India’s energy security, at its broadest level, is primarily about ensuring the continuous availability of commercial energy to support its economic growth. India faces formidable challenges in meeting its energy needs and providing adequate and varied energy of desired quality to users in a sustainable manner.

Lowering the energy intensity of GDP growth through higher energy efficiency is important for meeting India’s energy challenge and ensuring its energy security. In this context, energy planning through demand side management is one of the most viable, feasible and cost effective options that exist for our country.

The results which we have obtained from the present study, particularly from composite and industry level analysis show that we are going towards the right direction; however the input-output based study does not provide the same trend especially in case of electricity, where the overall change due to intensity effect has been increasing. The planners are
also aware of the fact that is why it is being recommended that no new thermal power plants should be allowed without a certified fuel conversion efficiency of 38% to 40%. Simultaneously, a major stress must also be laid on energy efficiency and conservation, with particular emphasis on efficiency of electricity transmission, distribution and end-use (Integrated Energy Policy, 2006).

The overall effect of intensity of petrol between 1993-94 and 1998-99 has also increased that is due to effect of effect of final demand pattern on intensity change. In this case the best policy can be to use price as a leverage to shift or reduce its consumption and increase efficiency of its usage.

The change due to technology has helped reduce the intensity of both the fuels i.e. coal and petrol, however in case of electricity sadly the story is not that good. This is primarily because of the fact that electricity is provided to many sectors especially agriculture at a subsidised rate which prevents the usage of the same in an efficient manner.

The change in the final demand pattern has also helped in increasing the intensity for all fuel types especially between 1993-94 and 1998-99 this can well be attributed to sudden increase in consumption especially after liberalization, when we are also witnessing increase in per capita income. Similar trends are also visible in the regression where we get that unit percentage change in per capita income affects percentage change in per capita energy consumption by 0.925. This can also be attributed to increased materialization and infrastructure & housing boom that the country is witnessing.

Because of the nature of our imports i.e. as we import mostly finished items; is the reason that the pattern of import of goods has positive
impact on the efficiency of all types of fuel (viz. coal, petroleum and electricity).

It can well be said that the energy policies that we have adopted since independence to serve the socio-economic priority of development have encouraged and sustained much inefficiencies in the use and production of energy, however of late the pattern has moved in the right direction. However there are many obstacles to increase in energy efficiency.

Obstacles to end-use efficiency are there for many reasons, including lack of technical education and training, entrepreneurial and household traditions, the un/availability of capital, and existing legislation. Market imperfections are other obstacles which include the external costs of energy use as well as subsidies, traditional legislation and rules, and traditions, motivations, and decision-making in households, companies, and administrations. Finally, an inherent obstacle is the fact that most energy efficiency investments remain invisible and do not contribute to politicians' public image.

Lack of knowledge, know-how, and technical skills and high transaction costs are the biggest impediment. Improved energy efficiency is brought about by new technology, organisational changes, and minor changes in a known product, process, or vehicle. This implies that investors and energy users are able to get to know and understand the perceived benefits of the technical efficiency improvement as well as evaluate possible risks.

Lack of access to capital and historically or socially formed investment patterns is another barrier. The same energy consumers, even if they gain knowledge, often have trouble raising funds for energy efficiency investments. Their capital may be limited, and additional credit may be
expensive. Especially when interest rates are high, households and small firms tend to prefer to accept higher current costs and the risk of rising energy prices instead of taking a postponed energy credit.

In a diverse country like India, disparity of profitability expectations of energy supply and demand is also a hurdle. The lack of knowledge about energy efficiency among small energy consumers raises their perceptions of risk, so different energy consumers and suppliers expect different rates of return on investments.

There are legal and administrative obstacles in almost all end-use sectors. In our country they often date back to pre-independence, when energy prices were low and declining in real terms and there was no threat of global warming. With a lot of other urgent needs calling for capital investment, energy efficiency measures are given low priority. The poor perception of public goods adds to the obstacles confronting energy efficiency in developing and transition economies.

Unpaid energy bills are also an obstacle to improvement in energy efficiency. This creates special obstacles to investing in energy efficiency, moreover non-payments make energy companies also go in losses moreover they are not able to further invest in supply side efficiency as well.

A large portion of customers are subsided; fuels are of poor quality, expensive, or both; resellers charge excessive costs and receive large profits; detailed information is lacking on the production costs of suppliers; and the decisions of governments do not sufficiently reflected cost considerations, but depend on the political priorities of the local authorities.

Subsidies are driven by traditional concepts of public goods or social policy. In addition, some groups pay discounted residential tariffs.
Moreover subsidised energy prices reduce the economic attractiveness of energy efficiency measures.

We still lack an effective energy efficiency policy at the national level. In India, energy supply constraints provide no alternative fuel and technology options for consumers. The limited availability of commercial fuels (petroleum products, electricity) in rural areas impedes switching to more energy-efficient stoves, and other technologies, posing a major challenge for energy policy.

Inappropriate energy pricing and cross-subsidies are a major cause of concern. Some fuels are subsidised and others cross subsidised so that it can be provided to poor population, and they can switch over to more efficient commercial fuels. However many times due to corruption this results in these fuels reaching to those groups who can well pay its actual price.

Lack of capital and import of inefficient used plants and machineries are also a major stumbling block. Many energy efficiency measures are delayed by a lack of financing. The availability of credit at high interest rates tends to make energy efficiency investments a low priority. Government generally favours investments in additional capacity over investments in energy efficiency.

Proliferation of inefficient equipment and the desire to minimise initial costs: In the absence of energy labelling schemes and of standards for energy efficiency, energy-inefficient products continue to be manufactured and marketed. Though now the Bureau of Energy Efficiency (BEE) has been constituted and it is taking steps in the right direction.
If comprehensive policy strategies are implemented, we will discover that the economics of end-use efficiency are far more attractive than is currently believed.

The importance of research and development increased energy efficiency is still underestimated in India. The spending on R&D in proportion to our GDP is very low. Tackling the complex technological problems of the energy sector, particularly end-use efficiencies, will require research and development on steadily increasing scale.

The preceding paragraphs covered only individual technology for energy conversion and use. But additional and sometimes major energy savings can be realised by looking at energy using systems in a broader sense. Aspects of this systemic view include:

- Optimising the transport and distribution of energy: Commercial energy use is often highly decentralised, yet the energy is produced in central plants; examples include electricity, and then it is transported from one state to the other resulting in heavy T&D losses.
- Optimising the location of energy users: to avoid transporting goods or people, this also means planning the cities and towns in such a manner that transportation and mobility of people remains minimum.
- Optimising according the second law of thermodynamics: by supplying the suitable form of energy, including heat at the needed temperature and pressure, or by exploiting opportunities for energy cascading.

These concepts are not new. But they are often neglected in the planning of cities and suburbs, industrial sites and areas, airports, power plants, and greenhouses.
India has made great strides in improving the energy productivity of its economy since 1992-93. The progress made in specific sectors in India offers valuable lessons on efficiency improvement for the rest of the Indian economy. Efficiency improvement can be achieved through both mandatory and voluntary means, through central and state government programmes, through better business practices and vigilant non-profit associations. India needs to pursue a comprehensive approach that establishes and promotes the energy conservation ethic within central and state government agencies and all consumer classes, while maximizing the participation of the private sector in the implementation of energy efficiency activities.

In India, the thrust on energy efficiency has largely been focused at the central government level with some delegation of roles to the state governments. Recent steps by Indian states to introduce state-wide energy conservation programmes are a welcome development that needs to be encouraged. It is reflective of the growing understanding that centralized planning and design of energy efficiency programmes that are the responsibility of the Bureau of Energy Efficiency (BEE) must be supported by a strong and vigorous decentralized programme at the state level. These programmes should aim at setting up responsible state agencies, passing enabling legislation, training professionals, establishing technology demonstration centres and offering energy efficiency services. Indeed, anticipating such a need, the Energy Conservation Act 2001 provides for the establishment of state energy conservation agencies to plan and execute energy programmes.

State government agencies, state utility companies and regulatory commissions all need to participate in the promotion of energy efficiency. The need, content and strategic thrust of a state energy conservation programme will differ from state to state depending upon its size, energy
resource mix, the nature and pattern of energy demand, status of power sector reforms and size and growth of the power sector-subsidised losses that contribute to the state's fiscal deficit. Reducing the fiscal deficit through energy efficiency measures is perhaps one of the strongest arguments for instituting a state level energy efficiency programme. Efficiency offers a cost-effective solution to electricity shortages, and consequently the increased and better quality of electricity supply can amplify industrial production and government tax revenue.

Where ever the cost of power supply and distribution is greater than the revenue realized from the sale of power, introduction of energy efficiency must be the foremost priority. Public use of electricity for street lighting, public buildings, water pumping, municipalities, hospitals and schools together with subsidised electricity supply to farmers represent a major claim on public finances. These public and subsidised uses of electricity should receive priority action and policies should be so devised so that it does not create much distortion and promote efficient usage.

Among these, agricultural efficiency programmes that include rectification of existing pump sets, use of efficient equipment in new installations and metering of pump set electricity use merit attention. Agricultural efficiency programmes represent a unique challenge in that they need to be integrated with utility programmes aimed at strengthening the rural distribution network.

The time lag between programme implementation and its realized electricity savings varies depending on the technologies targeted by a programme. End-uses that have a short turnover period, such as lighting, will yield savings sooner than those with longer gestation periods. For a chronically electricity-short India, short-turnover-period technologies
should be the primary for implementation followed by the planting of energy efficiency seeds that will yield longer term benefits.

Combining energy efficient procurement with technology-specific building retrofits is also one of the measures that we should adopt. Lighting technologies are ideally suited for this strategy. Lighting retrofit projects are more amenable for private sector financing because of the use of standard, reliable technology and little or no likelihood of degradation of savings. This way, one can develop the energy services market in small incremental fashion allowing the key stakeholders to get familiar and comfortable with the concepts and risks involved with performance contracts.

Several energy efficiency measures with considerable savings potential involve technologies that are either not available or not yet widely manufactured in the country. Targeted efforts are called for to promote the widespread production, availability and use of such products. Such efforts are energy efficiency market transformation strategy whose key elements are:

- Research, development and demonstration projects (RD&D) with emphasis on technology commercialization and/or adaptation (to adapt foreign technologies to the Indian market).
- Technical and financial assistance to manufacturers including corporate tax incentives to users of energy efficient technologies, equipments and devices.
- Selective reductions in import duties and sales/excise taxes. Relief could be provided on manufacturing equipment needed to produce energy efficient products domestically and on limited quantities of actual products so that a sufficient market demand could be created to catalyze domestic manufacture.
- Prescribing mandatory efficiency standards and compulsory labelling for selected energy consuming equipments.
- Opportunities exist in India for 'carrot' programmes for the introduction and adaptation of superior energy efficient devices and equipments. Such opportunities could be realized through innovative financing mechanisms.

Access to competitive financing and trained manpower and institutional infrastructure is critical for initiation and replication of energy efficiency programmes. Financing through international and national development banks, government subsidies, and tax rationalization is already practiced in our country. It is important to bear in mind though that the borrower and lender may be looking beyond merely reducing energy costs. Reducing total costs, improving infrastructure, and/or establishing credit worthiness are often the main goals that can and are being pursued through efficient energy finance. Improving a borrower's credit worthiness may be particularly important when lending to small and medium scale enterprises and municipalities. More recently carbon finance has emerged. Energy service companies are an important route to providing market-based solutions for energy efficiency. They have thus far been mostly small size companies that are engineering-oriented. Bundling of projects through financial and other entities and standardization would reduce transaction costs and risks of energy efficiency projects.

Demonstrations of such facilities are important, but their replication requires capacity building and training of builders, industry managers, analysts, and other professionals to ensure that the gains are captured and sustained. Benchmarking, voluntary agreements, financing of SMEs and unorganized sector, are some of the key areas where large gains are possible.
In India, however, utility data are only now starting to be collected to a limited extent by the more progressive states. Data are a two-edged sword; they sometimes reveal facts that are uncomfortable to even planners. But we must always remember without quantitative analysis there will be no firm basis for future improvements in energy efficiency. This has been forcefully put forward by many analysts (Chikkatur and Chakravarty 2008).

Monitoring, evaluation and verification to ensure that energy savings are quantifiable, reliable and creditable is key to all energy efficiency programmes and measures. Without these activities, no amount of promotion can turn energy efficiency into a business practice. Setting up centres of excellence in energy efficiency is an important requirement. An energy conservation centre at the state level will have the prime function of ensuring the proper implementation and monitoring of energy efficiency programmes adopted by the government. The centre should preferably function with direct industry participation and besides its prime function; its activities could include conducting awareness campaigns, facilitating technology information sourcing, showcasing energy efficiency technologies, promoting technology cooperation and transfer, and organizing audits.

There is considerable evidence that a state energy conservation centre is useful in supporting a national energy efficiency programme by mobilizing existing private and public institutions to provide the information and technical expertise needed by energy consumers. To have maximum impact, centres should be constituted and staffed to reflect the nature of the state’s industrial sector, its energy/power sector reform and restructuring plans, the potential for energy savings and the ability to mobilize market forces and capital markets.
In the end we must remember that energy efficiency is the most important virtual supply source that India possesses.