Open access Journal International Journal of Emerging Trends in Science and Technology

Energy: Sustainable Option for Economic Development

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Abstract

At the time of liberalisation and opening up of the economy, India was classified in the category of low income countries. After two decades of major policy reforms, Indian economy entered into the category of middle income countries and is further likely to enter into club of developed nations in the next two decades. Among major sectors of economy, energy is termed as key sector around which the economy revolves. As a matter of fact, energy sector is one of the major sources for draining out resources that lead to serious problem of balance of trade. If energy sector is managed the way it requires priority, the economy can have much focused and faster turnaround and entry into the club of developed nations could be achieved at least five years prior to the perceived time frame. Advantages of this phenomenon could be multi-fold and difficult to quantify but the fate of one-third of the lower strata of population can be changed wherein the perceived impact could be most thrilling and beneficial. That is what the country is in need at this stage. This paper attempts to examine various dimensions of energy sector, identifies lop sided areas, usable options available at current stage of technological advancement and requirements of over-coming anomalies and cement loose ends and finally take call to translate priorities into reality.

India has number of comparative advantages of high potential of economic development, population growth, increasing standards, exports, growing consumerism, etc. The composite phenomenon has resulted in additional demand for energy including electricity, petroleum and gas. As per assessment of different estimates, the energy requirement for electricity would be four times by 2031-32 as against 2009-10 capacity. The focus has been more on utilisation of conventional resources by taking few assumptions including technology as partly constant. An analysis of different sources of electricity generation clearly reveals that we are much behind the targets whatever has been fixed from time to time and those fall short of potential of all sub-sectors. Under-utilisation of internal sources for energy primarily hydro, coal, gas, nuclear and

thorium has put strain on oil sector for power generation apart from its major utilisation in transport sector. The share of oil sector in total energy sector in India is reported nearly 32 per cent in the year 2011-12.

SECTION I CONCEPTUALISATION

The electricity generation is suffering from number of paralysis including conceptualisation, policy formulation and implementation. In India, funds allocated for R&D are very meagre and advancements for necessarily required technologies for energy sector are not adequately addressed. Even bringing well established technologies for implementation are not very well focused, appreciated and realised. Land use analysis very clearly shows that we have 51.97 million hectare[1] as other uncultivated and fallow land and if we allocate 10 per cent of it for plantation of hybrid variety of beema bamboo[2], we would be able to produce renewable bamboo fuel, an average of 50 tons per acre per year for power generation. India satellite data revealed, "forest cover 6,39,600 sq. km. (14.47%) and only 5,18,487 sq.km. (11.73%) has good forest cover of over 40% crown density. Nearly 60,000 sq. km. land is reported as denuded, without any tree cover"[3]. If we bring 10 per cent of the forest area under bamboo cultivation with mix of other local species, we would be able to produce large stock bamboo fuel. By adding bamboo production from both sources of land use, total renewable production of bamboo fuel is assessed to the tune of 1500 million tons per year or 164835 MW electricity, which is more than adequate for rural sector population level likely to be achieved in next two decade. Bamboo production could be increased to higher level if required by bringing additional 10 per cent land of both identified uses and its impact on employment would be in the same proportion. By adopting such measures, we can also protect our forests, increase green cover and improve environment. We can attain better harmony of environment, natural resources, soil cover and many other related advantages. Unfortunately in India bamboo is classified as timber, whereas all over the world, it is termed as grass. This has caused exclusion of a very major source of fuel for utilisation for energy generation. What we need to do at this stage is to de-classify bamboo as timber, classify it as grass and also provide access to forest land for plantation and its exploitation by bringing suitable modifications in the Indian Forest Act. With the bamboo plantation of hybrid variety suitable for cultivation in different geo-climatic regions, we can achieve the highest level of absorption of carbon-dioxide; around 60 tons per acre per annum. This also provides the scope for achieving millennium development goals, especially number seven and one as well as generation of direct employment of one person per acre and equal number of indirect employment; say 59 million additional workforce can be accommodated in rural sector at 10 per cent level of allocation of land from both the identified sources. Keeping in view fuel wood requirements and employment generation, we can adjust land allocation, either on higher or lower side, for bamboo cultivation. It may work as one of the best green initiatives for absorption of carbon dioxide, electricity generation, provision of additional employment and local initiative for poverty reduction in the country side, no or low transmission and distribution losses. Each kilogram of dry bamboo fuel can generally help in generation of one kilowatt electricity per hour. We can have application of environment friendly technology by introduction of plasma torch[4], which is safe and efficient in operations. We can have village cluster planning approach for economy and sustainable purpose by grouping them into suitable size of cluster, broadly say 10 villages. Therefore, we can have 60,000 such clusters all over the country. Such small scale cluster planning approach can help in power generation as well as distribution and eliminate/minimise distribution losses for 50 per cent rural population. These clusters would emerge as engines of rural growth and industrialisation, which is a need of the hour. Now

the question arises why we have taken 50 per cent and not the entire 69 per cent country side population. The World Development Report 2009 has come up with an alternate methodology[5], based on population size, density and travel time and obtains a figure of 52 per cent, as some kind of proxy for percentage of urban population which is supposed to be globally comparable. Therefore we have taken 50 per cent as country side population for this exercise for electricity generation from bamboo renewable fuel and environment friendly green initiative.

Another option available for rest of urban population in India in terms of use of technology is to convert city liquid and solid waste into energy by application of thermal depolymerisation process. As per information of ministry of urban development, government of India, few cities are treating sewerage and producing energy only adequate for propelling its treatment plants[6]. Technology input has been provided by IITs, operating indigenous technology is nearly six times less efficient as compared to thermal depolymerisation process[7]. This wealth is still hidden from energy domain of the country and administrative machinery and policy planners are not geared to accept this newly developed efficient environment friendly technology. This area is still beyond the scope of energy development priority and its application can either be as bio-hydrogen or bio-diesel for city transport as one of the clean fuels. Focussed development in this area would also work as three prong strategy of development of additional/alternate clean fuel, employment and poverty reduction through direct and indirect regular employment generation in cities, towns and hinterland of urban India. The similar intervention could also be made for country side human settlements either by scaling down the size of thermal depolymerisation process (TDP) plants or by adopting cluster approach to feed TDP based power plants for additional energy requirements. However, recognition of innovative concepts, policy formulation and its implementation would take time as per prevailing trend in the country but pilot projects need to be considered on priority before scaling them up. The table 1 below gives comparative scenario of city waste and energy that can be generated by using technologies

Table1: Comparative scenario of municipal solid waste and its uses for TDP

MSW (percentage)	Bhopal	USA	Jakarta
Food waste	50	25	72
Plastic	5	15	9
Paper	8	39	8
Green waste	5	7	-
Textile, leather, rubber	2	-	1
Nonconvertible	30	14	10

Source: Recycled Energy Corporation.
Note: 350 liter MSW of Bhopal, 470 USA and 330 Jakarta are having same energy units.

During the last five years (2007-12), as a matter of policy perspective, government has been primarily focusing more on nuclear power generation while other countries are either not taking nuclear energy as major focus or closing down the existing plants in a time bound manner. As far as

fuel and technologies are concerned India as nation do not have much to offer and most of the required technological and fuel processing inputs are to be imported. It thus puts lot of pressure on draining of resources at the same time causing possibility of hazardous risks. Former President of India, Dr A.P.J. Abdul Kalam has been propagating utilisation of thorium as fuel for power generation. India has largest quantity of thorium, one-third of global reserves, proficiency of indigenous processing techniques and technology to take care of energy requirements. India's 40MW thorium based Fast Breeder Test Reactor (FBTR) has completed 25 years of operation[7] at Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam. This aspect has been kept highly secret from public and policy makers. The government of India has been propagating that if we do not focus on nuclear technology for energy application, there would be a serious energy crisis in the country. Managing number of sectors including industrialisation and achieving higher growth and productivity would be difficult. It is further to add that government of India has disclosed, as reported by The Times of India on 26th October 2012, thorium base plants are safe and have achieved proficiency for installation of 500MW power plant and there would be no consequences regarding safety and such plants can even be considered for installation right in the heart of the city[8]. The possibility of its growth and expansion doesn't seem to have any limitation, keeping in view the energy requirements of the country and availability of technology and thorium. An additional benefit of such efforts could be that we need not to have focus much on transfer of electricity from one region to another as such plants can be constructed at those places wherever there are requirements of energy. In this scenario, there is no problem of transmission losses and energy requirements can be taken care of locally in a very efficient manner. If we achieve highest level of energy availability, there is a possibility to build energy highways to run even road transport by utilising electricity as fuel to propel and have efficient mobility all over the country. The potential of power generation by using thorium fuel is assessed to the tune of 150 million MW against 0.7 million MW assessed energy requirements by 2031-32 for the country. What is missing at this moment is decision making in favour of this technology, its aggressive application and even selling such power plants to other countries as we had put emphasis on acquiring nuclear technology, need to reverse our policy and implementation approach. Argument developed in the above paragraphs has focused on Conceptual paralysis, which country has suffered for no reason except no body pushed from the top.

Europe and North America are focusing on development of hydrogen highways for mobility of goods and services. India has not joined the club of such nations; however, there is elementary level of efforts being done through IITs and other scientific institutions for its testing and utilization in the transport sector. The automobile sector is considering this as one of the efficient fuel for mobility both within cities as well highways. IIT Delhi and Mahindra & Mahindra have successfully tested use of hydrogen in automobile and latter planned to bring hydrogen propelled auto rickshaw somewhere next year. Indian Institute of Chemical Technology, Hyderabad and other Institutions are working on for production of bio-hydrogen from municipal and household bio-degradable waste. There are also few success stories of power generation by burning of toxic and industrial waste at very high temperature by application of plasma torch technology and SMSIL is generating 1.43MW around 50 km from Pune. Such projects can be scaled up and can be promoted for energy generation in most of the states all over the country as requirements for disposal of industrial and hazardous waste are somewhat similar. Few countries are utilizing Oxy-hydrogen as a combination with the existing fuel and this application has improved the fuel efficiency of internal combustion engines. This

area has been ignored by Indian transport sector. TATA has signed project for technology up-gradation with MIT. TATA–MIT has collaborated to create energy from water and this effort is likely to bring power to 3 billion people. MIT scientist Daniel Nocera and team have struck an artificial cobalt- and phosphate –coated silicon leaf into a jar of water could manage to create power, at an efficiency that surpasses today's solar panel. The technique mimics photosynthesis by splitting hydrogen from water to generate power from sun. TATA and Nocera imagine that the research could lead to a refrigerator sized mini power plant in a development that could, according to *Live Mint*, bring power to the three billion people currently living without. The non-conventional sources of energy are known quite for some time, while in India, significant results have not been achieved, keeping in view our potential. This includes wind, solar, hydrogen, bio-methane, etc. The potential of non-conventional sources of energy is reasonably very high while efforts made or its growth and development are quite insignificant. This area also requires major investments to reach to respectable level in a phased manner in order to harness full potential. The current level of utilization of potential is in the range of 10 to 15 per cent, we need to be aggressive for improving this area.

SECTION II POLICY FORMULATION

India's total import bill for the year 2011-12 is $485 billion, of which $150 billion reported for energy requirements[9]. As regards policy for the sector, India has left huge energy potential for utilization in future, both public and private sector is waiting for approvals. It is difficult to perceive the kind of policy implementation approach followed by the country for managing its macro parameters and real rationale behind such inefficiencies. If we examine the impact of $150 billion per year, which drains out in name energy requirements, through application of accelerator and multiplier principles of macro modelling on Indian economy, the outcome scenario on growth model would exhibit very exciting results. Even today's policy framework seems to be very insensitive to these inefficiencies. The higher scale of inefficiency in policy decisions has denied an opportunity to our population to suffer due to scarcity. The energy policies are not investment attractive to both public as well as private sector to exploit potential of conventional energy sources which is quite substantial to meet out requirements of population. The hydro sector alone has potential of 250,000MW as per the conventional approach[10] of assessment by taking technology as constant. If we take into consideration the dynamic parameters including friction free magnetic levitation bearing, use of run of the river water for power generation and efficient technologies, an assessed potential can easily be achieved up to 400,000MW. The current utilisation of hydro based installed capacity is hovering around below 40,000MW, not even 10 per cent of the real potential. No logic or rationale may support an argument of indecisiveness that too in a scenario of scarcity of electricity throughout the time till today, hydro is renewable and environment friendly.

The nationalist school of thought would even argue by ignoring the fundamental macro-economic parameters to support that let us take high cost loans, introduce subsidy and even other incentives, in order to plug leakages of draining out of resources on energy import inputs on yearly basis, for early self-reliance and sustainability through clean energy generation initiatives such as hydro. Therefore one may argue that there is Policy paralysis that leads to a scenario which is not encouraging to make investment in energy sector. There are many hesitations in sanctioning of most of projects and when they are sanctioned, many are attached with long list of conditions which at times, difficult to fulfil and have smooth execution of projects. The investments done by public as well as private sector do suffer in the hands of in-efficiencies in the name of environment, forests and other local issues. The

large projects are delayed and time over-run leads to cost over-run which is registered in the range of 2 to 3 fold. This has adverse impact on all aspects of life including cost of living and further reduces our competitive advantages for exports. Interventions from public sector are not encouraging and projects which are stuck for want of policy interventions are left like orphans.

Shree Maheshwar Hydro Power Project in Madhya Pradesh was conceived in 1993. S Kumar entered into MoU with government of Madhya Pradesh to execute 400MW hydro power project on operate and own basis. The initially equity was contributed by promoters and government of Madhya Pradesh, however, large percentage resources were mobilised from the market by the support of eight institutions. The execution of the project could not be completed on designed timeframe. Once again, consortium funding was done by lead lender PFC with the support of REC, SBI, HUDCO, CBI, LIC & 8 old lending financial institutions. The project mainly had many ups and down for want of funds. There is hardly much progress of work from the last two years for funds and environmental clearance. Environmental clearance has been received on June 3rd 2012 for filling up dam up to 154 meters but no work has progressed. Promoters could bring required for pending work of R&R and works. The promoter has defaulted from April 2011 and all financial institutions supported the project are getting big hit. There seems to be no way out and precious resources are un-utilised, everything at the will of promoter.

The hydro sector is still having a huge potential and its utilization is left in favour of coal, nuclear, gas and other sectors. There is also in-decisiveness in the area of allocation of coal mines, its transportation, environmental and forest clearances, apart from serious environmental implications. This has really put strain on growth and efficiency of coal based thermal power projects. The increasingly growing dependency of coal imports, transportation, problem of ports and in-land scenario, etc. are major issues. On one hand focus is on sourcing of fuel from different sources including imports, on the other hand thermal technologies are such that majority of coal projects are working below 30 per cent level of efficiency. It implies that in thermal projects, coal energy is wasted to the extent of 70 per cent. We are yet to modernise our thermal plants and most of them could not adhered to the timeframe stipulated in most of the documents. Difficult to believe and very surprising to note that even in USA, level of efficiency of thermal plants is just 33 per cent[11]. What a waste of energy that too when thermal plants are emitting harmful gasses, attributing alarmingly to global warming. Therefore policy decision to maintain very high level of excess capacity of hydro sector (around 90 per cent) and promoting thermal power projects, it is difficult to perceive and support the rationale of this phenomenon at this stage of development However, there is very strong possibilities to reverse this scenario by putting full stop on new thermal projects and focusing primarily on hydro power.

The focus has moved in favour of nuclear sector despite the fact there are technological gaps, fuel, its processing and safety concerns. There are so many protests and government has not adequately addressed the issue of security and natural disaster. Though there has been lot of sensitisation after the disaster of nuclear plant of Japan, government of India has been making mere statements that our nuclear plants are safe and safety concerns do not seem to be adequately addressed. Very recent disclosure of 25 years of experience of successful operation of thorium based 40MW power project and proficiency of technology, its fuel processing, least requirements of safety and possibilities of construction of 500MW plants right in the heart of cities and densely populated area show deliberate policy

priorities for nuclear sector. This clearly reflects that government is giving priority to foreign investment and technologies as against locally available fuel and technologies. One may argue and defend to really prove that there is deliberate policy paralysis which has affected population all over.

Use of natural gas has emerged as one of the environment friendly and cost effective options of energy. It is available in India in huge quantity but exploration and development of strong distribution networks in cities for households, transport sector and power plants is of vital importance at this point of time. The major area of the country is not available on gas map of India. For oil sector, we need to upgrade technology of refineries for clean fuel, introduce policy framework to reduce oil consumption from the current level by introduction of alternate transport options, technologies, fuel, etc. Policy on fuel efficiency, retiring old vehicles in time bound manner, introduction of vehicles on alternate fuel is yet to be conceived and followed as top priority.

SECTION III IMPLEMENTATION

Apart from sub-sector issues, implementation of projects is not as efficient as one perceives. If the country has to grow around 8 to 10 per cent and move fast into a club of developed nations, we need to have right policy perspective and efficient implementation framework and there should be no reference in planning commission documents that cost escalation is reported in certain cases as high as 347.25 per cent[12]. Investment of most of the power projects has turned out to be lumpy in nature as many aspects of the sector are left un-addressed which have to be essentially be the part of sanction process. The synchronisation and co-ordination gaps are also serious issues and concern. Monitoring aspect of implementation of sanctioned projects seems to be predominantly missing, when it is utmost important in energy scarcity scenario. There are five ministries in the central government dealing with different components of energy sector and due to fragmented approach, this sector is not represented in true sense as power or energy. There are major issues regarding overlaps, deficiencies and co-ordination. Coal mines, auctioning, allocation of blocks, environmental clearance, transportation and tariff are major issues which are addressed in isolation and patched manner. Therefore unified policy which is the need of hour is still not adequately formulated and implementation aspects remain a very major and serious concern. This is causing serious problem of investment inefficiencies and has many implications in terms of fuelling inflation and making commoners to suffer in the hands of operational inefficiencies.

Advancements in technology development are lagging nearly two decades behind the research efforts in laboratories. Maglev is now a very big name in the areas of advancement of technologies and operationalization in the area of achieving speed to next level for transport sector and development of turbines for power generation. Maglev is using primarily magnetic levitation rotation system to reduce energy requirements and generate multi-fold efficiencies for energy generation[13]. Introduction of such bearings in transport sector and turbine rotation may change definitions and meaning of energy sector. We may not be required to build dams having operational height of 162 to 170 meters. Run of the river and canals could turn out to be operationally very efficient projects by simply changing bearing and rotational gears. Even the transport sector including road and railways may require much lower level of energy requirements. Magnetic railways tracks using levitation as friction free mode of speed could completely change the concept of speed, energy and safety requirements. To site an example, the fully elevated Shangai Maglev was built for $US1.33 billion total length of 30.5 km including trains and stations in the year 2004. Thus cost per km for dual track was $US43.6 million against $US 30.8 million per km

for fast rail in rural and intercity areas[14]. For city rail, density of stations is very high as against intercity tracks, thus the cost parameters may not be strictly comparable. Delhi Metro Rail Corporation has proposed to construct 11km monorail corridor with 12 stations at a cost of $US36.94 million per km, project likely to be completed in 2017. The similar options are under consideration in many cities but technological options chosen are still seems to be of lower order.

The electricity act 2003 has reflected number of improvements and modification for commercialization and investment efficiency. Tradability of the electricity in true sense is yet to be achieved and supporting environment is to be developed, number of approvals from different departments is required and it is still a rule of the day. This has also caused inefficiency for wheeling of electricity from surplus to deficit areas and in a way and true sense there is no national grid as such. The quality of grid is not as good as one perceives and expects. We need to introduce the concept of net metering where the consumer can have two way flow of energy, while deficiency of energy at local level, one is able to consume as it exists in the operating circumstances and if one has to put an extra generated energy on the grid without backup system, it provides scope and reduce the capital cost for non-conventional resources at household level. Outflow has not become the possibility as the quality of existing grid system is very poor. Therefore, one can conclude that utilisation of non-conventional sources of energy is not adequately investment supportive at household level as per prevailing policy regime. As on date, we have very high percentage of transmission and theft losses and non-conventional sources of energy which is comparatively costly at current level of technological advancement, it is purchased at higher rates and left to its fate to have equal treatment of theft and transmission losses. The household sector is one of the largest consumers of electricity and has not been given level playing field to compete and save in terms of energy efficiencies. The subsidies and other soft options are given to those who can install at least one kilowatt unit. Therefore, actual utilization of non-conventional sources is still termed as an elite concept and concern for general public is yet to be addressed through policy and implementation programmes.

India signed Proto Kyoto Treaty in the year 1995 to take care of all the issues relating to global warming. It was intended that we would start constructing buildings and other support infrastructure by utilising environment friendly technologies having advantage of sound and thermal insulation. In India there is hardly any sensetisation about green buildings, very few buildings have come up as green in nature but without the support of government. Government departments primarily CPWD at the central level and PWD at state level have not updated schedule of rates by incorporating green building concepts. All tenders floated normally provide very age old specifications for construction. This clearly shows that there is hardly much follow up of policies and global commitments and ground realities are non-reflective in true sense. Construction of buildings by implementation of green construction technologies can alone help to save around 10 per cent energy. If we introduce other supporting heating, cooling and energy efficient appliances, there is possibilities to save 30-50 per cent electricity consumption at household level.

We are also lacking in setting up plants by utilisation of tidal energy while the potential is estimated to the tune of 9000 MW. The recent technologies in the area of hydro projects, particularly generation of electricity by run of the rivers has also not been considered. Many countries globally have come out with electric vehicles. This area in the automobile sector is also not adequately addressed. We need to have integrated energy policy by clubbing together five

different ministries at central level to address issues which are left to the project team to struggle and execute. While granting licenses for power sector projects, there has to be attached responsibility of the teams at the helm of the affairs to monitor the projects which are slow in implementation and help to overcome problematic aspects for fast implementation of projects.

The energy sector is still having major deficiencies of transmission and distribution losses in the range of 35 to 40 per cent. If we want to really improve this area, there is a need to encourage household and industrial sector by providing subsidy in the range of energy losses to encourage them to implement new technologies for saving electricity. The products which are arriving in the market have almost double or even manifold prices and this is how appliances and instruments for energy efficient are still not popular. This includes fans, tube lights, refrigerators, air-conditioners, washing machines, bulbs, street light, electric motors and even the vehicles. To promote energy efficiency we need to promote fast growth of energy efficient instruments and appliances. Therefore, role of subsidy is highly recommended or regulatory framework of pricing of such products is felt important priority. There are other technologies, which helps in demand management of electricity. This includes air-conditioning and other heating and cooling processes. This area also needs to be encouraged and electricity can be utilised more efficiently during of peak hours.

After focussing more on lost priorities in decision making and the implementation aspect of energy sector we would like to draw attention to energy conservation. It is widely accepted argument that energy saved means energy produced. We would like to substantiate this argument by citing few success stories and projects in the pipeline under the solar city planning programme of Government of India. The Thane Municipal Corporation has shown significant results in different areas. The Thane Municipal Corporation is recognized as a first solar city of the country. The solar city master plan has indicated to reduce 10 per cent energy consumption in the coming five years from the existing level of 2010-11 despite the city is expanding and accommodating additional population. The Thane Municipal Corporation initiated energy efficiency and renewable measures from 2000-01. In the year 2001-02, the energy consumption for managing the city was much more for 1.36 million population, by introduction of energy efficiency measures, the Thane Municipal Corporation is managing city with lower level of energy units in the year 2009-10 for 2.06 million population. These facts are very pertinent for other local governments to take energy efficiency measures and reduce energy consumption. Adding few more details, it is important to note that energy consumption for street lights has been reduced from 22.99 lakh units to 16.09 lakh units indicating a 30 per cent saving[15]. Similar savings have been noted in the municipal buildings by reflecting 15 per cent savings and absolute number of units has been reduced from 4.39 to 3.74 lakh. The energy consumption for the Municipal Hospital has been reduced from 3.03 to 2.27 lakh units per annum by saving one quarter energy. The municipal hospital is also supported by putting up solar concentrator air conditioner. During the rainy season, water is heated by biomass and air conditioners function throughout the year by using dual energy mode, solar or biomass. The hospital building is also supported by Bio-Methane gas power plant. The city hotels waste food and biodegradable household waste is being collected at small scale and that helps in production of bio-methane, which is further used for power generation. The city street lights are supported by microprocessor almanac to set the sunrise and sunset timings and helps in switching on and switching off street lights automatically based on light sensors. The entire city street lights are put up on three phase system. From dawn to 11pm, the city lights operate on three phase system, from 11pm to 1am

on two phase and from 1am to 4am on single phase and from 4am till adequate sun light, on two phase. This microprocessor based almanac supported by automatic dimmer has helped in saving a substantial amount of energy and money. The city street lights have been shifted from conventional blast to electronic blast and from normal tube light to T5 tube light, this is another important energy saving device. The Thane Municipal Corporation has also done experiment by introduction of induction and LED street lights, which would turn out to be one of the major inputs for taking decision for introduction of efficient street lighting system. The city advertisement hoarding and traffic signals are supported by LED devices. One of the largest cultural centres of Municipal Corporation, having a seating capacity of 1200 persons is supported by LED lights with power consuming 1.7KW. There has been a substantial energy savings by introduction of SCADA for managing water pumping system. The air conditioner of another cultural centre has been shifted from conventional refrigerant to modern chiller, electricity consumption has been reduced from 1.8KW per ton to 0.8KW per ton for cooled air. Apart from efficiency of refrigerant, the concept of energy management has also been introduced. The air conditioned chiller runs during of-peak hours form 10pm to 5am and stores chilled air in the chiller. This system has many advantages including demand management, three-phase electricity connections also run on low power tariff during of-peak hours and cooling temperature during night is also recorded at the lowest level, thus consumes less energy. The Thane Municipal Corporation did not have any hesitation to introduce power generation by using solar PV. Therefore the energy production is through solar PV, Bio-methane and saving through different operating mechanisms is a game changing. The Thane Municipal Corporation has also brought changes in the building by-laws. From 2005 onwards, building occupancy certificate is issued only after installation and operation of solar water heating system. The old properties are given 10 per cent rebate in the property tax if owners submit solar water heating installation and operation certificate. Such measures have made significant dent on reduction of electricity consumption in the entire city. As there is availability of CNG, the entire city transport has been switched over to new propelling fuel and saved diesel and petrol on city transport including buses, auto-rickshaws, taxis and individual modes of transport.

Dongar Prasiya municipality having population of 25000 persons in Madhya Pradesh, has 1480 street light poles. The electricity bill reported for the year 2011-12 is of Rs. 23.46 lakh and electrical maintenance spares of Rs. 12 lakh[16]. It is pertinent to note that cost of electrical maintenance spares varies from 50 to 70 per cent of annual electricity bills. With introduction of LED street lights we can save two third electricity bill on energy consumption and entire maintenance spares cost for the first five years from introduction of new lighting system. HUDCO from its corporate social responsibility fund has committed to execute demonstration project of LED street lights, one kilometre each in four major cities of Madhya Pradesh including Bhopal, Gwalior, Indore and Jabalpur. Based on small success stories and reports of energy efficiency of committed projects, the government of Madhya Pradesh has instituted a study of 376 all cities and towns for considering installation of new generation street lights to improve lux level and conserve energy. Many other cities are on experimental mode including Pune, Kolkata, Delhi, etc. Recently, the government of Bihar has announced to switch over from conventional street light to LED lighting to save energy bill around 65 per cent in 27 urban governments. This project is supported by DFID in collaboration with state and local governments.

CONCLUSIONS

To conclude, one can say that we need to work on well researched concepts, develop new and sustainable energy areas, development of modified technologies and use indigenous resources and technologies, prioritise them and move from passive to aggressive mode of implementation. We do not have shortages but need to come out of the concept of scarcities by translating innovations into reality. The concept of good governance having fairness, equity and justice seems to be largely missing in public life and sufferings of public in general and especially of the poor are reflected by prevailing circumstances of poor and their sufferings due to scarcities. If India emerge as self sufficient in energy and also propel transport on electricity as fuel, the savings through balance of payment can be diverted for development, the pace of development can change very fast and we can enter into club of developed nations through fast track mode. The dream of poor to live life like human beings can be realised at least one generation in advance.

The views expressed by authors are personal and not of organisations to whom they represent.

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