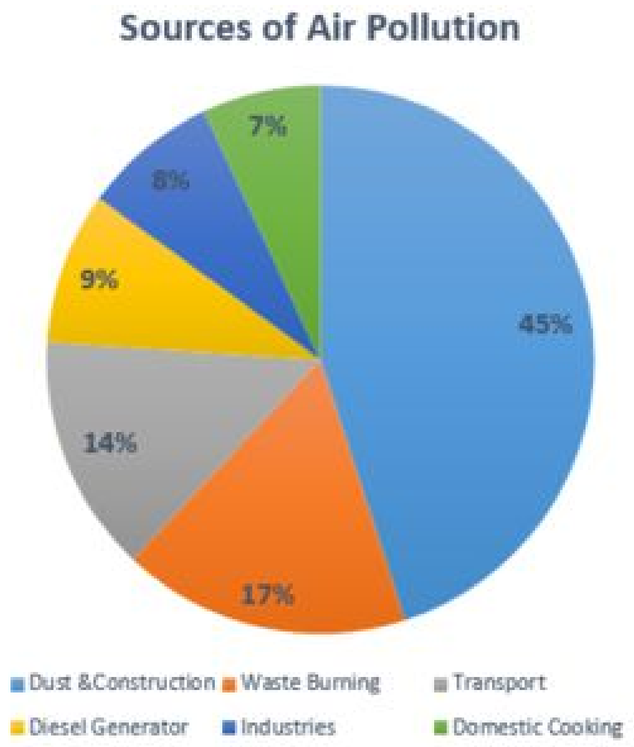
The conditions of Indian transmission, generation and distribution are to be changed implementing by adapting new, and innovative strategies. Renovation and Modernization of Generation Sector

Clean Coal Technology Clean coal technologies offer the potential for significant reduction in the environmental emissions when used for power generation. These technologies may be utilized in

new as well as existing plants and are therefore, an effective way of reducing emissions in the coal fired generating units. Several of these systems are not only very effective in reducing SOx and NOx emissions but, because of their higher efficiencies they also emit lower amount of CO2per

unit of power produced. CCT's can be used to reduce dependence on foreign oil and to make use of a wide variety of coal available. Blending of various grades of raw coal along with beneficiation shall ensure consistency in quality of coal to the utility boilers. This approach assumes greater relevance in case of multiple grades of coals available in different parts of the country and also coals of

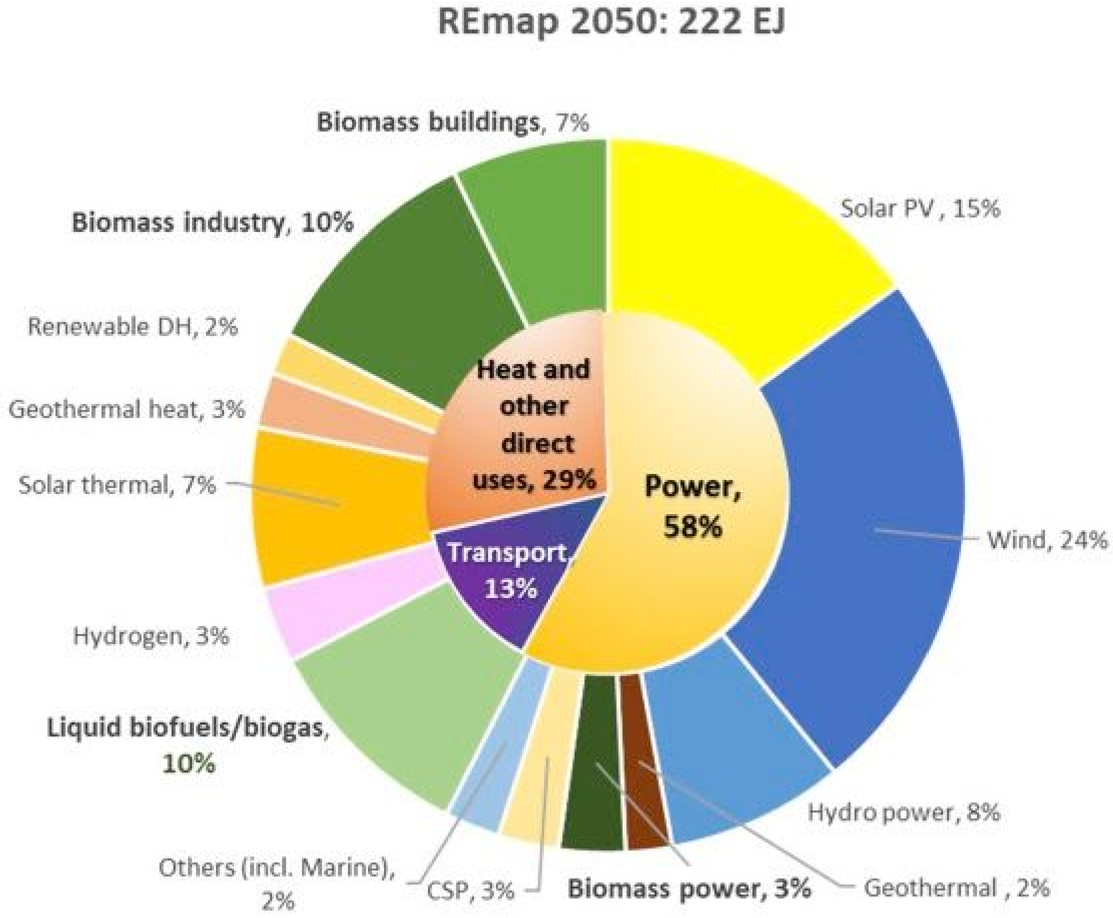
different qualities being imported by IPPs. Ministry of Environment and Forests, vide their notification dated June 30, 1998 had stipulated the use of raw or blended or beneficiated coal with an ash content not more than 34 % on an annual average basis with effect from June 1, 2001. CPCB has constituted a Steering Committee consisting representative from some SEBs, CPCB, Ministry of Coal, Ministry of Power, CEA and World Bank to carry out cost benefit analysis of using clean coal technologies and assess and prioritize technically feasible and economically viable measures to improve coal quality.



Role of Renewable in the Power sector

The scenario of dominant energy sources in world as a whole is not different from that of India. The world's energy supply is largely based on fossil fuels. It is estimated that by 2030, 80 % of primary energy mix will be dominated by fossil fuels. Oil will remain as the dominant fuel and the demand for coal will rise more than that of any other fuel in absolute terms. In such a scenario, the realisation that these exhaustible sources of energy and are also contributing to environmental problems has made renewables a lucrative and sustainable option. This has also led the governments around the globe, along with industries, thinking seriously about alternative sources of energy, the need for which was further affirmed by the 1973 oil embargo and oil price shock of 2008, coupled with the ever increasing oil prices. To boost investment in renewable energy, it is essential to introduce clear, stable and long-

term support policies. A number of policy measures at national level, which could be applied concurrently, would significantly improve the framework for renewable energy in India. However, they must be carefully designed to ensure that they operate in harmony with existing state level mechanisms and do not lessen their effectiveness.



Plan of Smart Grid for India

The effect of Smart Grid towards Indian power sector is promising and fore sighting to transform and develop secure, adaptive, efficient and sustainable system by 2027 to provide the citizens with reliable and competitive energy by usage of innovative technologies and policies to fulfill the needs and aspirations of all by active participation of stakeholders. Smart Grid has a very wide view towards the future and is passionately progressing to achieve the targets and goals propagated in the 5 year plans. These 5 year plans are divided as:

(a) Near Term Plan (2012-2017)
(b) Mid Term Plan (2017-2022)
(c) Long Term Plan (2022-2027)

The focus of the Near Term Plan (12th 5 year plan from 2012 till 2017) is:

•Access to 'electricity for all'

•Reduction of transmission and distribution

•Reduction in power cuts

•Improvement in power quality

•Renewable integration

•Standards for smart appliances-energy efficient and disaster recovery (DR) ready

•Increase in inter-regional power exchange capacity

•Wide area monitoring

•Efficient Power Exchanges

•Training and capacity building in utilities and in the industry to build, operate and maintain smart grid systems and application. The goal of the Mid Term Plan (13th give year plan from 2017 to 2022) is

Reduction of T&D losses to below 10 % in all utilities

•End of load-shedding

•Improvement in power quality

•Efficient forecasting and dispatching of renewable

•Infrastructure and standards for electric vehicles

•1,200 kV ac system in operation

•Mandatory standards for appliances regarding DR readiness, energy efficiency and emission

•Export of smart grid products to overseas

The Long Term Plan (14th 5 year plan from 2022 to 2027) will look at:

•Economically viable utilities

•Stable 24 97 power supply to all

•33 % or more renewable in power system

•EV infrastructure leveraged as virtual

Power Plant (VPP)

•Export of Smart Grid products, solutions and services overseas.

•IT network and CRM system for electric utilities provided to other service providers such as water and gas distribution, land revenue collection, etc

Power Scenario in India in Coming Future India's electricity consumption accounts for about 4 % of world's total electricity consumption and it is growing at the rate of 8–10 % per year. In India total energy shortage is 9 % with peak shortage at 15.2 % and country's power demand is likely to around 120 GW at present and to 315 to 335 GW in 2017. In order to estimate the total future requirements of individual fuels of the different sectors directly and indirectly through power, the study considers two fuel mix scenarios for the gross generation of electricity. In the first scenario, one assumes the business-as usual growth of share of new renewables in the total gross generation of electricity with some moderate challenges so as to reduce the share of coal in thermal generation from 70 % in 2009–2010 to 60 % in 2031–2032. The second scenario, on the other hand, assumes a much higher rise in the share of renewables in power generation such that the share of coal can be brought down to 50 % by 2031–2032. In both the scenarios these have tried to keep within the realms of realism by setting the shares of new renewables as substantially lower than what the national action plan of climate change has targeted due to the slow pace of their adoption in the Indian energy industry. Table 1shows the fuel composition of electricity generation as per the base line scenario, while the shares of coal and renewables in the scenario of accelerated introduction of new renewables are 60 and 9.4 %, respectively in 2021–2022 and 50 and 17.7 %in 2031–2032 and those of all other fuels remains the same as in the base line fuel composition scenario. The Indian Power sector is the third largest in Asia after China and Japan. Power grid has projected that by 2025–2026 there shall be around 35 numbers. 1,200 kV substations having 100,000 MVA transformation capacity In Ninth and Tenth five-year plan together, country has added only 40 GW i.e. 4 GW/year and 9 GW in 2007–2008. The Eleventh Plan envisages capacity addition of 78.5 GW. If business continues as usual, India is likely to face a capacity shortfall of 95–140 GW by 2017 the peak deficit shall be of about 70 GW by 2017. Investments required in Indian Power Sector is US $ 600 billion i.e. Rs 24 lakh crores by 2017, around US $ 300 billion or Rs 12 lakhs crores will be necessary in generation, remaining in transmission and distribution. Along with the rapid development, there are some problems in power systems; inadequate reliability, high line losses and unsatisfactory power quality. Hence FACTS devices and smart grid are greatly needed to solve this problem. In recent, a STATCOM, consisting of non intrusive shunt type active filter configuration, DSP based controller with IGBT technology, 5 ms response time for

load changes, reactive and harmonic power compensation, rated at 30–1,000 KVAR, is manufactured by Power-one Micro Systems Pvt. Ltd., India

Two Way Integrated Communication Technology Substation automation, AMR, demand response, SCADA and EMS. Sensing and Measurement Technologies To evaluate equipment health, aid in theft control, congestion management, WAM, Time of use, real-time pricing etc.

Improved Interface and Decision Support Tools

1. For grid operation
2. Convert complex data into easily understood information for decision making
3. Visualization techniques
4. Knowledge management

1. Adjust your day-to-day behaviors

To reduce energy consumption in your home, you do not necessarily need to go out and purchase energy efficient products. Energy conservation can be as simple as turning off lights or appliances when you do not need them. You can also use energy-intensive appliances less by performing household tasks manually, such as hang-drying your clothes instead of putting them in the dryer, or washing dishes by hand.

The behavior adjustments that have the highest potential for utility savings are turning down the heat on your thermostat in the winter and using your air conditioner less in the summer. Heating and cooling costs constitute nearly half of an average home's utility bills, so these reductions in the intensity and frequency of heating and cooling offer the greatest savings.

There are tools you can use to figure out where most of your electricity is going in your home. A home energy monitor can help you understand which appliances are using the most electricity on a day-to-day basis.

2. Replace your light bulbs

Traditional incandescent light bulbs consume an excessive amount of electricity and must be replaced more often than their energy efficient alternatives. Halogen incandescent bulbs, compact fluorescent lights (CFLs), and light-emitting diode bulbs (LEDs) use anywhere from 25-80% less electricity and last three to 25 times longer than traditional bulbs.

Although energy efficient bulbs are more expensive off the shelf, their efficient energy use and longer service lives mean that they cost less in the long run. Energy efficient bulbs are the clear winners in terms of their environmental and financial benefits.

3. Use smart power strips

"Phantom loads," or the electricity used by electronics when they are turned off or in standby mode, are a major source of energy waste. In fact, it is estimated that 75% of the energy used to power household electronics is consumed when they are switched off, which can cost you up to $200 per year. Smart power strips, also known as advanced power strips, eliminate the problem of phantom loads by shutting off the power to electronics when they are not in use. Smart power strips can be set to turn off at an assigned time, during a period of inactivity, through remote switches, or based on the status of a "master" device.

4. Install a programmable or smart thermostat

A programmable or smart thermostat can be set to automatically turn off or reduce heating and cooling during the times when you are asleep or away. When you install a programmable thermostat, you eliminate wasteful energy use from heating and cooling without upgrading your HVAC system or sacrificing any comfort.

On average, a programmable thermostat can save you $180 per year. Programmable thermostats come in different models that can be set to fit your weekly schedule. Additional features of programmable thermostats can include indicators for when to replace air filters or HVAC system problems, which also improve the efficiency of your heating and cooling system.

5. Purchase energy efficient appliances

On average, appliances are responsible for roughly 13% of your total household energy use. When purchasing an appliance, you should pay attention to two numbers: the initial purchase price and the annual operating cost. Although energy efficient appliances usually have higher purchase prices, their operating costs are 9-25% lower than conventional models.

When purchasing an energy efficient appliance, you should look for appliances with the ENERGY STAR label, which is a federal guarantee that the appliance will consume less energy during use and when on standby than standard non-energy efficient models. Energy savings differ based on the specific appliance. For example, ENERGY STAR certified clothes washers consume 25% less energy and 45% less water than conventional ones, whereas ENERGY STAR refrigerators use only 9% less energy.

6. Reduce your water heating expenses

Water heating is a major contributor to your total energy consumption. Other than purchasing an energy efficient water heater, there are three methods of reducing your water heating expenses: you can simply use less hot water, turn down the thermostat on your water heater, or insulate your water heater and the first six feet of hot and cold water pipes.

If you are considering replacing your water heater with an efficient model, you should keep in mind two factors: the type of water heater that meets your needs and the type of fuel it will use. For example, tankless water heaters are energy efficient, but they are also a poor choice for large families as they cannot handle multiple and simultaneous uses of hot water. Efficient water heaters can be anywhere between 8% and 300% more energy efficient than a conventional storage water heater. Also, be sure to account for its lengthy service life of 10 to 15 years in which water-heating savings can accumulate.

7. Install energy efficient windows

Windows are significant source of energy waste, which can amount to 10-25% of your total heating bill. To prevent heat loss through your windows, you can replace single-pane windows with double-pane ones.

For homes in cold regions, gas-filled windows with "low-e" coatings can significantly reduce your heating expenses. In addition, interior or exterior storm windows can reduce unnecessary heat loss by ten to 20 percent. You should especially consider storm windows if your region experiences frequent extreme weather events.

In warmer climates, heat gain through windows may be a problem. In addition to minimizing heat loss, low-e coatings on windows can reduce heat gain by reflecting more light and lowering the amount of thermal energy diffused into your home. Depending on the climate where you live, ENERGY STAR windows can save you $20-$95 each year on your utility bills. Window shades, shutters, screens, and awnings can also provide an extra layer of insulation between your home and external temperatures.

8. Upgrade your HVAC system

An HVAC system is composed of heating, ventilation, and air conditioning equipment. Heating alone is responsible for more than 40% of home energy use. Because homes in Northern regions are exposed to much colder temperatures during the year, ENERGY STAR gas furnaces have different specifications in the northern and southern halves of the United States.

Upgrading to a "U.S. South" ENERGY STAR certification can save you up to 12% on your heating bill, or an average of $36 per year. ENERGY STAR furnaces in the northern half of the U.S. are labeled with the standard ENERGY STAR logo and are up to 16% more energy efficient than baseline models. This translates to average savings of $94 per year on your heating bill in the Northern U.S.

Air conditioning, by comparison, isn't a significant contributor to energy bills – on average, it only makes up six percent of the total en use of your home. ENERGY STAR central air conditioning units are eight percent more efficient than conventional models. Air conditio systems are usually integrated with heating systems, which means that you should purchase your new furnace and air conditioner at the s time in order to ensure that the air conditioner performs at its maximum rated energy efficiency.

Upgrades to the third component of an HVAC system – ventilation – can also improve your energy efficiency. A ventilation system is composed of a network of ducts, which distributes hot and cold air throughout your home. If these ducts are not properly sealed or insulated, the resulting energy waste can add hundreds of dollars to your annual heating and cooling expenses. Proper insulation and maintenance on your ventilation system can reduce your heating and cooling expenses by up to 20%.

9. Weatherize your home

Weatherizing, or sealing air leaks around your home, is a great way to reduce your heating and cooling expenses. The most common sources of air leaks into your home are vents, windows, and doors. To prevent these leaks, you should ensure that there are no cracks or openings between the wall and vent, window, or doorframe.

To seal air leaks between stationary objects, such as the wall and window frame, you can apply caulk. For cracks between moving objects, such as operable windows and doors, you can apply weather stripping. Weather stripping and caulking are simple air sealing techniques that typically offer a return on investment in less than a year. Air leaks can also occur through openings in the wall, floor, and ceiling from plumbing, ducting, or electrical wiring.

Air leaking out of your home is most often from the home interior into your attic through small openings. Whether it is through ducts, light fixtures, or the attic hatch, hot air will rise and escape through small openings. As the natural flow of heat is from warmer to cooler areas, these small openings can make your heating bill even higher if your attic is not sufficiently insulated. To reap the full amount of savings from weatherization, you should consider fully insulating your home.

10. Insulate your home

Insulation plays a key role in lowering your utility bills through retaining heat during the winter and keeping heat out of your home during the summer. The recommended level of heat resistance, or "R-value," for your insulation depends on where you live. In warmer climates, the recommended R-value is much lower than for buildings located in colder regions like the Northeast.

The level of insulation you should install depends on the area of your house. Your attic, walls, floors, basement, and crawlspace are the five main areas where you should consider adding insulation. Use the Home Energy Saver tool for recommendations based on the specifications of your home, or find general regional recommendations on the Department of Energy's webpage on insulation.

Energy policies

Government energy conservation policies would appear to build on the progress to greater energy efficiency and lower oil use. Twenty countries have stated that energy conservation is a priority among their energy policy options. Implementation methods vary. Financial incentives and energy pricing are used by many countries. Others combine these policies with technical solutions. Yet other countries have chosen strict demand management together with improved technical skills and reducing institutional barriers. Public information and education is also widely used.

These programmes are to save energy in all demand sectors. About twenty-five countries propose to save energy in buildings. This is generally seen to be a key area for a wide range of efficiency improvements and fuel switching techniques. Nineteen countries want to reduce energy consumption in transport in industry. At least ten countries have clearly stated that they seek to reduce oil consumption (Senior Advisers on Energy 1979 to 1981). These policies are shown in Figure 1.7. The energy conservation policies for the seventeen countries in the study group are described very briefly below.

In the United States of America, the passing of the National Energy Conservation Policy Act in 1978, with resulting grant programs to promote energy conservation, has led to establishment of more or less standardized procedures for making energy audits and for preparing engineering analyses of potential energy savings resulting from installation of energy saving devices or systems or for energy saving changes in operational and maintenance procedures. The collection of the data and the engineering analyses are termed an “Energy Audit”. The collection of data requires a survey of the building to identify the type, size, energy use level and major energy using systems. It also reports on operation and maintenance practices. The engineering analyses determine the appropriate energy conservation (usually in terms of annual savings) for installing energy conservation measures and for modifying operational and maintenance procedures.

Successful energy conservation requires an organized energy management program. Fig. 11.1 depicts the typical public office building energy usage. Successful energy management involves managing the function indicated in this figure to accomplish a reduction in the major energy usages. As can be seen from this figure, the heating and cooling requirements constitute 76 percent of the total energy used. Lighting also affects the heating and cooling requirements since lamps not only provide light, but they emit heat. Thus the energy audit is primarily concerned with the heating and cooling systems and those factors or conditions, whether building construction or operational and maintenance procedures, that affect these systems. There are seven basic factors that affect heating and cooling. These are illustrated in Fig. 11.2. After these factors are discussed, the procedures for surveying a building and collecting data as well as for engineering analyses of this data are treated. For purposes of illustration, examples are based on a college building in the State of New York.

The Netherlands:

The National Insulation Programme, developed in 1974 and revised in 1978, is the central part of the Netherlands' energy conservation policy. Within the programme it is planned to enforce energy-saving measures for all suited existing dwellings. In order to assure that this target is reached, subsidies for energy conservation measures have been increased. The government plans to support a 20-year conservation programme with an annual budget of dfl 600 million, compared with dfl 300 million in 1979 (itself a fourfold increase over 1975). The Netherlands' building code issued in 1974 has been revised such that insulation regulations are stricter for new buildings.

The installation of solar space and water heating systems is not as financially supported as other energy conservation measures are. In addition, the economic prospects of residential solar energy utilization are more unfavourable than in other EC countries (see Chapter 7) due to low household gas tariffs. An improvement of this situation can be expected since the government plans to raise natural gas prices to the market price level of oil and since rather substantial R&D efforts in the solar energy field are being made. The government issues loans to industry to guarantee risk-free development and commercialisation of energy conservation technologies. These loans covering R&D expenses need not be repaid if the attempt to commercialise fails.

Many analysts of the energy industry have long believed that energy efficiency offers an enormous “win-win” opportunity: through aggressive energy conservation policies, we can both save money and reduce negative externalities associated with energy use. In 1979, Pulitzer Prize-winning author Daniel Yergin and the Harvard Business School Energy Project made an early version of this argument in the book *Energy Future*:

If the United States were to make a serious commitment to conservation, it might well consume 30 to 40 percent less energy than it now does, and still enjoy the same or an even higher standard of living. Although some of the barriers are economic, they are in most cases institutional, political, and social. Overcoming them requires a government policy that champions conservation, that gives it a chance equal in the marketplace to that enjoyed by conventional sources of energy.

Thirty years later, consultancy McKinsey & Co. made a similar argument in its 2009 report, *Unlocking Energy Efficiency in the U.S. Economy*:

Energy efficiency offers a vast, low-cost energy resource for the U.S. economy – but only if the nation can craft a comprehensive and innovative approach to unlock it. Significant and persistent barriers will need to be addressed at multiple levels to stimulate demand for energy efficiency and manage its delivery. If executed at scale, a holistic approach would yield gross energy savings worth more than $1.2 trillion, well above the $520 billion needed through 2020 for upfront investment in efficiency measures (not including program costs). Such a program is estimated to reduce end-use energy consumption in 2020 by 9.1 quadrillion BTUs, roughly 23 percent of projected demand, potentially abating up to 1.1 gigatons of greenhouse gases annually.

In economic language, the "win-win" argument is that government intervention to encourage energy efficiency can improve welfare for two reasons. First, the consumption of fossil fuels, which comprise the bulk of our current energy sources, causes externalities such as harm to human health, climate change, and constraints on the foreign policy objectives of energy-importing countries. Second, other forces such as imperfect information may cause consumers and firms not to undertake privately profitable investments in energy efficiency. These forces, which we refer to as "investment inefficiencies," would create what is popularly called an energy efficiency gap: a wedge between the cost-minimizing level of energy efficiency and the level actually realized. Yergin, McKinsey & Co., and other analysts have argued that this gap represents a significant share of total energy use: in their view, the ground is littered with $20 bills that energy consumers have failed to pick up

The energy efficiency policy debate often comingles these two types of market failures – energy use externalities and investment inefficiencies – causing imprecision in research questions and policy goals. In this paper, we distinguish between the two market failures and clarify their separate policy implications. If energy use externalities are the only market failure, it is well known that the social optimum is obtained with Pigouvian taxes or equivalent cap-and-trade programs that internalize these externalities into energy prices, and that substitute policies are often much less economically efficient. If investment inefficiencies also exist, the first-best policy is to address the inefficiency directly: for example, by providing information to imperfectly informed consumers. However, when these interventions are not fully effective and investment inefficiencies remain, policies that subsidize or mandate energy efficiency might increase welfare. The central question in this context is thus whether there are investment inefficiencies that a policy could correct – in other words, "Is there an Energy Efficiency Gap?"

This chapter examines two classes of evidence on the existence and magnitude of investment inefficiencies that could cause the energy efficiency gap. First, we examine choices made by consumers and firms, testing whether they fail to make investments that would increase utility or profits. Second, we focus on specific investment inefficiencies, testing for evidence consistent with each. After presenting the evidence, the chapter discusses policy implications.

Three key conclusions arise. First, although there is a long literature assessing investment inefficiencies related to energy efficiency, this body of evidence frequently does not meet modern standards for credibility. A basic problem is that much of the evidence on the energy cost savings from energy efficiency comes from engineering analyses or observational studies that can suffer from a set of well-known biases. Furthermore, even if the energy cost savings were known, energy efficiency investments often have other unobserved costs and benefits, making it difficult to assess welfare effects. This problem is general to other economic applications: in order to argue that an agent is not maximizing an objective function, the analyst must credibly observe that objective function in full. We believe that there is great potential for a new body of credible empirical work in this area, both because the questions are so important and because there are significant unexploited opportunities for randomized controlled trials and quasi-experimental designs that have advanced knowledge in other domains.

HUMAN CONTRIBUTION

The integration of human settlements and energy policies in a wider socio-economic framework encounters one particular problem of great importance. Energy policies and the key energy supply decisions are normally made at the national or even international level, and the dominant trend in energy supply and energy management in the past has been towards a centralization of decisionmaking. The creation of national or international electricity distribution grids and the construction of long-distance oil and gas pipelines have encouraged this trend; the importance, in much of the ECE region, of energy imports has made it inevitable. As the Hungarian paper for the Ottawa Seminar expressed it:

… the main trend of national energy policy and development deviates from that of the demand of towns… . This is due to the fact that the main development trend of the energy system of the national economy is determined by the interaction between the energy economy and other sectors. This main development trend is characteristic of the entire energy system, but the regional projections differ. They depend on regional specifications, as well as on aspects which are primarily on the town planning level. Nowadays, the determination of the energy requirement of a town and the supply district belonging to it and the projection of the development trend on the basis of past tendencies no longer coincide.

(R.36, para. 17.)

Meanwhile, human settlements decisions are characteristically taken at the regional or local level, either through the exercise of local governmental powers or through individual decisions. Most of the responsibility for the management of community form and building design is delegated by national governments to the community level, and this trend is accelerating rather than diminishing, in response to demands for public participation. One result of this situation was noted in a Canadian contribution to the Ottawa Seminar:

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In terms of the effect on people's life styles, decisions on energy use planning are as important as decisions on the physical layout of the community. While it is generally accepted that local citizens can participate in the development of physical plans for their community, there are no opportunities for them to participate in the energy use plan for their community.

(R.40, pp. 15 - 16.)

The implications of this separation between national energy planning and community settlement planning extend well beyond the question of public participation. The decisions taken at the community level on such matters as community form, building design and transportation planning have, cumulatively, an enormous influence on national energy use. Energy conservation policies for human settlements must in most cases be implemented through this decentralized structure of administration. In most countries this involves hundreds of units and thousands of individuals, whereas major shifts in energy policy can in principle be achieved much more quickly and expeditiously. As the International Energy Agency* has pointed out, many countries have, since 1973, given more emphasis to increasing their energy supply alternatives than to energy conservation. This may in part be due to a perception that energy supply measures can be implemented more quickly and effectively than conservation measures because of the complex and decentralized system of human settlements planning and decisionmaking.

CONCLUSION

The need for energy conservation

has often been referred to as the ‘Fifth Fuel’, the other four being the so-called primary or ‘fossil’ fuels of coal (solid), oil (liquid), gas and nuclear/hydro-electricity. This emphasizes the importance of reducing the amount of energy used, not only nationally but also internationally.

The simple fact is that the world's reserves of fossil fuels will eventually run out, depending on the rate of use, and therefore, if the consumption of these forms of energy are reduced, the existing reserves will last longer. Research and experimentation could lead to those reserves currently available but uneconomic to recover and use being rendered economic, thus extending further the number of years before these non-renewable sources of energy do eventually run out.

The amount of worldwide energy reserves and life is variable according to the source of information used, but the position is of the order

The estimates of remaining reserves has been roughly the same over the last ten years despite the large increase in oil and gas extracted. This is due to new discoveries being made and new technology allowing the exploitation of previously unviable discoveries.

No mention is made of coal for which there are still vast amounts available, probably sufficient for some one thousand years, so that if oil and gas do become depleted then recourse to coal is a possible answer.

Oil and gas are the two non-renewable energy sources for which consumption has increased rapidly over the last ten years in the United Kingdom, as the mining of coal has declined from some 123.5 million tons in 1980 to 62.9 million tons in 1998.

are also being utilised, although the quantities provided are small compared to the original fossil fuels.

During 1998 some 2.655 million tons of oil equivalent was produced in the United Kingdom by Active solar heating, Onshore wind, Hydro electricity, Landfill gas, Sewage sludge, Wood, Straw, Municipal solid waste and other biofuels.

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